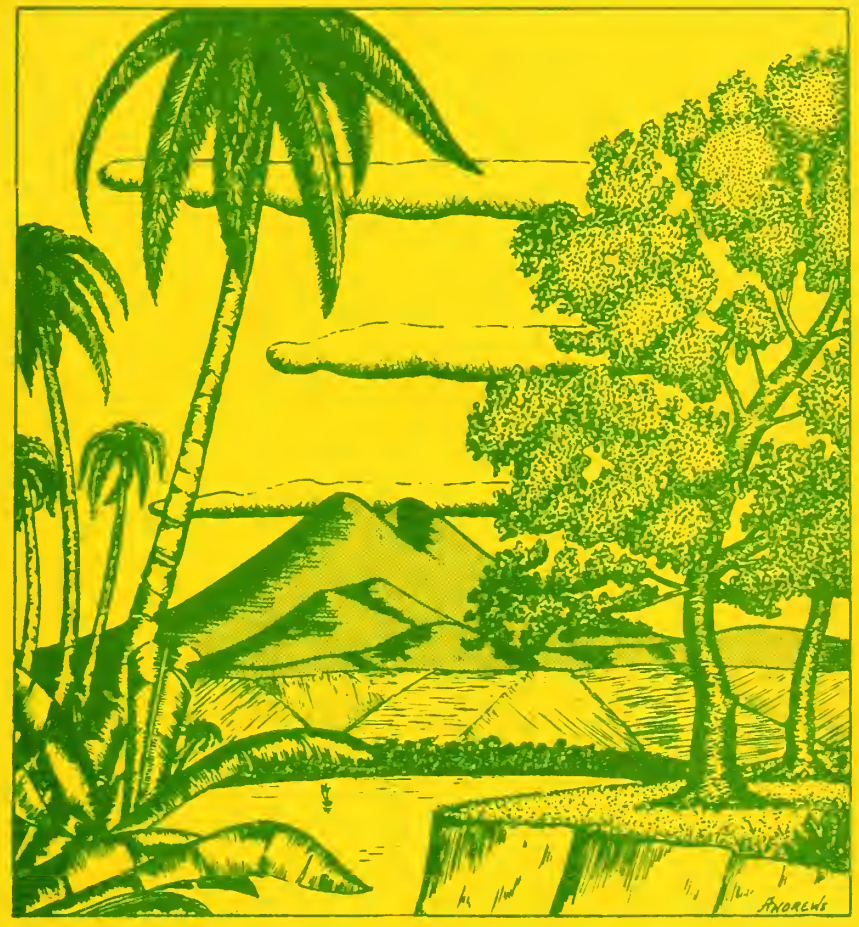
THE CARIBBEAN FORESTER



It is my pride and joy to be the shepherd of my country's trees.

TROPICAL FOREST EXPERIMENT STATION,
UNITED STATES FOREST SERVICE,
RIO PIEDRAS, PUERTO RICO

Vol. 1, No. 1

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THE CARIBBEAN FORESTER

This journal is planned as a medium of exchange of knowledge between those interested in forestry in the islands and countries in or near the Caribbean Sea. Invitations to cooperate in this project have been sent to forestry and agricultural officials in the following places:

Bahama Islands
Barbados
British Guiana
British Honduras
Canal Zone
Colombia
Costa Rica
Cuba
Dominica
Dominican Republic
French Guiana
Grenada
Guadeloupe
Guatemala
Haiti
Honduras
Jamaica
Leeward Islands
Martinique
Mexico
Nicaragua
Panama
St. Lucia
St. Vincent
Salvador
Surinam
Trinidad & Tobago
Venezuela

It is planned to present this journal quarterly. Material for publication should be submitted at least two months before publication date and be addressed to the Director, Tropical Forest Experiment Station, Rio Piedras, Puerto Rico.

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To Our Collaborators

Now that the first issue of The Caribbean Forester is ready for publication and distribution, we wish to express our most sincere appreciation to those who have taken time from their own pressing duties to prepare an article for this number, and also to those who sent encouraging letters and promised participation in later numbers. For foresters and agricultural men, the summer is necessarily the time of greatest field activities; at this period it is sometimes more than difficult to proportion the necessary time for preparation of written material. In addition to that, we had misjudged somewhat the length of time required for communication by boat mail, so that the time available before the requested date was not sufficiently adequate for participation by all who might have wished to do so.

After receiving this initial issue, many of you undoubtedly will have suggestions for improving the makeup and quality of the journal. These will always be gladly welcomed, as it is only by such means that we can improve the journal and make it most useful to all concerned. Mr. Stevenson of British Honduras has suggested that this Station serve as a clearing house for request articles, so that if you advise us of some item from another country which is of especial interest to you and about which you may wish to have further information, we will write to the particular country and ask for a detailed article on the findings or procedure requested. Such items will be suggested by notes from the various contributers as to what they are working on, so please remember to send in news of the work in progress, so that we all may be informed of the character of the work in your department. Some work which may seem a minor item to you may be of tremendous interest to someone else.

We are looking forward to a greatly increased number of contributions for the second issue which it is planned to put out in January. Please start as soon as possible on that article you are intending to write, so that we may have it on hand by the first of December. Remember that forestry covers a broad field and that agricultural men can add appreciably to our understanding of the many factors which affect the forests of a country. It would be appreciated greatly if all of you would attempt to extend the usefulness of this journal by getting in touch with the various natural scientists in your country and request their cooperation in this project. Such men frequently have a strong interest in forestry even though the nature of their work prevents them from active participation in it. Also, invite young men in your department to send in contributions, as this will give them an opportunity to publish informally some of their observations. Let us go on to an increased exchange of information, to better the present practises of forestry and land use, and to help, if we can, to extend the proper management of forests to areas and countries not well managed at the present time. - - - - L. R. HOLDRIDGE, Tropical Forest Experiment Station.

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FORESTRY IN BRITISH HONDURAS

N. S. Stevenson,
Conservator of Forests

Although British Honduras has been dependent for more than 2 centuries on the exploitation of its forests for export, forestry in the Colony is perhaps fortunate in that only about 10 percent of the area is or has been in recent times under plantation, while the utilization of the forests has been restricted for the most part to the cutting of logwood (Haematoxylon campechianum), mahogany (Swietenia macrophylla), and cedar (Cedrela mexicana) and to the bleeding of chicle, a chewing gum base (latex of Achras zapota). The only dependency of the British Crown in Central America, it lies on the Caribbean coast and is bounded on the north, west, and south by Mexico and Guatemala. The population is slightly less than 58,000 persons, of whom no less than 53 percent live in the capital, Belize, and the district towns. There are few roads, and the rural population of about three persons per square mile is for the most part distributed in small settlements along the lower reaches of the rivers, which are the chief lines of communication. Of the total area of 8,867 square miles, about 45 percent is privately owned, and the land remaining in the ownership of the Crown includes most of the mountain area of the south. Although a large portion of the total area was undoubtedly cultivated by the ancient Maya, the Mayas and Kekchis now in the colony are comparatively recent immigrants.

A Forestry Department came into being April 1, 1922; and it is obvious that the forest officers have been spared many of the tribulations of their less fortunate colleagues elsewhere, who may have had to work in competition with severe land hunger or who may have been called upon to reconstitute the forest, to check active erosion, and to cope with the problems of a deteriorating climate. With all the advantages of starting on the ground floor, however, there are very definite problems to be solved, and the financial stringency of the past 10 years has restricted seriously the activity of the Department.

The Colony is dependent on the export of produce, of which in 1938 no less than 75 percent by value was derived from the forests. Mahogany (57.35 percent) and chicle (15.95 percent) have been the chief forest products for many years, and the problem of conserving and developing the remaining stocks of these products and of developing a more complete utilization of forest produce is obviously of prime importance. The Government has at present no control over the exploitation of the forests on privately owned lands, which have been seriously overcut for mahogany in the last few years, but a comprehensive forest ordinance gives it control over forests on Crown lands.

On Crown lands, general control over mahogany cutting is ensured by the enforcement of a high minimum-girth felling limit. In the few forest reserves and particular areas where detailed information of topography, vegetation type, and stocks is available, exploitation is more closely controlled by simple working plans and marking for felling. It is hoped gradually to determine the stocks on Crown lands, so that they may be worked on a clearly defined rotational basis that will permit ample time for recuperation and will remove no more than the increment. Cruising of the mahogany forests gradually is giving average stocks,

and increment measurements are taken in various vegetation types. An attempt is being made to increase the stock of mahogany, cedar, and pine by silvicultural improvement in accessible areas. It has been necessary to work out the silviculture most suited to local conditions, and many methods of obtaining regeneration in large quantities have been tried, usually with fair success. Such regeneration, however, requires constant attention during the early years, and continuity of funds to carry on the work is essential.

The buying and selling of chicle from all lands is controlled by legislation, but the complete control over bleeding methods on Crown land is at present prevented by lack of inspecting staff.

The selective exploitation of mahogany and chicle has left in the forests many potentially valuable timber species. Only one of these, slash pine (Pinus caribaea), occurs in gregarious stands in the dry savannah and pine forest which covers about 15 percent of the total area. About 65 percent of the total area is covered by a high rain forest composed of a large number of hardwood species; these are individually of very low stocking, rarely exceeding six large trees per acre and usually much fewer. A resources survey has recently been carried out over a period of 7 years. The stocks of the commonest species not at present utilized have been enumerated for many different vegetation types on Crown land in various parts of the Colony. In addition, a testing programme of the most important of these species has been carried out by the Forest Products Research Laboratory, Princes Risborough, England. Marketing efforts are also being made, but the preoccupation of the logging contractors with mahogany, the high cost of selective logging, and the low price obtainable for unknown tropical hardwoods have thus far prevented development. The lack of population, along with the absence of a local market capable of absorbing the lower grades of lumber, has also prevented the conversion of these species in the Colony and the export of a select high-grade portion.

Pine is probably the most promising of the species enumerated. There is a local market for 1 - 1½ million board feet and a large potential market in the West Indies and the neighbouring republics. At present, efforts are being made to improve the few small sawmills in the Colony, first to supply the local market and later, if possible, to export a select fraction.

A very considerable amount of exploration has been done by forest officers since 1924, and in 1933 a map was compiled to show the major types of vegetation. The Colony has been most fortunate in receiving this year photographs of an aerial survey carried out over all except the most mountainous portion of the Colony by a commercial company prospecting for oil. It is hoped that the remaining portion will be photographed later. Stereoscopic examination of these photographs has shown that it will be possible to map the major vegetation types and the topography over large areas of private and Crown land, for which no adequate maps now exist. The value of a good aerial survey has certainly been proved in the Colony, and it is a matter of considerable regret that this work was not carried out years ago

It has been found that vegetation type can be used as an approximate index of soil value, and it should be possible shortly to decide which areas should be set aside for agriculture, which should be reserved as protection forest, and which should be set aside as production forest. Shifting cultivation in the

Colony has been temporarily restricted within well-defined reservations, but such reservations can be only a palliative until the agricultural population is persuaded to change its methods of cultivation. The obvious risk of reducing the land within the reservations to unproductive and worthless scrub by a shorter rotation of plantation has had to be taken in order to protect from destruction forests containing valuable stocks of mahogany; but permanent agriculture is being encouraged by offering the free hold of small areas at a low purchase price, provided the land is permanently improved. Fortunately, the most valuable forests do not grow on the best agricultural land, and until there is a definite land hunger there need be no encroachment of agriculture on land more suited to forestry.

The prevention of destructive exploitation of the forests in privately owned land still awaits solution, but the close cooperation of the technical departments makes possible comparatively rapid progress in carrying out the policy for Crown lands. This policy aims at the fullest utilization of the land, based on careful estimation of the soil and the forests; the encouragement of permanent cultivation on the truly agricultural soils; the improvement of yield in the best forest areas; and the safeguarding of the land from erosion and the climate from deteriorating.

Summary

British Honduras, which is still largely covered by forest, is sparsely inhabited, while the forest exploitation of over 2 centuries has been restricted to a few products only. The most important problem is the maintenance of the export trade by the development of more complete utilization of forest produce. In addition, silvicultural work in the mahogany and pine forests is being carried on. A recently completed aerial survey, and 15 years of exploration of the soil, vegetation, and topography, form the basis on which the Forest Department and the other technical departments concerned in land usage are now planning the fullest utilization of the land.

Resumen

La Honduras Británica se encuentra todavía cubierta de bosques en su gran parte y está poblada muy escasamente, mientras que la explotación forestal se ha limitado durante más de dos centurias a unos pocos productos forestales. Un desarrollo más completo para el aprovechamiento del producto forestal para mantener el comercio de exportación constituye el problema más importante. Además, se está llevando a cabo trabajos silviculturales en los bosques de caoba y pino. Un reconocimiento aereo terminado recientemente y quince años de exploraciones del suelo, vegetación, y topografía, constituyen la base sobre la cual el Departamento Forestal y los otros departamentos técnicos interesados en el aprovechamiento de tierras, están haciendo actualmente sus planes para la utilización más completa de aquellas.

THE FORESTS OF DOMINICA, B.W.I.

H. B. Pidduck, Acting Agricultural Superintendent

A large part of the interior of Dominica is still occupied by luxuriant tropical rain forest, although inroads are being constantly made by peasants in search of virgin soil for the growing of food crops and bananas for export.

Although the forests occur mainly on Crown lands, there is no provision for the enforcement of legislation, which is inadequate and deals only with the disposal of such lands (Crown lands ordinance, No. 1, 1915).

A forestry ordinance is under consideration at the moment, but two factors would negative its usefulness, viz., lack of funds to provide the necessary staff and the fact that the boundaries of alienated lands on which forests also occur are in a state of considerable confusion. For the latter reason, a cadastral survey has been suggested.

Parts of the more accessible forest land have for years been exploited for such products as hardwood, firewood, canoe shells, charcoal, etc., and at Portsmouth, in the north of the island, a sawmill was established some 20 years ago but was soon abandoned. This was because the land is very mountainous, and also there is nowhere a plentiful stand of any one species of timber tree. The forest, in fact, although rich in excellent materials, is very heterogeneous.

Exploitation tends to be limited, with the exception of felling and burning for garden purposes; on the leeward side, and parts of the windward, much land has become ruinate on that account. Since the rainfall exceeds 200 in. a year in the interior and averages 100 in. on the coast, exposure of the soil inevitably leads to heavy erosion, and recently floods and landslides have increased in frequency and volume. The need for a Forestry Department is obvious.

Resumen

El interior montañoso de Dominica posee extensas áreas de bosques tropicales lluviosos, ricos en materiales. Las áreas más accesibles se explotan por sus productos maderables o son desmontadas para uso de los agricultores, y conjuntamente con una precipitación abundante tal destrucción del bosque ha resultado en un aumento de inundaciones y derrumbes. Una legislación forestal está bajo consideración y hace falta un departamento forestal.

FORESTRY IN JAMAICA

C. Swabey, Forest Officer

Jamaica with an area of 4,450 square miles has a density of population of 270 to the square mile. Topographically the island consists of (a) a backbone of mountains (volcanic and residual) rising to 7,300 ft., (b) an elevated limestone plateau, much dissected, rising to 3,000 ft., (c) coastal limestone cliffs and hills to 500 ft., and (d) coastal alluvial plains. Rainfall ranges from 30 in. on the coastal plains to 200 in. in the interior hills.

The whole island was at one time covered with forest, but by the middle of the nineteenth century all the accessible areas had been cleared either for export crops (sugarcane, coconuts, coffee, cacao, ginger, tobacco, etc.) or for food crops for local use. During the early period of British occupation (i.e., from 1665) considerable quantities of mahogany (Swietenia mahagoni), cedar (Cedrela odorata), fustic (Chlorophora tinctoria), and other cabinet and dye woods had been exported, but today very little economic timber is available and exports are negligible.

About 1860 the dangers of excessive deforestation became apparent, and a number of abortive attempts were made to deal with the problem: reports and recommendations were made in 1886, 1913, 1924, 1926, and finally in 1935. Forest laws were passed in 1889, 1892, 1913, and 1927, but practically no progress in forestry matters can be recorded during this period. In 1937, a comprehensive Forest Law repealing previous enactments was passed, and 200,000 acres have been declared Forest Reserve. Also in 1937 a Forestry Division of the Lands Department was formed and was transferred the following year to the Department of Agriculture; the Division now functions to all extents and purposes as an independent department.

The policy of the Lands Department is (1) to develop measures of soil and water conservation and the prevention of erosion by (a) the formation, reafforestation, and maintenance of forest reserves under public ownership, and (b) the encouragement of protective measures on private lands; and (2) to develop the local timber industry on conservative lines.

The staff of the Division consists of a forest officer (trained), a forest settlement officer, a forest supervisor, a forest surveyer, and 16 rangers.

Acquisition of land for forest reserve is an important aspect of the work of the Division, and an immediate programme embracing 15,000 acres has been approved; this is financed in part, by the Water Commission. Compulsory acquisition powers have not yet been called into play, but are available if necessary. The absence of adequate surveys is a serious handicap, and in some districts little progress can be made until extensive surveys have been completed.

Reafforestation of denuded areas has been begun mainly at 2,000 to 4,000 ft.; the principal species used are Hibiscus elatus, Cedrela odorata, Podocarpus elongatus, Juniperus lucayana, and Pinus massoniana. Particular

attention is being paid to the catchment areas of the Kingston water supply. Attention is also being directed to private tree planting, and district nurseries are being established. Coupled with reservation and reafforestation measures is the construction of bridle roads and inspection bungalows in the remoter districts.

Erosion is an extremely serious factor in the interior mountains, and the bulk of the work of the Division is in protecting water supplies and in decreasing the number of floods and droughts.

The control of timber cutting on Crown lands is being achieved gradually, and felling is now permitted in certain areas under rigid minimum-girth rules; uncontrolled cutting, the destruction of immature saplings, and extensive stealing have seriously reduced the stocking of the forests, and the younger age-classes are poorly represented.

Research is a crying necessity, not only in reafforestation technique and timber utilization, but in the fundamental sciences of botany, ecology, soils, etc. In the absence of specific research staff, however, this has to be undertaken on a small scale in the course of routine work.

Finally, education and propaganda are being attempted. Posters have been designed, instructional leaflets have been prepared, and it is intended to try and make the rising generation "forest minded" through education in the schools.

Resumen

Hace mucho tiempo que los bosques en las áreas accesibles de Jamaica fueron tumbados para la producción de cosechas agrícolas. Grandes cantidades de madera se exportaban anteriormente, pero actualmente este negocio es casi nulo.

En el 1937 se estableció una Sección Forestal la cual se compone de 20 empleados; 200,000 acres fueron declarados reserva forestal y la adquisición de tierras continúa. Se está llevando a cabo la reforestación de las áreas desmontadas, prestándosele atención especial a la conservación del suelo y del agua. El corte de madera en el patrimonio de la Corona ha sido restringido, y se han tomado medidas para enseñar al pueblo el valor de la silvicultura. Se han empezado investigaciones importantes, pero en pequeña escala.

FORESTRY IN PUERTO RICO

L. R. Holdridge, Associate Forester

Puerto Rico, the smallest of the Greater Antilles, is roughly rectangular in outline, 100 miles long by 35 miles wide with an approximate area of 3,435 square miles. The main mountain range runs lengthwise and slightly south of the center of the island, reaching an elevation in the highest peaks of slightly over 4,000 ft.

The island enjoys a subtropical climate, which is relatively uniform throughout the year. The average annual temperature is 76° F., ranging from an average of 73° in the cooler months to 79° in the summer. Maximum temperatures rarely pass 100°, so that, as far as heat is concerned, working conditions are very comfortable. The equability of the climate rests in large part on the presence of the almost continuous northeast trade winds. These same moisture-laden winds bring the rains, which fall in greatest profusion on the eastern mountains, where recent records at about 2,000 ft. above sea level have shown a total of over 200 in. per year. Precipitation, which in general decreases as one goes westward, as a result of the removal of moisture from the trade winds by the high mountains to the north and east, reaches a minimum of around 30 in. per year on the southwest corner. Where high rainfall occurs, there is no marked dry season or only a short dry spell from January to March, but in the areas of considerably lower precipitation, there is a definite period of drought from November or December to April or May and a shorter midsummer dry spell in July and part of August.

The island came into existence by the folding and raising of the ocean floor. Volcanic action was restricted to two peaks long quiescent. In addition, partial submergence and subsequent lifting of the land mass account for strips of coral limestone on the north and south coasts. Erosion has been so active for centuries that the land mass has been cut up into sharp ridges and deep valleys in the mountains, and the washed material has built large alluvial plains at the mouths of the river valleys.

The soil consists chiefly of deep, reddish clay-loams or tenacious, red clays. The alluvial plains produce excellent crops, but the agricultural lands on the hills and slopes have lost a large part of their fertility through leaching and erosion of the soil.

Agricultural crops represent the major part of the income of the island. Sugarcane leads all other crops in importance and utilizes the greater part of the fertile lowlands. This is followed in order of value by tobacco, coffee, coconuts, grapefruit, and minor crops.

The population of Puerto Rico is denser than that of any other country or island in this region, with the exception of Barbados. The total number of inhabitants is over 1,500,000, which amounts to over 500 per square mile. Coupled with this, and of great significance to forestry, is the fact that the major portion of the population is rural, as commercial development is only slight and is restricted mostly to the rum and needle-work industries.

Naturally, under the pressure of such a concentration of population, the extensive stretches of forest which were found by the early Spanish explorers have been reduced to a mere remnant of their former glory. As a matter of fact, the effect of man on the natural vegetation of the island has been so far-reaching that it is almost impossible to obtain a true picture of the plant associations and successions pertaining to our area. Practically no virgin stands of forest exist for study today, except for those small areas of dwarf forest at high altitudes, where timber production is negligible and the forest values will ever be in terms of protection and scenery.

Difficult as it is to obtain an exact idea of the original forests, about which unfortunately all too little was written, by piecing together all available evidence, one is able to secure a rough picture of the makeup of the original forests. Scattered unevenly around the coast are various areas of mangrove swamps or woodlands, which comprise a total of approximately 16,000 acres. Another coastal type, littoral woodlands, occurs on areas of white sands along portions of the north coast.

From these types up to about 1,000 ft. above sea level on the north, east, and west coasts, agriculture has almost completely taken over the area. From the little data available, it would appear that the original forest on this strip would fall in the classification of semi-evergreen rain forest. Between 1,000 ft. and 2,000-2,500 ft. above sea level, rainfall is somewhat heavier, and the temperature is considerably lower. Although this strip would fall within the general classification of the preceding type, a few dominant trees not found in the preceding justify setting it apart as a distinct type, or at least a subtype.

Above this strip, there is a sharp change to smaller-leaved species; this is accompanied by a general change in appearance that is distinct at a distance. This region apparently would fall within the upper montane rain forest. At or near the summits of the higher mountains, this same composition of species prevails, but conditions of growth are so poor that a dwarf forest, or what might be termed an alpine elfin woodland, results.

On the southern dry coast, the lowlands have been rather thoroughly stripped of their forest cover and by means of irrigation made to serve in the production of agricultural crops. There is some mention in old literature of savanna areas, and although not extensive the southern lowlands would be classed as savanna woodland or moist deciduous forest, depending on the amount of precipitation. In any case, considerable more study will be necessary before it is possible to delineate exactly the various climax types and their boundaries. Then too there is the possibility that the wholesale destruction of forests over considerable areas may have had a definite influence in throwing an area out of one classification and into a distinctly drier type.

Forestry was started on the island in 1903, when President Theodore Roosevelt proclaimed the establishment of the Luquillo National Forest on about 13,000 acres ceded to the Federal Government by the Treaty of Paris; but it is only in recent years that activities have assumed large proportions, owing to the impulse of the conservation movement in the United States and the relief activities on the island. In 1917, an Insular Forest

Service was established to administer the mangrove swamps, forest areas in the western mountains and along the south coast, and Mona Island about 40 miles west of Puerto Rico. The total acreage of these forests amounted to about 30,000. At the same time, appointment was made of a Forest Officer to head both the Federal and Insular services. At first, practically the only activity consisted of protection of the forest areas; but beginning in 1921, some planting was carried out each year on the Insular Forests, and nurseries were in operation to provide trees for those farmers who wished to plant on their own land.

In 1933, acquisition of additional Federal lands was started; the Civilian Conservation Corps, a relief agency to carry out works of conservation, was set up on the island; and forestry entered a phase of enormously expanded activities. In 1935, the official name of the national forest was changed from that of Luquillo to Caribbean, owing to the establishment of a new purchase unit outside of the Luquillo Mountains.

Also, in the fall of 1935, a Forestry Division was formed as part of the Puerto Rico Reconstruction Administration, and purchase of additional Federal lands was undertaken on five new purchase units. These units were selected for their importance in protecting the watersheds of streams used for power and irrigation and, at the same time, where they would interfere least with agriculture.

The Caribbean National Forest, the C.C.C., the Insular Forest Service, and the Forestry Division of the P.R.R.A. are all directed by one administrative head, this position having been filled since 1935 by Mr. E. W. Hadley. The work of these organizations is carefully coordinated in the central office, where departments have been set up to handle the various activities, such as planting or engineering, regardless of the unit on which the work is performed.

Forestry activities

Planting.-One of the largest activities consisted of the reforestation of brush and grass lands on the new purchase areas. At the height of this project in 1936, over 6,000 men were employed on planting alone, and the total area planted to date amounts to over 18,000 acres. The principal species used in reforestation have been Swietenia mahagoni, S. macrophylla, S. candollei (the Dominican, Honduras, and Venezuelan mahoganies, respectively), Cerdana (Cordia) alliodora, Petitia domingensis, Montezuma speciosissima, Vitex divaricata, Cedrela mexicana, and Casuarina equisetifolia. Calophyllum antillanum, Andira inermis, and Lucuma multiflora were seeded directly. Besides these species, several other have been tried out, such as Xanthoxylum flavum, Colubrina ferruginosa, Tectona grandis, Eucalyptus sp., Haematoxylon campechianum, Neltuma (Prosopis) juliflora, Guarea guara, Byrsonima spicata, Mimusops nitida, Hymenaea courbaril, Ocotea moschata, and Sideroxylon foetidissimum.

Clearing land of brush and grass and subsequent cleanings of the areas following planting was found to be extremely expensive, especially in those sections of high precipitation where weed growth is very rapid. In order to reduce such high expenditures, a system of combined forestry and agricultural use was worked out whereby squatters and former tenants on newly acquired lands would be given permission to continue in residence on the property and cultivate their agricultural crops, provided they would interplant such plots with forest

tree seedlings or seeds provided by the Forest Service. The only expenditure under this system is the cost of seed or stock and the administrative costs necessary for supervision. To date this is working out very satisfactorily to both parties concerned, and the growth of trees within such cultivation is 2 to 3 times more rapid than within natural vegetation.

Nurseries.-In order to provide sufficient nursery stock for the increased planting program, several large nurseries were established about the island. The largest of these, at Cayey, produced about 20 million seedlings per year. With more recent reductions of the planting program, the policy has been changed, and small nurseries on the individual planting sites have replaced the centrally located nurseries. The latter system cuts down the cost of transportation and provides fresher stock for the planting crews.

Management.-Owing to the small amount of timber left standing within the boundaries of the forest units, the existing stands require protection more than anything else. Each unit (sometimes two adjacent units) is administered by a forest ranger, with various forest guards carrying out the actual police work. The Insular Forest Service uses a plane for the detection of illegal cutting or charcoal burning and also to detect stills, which are often set up in the mangrove swamps.

A complete aerial survey has been made of the island, and a set of the pictures finds considerable use in the Service. Soil surveys are likewise complete, but have not been published. Besides these, the Forest Service has carried on management surveys to determine stocking, etc. on most of the units, and all new tracts acquired by purchase are first surveyed and appraised.

Certain sections of the forest that have been only lightly culled of valuable timber in the past have been treated silviculturally on "timber-stand improvement" projects to release valuable timber species by the removal of weed and other species for charcoal and fuel. Sometimes these operations provide timber or other valuable timber products.

Roads and trails.-In order to open up inaccessible areas of the various units for management, the several work projects have constructed approximately 104 miles of truck trails and forest highways and about 116 miles of foot and horse trails. Most of these have been within the mountainous sections on very difficult terrain.

Recreation.-This rather recent activity has assumed considerable importance on the island as sites are developed for recreational areas in the forests for thousands of city dwellers. The La Mina Area in the eastern mountains has provided facilities for swimming, hiking, picnics, and overnight visits. Other areas are in various stages of development.

Extension forestry.-One trained forester spends his entire time in contacting private-land owners and providing information and assistance to those interested in forestry. Government nurseries provide free seedlings from the nurseries for distribution to such individuals.

Research.-Forest research was initiated 1½ years ago on a small scale with emergency funds; studies were made on various phases of planting and nursery work. In addition, work started on an illustrated popular booklet of the forest trees of

Puerto Rico will be assimilated into the larger program of the new Tropical Forest Experiment Station.

Summary

Puerto Rico, with an area of 3,435 square miles, enjoys a subtropical climate with rainfall varying from 30 to over 200 in. per year. The island was raised by a folding of the ocean floor, with later deposits of limestone along the coast. Soils are clays or clay-loams, on which are produced a variety of tropical crops.

The population is very dense, and this has resulted in nearly complete destruction of the original forests. From the evidence available, it would appear that the forests fall into approximately seven distinct tropical types. A beginning of forestry was made several years ago, but during the last decade forestry activities have been greatly expanded.

To date, over 18,000 acres have been planted with tropical hardwoods, nurseries operated to provide the necessary stock, various surveys made for management purposes, and many miles of roads and trails constructed to facilitate the various activities of forest management. In addition, facilities have been provided for recreation in the forest areas, private forestry has been assisted, and research on silvicultural problems has been initiated.

Resumen

Puerto Rico es una isla con un área de 3,435 millas cuadradas, que goza de un clima semitropical y una precipitación pluvial desde 30 a más de 200 pulgadas anuales. La isla se formó por un levantamiento del fondo oceánico y sedimentaciones subsecuentes de roca caliza en el litoral. El terreno es algo variable predominando los barros, en los cuales se producen una diversidad de productos tropicales.

La población es dense trayendo como consecuencia la destrucción de la foresta original. De la evidencia actual podemos decir que los bosques pertenecían aproximadamente a siete tipos tropicales distintos. Hace algunos años se iniciaron trabajos y estudios silviculturales y durante la última década éstos se han intensificado.

Hasta la fecha más de 18,000 acres se han plantado de maderas tropicales duras, se han establecido almácigas para obtener el material necesario, se han hecho reconocimientos con el fin de llegar a conclusiones conducentes a las operaciones y se han construído veredas y caminos en abundancia para facilitar las diversas operaciones silviculturales. Además de todo esto, se han organizado parques de recreo en las zonas forestales, los bosques privados se han atendido en diferentes sentidos e investigaciones científicas se han esbozado para todo trabajo de silvicultura.

FORESTRY IN ST. LUCIA

E. Y. Wald, Agricultural Superintendent,
Department of Agriculture

St. Lucia, in common with the other islands forming the Windward Islands Group, has no separate forest staff, with the result that little or no work in forestry has been carried out. Early in 1936, Mr. A. Wimbush, lately Conservator of Forests, Madras, conducted a short investigation to study and report on the steps to be taken to introduce a policy of forest conservation, as a result of which it is now likely that a forest officer shortly will be appointed to serve the Windward Group.

As I assumed charge of this Department only within the last year, I have not had much opportunity for forestry work; and, with the pressing needs of agriculture, the appointment of a forest officer to give a closer study to local forestry problems is urgent. A rough estimate made a few years ago gave the area under natural mixed forest as 12,000-13,000 acres (equal to only about 9 percent of the total area of the Colony). The natural resources of the forests, through constant exploitation in the past, have been depleted seriously, until at present the most valuable trees have been reduced considerably in number. The forests of this Island thus have little remaining monetary value, but their importance in soil and moisture conservation, particularly in the vicinity of the headwaters of the principal rivers, cannot be overstated, and it is unfortunate that these points have been appreciated insufficiently in the past.

"Squatting", or shifting cultivation, has also been responsible for a great deal of devastation in the forest areas, but some improvement is now being shown owing to a general "tightening up" in regulations concerning squatters. The problem is complicated, however, owing to the fact that a large proportion of the primary forest areas remaining are unescheated (or ungranted) lands, which cannot be regarded as Crown property until they have been formally escheated; this entails a period of 12 months after the area has been surveyed. The shortage of staff in the Survey Department, and the absence of any defined forestry policy in the past, is responsible for the fact that most of these unescheated forest areas have not yet been acquired by the Government, but steps have recently been taken with a view to obtaining the necessary funds with which to undertake this work. The allocation of limited funds this year has enabled a small subordinate forestry personnel to be appointed, consisting of a forest ranger, two forest guards, and two forest watchers. The forest ranger has not been appointed yet, and may now await the decision of the forest officer, who (it is hoped) will be appointed soon; but two forest patrols have been organized, one for the northern part of the Island, and one for the southern part, each comprising one forest guard and one forest watcher. These patrols have had no forestry training, and for the present are concerned in preventing further encroachment and devastation in the remaining forest areas by squatters, in short, in general policing.

The local forests have been described by Mr. Wimbush as "tropical evergreen protection forests", the commonest tree met with being gommier (Dacryodes hexandra), which is of no commercial value except in the construction of canoes. Good timber trees are laurier canelle (Ocotea rubra) and a few other kinds of laurier, balata (Mimusops balata), white cedar (Tecoma leucoxylon), and fustic (Chlorophora tinctoria); other trees in general use are maruba (Simaruba sp.), angelin (Andira inermis), fiddlewood (Vitex divaricata), and yellow savonette (Lonchocarpus latifolius). Annual rainfall in the forest areas ranges from about 80 to 120 in. per annum. Considerable scope exists for reafforestation programs in several parts of the Colony, but the inadequate staff and lack of funds have prevented any execution of these programs. A beginning was made last year, however, with the importation of small quantities of teak and Honduras mahogany seed, subsequently raised in the Departmental nurseries and transplanted to small areas in the vicinity. This work is being continued this year, and will be featured regularly in the activities of this Department in the future, commensurate with the funds at our disposal. Cassia siamea is under trial for the drier districts of the Colony, especially in the North, where an early program of reafforestation could do much to arrest the combined effects of soil and wind erosion.

Summary

The forests of St. Lucia equal about 9 percent of the total area of the Colony, or roughly between 12,000 and 13,000 acres of tropical evergreen protection forest. They have been considerably reduced in value by constant exploitation and shifting cultivation. Two forest patrols, each comprising one forest guard and one forest watcher, have been organized during the past year for protection of the remaining forests; Government forest lands are being increased; and reforestation with timber species is already under way.

Resumen

Los bosques de Santa Lucia constituyen alrededor de un nueve por ciento del área total de la Colonia, o sea entre 12,000 y 13,000 acres de bosques tropicales vivaces de protección. Su valor ha disminuido considerablemente debido a la constante explotación y al cultivo desmesurado. Dos patrullas forestales, compuestas cada una de un guardabosques y un policia de bosques, se organizaron durante el año pasado para la protección de lo que resta de éstos. Los terrenos forestales del Gobierno se están aumentando y ya se ha encaminado la repoblación forestal con árboles maderables.

FORESTRY IN TRINIDAD AND TOBAGO

R. L. Brooks, Conservator of Forests

The forest policy of Trinidad and Tobago may be briefly summarized as follows:

(1) The permanent reservation by the Crown of suitably situated areas of forest of a total acreage sufficient to supply the benefits necessary for the welfare of the community —— indirect benefits in the form of the maintenance of climatic conditions for agricultural crops, preservation of water supply, prevention of erosion and flooding, etc., and direct benefits in the form of the supply of forest produce.

(2) The management of these forests in such a way as to encourage the fullest possible utilization of their products on the basis of a sustained yield.

(3) Such improvement of the existing growing stock as will enable the Colony in the future to become at least self-supporting in lumber.

The general position with regard to forest reservation is eminently satisfactory, except in so far as the western portion of the Northern Range is concerned. In this district, however, the greater part of the land area has for many years been under private ownership, and until recently was mainly covered by cacao or second-growth forests.

In the present depressed state of cocoa, landowners are renting out increasing areas of steep hillsides to agricultural peasants, who grow field crops, such as maize, tomatoes, etc., under a system of shifting cultivation. Many of these peasants prefer the highest, steepest, and most inaccessible portions of the hillsides, as the danger of loss of crops by praedial larceny is lessened thereby.

The abnormally high rainfall of 1938, coupled with the increase of clearings, was productive of erosion, flooding, and landslides to an unusual degree, and revealed clearly the dangers of the existing situation. The problem is under investigation by the Lands Advisory Committee.

So far as the maintenance of a sustained yield is concerned, all Forest Reserves are subjected to an elementary form of yield control, either by girth limits or some form of the Brandis-Burma method. Control of the cutting in Forest Reserves by petroleum companies, however, is badly in need of intensified supervision, if the overcutting of the past is not to be continued.

Generally speaking, however, the utilization of forest produce has not reached, by a long way, the maximum production permissible: the mora forests, for example, are yielding only a fraction of their potential production. The lack of supplies of seasoned local wood continues to be one of the biggest factors militating against increased consumption. Research is required into

the utilization of species, regarded at present as of little or no market value, and into many other problems of utilization. As time permits, research is being carried out on durability tests, the suitability of substitute species for sleepers, wood preservation, etc.

The Forest Department is in touch with persons interested in the possibilities of the exploitation of the mora forests, and it is hoped that results will materialize in the not-too-distant future. In the meantime the number of small country sawmills has shown an increase.

Since the high cost of exploitation of the natural-mixed forests of the Colony, which have a small volume production per acre of marketable species, is a further factor contributing to its dependence upon imported softwoods, the improvement of the growing stock, aiming at a high volume production per acre with consequent cheap exploitation, forms an important part of the forest policy of the Colony. The Department's activities in this direction have included, besides the regeneration of indigenous species, a cautious teak-planting program dating back to 1913. The oldest Trinidad-grown teak trees (apart from a few trees about 60 years old in the Royal Botanical Gardens) are 25 years old, therefore; and the results from the aspects of volume production, health, and costs are so good that a reasonable expansion of the planting program would appear to be thoroughly justified.

The regeneration of indigenous species is proceeding satisfactorily under the shelterwood-compartment system, but improvement-felling technique needs intensified research, followed by considerable expansion of the program.

The foregoing very brief analysis reveals both shortcomings in some, and the need for expansion in other directions, in the satisfactory prosecution of our forest policy. Improvement can be effected only by an increase of staff; and the sanctioned personnel, both technical and subordinate, has now been expanded.

Resumen

La política forestal de Trinidad y Tobago consiste brevemente de (1) la reserva permanente de tierras reales suficientes para suministrar adecuadamente los beneficios forestales necesarios para el bienestar de la comunidad, (2) administración de estas áreas para utilizar lo más posible sus productos y mantenerse en una base de producción, y (3) su mejoramiento para hacer que la Colonia pueda ser dependiente de sí misma en sus necesidades maderas.

En general, la reserva forestal es satisfactoria, excepto por la depresión económica en el distrito de cacao al oeste de la Sierra del Norte, donde los cambios en el cultivo de cosechas junto con las fuertes lluvias recientes, han causado grandes pérdidas de terreno e inundaciones. La restricción de las cosechas para mantener una producción permanente está en práctica en todas las reservas. La utilización puede aumentar todavía, como en los bosques de mora, y se están efectuando las investigaciones más necesarias hacia este fin. Los bosques mixtos y naturales se están mejorando por medio de desmontes sistemáticos y siembra de especies nativas y de "teak". Después de 25 años de haberse sembrado esta última especie, el estado actual de las plantaciones justifica la expansión de su siembra.

COMPTE RENDU PRÉLIMINAIRE DU TRAVAIL FORESTIER A LA STATION DE KENSCOFF, HAITI

Pierre Sylvain, Spécialiste en Horticulture,
Service National de la Production Agricole
et de
L'Enseignment Rural

Généralités.

La région de Kenskoff offre un intérêt tout particulier pour l'agriculture en raison de son climat exceptionnel pour les tropiques, présentant une température minimum de 4.5° et maximum de 31°C., qui peut la faire ranger dans la série des régions tempérées chaudes. Kenskoff est plus populaire en raison de son voisinage de la Capitale, mais il existe en Haiti plusieurs autres localités présentant à peu près les mêmes conditions, notamment toute la partie élevée du Massif de la Selle et les pics les plus hauts du Massif de la Hotte. Il est possible de cultiver dans ces différentes régions toute une série d'espèces qui ne sont pas susceptibles de se développer dans les autres parties du pays. Leur flore spontanée est d'ailleurs franchement différente de celles des autres régions.

Le plus grande problème agricole de Kenskoff est l'érosion favorisée par un déboisement intempestif, érosion que se fait sentir plus que partout ailleurs sur les collines abruptes qui caractérisent cette partie du pays.

Ce déboisement exagéré tire probablement sa cause dans les conditions climatiques mêmes de la région et dans sa proximité de la capitale. De temps immémoriaux, les meilleurs légumes sont venus de Kenskoff, dont la température idéale favorisait la culture. Dans le but d'en produire toujours davantage sans utiliser d'engrais, les paysans ne se sont pas contentés de cultiver les plateaux et les vallées, dont la fertilité diminuait chaque année, mais ils se sont attaqués aux flancs des collines boisés, dont le sol encore vierge fournissait plus facilement de meilleures récoltes. Malheureusement ces terrains en pente, remués tous les ans, perdent à chaque averse un peu de leur couche superficielle, ne gardant que le sous-sol et parfois, au bout d'un certain temps, uniquement un roc impénétrable pour la végétation.

La culture du maïs entreprise sur une grande échelle dans la région est tout aussi contre indiquée. Pour permettre la culture de ces plantes annuelles, le paysan haitien a toujours en coutume d'avoir recours au déplorable procédé de "bois neuf", consistant à couper tous les arbres existant sur la parcelle et à bruler les brindilles de bois et les herbes sèches, procédé qui occasionne une sérieuse déperdition de matière organique.

Une autre cause qui a grandement contribué à l'abatage des arbres, c'est la vente des pins, tant sous la forme d'arbre de Noël que de bois de construction ou de bois à brûler.

Nous savons qu'à l'origine Kenskoff et Furcy étaient surtout boisées de pins, la forêt du Mont des Commissaires s'étendant jusqu'à ces parages; on peut encore en voir quelques vestiges au Morne Bourette et au Morne de la Découverte. L'exploitation irrationnelle de cette partie de la fôret, ainsi que les nombreux incendies dûs à la négligence des paysans et à la pratique du "bois neuf" ont fait de cette zone forestière les collines dénudées que nous voyons actuellement.

Quoique veuillent croire certains, la terre de la région est pauvre et s'appauvrit encore sans cesse en raison de la grande déperdition d'humus causée par l'érosion. Le régime des sources même est atteint, l'eau devenant de plus en plus rare. Toutes ces considérations prouvent qu'il est tout à fait essentiel de remplacer le système de plantation de cultures annuelles par des cultures permanentes industrielles ou fruitières, là où la terre le permet, et la plantation d'espèces de reboisement proprement dites, où la terre végétale fait entierèment défaut, et où il faut refaire pour ainsi dire le sol. Tel est le principal but que nous nous sommes assignés et la raison même de notre projet.

En plus de ceci, nous voulons faire des essais d'acclimatation de la plus grande quantité d'espèces, vu que cette région étant tout à fait typique, l'on peut y faire venir des espèces tempérées qu'on ne peut obtenir dans la plupart des autres localités en Haiti.

Ce premier rapport exprime les résultats obtenus jusqu'à ce jour. Nous ne pouvons encore énoncer que des observations préliminaires, vu que l'acclimatation est une opération très complexe que réclame beaucoup d'expériences avant qu'on puisse se prononcer sûrement. Il arrive souvent, en effet, qu'une plante se développe bien dans les premières années de sa plantation et présente par la suite des arrêts de croissance la rendant indésirable. Il ne faut pas non plus confondre le point de vue de l'amateur et celui de l'agronome; un jardinier peut, à force de soins, réussir à développer une espèce qui ne peut cependant être considérée comme acclimatée, sa culture étant trop difficile pour pouvoir être entreprise économiquement. De fait, on ne peut considérer une espèce comme véritablement acclimatée que si elle peut se repeupler naturellement, c'est-à-dire dans le cas des plantes à graines produire des semences viables.

Espèces Forestières.

Eucalyptus.—Une des premières essences essayées à notre Station a été l'eucalyptus que s'est acclimaté un peu partout dans les régions tempérées et tropicales. Nous n'avons pas rencontré les mêmes difficultés qu'à Damien pour la pépinière et le pourcentage de plants obtenus a été en général satisfaisant surtout pour l'Eucalyptus globulus.

L'Eucalyptus présente divers avantages qui nous ont fait en essayer la culture.

(1) Sa croissance très rapide permet d'obtenir rapidement une assez grande quantité de bois sur une superficie donnée.

(2) Le bois quoique parfois difficile à débiter peut être employé en ébénisterie[1] et comme bois de chauffage de même que dans les travaux d'eau.

(3) Les feuilles de l'E. globulus contiennent 1.5 à 3 pourcent d'une essence servant de base à divers produits pharmaceutiques[2].

(4) L'Eucalyptus repousse après que la tige principale a été coupée, ce qui permet l'exploitation des forêts à intervalles réguliers sans nouvelle plantation.

A côté de tous ces avantages l'Eucalyptus présente de nombreux inconvénients comme espèce de reboisement.

(1) Les jeunes plants donnent un certain mal pour être obtenus de semis et sont très delicats dans le premier stade de leur croissance exigeant quelques binages après la mise en place.

(2) L'Eucalyptus ne se fait pas dans tous les sols demandant généralement un terrain plutôt riche.

Rivière et Lecq racontent bien la défaveur dans laquelle est tombée cette essence après avoir joui d'une grande vogue dans l'Afrique de Nord. Le climat de l'Algérie, cependant un peu trop froid pour la plupart des espèces essayées, comptait probablement pour beaucoup dans l'insuccès rencontré. Nous pouvons espérer trouver en Haiti une espèce qui satisfera nos conditions. Il est en tous cas intéressant de faire des essais dans ce sens, vu la nécessité de trouver une espèce de reboisement à croissance rapide. Si l'Eucalyptus ne peut être employé chez nous que dans les meilleurs terrains, il faudra localiser sa culture à certaines régions de sol plus riche et employer le pin occidental ou quelque espèce moins difficile pour les parties les plus arides.

Nous avons essayé sept especes d'Eucalyptus au cours de l'année et voici les résultats obtenus:

Espèce	Date de semis	Croissance	Aspect général des plants
		Après 10 mois:	
E. robusta	20 novembre	max. 85cm. moy.75 cm.	Satisfaisant, malgré quelques cas de rouille.
		Après 8 mois ½:	
E. globulus	7 janvier	max.110cm.moy.100 cm.	Satisfaisant.
E. maideni	7 janvier	max.120cm.moy.100 cm.	Satisfaisant, quelques cas de rouille.
E. resinifera	7 janvier	max. 40cm.moy. 25 cm.	Croissance chétive, beaucoup cas de rouille.
E. gunni	7 janvier	max. 99cm.moy. 70 cm.	
E. rostrata	24 juillet		Les plants présentent jusqu'à présent une bonne croissance, mais sont encore trop jeunes pour être étudiés.

1/ L. H. Bailey, Standard Cyclopedia of Horticulture.
2/ Rivière et Lecq, Cultures du Midi.

E. gigantea.—Les Eucalyptus gigantea, après avoir offert un très faible pourcentage de germination, ont eu une croissance chétive pendant quelques mois. Deux aspersions de bouillie bordelaise n'ont pu venir à bout de la rouille et finalement tous les plants sont morts; il semble que cette espèce généralement considérée comme convenant aux régions fraîches ne puisse être acclimatée à Kenskoff.

De ce tableau, il ressort qu'excepté l'E. gigantea et l'E. resinifera toutes les espèces essayées semblent pouvoir être acclimatées. L'E. robusta et l'E. rostrata présentent l'avantage de pouvoir être aussi plantées dans les régions plus chaudes du pays. Le développement ultérieur des plants révèlera l'espèce convenant le mieux à Kenskoff.

Ce tableau fait aussi clairement ressortir le développement très rapide de l'Eucalyptus, car les chiffres obtenus sont de beaucoup supérieurs à ceux cités dans la table établie par Green pour 78 espèces forestières cultivées dans un bon sol moyen du Minnesota. D'après cette table où l'Eucalyptus n'est pas cite, les trois espèces ayant atteint le plus grand développement: l'Acer saccharinum (érable à sucre), le Robinia pseudoacacia (faux acacia) et le Catalpa speciosa ne dépassaient pas 60 cm. après un an3/.

Cette année nous avons surtout propagé l'E. globulus qui nous semblait mieux venu en pépinière que les autres espèces. Quelques plantations expérimentales ont pu en être faites sur une petite échelle dans les endroits suivants:

Localite	Propriétaire	Superficie	No. plants	Sol
Kenskoff	Louis Roy	½ ha. apprx.	617	argile rouge
Kenskoff	Henri Roux	½ ha. apprx.	934	argile rouge très rocailleuse
Platon Café	Léonce Borno	1,062 m^2.	118	argile noire très rocailleuse
Viard	R. T. Auguste	¼ ha. apprx.	267	argile rouge
Furcy	Naudé - Ziegel		132	argile rouge

Ces plantations faites dans des regions et des terrains de nature tout à fait différente donneront une idée générale du comportement de l'espèce dans notre district.

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(3) Samuel B. Green, Principles of American Forestry.

Le total des plants produits pour les sept espèces envisagées est le suivant:

Eucalyptus globulus	4400
" robusta	749
" rostrata	952
" maideni	80
" resinifera	40
" gunni	147
" gigantea	-

Pins.—Les nombreuses espèces du genre Pinus se rencontrent dans des conditions tellement differentes qu'elles ont su donner à cette plante un caractère tout à fait cosmopolite. Les pins se voient en effet tant dans les régions chaudes que dans les régions froides, au bord de la mer comme au sommet des pics les plus elévés, dans les sols siliceux comme dans les calcaires. Il semble donc qu'il suffise de savoir choisir les espèces convenant à une région déterminée pour les y voir y croître.

Haiti a eu la grande chance d'avoir à l'état spontane une des espèces les plus intéressantes et alors que les stations de diverses nations tropicales ont à essayer l'acclimatation de nombreux types pour trouver celui que convient le mieux à leur pays, nous n'avons qu'à propager intensivement celle que la Providence a placée spontanément sous nos cieux. Le Pinus occidentalis, qui pousse chez nous à l'état sauvage, nous semble présenter bien des avantages.

Sa croissance est relativement très rapide. D'aprés des mensurations pratiquées sur les pins d'environ 18 ans de la propriété Buch, à Furcy, le diamètre moyen des plants a été de 31 cms. alors que d'après le Dr. Web cité par Véges et Dupont, le pin à longues feuilles des États Unis (Pinus longifolia) prend plus de 70 ans pour atteindre un tel diamètre.4/ D'après les mêmes auteurs, le pin maritime français, considéré comme ayant un développement très rapide, prend de 20 à 25 ans pour atteindre le diamètre de 25 cms., diametre minimum pour l'exploitation de la résine. Un forestier haitien pourrait donc constituer une forêt 3 ou 4 fois plus vite qu'un planteur américain de Pinus longifolia.

La résine du Pinus occidentalis est considérée comme tout à fait bonne pour le marché international alors que certaines espèces ne fournissent pas de résine commerciale. Pour toutes ces raisons, nous croyons que, jusqu'à preuve du contraire, tout reboisement intensif de pins devrait se faire à l'aide de l'espèce indigène. Nous avons cependant expérimenté certains types étrangers qui pourraient être susceptibles de donner de bons résultats dans notre région.

(4) Bulletin Agricole du Congo Belge. [Pinus palustris Miller (the longleaf pine of the United States), according to growth records collected by the Southern Forest Experiment Station, has shown increments of 2 cm. a year and frequently attains a d.b.h. of 1 ft. at the age of 40 years.—O.R.]

Voici les résultats obtenus pour quelques mois de plantation.

Espèce	Age des plants	Crois moy.	Crois max.	Aspect gal.
P. radiata[5/]	9 mois	11 cms.	22 cms.	Bon.
P. pinaster	9 mois	6 cms.	9 cms.	Croissance presque nulle.
P. occidentalis	8 mois ½	5 cms.	7 cms.	Satisfaisant.
P. densiflora	6 mois	4 cms.	5 cms.	Croissance très faible.
P. canariensis	8 mois ½	7 cms.	12 cms.	Satisfaisant.
P. thunbergii	8 mois ½	6 cms.	9 cms.	Satisfaisant.
P. pinea	(semis le 15 janv.)	(pas de germination)		

Il est intéressant de comparer ces chiffres à ceux établis par Green qui, après un an, avait obtenu 7 cms. ½ pour 7 espèces de pins differentes des nôtres. La croissance du P. radiata est surtout tout à fait remarquable.

Autres conifères.—A part les pins, nous avons essayé d'acclimater quelques autres conifères. Le tableau suivant présentera sous une forme schématique les résultats obtenus:

Espèce	Age des plants	Croissance moy.	Croissance max.	Aspect général
Abies balsamea	8 mois ½			Presque nulle.
Abies cephalonica				Les graines n'ont pas germé.
Sequoia sempervirens				Une seule graine a germé, le plant n'a pas survécu.
Cupressus sempervirens				18 cms. 26 cm. Satisfaisant.
Libocedrus decurrens				Les graines n'ont pas germé.
Cedrus libani	6 mois ½			4 cm. 5 cm. Chétif.
Gingko biloba				Les graines n'ont pas germé.
Larix leptolepis	6 mois			1 cm ½ 2 cm. Chétif.
Larix europea				Les graines n'ont pas germé.
Picea pungens glauca	6 mois			2 cm. 3 cm. Chétif.
Juniperus bermudiana				Les graines n'ont pas germé.

Il ne faut pas déduire du fait que certaines graines n'ont pas germé que ces espèces ne peuvent être acclimatées. Certains conifères ont des graines preséntant un pouvoir germinatif très capricieux; il nous faudra essayer à nouveau les espèces qui n'ont pas germé.

5/ Les plants de P. radiata ont presénté de très grandes variations de croissance, ceci étant du probablement au sol de la plate-bande qui n'était pas de richesse suffisamment uniforme.

Summary

Kenscoff, in the mountains above the capital of Haiti, is an important agricultural section, possessing a cool climate, comparable with many other mountain areas in the Republic. Erosion is the great problem. The extensive pine forests which formerly existed here have been cleared and burned for agricultural use, or cut for Christmas trees and fuel. Such clearing has extended to the very steep slopes, where washing and impoverishment of the soil has been excessive.

Owing to the necessity for shifting from the annual cultivated crops to permanent fruit or forest groves, experiments are being carried on to determine the species adaptable to the environment. Although the preliminary results cannot be taken as definite proof of acclimatization, the findings to date are of considerable interest and indicate future results.

Species of Eucalyptus, because of their rapid growth, ability to sprout, their excellent wood, and the presence of commercial oil in the leaves (of certain species), are very desirable. Several species have been tried out; some attained a height of 120 cm. $8\frac{1}{2}$ mo. after seeding. Many pines and other conifers have been given a trial in the nursery, and rates of growth are given. Pinus radiata shows considerable promise. P. occidentalis, native to Haiti, is a good turpentine species, and grows very rapidly.

Resumen

Kenscoff, radicado en las montañas inmediatas a la capital de Haití es una sección agrícola importante y tiene un clima fresco parecido a muchas otras áreas en las montañas de la República. La erosión es el problema mayor. Los pinales extensos que existían anteriormente aquí, se han tumbado y quemado para uso agrícola ó cortados para leña y para árboles de Navidad. Tal desmonte se ha extendido hasta las cuestas más empinadas donde el lavado y empobrecimiento del suelo ha resultado excesivo.

Debido a la necesidad de cambiar de cosechas anuales a huertos frutales ó bosques, se están haciendo experimentos para determinar las especies que más se adaptan al medio ambiente. Aunque los resultados preliminares no se pueden tomar como prueba definitiva de aclimatación, los datos son de interés e indicativos de futuros resultados.

Los Eucaliptos son muy deseables debido a su crecimiento rápido, su habilidad para retoñar, la madera excelente y el aceite que contienen las hojas de algunas especies. Muchas especies han sido probadas y algunas han alcanzado una altura de 120 cms. ocho meses después de haberse sembrado. Se han ensayado muchos pinos y otros coníferos en viveros y los promedios de crecimiento anotados. Parece que Pinus radiata puede darse bien. P. occidentalis, el pino nativo de Haití, da muy buena trementina y crece muy rapidamente.

A MAHOGANY SEEDLING BLIGHT IN PUERTO RICO

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Agricultural Experiment Station
Rio Piedras, Puerto Rico

Introduction.-Among the various timber trees grown on hillsides and valleys at lower elevations in Puerto Rico, the West Indian mahogany, Swietenia mahagoni Jacq., is one of the most esteemed for furniture and other purposes. The hard, strong, reddish-brown wood is considered one of the best forest products of tropical America.

During the past few years, mild foliage troubles have been noticed in nurseries at Rio Piedras, Puerto Rico, and at Villalba; and in August of this year, our attention was called by the Forest Service at Rio Piedras, to a sudden and severe outbreak of a blight, followed by defoliation, among small 6-months-old mahogany seedlings growing in the Insular Forest Nursery at Guánica, Puerto Rico.

Isolations made from infected leaves, as well as the examination of the fruiting bodies present on them, revealed that the causative agent is a fungus belonging to the Sphaeropsidales. All the information hereby presented, unless otherwise stated, refers to the disease as it occurs in the Insular Forest at Guánica.

Symptoms.-The first noticeable symptom in the appearance of a discolored area along the margins, and particularly on the apical portion, of the leaves. The infection occurs in old as well as in young leaves, although more frequently in the former. The tips of the leaves appear necrotic, as if burnt. As the disease progresses, the tissues beyond the necrotic areas and across the whole width of the blade become a dull, light green; this is followed by a complete necrosis of the previously invaded regions. The dead portions are sordid yellow to dark brown, increasing gradually toward the petioles. Small, black, erumpent bodies are easily recognized scattered over the dead areas. With the advance of the disease, the tips of the leaves curl up, and finally the necrotic leaves drop off.

Causal agent.-The pathogen responsible for this malady has been found to be Phyllosticta sp., a member of the Sphaeropsidales of the Deuteromycetes. Since, to our knowledge, there have been no previous reports on a disease of this nature occurring in Puerto Rico or elsewhere, the organism is described here as a new species:

Phyllosticta swietenia sp. nov.; Pycnidia numerous, scattered, amphigenous, ochreous, lenticular to globose, thin membraneous, erumpent or piercing the epidermis, large 190-285 x 95-135 μ. in diam.; ostiole distinct, black bordered, 20 μ. in diam.; conidia hyaline, granular, ellipsoidal, pointed at both ends, 5.7-7.6 x 2.8-3.8 μ.

Epidemiology.-The incidence of the malady has been observed to be affected by the amount of inoculum present, and by the moisture on the leaves. The crowding of large seedlings in nurseries or the prolonged use of artificial shade and sprinkling favor extensive development of the disease. Nurseries kept without natural or artificial shade have shown no serious development of the trouble.

It has been noticed that the lesions are more frequent at the tips of the leaves, where water drops collect. These drops provide a very favorable medium for the germination of the conidia and consequently for infection. Germination of conidia placed in water occured within an hour. Apparently, the delicate spores are incapable of standing long periods of dryness.

In Guanica, where the nurseries are located, the annual precipitation fluctuates between 25 and 35 in. The climatic conditions are naturally unfavorable for the incidence of the disease, but in this case the nurseries were protected from the sunlight by palm-leaf shades and were watered regularly with sprinklers every night. The wetting of the leaves and the shade kept the environment very favorable for the spread of the pathogen. At Rio Piedras, where the rainfall is high, but where the seedlings are growing in the open, without shade, nurseries show no incidence of the disease, the free circulating air keeping the leaves relatively dry.

Summary

A sudden outbreak of a foliage blight attacking 6-months-old West Indian mahogany (Swietenia mahagoni Jacq.) seedlings growing at the Insular Forest Nursery at Guanica, P. R. was found to be caused by an unreported species of Phyllosticta, here described as P. swietenia sp. nov.

The initial infection, which starts generally at the apical portion of the leaves and progresses toward the petiole, is followed by necrosis and defoliation. Nurseries kept under artificial shade and in places of high humidity are severely infected. Seedlings grown in the open escape the malady.

Resumen

Un brote serio de una enfermedad foliar se manifestó recientemente entre los semilleros de caoba, Swietenia mahagoni Jacq., ubicados en el Bosque Insular en Guánica, P. R. El patógeno responsable es un hongo no informado anteriormente, perteneciente al genero Phyllosticta y aquí llamado P. swietenia sp. nov.

La infección, que se inicia generalmente en la punta de las hojas, como una pequeña mancha oscura, necrótica, avanza luego en forma continua hacia la base. Invadidas totalmente, las hojas siguen una defoliación intensa. La enfermedad toma incremento en semilleros bajo sombra, donde el ambiente es húmedo. En semilleros sin sombra la infección es mínima.

SOME NOTES ON FOREST ENTOMOLOGY

Luis F. Martorell, Asst. Entomologist,
Agricultural Experiment Station,
Rio Piedras, P. R.

Successful control of the coffee stem borer.—The coffee stem borer, Apate francisca Fabr. has been known for many years as an insect pest on coffee in Puerto Rico. The following trees or other plants are recorded as additional hosts of the insect: grape fruit (Citrus maxima (Burm) Merrill); citron (C. medica L.); chinaberry (Melia azedarach L.); pigeon pea (Cajan cajan (L.) Millsp.): Humboldt's willow (Salix chilensis Molina): Linociera domingensis Knobl.; Picramnia pentandra Sw.; avocado (Persea gratissima Gaertn.); pomme rose (Jambos jambos (L.) Millsp.); pomegranate (Punica granatum L.); flame tree (Delonix regia (Bojer) Raf.); annatto (Bixa orellana L.); Inga vera Willd.; sugarcane (Saccharum officinarum L.); tamarind (Tamarindus indica L.);and guava (Psidium guajava L.).

Recently, the insect has come to be better known, owing to the heavy damage it inflicts on forest trees, such as Dominican mahogany (Swietenia mahagoni Jacq.), West Indian birch (Elaphrium simaruba (L.) Rose), etc. In July 1937, a heavy outbreak of Apate francisca appeared in forest plantations in Mario Mercado's farm in the dry south-coast section near Guayanilla. Young mahogany trees about 3 years old and ranging in diameter from 1 to 3 ft. were found seriously infested by the borer, and sometimes individual trees contained as many as 20 or more tunnels. The outbreak was a direct result of the large amount of trash of tree trunks and branches left on the ground, following previous clearing of a growth of inferior species, and providing excellent conditions for the rapid breeding of the species. A high percent of the mahogany was attacked, and infestation spread to native Bucida buceras L. trees and adjacent plantings of Australian pine (Casuarina equisetifolia Forst.) and flame trees. As a control measure, Dr. Wolcott, Head of the Entomology Department at the Experiment Station, recommended running a large flexible wire (No. 6 or No. 8) into the tunnels to kill the beetles. Four or five men carried out this operation on the several thousand trees in the plantation in one week, and almost completely destroyed the infestation. Some of the trees had been so seriously attacked that they died a few months later, but the rest were saved and subsequent infestations have not been serious.

Control of the "capá" leaf-roller.—A very extensive infestation of the capá leaf-roller, Hyblaea puera Cramer, on capá blanco (Petitia domingensis Jacq.) appeared in the Forest Service nurseries at Cayey in July 1937. The infestation spread rapidly and each day appeared in new seed beds. By spraying with arsenate of lead in the proportion of 2½ pounds to 50 gallons of water, and using soap as a spreader, the infestation was stopped in about a week. Since that time, only small outbreaks of the pest have occurred, and similar sprays of arsenate of lead have always given satisfactory control.

A new insect record for Puerto Rico.-Phostria originalis Lederer, appeared in Puerto Rico as a pest on moca (Andira inermis, H.B.K.), one of our valuable forest trees. This is a web-worm which is found in clusters of about 80 to 100 at the ends of the branches, in a web made of silken hairs, dry twigs, and leaves.

The tree is completely defoliated by the larvae. This insect was recorded for the first time at Aibonito and Barranquitas in July 1936, and again in July 1938. Several moca trees were seen badly defoliated by this insect near Aibonito.

The larva of Phostria originalis is a small, greenish worm, about 20 mm. long, with greyish spots scattered over the body. The pupa, which is dark reddish-brown, measures about 16 mm. in length. The pupal period in the laboratory varied from 8 to 12 days.

Summary

The coffee tree borer, Apate francisca Fabr., has seriously infested Dominican mahogany plantations in Puerto Rico. Control was secured by pushing flexible wire into the tunnels to kill the beetles.

The capá leaf-roller, Hyblaea puera Cramer, attacked Petitia domingensis seedlings in Forest Service nurseries. Adequate control was secured by spraying arsenate of lead.

Phostria originalis Lederer, a web-worm, has been found defoliating Andira inermis.

Resumen

El taladrador del tallo del café (Apate francisca Fabr.) ha infestado grandemente las plantaciones de caoba dominicana en Puerto Rico. Este ataque pudo combatirse introduciendo un alambre flexible dentro de los túneles para matar el insecto.

El pega pega del capá (Hyblaea puera Cramer) atacó los arbolitos de capá blanco (Petitia domingensis) en los planteles del Servicio Forestal. Este insecto se pudo combatir con aspersiones de arseniato de plomo.

Phostria originalis Lederer, la oruga tejedora de la moca, fué hallada deshojando los árboles de moca (Andira inermis).

PREPARACION Y USO DEL MANTILLO O ESTIERCOL COMPUESTO EN VIVEROS FORESTALES

J. A. Gilormini,
Assistant Forester,
Servicio Forestal de Puerto Rico

Introducción--Para los que practicamos siembras en jardines, planteles y viveros, el estiércol compuesto nos es de grandísima utilidad. En la práctica de viveros forestales por ejemplo, donde las plántulas van a estar muy poco tiempo, tenemos que proporcionarle alimento de ligera asimilación para poder obtener arbolitos de buena calidad para ser luego llevados a los distintos distritos forestales donde serán trasplantados definitivamente.

Sitio donde se usa el mantillo--La cantidad de árboles propagados anualmente en los distintos viveros forestales es bastante considerable. Las materias fertilizantes que éstos toman del terreno durante años, disminuye la propiedad fertilizante de dichos terrenos. El uso de abonos químicos proporcionaría una ayuda en cuanto a la alimentación de los arbolitos por cierto período de tiempo solamente; ya que estos abonos son arrastrados por las lluvias y debido a su gran solubilidad se pierden considerablemente con las aguas. Además muchos de los terrenos usados para la propagación de arbolitos son pobres en materia orgánica la cual puede ser suministrada con la aplicación de un estiércol compuesto bien curado que no perjudique a las siembras que se hagan en dichos terrenos.

Cómo se prepara el mantillo--El mantillo es una mezcla compuesta particularmente de estiércol de establo, hojarasca, cachaza, yerbas, tierra y otras materias vegetales que se consigan.

Al preparar el montículo de estiércol compuesto, la primera capa que se pone consiste de terreno fértil de un espesor de 10 a 12 pulgadas. Entonces las siguientes capas se alternan con estiércol, paja, yerbas, hojarasca, cachaza y otras de las materias que estén a la mano. Cada capa no debe ser de un espesor mayor de 4 a 7 pulgadas. Al terminar el montículo de estiércol compuesto, se la aplica una capa de tierra fértil encima del último material usado. Esta última capa debe ser de 6 a 10 pulgadas de espesor.

Es recomendable que se aplique cal para mejorar su composición y evitar la pérdida de nitrógeno durante la fermentación.

Las capas deben quedar bien apretadas, pues si el estiércol y los otros fermentos quedan flojos, se calientan mucho durante la fermentación con la consiguiente pérdida de algunos productos de nutrición de las plantas como el nitrógeno. Al mantillo se le puede añadir abonos químicos tales como el superfosfato y sulfato de potasa para hacerlo más rico en materias fertilizantes. Esto queda a elección de acuerdo con la calidad del mantillo que se desee preparar.

Después de preparar el montículo de estiércol compuesto, éste puede moverse dos ó tres veces durante la fermentación para obtener un producto homogéneo y bien curado.

Durante el período de seca, el montón de estiércol compuesto debe ser regado varias veces durante el tiempo de fermentación para asegurar una completa podredumbre de los distintos materiales.

El tiempo que toma un montón de estiércol compuesto para estar listo para ser usado varía desde ocho meses a un año.

Uso del mantillo.-El mantillo se aplica de acuerdo con la fertilidad y condiciones físicas del terreno. En terrenos medianamente fértiles usamos mantillo a razón de 27 a 30 pies cúbicos por 400 pies cuadrados de terreno en los semilleros.

Se aplica antes de la preparación de los semilleros. Al aplicarse se mezcla bien con el terreno y luego se procede a la preparación de éstos para sembrar la semilla inmediatamente después.

Summary

The addition of compost to forest-nursery sites balances the drain on the soil in producing sturdy stock over successive years and gives more satisfactory results than chemical fertilizers, which are rapidly leached from the soil by the heavy rains of the tropics.

The compost heap is started with a layer of fertile soil 10 to 12 in. deep followed by successive layers 4 to 7 in. deep of materials available, such as manure, grass, weeds, leaves, filter-press cake, or other litter, with a final topping of 6 to 10 in. of good soil. Some lime should be added, the layers well packed, water added during dry spells, and the heap worked over occasionally to insure thorough rotting of the materials and a homogeneous mixture. The compost is ready for use at the end of 8 to 12 months.

It is applied previous to bed preparation and thus well mixed with the soil. The amount to be applied varies with the condition of the nursery soil; in Puerto Rico about 27 to 30 cu. ft. are used on a bed of 400 sq. ft.

THE FORESTS OF SURINAM

Gerold Stahel, Director,
Agricultural Experiment Station

The forests of Surinam cover about 90 percent of its area of 54,291 square miles. Between 1904 and 1925 a well equipped forestry department was in operation with one or two trained foresters, but since 1925, the country has had no such officers, and the care of the forests has rested upon the Surinam police.

Los bosques de Surinam cubren alrededor de un noventa por ciento de su area de 54,291 millas cuadradas. Un departamento forestal bien equipado estuvo en operación entre los años 1904 y 1925 con uno ó dos silvicultores adiestrados, pero desde el 1925 el país no ha tenido esos oficiales y el cuidado de los bosques ha descansado sobre la policía de Surinam.

NEW TROPICAL FOREST EXPERIMENT STATION

The Federal Government of the United States of America recently has appropriated funds for the establishment of a Tropical Forest Experiment Station with headquarters in Puerto Rico. The appropriation of $30,000 was granted by the Congress for the two-fold purpose of laying the scientific foundation for sound forestry practices in Puerto Rico and elsewhere in the American tropics, and to serve as far as feasible as a center for the reception and dissemination of knowledge in the field of tropical forestry in America.

Mr. Arthur Bevan, who is being offered the Directorship of this new Station, and Dr. I. T. Haig, Chief of the Division of Forest Management Research of the United States Forest Service, are now in Puerto Rico to set up the organization of this unit. It is hoped under these auspices to greatly expand the progress of work, which has been under way for the last 1½ years on emergency funds.

The results from the studies to be undertaken should help greatly to solve the forestry problems in Puerto Rico. At the same time, it is hoped that many findings will have a wide application in the Caribbean region.


UNITED STATES OF AMERICA
GULF OF MEXICO
MEXICO
BAHAMA ISLANDS
CUBA
HAITI
DOMINICAN REPUBLIC
PUERTO RICO
JAMAICA
CARIBBEAN SEA
GUADELOUPE
DOMINICA
MARTINIQUE
ST LUCIA
ST VINCENT
BARBADOS
GRENADA
TOBAGO
TRINIDAD
BRITISH HONDURAS
GUATEMALA
HONDURAS
SALVADOR
NICARAGUA
COSTA RICA
CANAL ZONE
PANAMA
VENEZUELA
BRITISH GUIANA
SURINAM
FRENCH GUIANA
COLOMBIA
PACIFIC OCEAN
ATLANTIC OCEAN

THE CARIBBEAN FORESTER

It is my pride and joy to be the shepherd of my country's trees.

TROPICAL FOREST EXPERIMENT STATION,
UNITED STATES FOREST SERVICE,
RIO PIEDRAS, PUERTO RICO

Vol. 1, No. 2 JAN. 1940

THE CARIBBEAN FORESTER

This journal is planned as a medium of exchange of knowledge between those interested in forestry in the islands and countries in or near the Caribbean Sea. Invitations to cooperate in this project have been sent to forestry and agricultural officials in the following places:

Bahama Islands
Barbados
British Guiana
British Honduras
Canal Zone
Colombia
Costa Rica
Cuba
Dominica
Dominican Republic
French Guiana
Grenada
Guadeloupe
Guatemala
Haiti
Honduras
Jamaica
Leeward Islands
Martinique
Mexico
Nicaragua
Panama
St. Lucia
St. Vincent
Salvador
Surinam
Trinidad & Tobago
Venezuela

It is planned to present this journal quarterly. Material for publication should be submitted at least two months before publication date and be addressed to the Director, Tropical Forest Experiment Station, Rio Piedras, Puerto Rico.

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To Our Collaborators

The coming of each new year is conducive to a short period of retrospection as well as to consideration of intended accomplishments for the next 12-month period. Like a young child, however, "The Caribbean Forester" has had too little experience to allow us to indulge in thoughts on past accomplishments. We wish to mention only in passing that the first step taken, namely, the October issue, brought forth a great number of congratulatory letters from far and wide, expressing the wish for long-continued life of the new periodical. This information is gladly passed on to the several contributors who made the first number possible.

As for the future, the satisfactory fulfillment of the Journal's purpose to assemble the vast amount of silvicultural information scattered about the Caribbean region and to make it available for all interested workers, will depend in great measure on the extent to which contributors from the various countries are willing or able to participate. At any rate, the fact that articles are arriving from countries new to the list of contributors augurs well for an increased participation during the present year.

Such an increase in the number of organizations taking an active part in the journal is highly desirable, since it makes possible the attainment of a much more complete picture of the forestry situation in the Caribbean region, where this publication may serve as a document for future study of the local growth of the forestry movement and of silvicultural knowledge. Even a rapid scanning of the articles in the first two numbers suffices to demonstrate the strong desire already present to put an end to devastating forces and to show the forests in their true economic light.

It is hoped that the remaining countries in our region will go on record soon with descriptions of their forestry situations, so that we all can watch the future developments not only within our own borders but also within the region as a whole, and thus enjoy the encouragement for our own efforts and the pleasure which concerted participation in a good cause affords.--L. R. Holdridge, Tropical Forest Experiment Station.

CONTENTS

MAPPING VEGETATIONAL TYPES IN BRITISH HONDURAS FROM AERIAL PHOTOGRAPHS

J. B. Kinloch,
Assistant Conservator of Forests

In 1939 British Honduras was fortunate in receiving photographs of an aerial survey carried out over the greater part of the Colony; and the Forest Department has started an attempt to interpret these photographs for a revision of its vegetation map, but our experience is still very limited. The following notes, however, may be of interest to tropical foresters who for the first time are attempting similar work; and it is hoped that they will bring out helpful suggestions from more experienced men.

Mapping vegetation types in the Colony is aimed at obtaining (1) data as to the available volumes of timber other than the one export species, mahogany, in order to develop a wider utilization of the country's forest resources; and (2) soil-type information on which to lay the foundations of a sound policy of land usage. In this densely wooded, sparsely inhabited country with its few internal communications, the determination of the boundaries of vegetation types by ground methods is of necessity slow and expensive; labor is costly, and the trained staff is short.

A triangulation framework exists, and on it the numerous cadastral surveys will be tied. As regards actual small-scale topography, little has been done except forest, river, and road surveys and the topography included on the cadastral surveys. From the aerial photographs, it will be possible to show all the topography, with the exception of the Maya Mountains, which were not photographed.

On account of the geological immaturity, there are no large uniform expanses of any one soil-type. Since vegetation is closely correlated with soil, vegetation types are very patchy. Interpolation of association boundaries on a map based on the usual 1- to 5-percent transect-samples may therefore be little more than informed guesswork, since the range of vision in the rain forest is little more than a chain. Our experience indicates that practically nothing short of 100-percent stock- and type-mapping can be considered accurate, but it is financially impossible to carry out 100-percent enumerations in reasonable time except in restricted areas. We do not have 6,000 C.C.C. workers! Therefore if association boundaries can be distinguished accurately on the aerial photographs, the value of sampling transects will be enhanced greatly.

There are two ways of interpreting photographs. In the first, the photographic survey precedes the ground survey. Photographs of selected, typical areas may then be taken to the field, and the ground conditions noted on the photographs. The second method is to carry out the ground survey and then attempt to correlate the photographs with this in the office. Here we have no choice; the second method must be adopted, since only one set of photographs is available and this has to be preserved carefully in the Survey Department.

During the past 7-8 years we have carried out a resources survey, in which it was attempted to sample a typical area in each of the major geological and floristic regions by transects, giving on an average a 3-percent enumeration with an ecological basis. A considerable volume of field data is now being summarized, and all plotting of maps has been completed. This field work was undertaken almost wholly by two European officers and later by small native crews trained under them. This point is mentioned, since it must be stressed that interpretation of vegetation in the office from the photographs we are studying is possible only with a good knowledge of conditions in the field.

The aerial photographs are being plotted in the Survey Department. The resulting map on a scale of approximately 1:40,000 will be compiled into plans of a convenient size. To Mr. G. A. Elliott, who has studied this branch with H. M. Ordinance Survey, thus obtaining very useful experience, I am indebted for collaboration in the preparation of this note.

The value of a knowledge of conditions on the ground is demonstrated amply, since the stations of the triangulation survey can be located in the photographs, which are thus being adjusted into an accurate framework. The degree of accuracy of the resulting map is much higher than could have been obtained had the triangulation survey not been carried out. Similarly the ground work of the vegetation survey is providing a sound starting point in obtaining information on the vegetation from the photographs.

The flying height of 21,000 ft. and the scale of the photographs were chosen as most convenient for a photo-geological survey. The vegetational detail is minute; and the magnification, while sometimes helpful, is generally unsatisfactory, since fine detail is obscured in the grain of the paper. Much finer differences in vegetation undoubtedly could be made from photographs taken between 5,000 and 8,000 ft. In spite of this limitation, the small-scale photographs are already affording valuable information, and it is hoped that further study will overcome most of the difficulties at present encountered in interpreting the vegetation.

Forest officers in British Honduras have flown on every opportunity afforded by a restricted travelling budget. During the last 3 years, the start of an internal air service has enabled them, while travelling to outstations, to become acquainted with the aspect of the different vegetational types from the air. Usual flying heights are between 1,000 and 2,000 ft., from which individual canopy species often can be recognized, especially when they are in flower. Sketching the vegetation has been attempted whenever possible. This limited flying experience has proved very helpful in studying the high-altitude photographs, in which individual species generally cannot be recognized, since the crowns of the rain-forest canopy appear fused into an indistinct mosaic.

Certain vegetational types, however, can be distinguished readily. Open grassland, slash pine forest, mangrove, low scrub-swamp forest, new cultivation, and rain forest all have their distinctive appearances. The most important type from the forestry aspect, the rain forest, is unfortunately much more difficult to subdivide into its various associations, which often differ markedly in species, timber sizes, and value for agricultural sites.

On first examination the rain forest appears the same in all localities, but it is essential that subdivision be attempted. The first major subdivision which suggests itself is into geological regions. As noted above, geology and vegetation are closely related in British Honduras, and the resources survey has sampled the main geological regions, which are readily distinguished by the type of weathering of the different rocks. The precipitous sinkhole, enclosed-valley weathering of the dense limestone is very different from the herringbone, rounded gullying of the granites and schists, which in turn differs from the knife-edge splitting of the slates or the low rolling terrain of the Toledo shales. Their floras, seen on the ground, are as distinct as the weathering appears from the air.

The present stereoscope is not fitted with a grid for measuring height. A new model, which should arrive shortly for the Survey Department, has this refinement, but how far it can be used on the high-altitude photographs is still to be discovered. Nevertheless, relative heights of the canopy can be estimated in any one locality.

The resources survey classified the forests in 10- to 15-foot height-classes, which have been found during the summarizing of the field data to correspond roughly with variations in the association within any one geological region. An approximate subdivision of the rain forest into low (30-50 ft.), medium (50-70 ft.) and high (70-100 ft.) classes can be made with the present stereoscope.

It is further known that the associations vary according to whether the slopes are steep or gentle, since slope affects drainage and consequently soil moisture. Hill-top vegetation differs from that of the valley sides, and the latter from that of the valley bottoms. Approximate contouring, therefore, provides a further clue to the association examined.

In all our ecological work, the palm associates have been regarded as important indicators; and most of our associations have been described from the several predominating broadleaved species, in conjunction with the palm associates, which appear to be much more selective of soil or soil moisture than most of the broadleaved species.

It has been found that the crowns of canopy palms show up white in contrast to the usual light or dark greys of the broadleaved species. This effect, probably caused by the reflection of light from the glabrous palm crowns, can be checked in the shifting-cultivation clearings in high rain forest, where the natives leave the canopy palms standing in their clearings. With X4 magnification, these isolated palms can be seen clearly, giving a clue to the nature of the adjoining forest. The white crowns of the palms stand out from the darker matrix of the broadleaved species and, wherever they are frequent in the canopy, create a peculiar pepper-and-salt effect; this is generally true only in high rain forest. It has been noticed on the ground that, in general, the larger the canopy palms the taller is the forest. In low rain forest, canopy palms are sparse.

It has not yet been found possible to differentiate between the two chief canopy palms, viz., Sabal, which is confined to limestone soils, and Orbignya, which occurs in the highest types of rain forest on the limestone, as well as on the granites and schists and Toledo shales. This may be found possible with further study of the magnified photographs.

For working out association differences in the rain forest from the photographs, there thus exists a number of clues; these include geology, slope, aspect, relative height of the canopy, abundance of canopy palms, and general appearance of the photographic matrix.

To interpret these results, an area that has been transect-sampled is selected. The plan, which is on the scale of 20 chains to the inch, shows the height-class association boundaries at their junctions with the transects. A map prepared from the photographs, showing all boundaries that can be ascertained from the factors listed above, is enlarged to the 20-chains scale. The field plan is then superimposed on the aerial map, and all possible boundaries are connected.

The aerial map is then superimposed on the field plan, and any association boundary junctions left unconnected are marked off on it. The sections between such unconnected boundaries will then be re-examined under magnification and the height grid to see whether finer distinctions cannot be discovered.

While this system will practically bring the field into the office, sufficient experience has not yet been gained to tell whether differences obvious in the field will be as apparent on the small-scale photographs. It is hardly to be expected that all the numerous associations recognized in the field will be distinguished, but our foundation of ground work enables us to make a fairly confident start.

Resumen

El Departamento Forestal de Honduras Británicas tiene acceso a un juego de estampas fotográficas de un reconocimiento hecho de la mayor parte de la Colonia, y se está empezando a hacer un mapa de la vegetación. Las fotografías fueron hechas a una escala pequeña y, por lo tanto, el detalle del terreno es diminuto.

Aunque las colindancias de la vegetación pueden ser distinguidas hasta por el más lego, la subdivisión de los bosques pluviales en sus numerosas asociaciones es mucho más difícil.

La necesidad de un conocimiento inteligible de las condiciones en el campo está acentuada, y ciertos factores sugeridos por los resultados de un estudio hecho sobre una base ecológica durante varios años se mencionan como ayudas definitivas en la subdivisión del bosque pluvial. Estos incluyen geología, declive, aspecto, altura relativa del covertor vegetal, abundancia de palmas de dosel y la apariencia general de la matriz fotográfica.

FORESTRY IN GRENADA

W. H. Hagley,
Forest Officer and Agricultural Assistant

The island of Grenada, some 120 square miles in extent, may be considered mountainous. The main chain of mountains, which runs from north to south, includes the most important forest areas of the colony. The St. Catherine "massif" to the North, with one spur having an altitude of 2,749 ft. above sea level, attains the highest elevation of the entire mountain system, but some 17 peaks in the chain have altitudes of 2,000 ft. and over. The forests of the colony are mainly of the tropical evergreen type, lying within (and to a great extent above) an isohyet of 100 in. of rainfall per annum.

As early as 1887, Mr. Hooper reported on the forests of Grenada and Carriacou and recommended the reservation of the forests on the central ridge of the colony for water-conservation purposes. With the exception of the appointment in 1898 of forest guards to prevent illicit felling of timber, there is little record of any action being taken in that direction until 1906, when an ordinance was passed bringing into being the Grand Etang Forest Reserve. In 1910 the Forestry Ordinance was introduced, and with it was established a Forestry Board, the primary function of which was to draft schemes for the protection of forest growths of the colony. In 1937 the administration of the forest reserves was vested in the Agricultural Department, and every effort is being made to develop the forests on scientific lines.

Reserved forests occupy about 4,000 acres, and the total area of state and private forests is approximately 16,000 acres. This area represents nearly 19 percent of the total land area of the colony. Major agriculture, the cultivation of cocoa and nutmegs, occupies some 33,000 acres. These orchard crops with their somewhat dense canopies play an important part as allies of forest growth in the conservation of soil and water.

Prior to 1937, the state forests were viewed solely from a protection point of view and were maintained absolutely as rain reserves. The present policy, it may be stated, aims at the development and extension of the forests on mixed lines. From the protection aspect, every effort is made to protect and maintain the headwaters of rivers, especially the catchment areas of potable waters; to maintain the forest cover on ridges and on steep hillsides in a campaign against erosion; and to establish windbreaks. From the economic point of view, merchantable species that have reached maturity are exploited; and the management of the forests, under a scheme of improvement fellings and liberation cuttings, aims at gradually changing the forests, in suitable areas, so that more valuable species may in time play the dual role of protection and supply, thus relieving at least a fair portion of the financial burden incurred by their conservation. Seed and seedlings of economic species are being distributed free of cost to estates for windbreaks and shelterbelts. It is hoped that by this means the management of such estates will establish, wherever practicable, woodlots on soils of low agricultural value and gradually replace existing shelterbelts with species of greater economic value.

Little work has been done as yet in carrying out enumeration surveys, and therefore no detailed stock of timber is available. It may be safely stated, however, that gommier (Dacryodes hexandra) is easily the dominant species, and in many areas of the forest can be found in almost pure stands. Bullet (Mimusops balata), laurier (Lauraceae), maruba (Simaruba amara), serette (Byrsonima spicata), greenheart (Buchenavia capitata), and crappo (Carapa guianensis), are occasional to rare. In the lower elevations and coastal areas, red cedars (Cedrela mexicana), West Indian mahogany (Swietenia mahagoni), Honduras mahogany (S. macrophylla), and white cedar (Tecoma leucoxylon) thrive well, and there is a considerable area in these belts where woodlots could be established successfully with these species.

Nurseries are being established to provide seedlings for regeneration work; maruba, serette, crappo, and the several kinds of laurier are the principal species grown. Seedlings of semi-forest crops, such as cloves, cinnamon, and pimento, are also being grown for free distribution to peasants, in an endeavor to encourage them to plant the steep hillsides of their holdings for the twofold purpose of agricultural extension and soil conservation.

Exports of West Indian mahogany on a small scale are being made to the neighboring colony of Trinidad, and a limited market for locally produced boards, scantling, and shingles exists in this colony. The conversion of this timber, which is principally gommier, furnishes employment for a moderate number of woodcutters, together with their help, throughout the year. Locally sawn boards are sold at a price which approximates 50 percent of that for imported lumber. This construction material is used, in large part, for building laborers' and peasants' cottages.

It must be stated that the Forest Service of this colony is small and perforce all efforts must be somewhat circumscribed; nevertheless, the various problems of forest management that present themselves are being attacked along technical lines. It is gratifying, therefore, to know that in the solution of some of these problems it may be possible to draw upon the experiences of other Forest Services through the medium of this journal.

Resumen

La isla de Grenada, que comprende aproximadamente 120 millas cuadradas, es más bien montañosa. Los bosques, que ocupan casi un quinto de la colonia, son principalmente del tipo tropical vivaz.

Antes del 1937, los bosques del estado se preservaban principalmente para la protección, pero la presente política de administración trata de conseguir la conversión gradual de los bosques al doble propósito de protección y producción. Al presente, la tumba de madera provee empleo local y material de construcción, así como tambien pequeñas cantidades de caoba antillana para exportar a Trinidad.

Se han establecido viveros para proveer arbolitos de especies maderables y de cosechas semi-forestales y se atacan por vías técnicas los varios problemas de administración forestal que se presentan.

FORESTRY AND FOREST RESOURCES IN HAITI

Schiller Nicolas, Service Technique

The Republic of Haiti occupies approximately one-third of the island of Hispaniola. The Indian name, "Haiti", refers to a mountainous and wooded land, but the traveler who comes to the country for the first time, whether by boat or airplane, after seeing what man has brought about, might conclude that the name was given in derision.

The topography, the climate, the soils (mostly from calcareous rock), the great variety of excellent woods, and the restricted valley area, should make forestry one of the most important economic activities of the country. On the contrary, however, nowhere else in the West Indies has deforestation and erosion played such tragic havoc and depleted agricultural resources to such a dangerous point. This mischief has taken place mostly since 1840, because previous to that date the farming operations of the French on the mountain slopes consisted mainly of growing coffee and cacao. Moreover, the application of drastic laws against clearing of land, the small population, and the intensive use of irrigation water for sugarcane plantations and for sugar, indigo, and coffee mills, kept the misuse of the hill lands within a reasonable limit.

When independence was secured (1804), Haiti had a population of about 520,000 inhabitants. Ever since, the population has increased about 500,000 every 25 years. The pressure of population, in conjunction with the absence of any agricultural and forestry organization and policy, the insecurity of land titles, political instability, the "peon" system for the share croppers, absentee ownership of land, inadequate fiscality, etc., have created outright the plague of "bois neuf" or shifting cultivation. To appreciate fully the dreadfulness of the situation, it may not be amiss to point out a few facts. Haiti, with a population of 3 million souls, has an area of 27,700 sq. km., including the adjacent islands, or 2,770,000 hectares of land. Of this, 2,070,000 has. consist of rugged mountains and tablelands, and the remaining 700,000 are in plains. In the upland regions, there were only 700,000 has. suitable for agriculture. About $\frac{1}{2}$ million has. of densely wooded areas have been cleared for permanent crops and about 1 million has. for annual crops. Observers admit that in less than a century about two-thirds of this land has become unproductive, and of the 500,000 has. of hill lands left, probably 100,000 are submarginal and could be restored to agricultural uses only at a heavy (probably prohibitive) cost. Thus the mountains and hills offer but 400,000 has., which, with the primitive, inadequate, and exhaustive agricultural methods of the peasants, are rapidly deteriorating. Two-thirds of this area may be considered as moist, receiving an average yearly precipitation of 175 cm. and having an annual mean temperature of 18°C.

The area in valleys and plains covers some 500,000 has., of which more than 100,000 are unproductive through alkalinization, drought, water occupation, lack of drainage, and deposition of gravel and sand by floods. Of the 400,000 left, approximately 300,000 at the most may be classified as agricultural. The portion irrigated by combined government and private works hardly reaches 40,000 has. The prevailing climate is mostly semi-arid, with 90-150 cm. of rain annually, and a high mean annual temperature of 27°C., concurrent with steady drying winds during the winter.

This total of 700,000 has. amounts to less than $\frac{1}{4}$ ha. per capita of the rural population, which is not enough for bare subsistence. All this has occurred in that surprisingly short time through deforestation (for agricultural purposes) of sites which were suitable for forest growth only and which, properly managed, would have insured permanent revenue to the public treasure and profitable labor to a goodly portion of the population.

According to its Indian appellation, in Haiti one would naturally expect to see forestry solidly and extensively established with government and private organizations, but the absence of, and indifference for, this branch of human activity is shocking. Up to 1924, the Department of Agriculture maintained an employee for forest and water conservation, but this function was exclusively figurative. As for legislation, the old "Code Rural", based on colonial regulations and containing some excellent dispositions, remained a dead letter.

Not until 1924, was an adequate Department of Agriculture, with a forestry branch, founded in Haiti. In Feb. 1925, the forester in charge, Wm. R. Barbour, took office at Port-au-Prince. After functioning for 6 years this branch was closed, owing to the impossibility of obtaining reserves under conditions which would allow the elaboration of an appropriate forestry program. The fundamental obstacle came from the inadequacy of domain legislation and the imbroglio of land titles. Most of the activities of the section centered on establishing the sisal industry. In 1926, however, an important bill authorized the creation in the north of a reserve of 38,700 has., mainly logwood. In 1937 another important reserve of some 15,000 has. was also established by law in the pine forest of the La Selle Mountains south of Port-au-Prince, but up to now these have been mere testimonials of good intentions.

A small watershed area of 80 has. at Petion-Ville, a suburb of Port-au-Prince, has been reserved since 1936. Also in the spring of 1939, a reforestation plan, comprising the planting of a mixed stand of quick-bearing fruit trees, shade trees for the establishment of coffee groves in the future, and economic hardwoods, was drawn up and is being executed. Urgent action was felt necessary, because one of the two springs which furnished water to a goodly portion of the population of Port-au-Prince had dried up for the first time, and severe hardship had resulted.

Other laws concerning forest conservation and the protection of steep lands were aimed at (1) preventing destructive fires in the cattle-range savannahs in the pine forests, and (2) controlling timber cutting on private and state land, based on minimum - girth allowances. Unfortunately, however, the personnel to carry out these laws is already overburdened with agricultural activities and has received no special training.

Last year a section of Silviculture which functions under the division of export crops, was created. It supervises extension projects of tree planting on slopes not suitable for annual crops, and the organization of fire prevention in the pine forests of La Selle and the North. At the former it has undertaken a small trial of turpentining to determine commercial possibilities. It will shortly undertake a progressive program of lumber felling and sawing of boards, in order to give employment to numerous idle farmers.

Summary

Haiti, occupying one-third of the island of Hispaniola, possesses the natural qualifications for extensive development of forestry activities, but since 1800 deforestation and erosion have played heavy havoc, resulting in serious depletion of forests and agricultural resources. For 6 years after its establishment in 1925, a forestry branch functioned within the Department of Agriculture but with very restricted forestry activities. Forest reserves have been created and conservation laws passed, but an adequate personnel is not available for their management and application. A new section of Silviculture established last year has again taken up forestry activities in the Republic.

Resumen

Haití, que ocupa la tercera parte de la isla de Santo Domingo, posee los requisitos naturales para el desarrollo de actividades silviculturales, pero desde el 1800 las tumbas irracionales y la erosión han producido grandes estragos que han resultado en serias desolaciones de los bosques y de los recursos agrícolas. En 1925, como parte del Departamento de Agricultura, se estableció una sección de silvicultura que funcionó durante seis años, pero con actividades muy limitadas. Se han establecido reservas forestales y se han aprobado leyes de conservación, pero no se dispone de personal adecuado para la explotación de las unas y la aplicación de las otras. Una nueva sección de silvicultura establecida el año pasado se ha hecho cargo de nuevo de las actividades forestales de la República.

RESERVATION POLICY IN JAMAICA

C. Swabey, Forest Officer

The formulation of a suitable policy to control the selection of permanent Forest Reserves in Jamaica is by no means easy; maladjustments in land use, absence of adequate maps, an apparent land hunger, and political complications all tend to obscure a rational interpretation of the fundamental land-use optimum. It is believed that similar difficulties arise in most islands of the West Indies, and a discussion of the views evolved in Jamaica might be of interest.

In the first place, we are faced with the following facts:

(1) The population which is 260 per square mile, is increasing at the rate of nearly $2\frac{1}{2}$ percent per annum, so we must expect a pressure of 600 to the square mile within 50 years.

(2) The bare maintenance of life of such a population demands that every acre of land capable of growing food and cash crops must be used for these purposes.

(3) The proximity of the North American continent permits the importation of supplies of softwood at a reasonable rate. While war conditions might cause temporary increases in prices, the preliminary data of the Forest Survey conducted by the Southern Forest Experiment Station at New Orleans indicates that fears of a southern timber famine are unjustified.

(4) In some districts, firewood, fence posts, and other forest products essential to the agriculturist are not available.

(5) Excessive deforestation and unsuitable agricultural methods (including methods of grazing) have caused enormous soil losses, with the inevitable results: general rural impoverishment, loss of soil fertility, declining crop yields, floods, droughts, lowered water table, and silting of streams, reservoirs, and irrigation channels.

From these basic facts, which have to be considered in framing a forest reservation program (although there is danger of oversimplification, if all other facts are ignored), several conclusions may be drawn:

(1) There is no justification to retain as Forest Reserves solely for production purposes any areas capable of permanent agricultural use. Exceptions to this are in areas of high population, where local reserves for fuel, etc. are not available on land unsuited for agriculture, but such conditions are not frequent.

(2) Areas where agricultural development cannot be carried on without seriously endangering the welfare of the community should be reserved as protective forest.

(3) Areas unsuited to any form of permanent agricultural use should be maintained as forest.

We thus have the following forest classification:

A. Land suitable for agriculture
   (i) but required for soil and water conservation (protection);
   (ii) but required for local supplies of fuel, etc. (production).
B. Land unsuitable for agriculture (protection or production).

Once these principles have been accepted, the next step is the actual selection in the field of areas to be reserved. Here we immediately are faced with problems of land classification, and certain queries present themselves. For instance, in the mountain areas of steep slopes, high rainfall, and erosible soil, the mere reservation of the main ridges and the stream banks can never solve problems of soil and water losses on agricultural lands on the intermediate slopes; the selection of reserves for protection of a natural drainage area must therefore be based, not on any absolute or theoretical land-use optimum, but on a knowledge of the type of agriculture which is to be practised on the unreserved land. If a highly developed soil-conserving agricultural technique is adopted, the requirements for Forest Reserves obviously will be far less than if primitive soil-wasting processes are employed. Forest reservation under such conditions, unless accompanied by improved agricultural technique, is of only limited value in the economy of the drainage area, and it is therefore necessary to assume that an erosion-control program on agricultural land will be pursued in conjunction with the reservation program. Such a scheme is under way in Jamaica, in an attempt to achieve control and balanced use of soil and water resources. Even so, selection of the actual boundary line is certain to be somewhat arbitrary with our present ignorance of the relationships between soil, water, and plant cover.

It is necessary to draw a distinction between areas already excessively deforested and those where agricultural development may still be extended; in the first case, selection of the limit of Forest Reserves is often based on local economic and social factors, i.e., on the extent of land it is possible to retire from cultivation without causing undue dislocation of the local economy. An actual example may illustrate this: In one of the Blue Mountain valleys, in great need of protection, the east side of the valley has been split up into small holdings, often less than 5 acres in extent. Any attempt at wholesale reservation and removal of the thousands of families involved would have been out of the question as long as they had been forced through land pressure to attempt mixed-crops farming and had saved some of their soil. On the western side of the valley, the land was mainly in the hands of large proprietors, the higher lands being subjected to transient tenancies; here it was possible to extend reservation down through these private lands, without depriving the rural population of irreplaceable means of support.

On the other hand, the selection of the reserve boundaries on undeveloped land can be effected on a somewhat less artificial basis. On the northern slopes of the Blue Mountains, under such conditions the underlying principal is to run the line at a elevation of 3,000 ft. (maximum elevation of the range is 7,300 ft.), below which permanent and mixed cultivation can be carried out; above that elevation, the principal cultivation would be annual crops highly conducive to soil erosion. The reserve boundary may drop down to 2,000 ft. or even lower where slopes are excessively steep or where ridges and spurs are to be guarded.

Turning now to land unsuited to agriculture, an entirely different approach is necessary. The requirements here are not to reserve the maximum of land compatible with the economy of the district, but to reserve only that land which can produce a better economic return under forest than under agricultural management. This problem is mainly met in the great limestone areas which cover three-fifths of Jamaica, and here again the decision is by no means easy. It has been the habit of peasants on the limestone areas of adequate rainfall to use shifting cultivation, and such a system, modified and controlled, may yet prove to be the soundest; the rocky hills certainly will not stand permanent cropping, while the porous nature of the soil renders this apparent abuse comparatively innocuous from the point of view of erosion.

The issue is complicated further by the presence of small fertile glades amongst the rocky "cockpit" formations; these may range from $\frac{1}{2}$ acre to 5 or 6 acres but they generally are small. There is great demand for land in these little glades; and it seems probable that, even when within a forest reserve, they will be leased or rented under some controlled form of land use. Reservation of the dry limestone areas is simple and straightforward, as the land is quite unsuited to any form of agriculture.

Resumen

Al formular una política de reservas forestales en Jamaica, uno se confronta con los siguientes hechos: una población de 260 habitantes por cada milla cuadrada que aumenta a razón de $2\frac{1}{2}$ por ciento por año; la necesidad que tiene esa población de utilizar toda la tierra disponible para la producción de alimentos y de frutos para la venta; la facilidad para la importación de maderas de pino del continente norteamericano a precios razonables; la ausencia en algunos distritos de combustible y de productos de madera para el agricultor; una excesiva despoblación de bosques y métodos agrícolas poco apropiados con sus males resultantes.

A base de éstos y otros hechos, las reservas forestales deben establecerse en tierras que no sean apropiadas para la agricultura o en tierras propias para la agricultura cuando esas reservas sean necesarias para la conservación del suelo o de la lluvia, o para suplir localmente combustible y otros productos de madera. La selección actual de las areas en el campo apareja muchos serios problemas; y si han de establecerse reservas en suelos de categoría agrícola, los métodos de cultivo que se practican, así como los factores económicos y sociales de la localidad, deben ser considerados.

EL SERVICIO FORESTAL EN LA REPUBLICA DOMINICANA

Tomás Erickson, Agrónomo Encargado,
Servicio de Foresta, Caza y Pesca

La isla Hispaniola o de Santo Domingo, que es la segunda en extensión entre las Antillas Mayores, tiene su superficie repartida entre la República Dominicana al Este y la República de Haití al Oeste. Comparándola con los otros países antillanos, la República Dominicana, con una extensión superficial de 50,070 kilómetros cuadrados, y una población de 1,479,417 habitantes, puede considerarse muy escasamente poblada, ya que la densidad de su población es de unos 30 habitantes por kilómetro cuadrado. El territorio de la República, afecta la forma de un polígono muy irregular, cruzado por cuatro sistemas de montañas que corren de Este a Oeste, con ligeras inclinaciones hacia el norte y el sur.

Los vientos alisios y la orografía del país, con tan notables diferencias de nivel, son causas de que la temperatura varíe bastante de una región a otra, de modo que mientras en los llanos costeros puede llegar a alcanzar hasta 35° y 36°C. en verano, en la misma época se registra en las montañas una temperatura de 20° - 22°C., la cual puede bajar en invierno hasta 0°C. Estos dos factores, los alisios y los sistemas de altas montañas, vienen a determinar para el país una temperatura mucho más moderada de lo que podría esperarse de tomar en cuenta, únicamente, su latitud. Así tenemos una temperatura media anual en el país de 24.7°C. y de 17.8°C. en el valle de Constanza.

La caída de lluvia también varía mucho, según la zona; así no es extraño que se registren mínimas de 30 pulgadas anuales en una zona y máximas de más de 100 en otras, mientras el promedio anual en el país es de 57 pulgadas.

De acuerdo con las últimas investigaciones realizadas,* se afirma que la República tiene alrededor de un 75 por ciento de su territorio ocupado por bosques, aunque tal afirmación parece a muchos exagerada, dado el gran desarrollo que ha adquirido la agricultura y especialmente por lo extendido del sistema de conucos, que conlleva el abandono de las parcelas cultivadas para poner en cultivo otras parcelas de monte vírgen. Estas mismas investigaciones han establecido la clasificación de nuestros bosques en las seis categorías siguientes:

1. Bosques espinares de la región árida. Estos bosques son formados por especies de madera dura, y en los que abundan Swietenia mahagoni, Phyllostylon brasiliensis. Caesalpina coriaria. Acacia lutea, Haematoxylon campechianum, Guajacum officinale, G. sanctum, Colubrina ferruginosa, etc., acompañados de Cactus, Eugenia, Croton, Pithecellobium y Stigmatophyllum; bosques éstos que ocupan las extensas regiones llanas y áridas del Sur y del Noroeste.

*W. D. Durland. Los bosques de la República Dominicana; y C. E. Chardón, Reconocimiento de los recursos forestales de la República Dominicana.

2. Bosques del litoral del llano costeño. Estos son formados por Swietenia mahagoni, Guajacum officinale, acompañados de Hura crepitans, Didymopanax morototoni, Cecropia peltata y Coccothrinax argentea, y ocupan la parte más oriental de la región del Este.

3. Selvas húmedas. Estas selvas son compuestas de Swietenia mahagoni, Coccoloba sp., Hymenaea courbaril, Hura crepitans, junto con Roystonea caribaea, Cecropia peltata, Piper aduncum, etc., las cuales ocupan gran parte del interior de la República, en zonas donde la precipitación pluvial es mayor de 70 pulgadas al año y la elevación de 200 a 800 metros.

4. Selvas de montaña. Estas selvas, que son integrada por manaclares (Euterpe globosa) y por selvas musgosas en las que predominan los helechos arborescentes (Cyathea, Alsophila) y el "palo de cotorra" (Brunellia comocladifolia) en los límites de la selva musgosa, entre ésta y los pinares, se encuentran en las montañas, desde los 750 a los 1,150 metros; pues a mayores alturas el manaclar es substituído siempre por el pino.

5. Pinares del interior. Estos son integrados exclusivamente por Pinus occidentalis, en la mayoría de los sitios y de Juniperus lucayana en otros, muy contados. Segun Chardón, los pinares ocupan unos 7,500 kilómetros cuadrados del territorio de la República, encontrándoseles desde los 150 a los 3,000 metros de altura en todas las cordilleras del país, donde impera sólo, asociado únicamente a la Gleichenia, la Danthonia domingensis, Rubus domingensis, y muchos musgos y líquenes.

6. Manglares y ciénagas. En éstos abundan mayormente Rhizophora mangle, Laguncularia racemosa, Avicennia nitida, y Chrysobalanus icaco. Estas especies se encuentran formando bosques, aunque no grandes, en las partes muy bajas, preferentemente en las desembocaduras de los grandes ríos, como el Haina, el Yuna y el Iguamo.

A pesar de que haya unos 20 aserraderos instalados en el país, y de que existan maderas propias para todos los usos, la exportación de maderas es bastante reducida. Puede estimarse que ésta no pasa de unos 13,000 a 15,000 kilos, con un valor aproximado de $200,000 a $250,000. Las maderas que en mayor cantidad se exportan son guayacán (Guajacum officinale), bera (G. sanctum), caoba (Swietenia mahagoni), cabilma (Guarea guara), y yaya (Oxandra spp. e Isidorea spp.). Se exportan principalmente traviesas y postes de distintas maderas duras, y también el fruto del dividivi (Caesalpinia coriaria), que se emplea como materia tintórea.

El principal material de construcción empleado por el campesino es la tabla de palma (Roystonea regia), lo cual deja reducido el consumo debído a la edificación de casas en los centros urbanos, donde precisamente se prefiere el cemento, y la tabla de pino importada, en ciertos casos.

La industria de la fabricación de muebles, no está tan desarrollada como sería de desearse, pero no obstante, va prosperando mucho. La importación total de madera, incluyendo madera labrada y muebles, no pasa de unos $100,000 al año.

Historia y organización del Servicio Forestal

Nuestros problemas forestales habían sido notados y hecho resaltar por distintos investigadores, pero solo con el advenimiento al poder del Dr. Rafael L. Trujillo Molina, se empezó a buscar solución a tales problemas.

Así fué como, respondiendo a esta necesidad, se creó el Servicio Forestal en el año 1934. Lo integraban 12 guardabosques, que adscritos al Servicio Nacional de Riego, y por lo tanto a la Secretaría de Estado de Agricultura, de la cual es dependencia el Servicio de Riego, comenzaron enseguida a prestar servicios, diseminados por todo el país, vigilando el cumplimiento de la Ley No. 641, sobre conservación de montes y aguas.

Habiéndose evidenciado en el curso de las actuaciones de los guardabosques, la necesidad de que este cuerpo fuera dirigido por un funcionario dedicado exclusivamente a los asuntos forestales, en 1936 se designó un Jefe del Servicio Forestal, y además se aumentó a 22 el número de los guardabosques.

El 4 de mayo de 1937 se introdujo una nueva organización en la Secretaría de Estado de Agricultura, en virtud de la cual se creaban los Distritos Agrícolas. De acuerdo con esta reforma se crearon oficinas regionales de agricultura, con un Encargado de Distrito Agrícola al frente de cada una. Estos Encargados de Distritos quedaron capacitados para dirigir todas las actividades agrícolas de sus jurisdicciones respectivas, mediante el personal de campo de la Secretaría de Estado, personal que fué puesto bajo la inmediata dirección de dichos funcionarios. De este modo se suprimieron los Encargados de Servicios de la Secretaría de Estado y fué distribuído el personal entre las oficinas de los Distritos Agrícolas.

Tal organización no fué alterada esencialmente hasta el lo. de enero de 1939, en que se designaron Agrónomos Encargados de Servicios, con su oficina cada uno en el edificio ocupado por la Secretaría de Estado de Agricultura y dependiendo directamente del Secretario de Estado y los Subsecretarios de Estado correspondientes. El Servicio además fué aumentado, ascendiendo actualmente a 40 el número de guardabosques que lo integran. De manera que, actualmente, aún cuando siguen actuando los Encargados de Distritos Agrícolas y el personal de campo de la Secretaría continúa dependiendo de ellos, son los Agrónomos Encargados de Servicios los que tienen a su cargo la responsabilidad de preparar y vigilar el cumplimiento de los planes de trabajo de cada rama de las actividades encomendadas a la Secretaría de Estado de Agricultura, Industria y Trabajo.

El Servicio de Foresta, Caza y Pesca, que es así como se denomina, aunque todavía carece de los fondos y del personal técnico que serían necesarios para desarrollar una intensa labor en pro de la conservación y aumento de nuestros bosques, no se ha limitado a vigilar el cumplimiento de la ley sobre conservación de montes y aguas, sino que, aprovechando el entusiasmo del Sr. Secretario de Estado y los recursos a su disposición, ha venido desarrollando una serie de labores tendientes a poner en práctica, en cuanto sea posible, la política forestal adoptada.

Esta política forestal consiste principalmente en organizar el aprovechamiento de los bosques de un modo previsor, y en algunos aspectos conservador. Tal objetivo se va logrando con la aplicación de la Ley No. 641, sobre conservación de montes y aguas del Reglamento No. 323, que establece las medidas que deben tener los árboles para poder ser cortados.

Impedir la tala de los bosques del Estado y limitar el desmonte de ciertos bosques particulares, mediante la declaración de vedados y parques nacionales.

Defender contra los incendios forestales los bosques de especies resinosas, por medio de reglamentaciones y de la organización de Brigadas Civiles Honorarias contra incendios.

Repoblar los lugares deforestados exigiendo el cumplimiento de la disposición que exige sembrar veinte árboles por cada uno que se corte y utilizando la producción de los veintidós viveros forestales oficiales diseminados por todo el país.

Además, proteger los ríos y arroyos, prevenir la erosión de los suelos impidiendo los desmontes en las cimas de las montañas, y finalmente conocer mejor nuestra flora mediante exploraciones frecuentes y las investigaciones y estudios de una oficina o establecimiento creado especialmente con ese objeto, según los proyectos que con tal propósito se están preparando.

En todos estos aspectos se ha venido laborando tenazmente durante el año, y se espera que en lo adelante puedan continuar intensificándose las actividades del Servicio Forestal, hasta dejarlo definitivamente encaminado hacia la satisfacción de las principales necesidades del país, por lo que respecta a la defensa, incremento y aprovechamiento racional de sus recursos forestales.

Summary

The Dominican Republic is crossed from east to west by four mountain ranges whose great elevation accounts in part for the considerable variation in temperature and rainfall. The population amounts to only 30 persons for each of the 50,070 square kilometers of land area, which has been estimated as being 75 percent forested —probably an exaggerated figure. The forests have been classified in the six following types: 1. Spiny forests, 2. Coastal forests, 3. Moist forests, 4. Mountain forests, 5. Pine forests, and 6. Mangrove swamps.

Although 20 sawmills are operating in the country, little timber is exported; this is limited mostly to exports of lignum vitae, mahogany, cabilma, lancewood, and ties and fence posts of durable woods. Local consumption as well as importations are also low.

The Service of Forestry, Game, and Fish, established in 1934, has increased in personnel up to the present number of 40 forest guards distributed throughout the Republic and working under the direction of the Agronomist in charge of the Service. The activities of the Service consist of regulation of cuttings, fire prevention, reforestation, regulation of stream-flow, soil-erosion control, and investigation.

CONSERVACION

José Marrero,
Assistant Planting Officer
Servicio Forestal, Puerto Rico

Cuatro siglos después de ocupado el continente americano y cuando ya millones de acres de terreno han sido inutilizados y exuberantes florestas destruídas; y de palpar funestas consecuencias de ello en forma de sequías, tormentas de polvo e inundaciones, es cuando el término "Conservación" ha venido a ser objeto de estudio y de la gran atención que su importancia demandaba. En este sentido no hay nada más a propósito que las autorizadas palabras del Secretario de Agricultura de Estados Unidos que sirvieron de prólogo a la Memoria de esa Secretaría de 1938.

"La naturaleza considera la tierra benignamente. El hombre la trata duramente. Este se excede considerablemente cuando cultiva los campos, al pastar sus rebaños y al explotar los bosques, y como consecuencia arruina por completo millones de acres de terreno. Año tras año vacía la savia de sus tierras hacia las ciudades las cuales vierten lo que no utilizan en los desagues, los ríos, y finalmente en el mar. El problema de las inundaciones como hechura del hombre es principalmente el resultado de tales excesos.

"Este procedimiento terriblemente destructivo es permisible en una civilización incipiente. No es perdonable en los Estados Unidos en el año 1938. Sabemos lo que debe hacerse y se ha comenzado a hacer. Como individuos y como nación hemos iniciado las medidas necesarias. El pueblo ha despertado a tiempo. Treinta años más tarde el problema pudiera haber sido irremediable.

"El fundamento social en relación con el deterioro del suelo es que ningún individuo tiene el derecho a destruírlo, aun cuando sea de su patrimonio. Hemos sido lentos en reconocer que la tierra le exige obligaciones al hombre."

En ningún momento se había enfrentado el hombre que llamamos civilizado a un caudal tan intocado y repleto de recursos como encontrara el europeo después del descubrimiento. Todos hemos oído narraciones de tan fabulosa riqueza que supo arrancar exclamaciones de admiración hasta de los labios rudos del conquistador. Los archivos de España, Francia e Inglaterra guardan los testimonios de admiración de Cristóbal Colón, de Sir Walter Raleigh, de Bartolomé de las Casas, y de centenares de historiadores y viajeros.

En aquella época la única preocupación fué establecerse en el nuevo paraíso de la manera más rápida y segura posible. La conquista de Norte, Sur y Centro América e islas adyacentes ha pasado a la historia como una epopeya magnífica y grandiosa.

Explorando el continente y cuando se hubo establecido diferentes demarcaciones entre las naciones conquistadoras siguieron los pobladores en carrera desenfrenada arrancándole al suelo y a los bosques sus mejores riquezas para así perpetuar y garantizar su vida en el Nuevo Mundo. Enorme fué el despilfarro de los recursos de América por nuestros abuelos, pero aún así podemos hablar de que hasta cierto punto hubo necesidad de ello. Lo que sí no está justificado ni

es perdonable, como bien lo enfatiza el señor Wallace, es que tal despilfarro esté ocurriendo en la América en este mismo instante.

Entre los agentes destructivos que hay operando en detrimento del bosque y del suelo merecen atención especial el conuco, especie de agricultura nómada característica del trópico, y el fuego usados ora para librarse de la maleza o como purificador de pastos. Hemos creído oportuno citar a dos testigos de renombre para apuntalar esta tesis con opiniones más autorizadas.

Muy interesante y de acertadísima aplicación es la tesis "Consideraciones acerca de la destrucción de los bosques y del incendio de las sabanas" producto de las experiencias en Venezuela del eminente botánico y hombre de ciencias, H. Pittier. A continuación citamos algunos párrafos de la referida publicación:

"El buen juicio indica que las crestas de los cerros y los declives con excesiva inclinación no deben desmontarse y en todos los países bien organizados, la ley, rigurosamente aplicada, vigila por la preservación de los bosques en tales situaciones.

"En cualquier caso, es un crimen la destrucción de selvas cuyo desarrollo ha necesitado siglos y cuyo valor no deja de ser enorme, simplemente con el objeto de sacar del terreno fertilizado por ellas algunas miserables cosechas de maíz o de caráotas.

"El clima de Caracas no es actualmente el de antaño, cuando existían los tupidos bosques del valle de Tacagua y sus avanzadas por las lomas de Catia. En aquel entonces, la temperatura era más uniforme, la sequedad del verano tal vez menos marcada y el verdor de la vegetación más persistente en el curso del año. Los mismos efectos desastrosos de la supresión de los bosques por la tala y el fuego se notan en toda la parte poblada del país.

"En el valle de Aragua, han pelado las vertientes hasta cerca de las cumbres, las aguas han escaseado al extremo de que la Laguna de Valencia, que en tiempo histórico bañaba los pies de la ciudad de este último nombre, se va reduciendo poco a poco a las dimensiones de una mera charca. El clima se ha vuelto más seco, y cultivos que como el cafeto y el cacaotero necesitan de una cierta humedad atmosférica ya no prosperan en las risueñas llanuras de la Victoria y Maracay.

"Otra falacia es la noción que el agricultor se ayuda usando el fuego para destruir las malezas. La paja seca, acaba siempre por podrirse y reducirse a humus que fertiliza la sabana, mejor que la ceniza sujeta a los caprichos del viento. Un conocimiento elemental de lo que son las raíces de las pebeteras, de los mastrantos y otras malas hierbas que suelen invadir las sabanas, demuestra que el fuego no las alcanza. Se queman los tallos y demás partes encima del suelo, pero luego vuelven a retoñar. Por otra parte, las gramíneas y otras plantas apetecidas por el ganado tienen raíces muy superficiales, habiendo repetidas investigaciones demostrado que su penetración vertical excede raras veces de 10 cm. Así resulta que el fuego, por rápido que sea, destruye con facilidad la macolla de las gramíneas más finas que son las que importa conservar.

"En cuanto a las garrapatas, su biología es hoy tan conocida que la pretensión de que esta plaga se destruye por medio del fuego se vuelve absurda. El mismo ganado lleva el insecto a las sabanas y el único medio para evitar esto es mantener las reses limpias, lo que se consigue por medio de bañaderos adecuados.

'El fuego encendido en una sabana en lo fuerte de la estación seca, constituye un grave peligro por la rapidez con la cual se propaga, alcanzando a veces habitaciones humanas, y casi siempre los cultivos y los bosques, causando en estos últimos estragos que no se borran sino en un largo período de años. Pero su mayor inconveniente es tal vez la acción que ejerce sobre el suelo, el que se halla despojado de las partes orgánicas que son la base de su feracidad y reducido a una mera masa mineral, suelta y facilmente lavada por la erosión de las aguas pluviales."

Debemos aclarar que el Ministerio de Agricultura y Cría de Venezuela ha iniciado actividades para la conservación del suelo y de los bosques posteriores a la publicación del trabajo del Dr. Pittier, de lo cual es de esperarse una razonable mejoría en las condiciones descritas.

Dejaremos a Thomas Belt en su obra "El Naturalista en Nicaragua"1/ describirnos como trabaja el conuco en los trópicos: "Al cortar el bosque y sembrar maíz por primera vez, abundan las semillas de las especies forestales, las cuales después de recolectada la cosecha germinarían y constituirían el bosque nuevamente, siempre que se le permitiera hacerlo; de manera que a los veinte años dificilmente se podría distinguir de las florestas adyacentes. Pero no sucede tal cosa. A los dos o tres años éste se corta nuevamente y he aquí la diferencia. Al no existir simientes de especies superiores, éstas son reemplazadas por gran variedad de arbustos endebles, los cuales solamente se encuentran donde se ha cultivado la tierra. las yerbas también se apoderan del suelo; si estas prevalecen, el Indio o Mestizo no osa repetir la siembra porque sabe que las yerbas la ahogarían y es muy indolente para destruirlas. Si a la larga la maleza prevalece y cubre el suelo, el Indio vuelve y repite la siembra de maíz. Como gran parte de los desmontes se revierten a yerbas, este agricultor incipiente sigue trabajando a expensas de la floresta haciéndola retroceder gradual pero efectivamente."

Hasta ahora hemos contemplado este problema en sus manifestaciones más recientes, ésto es, en la América. El Viejo Mundo nos ofrece ejemplos palpables de los funestos resultados de las prácticas en discusión. En la antiquísima China, el azote siniestro de las sequías y las inundaciones está arraigado seguramente en la completa denudación de sus montañas. Las desiertas llanuras del Asia Menor estuvieron salpicadas en la antiguedad de florecientes ciudades que poseían refinada cultura. Sería arriesgado calcular hasta qué punto influyó la desmedida explotación de sus recursos en dicha decadencia. Sin embargo, el deterioro del suelo tuvo que ejercer decisiva influencia en civilizaciones que estuvieron hondamente arraigadas en él.

El el Africa, donde existen las regiones más perfectamente desiertas del Globo, hay documentación que prueba como ha ocurrido la transición entre fértiles campos a desierto en el relativamente corto intervalo de dos siglos. Primero viene el agricultor nómada con sus inseparables agentes, el hacha y el fuego; después vienen los rebaños a aprovechar las raquíticos pastos; y por último, el desierto.

No habría razón para alarmarnos tanto si los métodos destructivos ya mencionados no fueran más allá de la destrucción del bosque original. Desgraciadamente tales métodos se extienden hasta incluir la casi totalidad de las áreas agrícolas especializadas y que se nos imaginan como permanentes.

1/ Tomado de la obra "Tropical forests of the Caribbean" por T. Gill.

La erosión geológica, o sea la formación natural de los suelos, es un proceso fundamental. Solamente cuando el hombre le resta la cubierta de bosques y pastos y altera las condiciones naturales del suelo por el cultivo se produce el proceso temido de erosión acelerada, la cual es hechura del hombre.

Nos consideramos afortunados al presentar estadísticas[2/] producto de una evaluación completa de este problema en Puerto Rico, evaluacion realizada por el Servicio de Conservación de Suelos. Por ser quizás nuestro pequeño país el único en la America tropical donde se ha completado tal labor de reconocimiento creemos que tales estadísticas ofrecen particular interés.

Tomando en cuenta la erosión y deslave sobre la superficie total del país (a base del cual se han calculado los por cientos ofrecidos en los diferentes cuadros) creemos que encabezamos la lista entre los países de la America tropical, ya que es el nuestro un país de muy limitada extensión territorial, casi sin otros recursos que las potencialidades de su suelo, y por añadidura, uno de los más poblados del orbe. La mayoría de los países ya mencionados solo ha explotado activamente una fracción de sus territorios, y con escasas excepciones ha contado con innumerables recursos naturales lo cual ha permitido un cultivo mucho menos intensivo de las zonas agrícolas. Sin embargo, entre las Antillas mayores resaltan Haití y Jamaica como países casi comparables con el nuestro en la acelerada pérdida de sus suelos. Aun en naciones de mayor extensión territorial como Venezuela, Colombia y Brazil, las regiones agrícolas mas intensamente cultivadas sufren pérdidas comparables a las nuestras. Venezuela, que en su mayor parte no ha sufrido las pérdidas de una erosión acelerada, presenta un caso conmovedor de terrenos arruinados en la zona comprendida entre la Guaira y Caracas. Por otro lado, El Salvador se ha dado cuenta de los peligros de la erosión y usa las barreras vegetativas como primer arma de combate.

Clases de erosión agrupadas en orden ascendente de importancia económica

Descripción	Area en acres	Por ciento
Ninguna o muy poca erosión	691,000	31.4
Erosión moderada	589,000	26.8
Erosión severa que ocurre por capas, y cárcavas, incluyendo erosión activa de arrastre de material "C" en suelos "AC"	917,700	41.8
Total	2,197,700	100.0

En el 68.6 por ciento del área total de nuestra isla el deslave es más o menos serio, dejando sólo el 31.4 por ciento de terrenos más llanos, o cubiertos por bosques, o que apenas se cultivan, donde el problema no causa preocupación. Teniendo necesidad de cultivar intensamente la más mínima porción de tierras laborables, nos confrontamos con el hecho de que el 41.8 por ciento de nuestro territorio sufre erosión clasificada

2/ Tomadas del trabajo "El Dominio de la Erosión de las Tierras en Puerto Rico" por el Sr. René Jiménez Malaret, publicado en La Revista de Agricultura de Puerto Rico de marzo del año 1939.

como severa. No es necesario comentar las repercusiones que tiene este hecho sobre nuestra economía y sobre nuestro peublo en general. El tabaco, segundo en importancia entre nuestros cultivos, ha sido afectado visiblemente. Este cultivo que se adapta al clima fresco de nuestras montañas, pero que requiere un laboreo constante de suelos en declives hasta de 50 por ciento, principalmente en las épocas de mayor precipitación, ha creado condiciones muy propicias para los arrastres. Como consecuencia la producción por unidad de terreno se ha reducido perceptiblemente, y sólo haciendo fuertes inversiones en materias fertilizantes pueden los agricultores obtener rendimientos aceptables.

Aún nuestros cafetales, que ofrecen condiciones mucho menos propicias para los arrastres, indiscutiblemente sufren continuas pérdidas. En lo que respecta a cultivos de subsistencia, es lógico suponer que la erosión no es menos severa que en el caso del tabaco, mayormente si se considera que esos cultivos se siembran en rotación con el tabaco en casi todas las áreas tabacaleras.

Area afectada y por ciento del total, por las diferentes clases de erosión, sin hacer referencia a los correntones

Descripción	Area en acres	Por ciento
No existe erosión acelerada aparente.	271,300	12.3
Breve erosión por capas (25 por ciento de la capa superficial perdida).	419,900	19.1
Erosión moderada. Ocurre por capas. Del 25 por ciento al 75 por ciento de la capa superficial perdida.	589,000	26.8
Erosión severa. Ocurre por capas. 75 por ciento o más de la capa superficial perdida.	850,000	38.7
Erosión activa de arrastre de material "C" en suelos "AC"	52,600	2.4
Frecuentes brotes de piedra caliza debido en parte a la erosión rápida.	15,100	.7
Total	2,197,900	100.0

Es de lamentarse que dependiendo tan íntimamente del suelo para nuestra subsistencia hayamos permitido que en el 38.7 por ciento de nuestra área total éste haya desaparecido en sus 3/4 partes o más. Solamente en el 12.3 por ciento no existe erosión acelerada aparente. Es indiscutible que es cuestión esencialísima para este país hacer evolucionar sus prácticas agrícolas hasta aumentar considerablemente el área de las zonas no afectadas por este mal.

Obedeciendo a la inaplazable necesidad que existe de conjurar el mal, el gobierno Federal ha iniciado en la isla extensos programas de repoblación forestal y de conservación de suelos. Demás está decir que los técnicos y todas aquellas personas que se inquietan por estos problemas en la América latina ya han hecho sentir sus voces de protesta.

El Dr. Juan Pablo Duque, Jefe de la Sección Técnica de la Federación de Cafeteros de Colombia en su informe sobre el viaje de estudio que hiciera a los países de Centro América dá énfasis a este inaplazable problema. El Sr. J. Marciano Rodríguez, Perito Agrónomo del Banco Nacional de Nicaragua, y quien acompañara al señor Duque, hace las siguientes y muy acertadas declaraciones:

"Una de las principales causas de la inconstancia de las cosechas de café en Nicaragua es debido a la erosión de los suelos. La planta, después de una buena cosecha, deja agotado el suelo y queda ella misma extenuada. Si a este agotamiento se agrega la pérdida por efectos de la erosión, los resultados tienen que ser precarios." A continuación añade: "Minuciosos estudios efectuados en el Brasil comprueban que la cantidad de elementos que extrae una cosecha en un año es veintiuna veces menor que la que extrae la erosión. Es éste uno de los principales problemas que urge resolver en Nicaragua."

Una de las notas más alentadoras en este respecto es la manera como los cafeteros salvadoreños se han enfrentado a la erosión de sus suelos. Hace algún tiempo los agricultores más adelantados siembran sus cafetos en terraplenes formados en sentido contrario a la pendiente. Asimismo cavan hoyos en la parte superior todo para reducir el arrastre. Además hacen uso intensivo de la planta llamada izote o espadillo (Yucca elephantipes Regel). Esta planta la siembran después de cada línea de café, en medio de la calle, y en sentido contrario a la pendiente. Cada calle forma una barrera que impide el paso de la tierra. Esta se va acumulando, hace subir el nivel del terreno y forma una terraza. Las siembras del café en curvas de nivel se ha generalizado bastante.

Quizás nos hayamos extendido demasiado al desarrollar este tema pero no queremos terminar sin sugerir medidas que tomadas a tiempo puedan atajar el mal. En primer término es importante que cada ciudadano de un país agrícola comprenda que su bienestar está íntimamente ligado a la productividad del suelo y a la perpetuidad de los bosques de su país. En este sentido nada más propio que empezar esta labor educativa en la escuela. Me permito sugerir que se preparen cursillos elementales donde se haga resaltar esta realidad al niño. En la celebración del Día del Arbol se la debe dar énfasis a este vital aspecto. Creo que debemos imitar el ejemplo de los europeos y norteamericanos en el respeto que sienten hacia los árboles y los animales.

La experiencia y los estudios científicos han demostrado la necesidad de actuar. Creo que los hombres de gobierno y legisladores, sintiéndose a tono con su responsabilidad hacia el futuro de su país, deben crear leyes que permitan atacar el mal efectivamente. Estas leyes deben inspirarse en el nuevo concepto de que los recursos de la nación son para el goce indefinido de sus hijos y de que ninguna generación tiene el derecho a comprometer la vida de las generaciones que han de seguir. Aquí debemos recordar las palabras del Secretario de Agricultura norteamericano cuando dice, "El fundamento social en relación con el deterioro del suelo es que ningún individuo tiene el derecho a destruirlo aún cuando sea de su patrimonio." En este sentido la presente administración de Estados Unidos de Norteamérica ha dado un magnífico ejemplo al inspirar la extensísima legislación agraria del Nuevo Trato en la conservación de los recursos de la nación haciendo posible dar la batalla en todos los frentes.

Sabemos que en varios países de la América se ha pasado legislación inspirada hacia la adopción de medidas de conservación, pero desgraciadamente en muchos casos tales leyes no se han llevado a la práctica. Sabemos de muchas repúblicas que tienen magníficas leyes para la protección de la floresta, en sus estatutos, y sin embargo sus bosques son víctimas de contínua destrucción. Tales leyes no han sido efectivas ora porque no se han creado los organismos llamados a hacer cumplir la ley o porque éstos cuando se crearon, no tuvieron la ayuda necesaria, o quizás los frecuentes cambios de gobierno no han permitido una política de conservación a tono con las necesidades del país. En otras palabras, las leyes forestales no han trascendido al público ni han hecho sentir su efecto bienhechor en los bosques.

La organización de centros experimentales y de divulgación agrícola, además de la creación de servicios forestales que cuenten con el respaldo del público, y con suficiente personal y asignaciones para efectuar satisfactoriamente sus importantes encomiendas, debe contarse entre los primeros esfuerzos a realizarse por los gobiernos preocupados en la resolución de este problema.

Tales métodos han dado espléndidos resultados en E.U. de N.A. y en Europa. Si se tuvieran dudas sobre su aplicabilidad a las condiciones del trópico, bastaría para disiparlas con fijarnos cómo estos métodos funcionan en nuestro país. A los centros de experimentación y de divulgación agrícola establecidos hace algunos años, y que en la actualidad marcan el paso al agricultor, hemos tenido la fortuna de haber añadido la administración de grandes extensiones forestales. Contamos además con un eficiente Servicio de Conservación de Suelos. Las unidades de demostración de este servicio que funcionan activamente en las zonas cañeras, cafetaleras, tabacaleras y de frutos de subsistencia, encontrarán medidas prácticas que le muestren al agricultor del trópico cómo conservar indefinidamente la tierra y cómo hacer de la agricultura una actividad permanente, en contraste de lo que ha sido hasta la fecha: una agencia cómplice de usar medidas destructoras. La reciente creación de la Estación Experimental de Silvicultura Tropical con miras a investigar los diversos problemas de los bosques tropicales, completa el cuadro de investigaciones encaminadas a perdurar las mejores riquezas de los bosques y los campos.

Resumen

Desde su ocupación por el europeo, el continente americano ha sufrido la destrucción, muchas veces viciosa, de millones de acres de bosques y el desmejoramiento de una porción considerable de los suelos agrícolas. Al presente estamos palpando las consecuencias funestas de esa destrucción en forma de sequías, inundaciones, tormentas de polvo y pobreza para los habitantes de las zonas afectadas. El uso desmedido del conuco y del fuego han sido responsables de la gran parte de las áreas arruinadas que a diario se observan.

Los Estados Unidos de Norte América, a pesar de su bien organizada agricultura, está sufriendo graves pérdidas en sus suelos. Para evitar mayores ruinas al darse cuenta de que es necesario conservar los recursos de la Nación para el uso de ésta y de las generaciones futuras, ha iniciado extensísimos programas de repoblación forestal y conservación de suelos. Asimismo se ha pasado extensísima legislación agraria como complemento a los programas mencionados, lo cual ha permitido atacar el problema en sus más variados aspectos.

En los países de la América latina, aunque los técnicos están alertos, no se han emprendido todavía medidas que conjuren el mal efectivamente. En Puerto Rico se están usando activamente medidas de conservación. Tales instituciones como las Estaciones Experimentales, el Servicio de Divulgación Agrícola, el Servicio de Bosques, y el Servicio de Conservación de Suelos, y la recientemente creada Estación Experimental de Silvicultura Tropical, ofrecen al agricultor medios factibles para conservar los recursos naturales.

Interés y conocimiento del público de la trascendencia de tales problemas, legislación adecuada y respaldo absoluto del gobierno, utilización adecuada de centros experimentales, y estudio de los medios de que se valen otros países para conjurar el mal, serán los medios que decidirán si América sera la tierra prometida de las generaciones futuras, o si habrá de correr la misma triste suerte de las áridas y desoladas campiñas del Viejo Mundo.

Summary

Since its occupation by the European, the American continent has suffered a vicious destruction of millions of acres of forests and the impoverishment of a considerable portion of its agricultural soils. At present, the inhabitants of the affected zones are suffering the severe consequences of this destruction in the form of droughts, floods, dust storms, and poverty. The uncontrolled use of shifting agriculture and fire has been responsible for a large part of the ruined areas that one sees on all sides.

The United States, in spite of its well-organized agriculture, is suffering severe losses of its soils. With the realization that it is necessary to preserve the resources of the Nation for the use of this and future generations, it has initiated extensive programs of reforestation and soil conservation in order to avoid further damages. Likewise, as a complement to the aforementioned program, there has been passed extensive agrarian legislation, which permits an attack on the problem from all sides.

In Latin America, the scientific workers are well aware of conditions, but so far have not been able to institute measures to control effectively the evil. In Puerto Rico measures of conservation are being put in practice. Institutions such as the Experiment Stations, Extension Service, Forest Service, Soil Conservation Service, and the recently established Forest Experiment Station, offer the agriculturalists practical methods to conserve natural resources.

Public interest and knowledge of the importance of such problems, adequate and well-enforced laws, use of experimental centers, and study of the means by which other countries effect control of the evils, will determine whether America shall be the promised land of future generations or whether it will suffer the same sad fate of the desolate arid areas of the Old World.

A RAPID METHOD OF EXTRACTING BALSA SEED

L. R. Holdridge, Associate Forester

The balsa tree (Ochroma), which has a wide range in the American tropics, needs little introduction because its extremely light wood has long been an important article of commerce; but our native species, O. pyramidale (Cav.) Urban, (=O. lagopus Sw.), locally called "guano", occurs only as scattered individuals at lower and middle elevations and has never been exploited commercially.

Last year, the Forest Service decided to raise a few seedlings of this species in the Rio Piedras Nursery and, while working on this assignment, José D. Meléndez, Assistant Planting Specialist, devised a simple method for seed extraction, which not only reduces hand labor to a minimum, but apparently increases the germination percentage. Additional trials will be necessary, but this preliminary note is written not only for those who are planting the species but also to learn whether someone else has worked out the process in more detail.

The fruit of the balsa is a long, ridged capsule, which dehisces to release great quantities of down similar to rabbit fur (note the specific name lagopus), in which the fine seeds are loosely embedded. This material, which is very light and enables the seeds to be transported long distances by the wind, is used locally for stuffing pillows and mattresses. To extract seeds by hand from this fluffy down is a very slow process. Finding that this material burned extremely rapidly, Meléndez tried out various methods of extraction with fire and tested the germination of the distinct lots, with the following results:

Lot no.	Method of extraction	No. of seeds	Total germination 11 days after planting	23 days after planting	35 days after planting	Percent germination
1	By hand	400	0	12	53	13.25
2	By hand	400	0	4	21	5.25
3	Fire, in an ordinary metal waste-paper basket	250	8	9	9	3.60
4	Fire, on a 1/8-inch mesh wire sieve, seeds dropping onto paper	300	81	81	81	27.00
5	Fire, on same screen but seeds dropping through to a pan of water 2 inches below	300	104	111	118	39.33

Many of the seeds extracted with fire in the metal basket were charred, as they were unable to drop away from the heat; this probably accounts for the very low germination. When the material is spread out thinly on the wire screen, the fire literally flashes across, the seeds drop readily through the screen away from the flames, and there is apparently little or no damage to the seeds. Besides the readily noted increase in germination, the heat seems to stimulate early germination; and there may be some connection between this earlier, increased germination and the habit of the tree of springing up on burned-over areas.

Resumen

Una prueba con frutas de balsa demostró que por medio del fuego la semilla se puede extraer rápidamente de la peluza en que se encuentra mezclada. Un cotejo preliminar del percentaje de germinación de las semillas demostró que con la apropiada extracción por fuego, la germinación aumentó grandemente al igual que fué acelerada.

A CEDAR SEEDLING BLIGHT IN PUERTO RICO

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Agricultural Experiment Station,
Rio Piedras, Puerto Rico

Introduction.-Spanish cedar, comprising several species of the genus Cedrela, is a highly esteemed timber tree in Puerto Rico and elsewhere in tropical America. Its soft, fragrant, reddish-brown wood is utilized for cabinet-making, cigar boxes, and many other articles.

In Feb. 1937, a severe blight was observed defoliating and even killing many small cedar trees (Cedrela mexicana Roem.) planted on a northeastern slope in the vicinity of Luquillo, Puerto Rico. There seems to be no previous record of the occurrence of this malady under our environment.

Symptoms.-The young lesions appear first as minute, discolored specks, which enlarge to form subcircular or irregular and poorly defined spots, varying from a very few to about 25 mm. in diameter. The tissues of the lesions gradually become yellowish brown in the center, and some are bordered with a darker brown band. Most of the spots are not well defined, however, the tissues staying green and concolorous with the leaf blade. From 50 to 100 minute, erumpent, black, fruiting bodies are produced gregariously and conspicuously on both sides of the spots, though more numerously on the upper side. When the number of lesions is rather large, the leaves turn yellow throughout. In some instances the chlorotic leaves show the minute, black fruiting bodies on a greenish, diffused spot. Heavily infected seedlings shed their leaves and eventually die.

In addition, the parasite infects the petioles of the leaves,as well as the young twigs. The lesions are similar to those described on the leaves, except for the elongated shape which they assume. The fruiting bodies are produced also on the necrotic areas of the lesions, though not so numerously.

Causal organism.-The disease is caused by the fungus Phyllachora balansae Speg., one of the Dothidiales, which produces a Linochora conidial stage. The organism has been reported on various species of Cedrela in tropical America.

Resumen

En 1937 se encontró en la vecindad de El Yunque en Luquillo, P. R., que un gran número de arbolitos de Cedrela mexicana Roem. sembrados en una ladera que mira hacia el noreste, sufría de una defoliación pertinaz. Muchos de ellos sucumbieron. El agente responsable es el hongo Phyllachora balansae Speg. Las hojas parasitadas mostraban numerosas y pequeñas lesiones salpicadas de peritecios negros, gregarios. Antes de ocurrir la defoliación, las hojas se tornan totalmente o parcialmente amarillas.

CALOPHYLLUM ANTILLANUM, A DESIRABLE TREE FOR DIFFICULT PLANTING SITES

L. R. Holdridge, Associate Forester

Calophyllum antillanum Britton (=C. calaba Jacq.) of the family Clusiaceae, ranges from southern Mexico through Central America and the West Indies into northern South America. The common names most in use for the species are "maría" (in general), "galba" (in Trinidad), and "ocuje" (in Cuba). The tree is identified readily by its opposite, elliptic, dark-green leaves, with very numerous, parallel, lateral veins; the exudation of a yellowish milky sap from broken leaves, twigs, or bark; and the diamond-shaped fissures in the bark of the trunk. The wood, which ranges in color from pinkish to red, is moderately hard and heavy, fairly easy to work, durable, tough, and strong, and finds many uses in general carpentry, ship construction, and furniture making.

The small, white, fragrant flowers are borne in lateral or axillary racemes. In Puerto Rico, the flowering period extends from March to June, reaching a peak in May, although a few flowers may be found at other times of the year.

The fruits, which are globose, one-seeded drupes about 1 inch in diameter, are referred to as seeds. These ripen between October and February and number about 120 per pound. The seeds maintain their viability well, and a fair germination is obtained even with seeds stored for 1 year in a dry room, but it is always desirable to use fresh seed. Average germination, as recorded in the Rio Piedras Nursery, is 70 percent, but this is believed to be a bit low and is probably due to inclusion of data on seeds held in storage. Trinidad reports germination between 85 and 95 percent. The seeds are produced rather abundantly every year and are easy to collect. Our local purchase price, based on a prevailing wage of $1.00 per day, is 3¢ per pound. Because of the large size of the seed and the high germination rate, this species is very suitable for direct seeding; and practically all reforestation with this species in Puerto Rico has been carried out in this manner. A further reason for direct seeding is the fact that the seedlings are rather difficult to transplant, and heavy losses ensue if bare-root planting is attempted.

Some of the earliest plantations in Puerto Rico, established in 1921 and ensuing years, consisted of several hundred acres seeded to this species within the Maricao Insular Forest. The site, in the western mountains, is extremely difficult; the underlying rock is serpentine, and the soil is notably lacking in phosphorus. Erosion had removed the greater part of the fertility of the soil, and the site was exposed to hot, drying winds and sun during the long dry season. In spite of these difficulties, however, the plantations were very successful; and although growth has been very slow, it is better than that of other species on the same area. All other species suffered a high mortality, and the growth of survivors was not as satisfactory as that of maría. Growth is speeded up after establishment of the seedlings and the corresponding alteration of the environment; and it is interesting, in walking through the seeded areas of several successive years, to note the change from the struggling, yellowish-leaved individuals 3 or 4 years old to the dark-green specimens flushed with new growth in the older plantations. In like manner, the soil has changed from bright-red, impermeable clay to a darker soil, more porous and fertile.

Because of the success on this extremely difficult site, maría has been used several times in recent years on other difficult sites, where other tree species failed; it has consistently proved its adaptability to trying environmental conditions. Even on the shallow-soiled tops of exposed limestone hills in the heart of the sinkhole country, where it is known that, although most of the area is too shallow for planting seedlings, trees once established can send their roots down into the porous limestone, planting maría seeds in the shallow soil pockets has given excellent results. Now 2 years after planting, the seedlings range in height from 3 to 5 feet, and although a small percentage dried out after germination, the most of the plantations look very healthy.

Another difficult planting site was found in the Luquillo Unit on wet, swampy, flat land about 2,000 ft. above sea level, where rainfall approximates 100 in. per annum. Here also, other trees failed, but by making small raised piles of earth and inserting seeds of maría, a successful plantation was established. Again in the limestone country on heavy, red clay, which had greatly deteriorated, owing to agricultural use, maría came through in fine shape ahead of all other species on the same site.

This does not mean, of course, that the planting of maría should be restricted to difficult sites; it responds much more readily to favorable conditions than to unfavorable ones. Also cultivation or intercropping with agricultural crops results in greatly increased growth.

From a general silvicultural standpoint, this species is very desirable. It is able to compete with abundant grass and other herbaceous vegetation, and the strength of its stem prevents the excessive doubling due to vines, which is detrimental to many other species. It forms a good straight trunk; and, where the proper density of plantation is maintained, the lower branches are killed and shed off at an early age because of the heavy shade from the evergreen leaves. So far, very few insects or diseases have been found attacking this species, and their damage is slight. One new seed borer was observed at Maricao this last fall, but determination has not been made, and its damage has not assumed appreciable importance.

Resumen

Calophyllum antillanum, un árbol de gran distribución en la región del Caribe, produce una madera valiosa. Sus semillas grandes dan un por ciento alto de germinación, y ésto la hace que sea muy satisfactoria para la siembra directa por semillas. Ha probado ser de gran utilidad en Puerto Rico para la repoblación forestal de sitios difíciles, usando la semilla directamente. La especie compite bien con otra vegetación, es de tronco derecho, se poda a sí misma fácilmente, y es relativamente libre a los ataques de insectos y enfermedades.

THE ENTOMOLOGIST LOOKS AT MAGA

George N. Wolcott, Entomologist,
Agricultural Experiment Station,
Rio Piedras, P. R.

The value of mahogany, Swietenia mahagoni, for the construction of furniture or for use as interior trim in the West Indies is due to a considerable extent to its resistance to the attack of the West Indian dry-wood termite, or "polilla", Cryptotermes brevis Walker. Mahogany is not absolutely immune from attack, and the light-colored sapwood is quite susceptible, but furniture built of mahogany heartwood has survived the varied vicissitudes of climate, hurricanes, and polilla attacks to which it has been exposed in the West Indies better than that made of any other wood or material.

The one serious objection to mahogany is the slow growth of the tree. For this reason, it seems desirable to call attention to another tree of much more rapid growth, which appears to have all of the desirable characteristics of mahogany. This is the Puerto Rican maga, Montezuma speciosissima Sessé & Moc. (=Thespesia or Maga grandiflora), which is a native tree of rapid growth. It produces a dark-red heartwood slightly more resistant to the attack of Cryptotermes brevis than is the heartwood of mahogany, and its light, yellowish-brown sapwood is also the equal of mahogany in its resistance to termite attack. From the standpoint of the furniture manufacturer, it is more desirable than mahogany, but it is at present little used because of the insignificant commercial supply of maga lumber.

The maga belongs to the Malvaceae family, and in cotton-producing regions it is considered undesirable because its fleshy seed pods can serve as alternate hosts for the caterpillar of the pink bollworm (Pectinophora gossypiella Saunders) during that part of the year when cotton is not being grown. The maga fruits from September to June, but it produces no pods during the summer, which is the time that cotton is maturing bolls in the Isabela region. As it happens, the maga has been planted most extensively along roads between Isabela and Aguadilla—in just that part of Puerto Rico where most of the native cotton is grown. Theoretically, therefore, the presence of maga trees in this region is a serious obstacle to the effective control of pink bollworm; but the occurrence of this pest of cotton depends to a much greater extent on factors other than the fruiting of the maga. In any case, the possible injury is to the cotton; that to the maga is negligible.

Other insect pests of cotton do no appreciable damage to the maga. The white scale of cotton, Hemichionaspis minor Maskell, has been noted on maga, but neither this nor any other scale insect occurs on maga in sufficient abundance to cause serious injury. The cotton caterpillar, Alabama argillacea Hubner, does not feed on maga foliage, the holes sometimes noted in the leaves being due to an unidentified Anomis. Examining a large amount of maga foliage with care, one will sometimes find a stray mealybug, Pseudococcus citri Risso; the oviposition spiral of an unidentified whitefly; a Capsid bug, Hyaloides

vitreus Distant; leafhoppers, Empoasca minuenda Ball or Dikraneura depressa McAttee; or the Fulgorids, Catonia cinerea Osborn or Cedusa santaclara Myers, but each so rare that damage to the host is negligible. Cotton stainers, Dysdercus andreae L., are possibly more often noted in Puerto Rico feeding on the seeds of maga than in cotton fields, although they cannot obtain access to them until the fleshy fruit surrounding the seeds has been broken open, or eaten away by rats. Feeding on, or hiding under the injured flesh of, crushed fruits, the following scavenger beetles have been collected: Carpophilus hemipterus L., Europs apicalis Reitter, Metamasius hemipterus L., and Hypothenemus sp.

Thus, in contrast to several other trees which have been suggested for extensive planting in Puerto Rico, the maga has no insect pests of any importance. Furthermore, when the wood matures, it will be the equal of, or superior to, mahogany in resistance to termite attack.

Resumen

El valor de la caoba como madera de ebanistería para uso local se debe mayormente a su gran resistencia a la polilla de la madera (Cryptotermes brevis Walker). Sin embargo, el crecimiento de la caoba es lento, y se llama la atención hacia la conveniencia de la maga para propósitos de reforestación extensa.

Este es un arbol nativo de crecimiento rápido, con un corazón rojo obscuro aún más resistente a la polilla que la caoba. En secciones algodoneras la planta actúa como huésped alterno de la oruga de la cápsula del algodón, pero ésta, así como algunos otros insectos que se encuentran a veces en el árbol, no le causan daños perceptibles.

SOME NOTES ON FOREST ENTOMOLOGY

Luis F. Martorell, Asst. Entomologist,
Agricultural Experiment Station,
Rio Piedras, P. R.

The Pustule Scale

The pustule scale, Asterolecanium pustulans Cockerell, is by far the worst pest on Cassia siamea Lam. (=Sciacassia siamea Britton) in Puerto Rico. Heavy infestation has been noticed throughout the Island, especially in the coastal sections. The first large infestation was noticed by the author at the Rio Piedras headquarters of the Forest Service, where a large group of mature trees was killed by the scale. Later, in Sept. 1937, a windbreak of 30 or 40 trees was found destroyed by the scale at Toa Baja. Going along the roads on the north coast of Puerto Rico, one commonly sees trees infested by the scale, most of them killed by the insect. The planting of Cassia siamea on the coastal plains of the Island is limited by this important insect pest, therefore, because sooner or later the tree will succumb.

The silver oak, Grevillea robusta Cunn., is a tree that the Forest Service formerly held in esteem and planted in many places in Puerto Rico. The reason for the present scarcity of this species is due, as in the case mentioned above, to its great susceptibility to the pustule scale.

Oleander, Nerium oleander L., a common ornamental shrub in Puerto Rico, is an additional host of the pustule scale and is very susceptible to attack. Whenever possible, oleander should be destroyed to avoid further spread of the scale to more resistant species.

The West Indian Peach Scale on Fraxinus

The papaya scale, or West Indian peach scale, as this insect is known, has found a new host plant on which to live. This is the genus Fraxinus, trees of which were imported by the Forest Service and were doing very well in a plantation at El Guineo Reservoir. These trees now, however, are heavily attacked by Aulacaspis pentagona Targioni, the scale insect in question; according to a careful tally, of the more than 200 trees planted, 44.5 percent were infested.

The scale attacked the whole trunk and caused a complete defoliation of the trees. Some of them retained their upper leaves, but the rest of the trunk was completely defoliated. In heavily infested trees, a sort of die-back was produced, starting from the growing point and extending downwards, with resulting mortality in many cases.

An attack by the same insect has been reported on trees growing in the Maricao Insular Forest in a plantation near Camp Santana; here most of the trees were destroyed.

The Sea-Grape Sawfly on "Moralon"

The sea-grape, Coccolobis uvifera (L.) Jacq. is very heavily attacked year after year by the sawfly, Sterictiphora zaddachi Dewitz. In June 1937, on a country road between Central Bayaney and Central Soller at San Sebastian, several trees of moralon, C. grandifolia, Jacq. were found almost completely defoliated. Upon careful examination, fresh leaves were found covered with egg clusters of the grape sawfly; on a single fresh leaf, 17 egg-clusters were collected. Adult sawflies also were abundant.

Further observations on this insect indicate that the heaviest infestations take place on sites protected from the full force of the wind; infested sea-grape trees along the coast are not as heavily infested as trees in the same section protected by hills or other windbreaks.

Resumen

La queresa pustulosa, Asterolecanium pustulans Cockerell, ataca a la Cassia siamea Lam., en Puerto Rico. El insecto causa gran mortalidad a dichos árboles, especialmente en las llanuras, cerca de la costa. El insecto es un factor limitante en la plantación de dicho árbol.

También el roble plateado australiano, Grevillea robusta Cunn., y la adelfa, Nerium oleander L., son muy susceptibles a los ataques de la queresa pustulosa.

La queresa de la papaya, Aulacaspis pentagona Targioni, causó gran mortalidad en plantaciones de fresno, Fraxinus spp., en Maricao y El Lago del Guineo.

El himenóptero, Sterictiphora zaddachi Dewitz, causó gran defoliación en el moralón, Coccolobis grandifolia Jacq.

I N M E M O R I A M

Ferdinand A. Silcox, Chief of the Forest Service, U. S. Department of Agriculture, died suddenly at his home in Alexandria, Virginia, on Wednesday, December 20, following a heart attack. He would have been 57 years old on Christmas day. Mr. Silcox was graduated from the Yale School of Forestry in 1905, receiving the degree of Master of Forestry. That same year he entered the Forest Service as a ranger and was assigned to duty in the forests of Colorado. He was rapidly advanced to the post of Acting Forest Supervisor and Forest Inspector for Western States, and in 1910 he became Regional Forester of the Northern Rocky Mountain Forest Region, with headquarters in Missoula, Montana, where he remained until 1917. During the World War, he served as Major with the 20th Engineers, but in April 1918 was aked by the Secretary of Labor and the Director of the U. S. Shipping Board to head the office handling labor problems in the shipyards at Seattle, Washington. Mr. Silcox was more or less closely associated with industrial problems until November 1933, when he was selected by President Roosevelt to be Chief of the U. S. Forest Service. As Secretary Wallace has said, "The death of Mr. Silcox is a blow to the whole American movement for conservation of human and natural resources.**** His work is commemorated in a Government organization of highest efficiency and esprit de corps--and in the grateful remembrance of great service to many of the worthy civic enterprises that American citizens are carrying on today."

Edmundo Martínez Mató falleció el 27 de septiembre último en la ciudad de Caracas, Venezuela. Fué el primer puertorriqueño en ostentar el título de Silvicultor y laboró arduamente desde los comienzos del Servicio Forestal en Puerto Rico. Desde 1928 hasta 1931 cursó estudios profesionales en la Universidad de Cornell y con algunos intervalos trabajó desde su graduación hasta 1937 en el Servicio de Bosques de Puerto Rico. En ese año embarcó para la república vecina de Venezuela donde ocupaba el importante cargo de subjefe de la Sección Técnica de Reforestación cuando le sorprendió la muerte a la temprana edad de 43 años.

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Correction

On page 23 of Vol. 1, No. 1, the name of the new species of mahogany seedling blight there described should read Phyllosticta swieteniae.

Note: Assistance in the preparation of these materials was furnished by the personnel of Work Projects Administration Official Project 65-2-64-74.


UNITED STATES OF AMERICA
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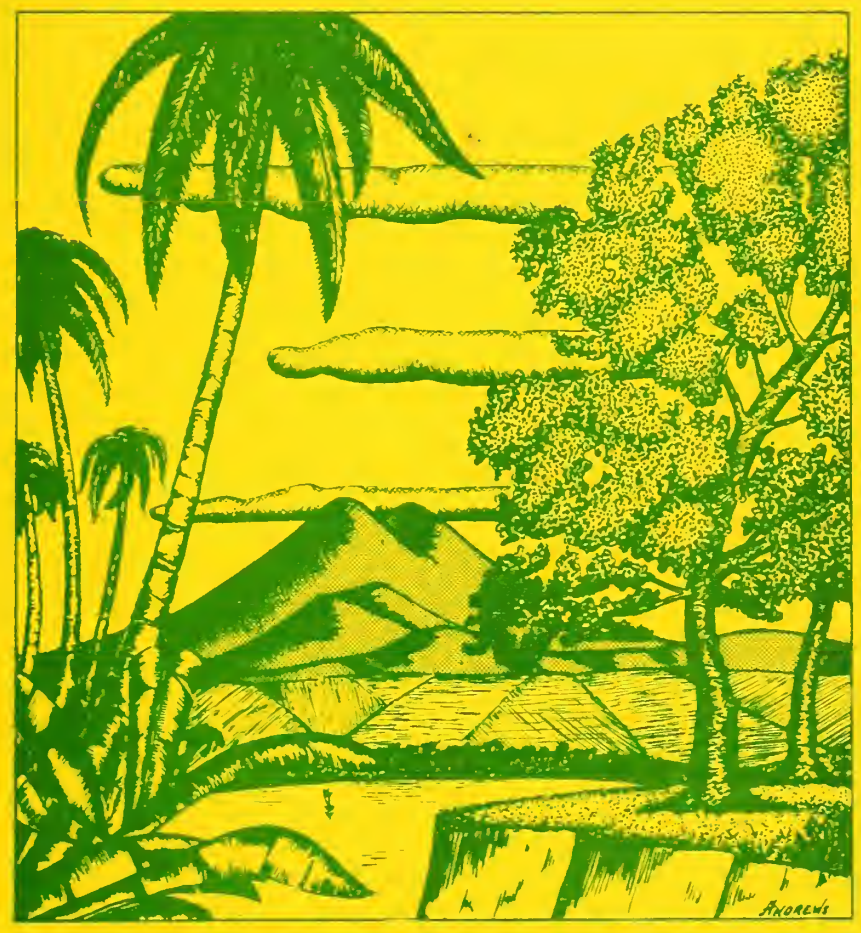
THE CARIBBEAN FORESTER



It is my pride and joy to be the shepherd of my country's trees.

TROPICAL FOREST EXPERIMENT STATION,
UNITED STATES FOREST SERVICE,
RIO PIEDRAS, PUERTO RICO

Vol. 1, No. 3

APRIL 1940

THE CARIBBEAN FORESTER

This journal is planned as a medium of exchange of knowledge between those interested in forestry in the islands and countries in or near the Caribbean Sea. Invitations to cooperate in this project have been sent to forestry and agricultural officials in the following places:

Bahama Islands
Barbados
British Guiana
British Honduras
Canal Zone
Colombia
Costa Rica
Cuba
Dominica
Dominican Republic
French Guiana
Grenada
Guadeloupe
Guatemala
Haiti
Honduras
Jamaica
Leeward Islands
Martinique
Mexico
Nicaragua
Panama
St. Lucia
St. Vincent
Salvador
Surinam
Trinidad & Tobago
Venezuela

It is planned to present this journal quarterly. Material for publication should be submitted at least two months before publication date and be addressed to the Director, Tropical Forest Experiment Station, Rio Piedras, Puerto Rico.

Edited, Multilithed, and Distributed
by the
Southern Forest Experiment Station
New Orleans, La. U.S.A.

To Our Collaborators

The establishment of the Tropical Forest Experiment Station, located on the grounds of the Insular Agricultural Experiment Station at Rio Piedras, Puerto Rico, is proceeding slowly and surely. A Laboratory and Office building to house the Station is under construction on a hill overlooking San Juan and the Island to the West. It should be completed and ready to occupy in September of this year.

It is hoped that full use of the Station and its facilities will be made by all countries and persons interested in tropical forestry. While the Station is the medium for issuing "The Caribbean Forester", we want you to consider it your publication. For those who do not have the time to write longer articles we would appreciate short notes giving us your experience, observations and problems concerning any item of interest. These would supply a medium for comment and exchange of views and would prove a valuable addition to the journal.

To get back to the Station, for the present we are continuing the experimental work in nursery practice, planting, and forest management. On the other hand, no attempt is being made to set up a complete long-range program until a careful study has been made of the entire field. To serve properly the needs, not only of Puerto Rico, but of tropical America, it is necessary that we be given every assistance in the formulation of our program. You can participate by advising us of your problems and how we can help in their solution. Will you not give us the benefit of your recommendations and suggestions? Nothing would encourage us more.

Some general plans have been tentatively approved. All these are with the purpose of increasing the usefulness of the Station. Provision is being made in the new building to furnish office and laboratory space for visiting scientists who wish to carry on studies of tropical forests or allied biological sciences.

As soon as facilities are available, we expect to make provision for men from tropical American countries, particularly younger men engaged in or who hope to be engaged in forestry work, to come to the Station for training in research work and forestry.

For those countries not able to send anybody to the Station, but who are anxious to carry on experimental work and who request technical collaboration and assistance, the Station expects to have a technical staff to furnish such a service.

It seems like an ambitious program to carry out in addition to our experimental projects, but there it is, and all we can do is to hope that if it meets with your approval, you will assist us in carrying it out. If you don't approve and feel that we can contribute more in other ways, won't you tell us so? - - - - - ARTHUR BEVAN, Tropical Forest Experiment Station.

CONTENTS

BALSA IN BRITISH HONDURAS

N. S. Stevenson, Conservator of Forests

The following extracts from reports on seed extraction and plantation work with balsa in British Honduras will be of interest to the Puerto Rico Forest Service. Botanical material of "polak", as it is locally known, has been identified as Ochroma lagopus, O. concolor, O. bicolor, O. velutina and O. limonensis, but Mr. Paul C. Standley of the Field Museum of Natural History in the "Flora of British Honduras" believes that all material reported from British Honduras is referable to Ochroma limonensis Rowlee.

Polak occurs very rarely in high rain forest, but is a common tree in "huamil" or second growth on abandoned plantations, where it makes very rapid growth. Many inquiries have been made for supplies of the wood and there is a local market for the floss for stuffing pillows and mattresses. Unfortunately, the wood of the tree in huamil shows very considerable variation in density, ranging from soft, very light wood in the center to comparatively hard wood on the outside, which may be as much as three times as heavy as the center wood. Natural stocks on abandoned shifting cultivation are, generally speaking, too scattered for commercial exploitation and in collecting the floss the normal local method is to fell the tree.

The experimental work undertaken since 1934 on a very small scale was designed (a) to grow polak in plantation and by silvicultural treatment to produce a wood of more uniform texture and density, (b) to obtain floss from plantation-grown trees and (c) to separate the seed from the floss efficiently and quickly.

The following conclusions have been drawn from our work up to date. Polak is essentially a "huamil" species demanding a fair degree of soil drainage. It will not tolerate waterlogging and is an extreme light demander. It gives excellent natural regeneration following burning either at seeding time (late April and early May) or up to 3-1/2 months afterwards--possibly longer. Experiments made on "unburnt" land, though giving promising regeneration, all failed and burning appears to give the polak seed the necessary stimulus and the other huamil species the necessary set-back to enable the former to establish itself against the latter. The seed has the power of lying dormant in or on the soil for some time (at least 3-1/2 months) under second growth and responds at once by germinating where the second growth is cut and burnt. In the absence of burning the seed germinates successfully but the seedlings do not thrive beyond a height of 1-1/2 - 2 inches, except in prepared nursery beds.

Artificial regeneration is to be avoided when possible. Direct sowing is the only practicable large-scale method, transplants being exceedingly delicate and subject to wiltering. A good, hot burn is essential to success. Experiments to date have been confined to sowing seed after clearing, with or without burning before sowing, but results obtained with natural regeneration seem to show that the correct method is to clear the land, broadcast the seed, and then burn. This sounds very drastic with such a small, delicate seed as that of polak, but would probably prove successful. Patch burning followed by

sowing has not been very successful, probably on account of the side-shade from the fast-growing huamil around the patches.

With dense regeneration it is probable that no cleaning would be necessary. Small areas of natural regeneration have been seen where no cleaning has been carried out and polak has established itself at the end of 1 year against all other species. Polak appears to reach a height of about 10 feet in the first year, after which thinnings would probably be necessary, as, being an extreme light demander, it responds to crowding by growing very tall and spindly.

Transplanted seedlings in a portion of 6-1/2 acres of plantation showed slightly better growth than the natural regeneration and attained a mean girth of 38 inches in 5 years. The growth in the first 2 years was extremely rapid and the first thinning carried out at 4 years 8 months should have been made sooner. The average height to the first branches was 12 feet but the trees are now cleaning themselves of these lower branches.

An alternative method of broadcasting seed without separating the seed from the floss was not completely successful. Pods were tied to high sticks through an area felled for plantation and it was expected that the drying pods would open and the seed be carried evenly over the area by the wind-borne floss. Heavy rains, however, thoroughly wetted the floss in the partly opened pods and the method, though cheap, cannot be guaranteed and is not recommended if clean seed can be obtained easily.

The collection of pods from trees removed in thinning the plantation already referred to, showed that large quantities of floss cannot be obtained annually from plantations managed primarily for the production of wood. This part of the research was therefore abandoned and new experiments were commenced to determine whether polak trees in pastures and other open spaces could be made to develop low-branching, heavy crowns from which the pods could be collected without felling the tree. The work done so far shows that saplings of about 4-6 inches girth can be cut successfully about 4 feet from the ground and will produce many branches. It is probable that periodical pruning will be required to keep the crown within reasonable picking reach.

At present the collection of seed or floss necessitates the felling of the tree and the gathering of pods by hand. Felling must be carried out either in the early morning when the fruits are still damp with dew or on wet days, otherwise the fruit bursts and the greater part of the seed is lost. In an early method of separation the fruits were spread out on tarpaulins in the sun on calm days and allowed to open thoroughly, the woody parts being picked out by hand. The floss containing the seed was packed loosely into bags and well beaten with sticks, separating the seed from the floss. The bags were then emptied and the floss winnowed or raked away from the seed. By this method 11 large sacks of fruits gave 12 sacks of floss and 22.3 lbs. of seed, 1 pound avoirdupois containing approximately 45,800 seeds.

A later and more efficient method was evolved to prevent loss of floss in sudden gusts of wind. The pods are now sunned in shallow trays covered with chicken-wire netting and the floss is removed by hand into large plywood boxes. The seed is then removed from the floss in a homemade machine consisting of 1/4-inch square mesh wire-netting cylinder about 18 inches in diameter and 3 feet long,

through which runs a shaft carrying two opposite sets of 1/2-inch square pegs spaced about 1 inch apart and leaving a clearance of about 1-1/2 inches between the ends of the pegs and the netting. The shaft is mounted on bicycle wheel hubs and is rotated in the cylinder by hand power transmitted through a bicycle crank and chain. The cylinder is filled about one-third full of floss through a removable section about 1/4 of the circumference and the full length of the cylinder. The upper portion of the drum is covered with paper to stop seeds being thrown out and they fall through the bottom onto an inclined sheet, the vibration and movement working them gradually downward to a receptacle. Experience shows that the seeds can be removed quicker by a backward-and-forward motion of the paddles rather than by straightforward rotation and the machine is worked in a draught to remove quickly the dust and fine particles which otherwise become a nuisance to the operator. Ten large bags of pods treated by this method gave seventeen large bags of floss and over forty pounds of seed. A considerable amount of time is wasted in filling and emptying the cylinder and it is believed that a cylinder of larger diameter would be just as efficient.

Our planting experience of 1934 was confirmed in an article by Samuel Greenhouse on "The Culture of the Balsa Tree in Ecuador" in the Journal of Forestry (Jour. Forestry 33 (10): 870-876, Oct. 1935) (Society of American Foresters, Atlanta, Ga.). There is also a note on Ochroma in Tropical Woods (Yale School of Forestry, New Haven, Conn.), No. 59, pages 15-18.

Resumen

Desde el 1934 se ha estado experimentando con la balsa (Ochroma sp.) para obtener madera de densidad y textura más uniforme y producir fibra o lana de los árboles sembrados en plantaciones, y para separar la semilla de la fibra rápida y eficientemente.

La balsa ocurre principalmente después de desmontes y requiere suficiente drenaje y luz abundante. La repoblación artificial usando plántulas no es satisfactoria debido a la naturaleza delicada de los arbolitos. Una excelente repoblación natural se obtiene quemando el sitio al tiempo de caer la semilla, a último de abril y a principios de mayo o hasta 3 meses y medio después; o la semilla puede regarse al voleo antes de la quema. El fuego estimula la germinación e inhibe el desarrollo de otras especies.

La recolección de las bellotas se lleva a cabo corrientemente cortando el árbol temprano por la mañana o durante días húmedos. Actualmente se ha demostrado que cuando los arbolitos se cortan a cuatro pies del suelo ramifican mucho, haciendo posible la recolección de las bellotas sin necesidad de tumbar el árbol.

La fibra se saca de las bellotas a mano, después de haberlas expuesto al sol en cajas llanas cubiertas con tela metálica. Las semillas se separan de la fibra por medio de una máquina rústica, que consiste de un cilindro de tela metálica con un eje dentado el cual se mueve a mano.

FORESTRY AND FOREST LEGISLATION IN THE DOMINICAN REPUBLIC

J. G. Scarff

Introduction.- The Dominican Republic occupies the eastern two-thirds of the Island of Hispaniola, lying between latitudes 20° and 17° 30' N. The Republic has an area of 19,325 square miles, approximately 60 percent of which is forested.

Forested	3,007,000 hectares[1/]
Under cultivation	1,000,000 hectares
Grassland	500,000 hectares
Coast, lakes, rivers, and roads	250,000 hectares
Urban and waste lands	250,000 hectares
	5,007,000

Principal Woods of Present Economic Importance.- Because of the relatively large percentage of its area in forest, the Dominican Republic has for many years been a rather large consumer and exporter of certain woods -- the most important of these being:

1. Caoba (Swietenia mahagoni (L.) Jacq.) -- true mahogany
2. Espinillo (Zanthoxylum flavum Vahl.) -- West-Indian satin-wood
3. Guayacán (Guaiacum officinale L.) -- lignum-vitae
4. Bera (Guaiacum sanctum L.) -- bastard lignum-vitae
5. Mora (Chlorophora tinctoria Gaudich.) -- fustic
6. Campeche (Haematoxylon campechianum L.) -- logwood
7. Baitoa (Phyllostylon brasiliensis Cap.) -- a native boxwood
8. Cedro (Cedrela odorata L.) -- cigar-box cedar
9. Sabina (Juniperus gracilior Pilger) -- pencil cedar
10. Pino (Pinus occidentalis Sw.) -- Santo-Domingo pine

The last named -- Pinus occidentalis Sw. -- is cut principally for local consumption, while most of the wood from the other species is exported, either in log or manufactured form. Such exports amount to between $150,000 and $200,000 yearly.

Wood Imports.- Notwithstanding the abundant supply of wood in the Republic, in the past a relatively large amount has been imported yearly from the United States. Most of this has consisted of southern pine in structural sizes and has supplemented the native pine, which is cut at a yearly rate of between 7 and 8 million board feet. Recently, however, pine imports have fallen off considerably owing not only to a noticeable decrease in construction, but also to the fact that during the last few years native woods have been utilized more and more. So that, where wood imports were often valued at between $400,000 and $1,000,000 yearly, they barely exceed $30,000 at present.

1/ One hectare is equivalent to 2.471 acres.

The three economically important forest regions of the Republic.- The 3,007,000 hectares classed as forest land present the greatest of variety not only as to species of trees supported thereon, but also as to stocking and accessibility. As a matter of fact, more than 50 percent of this area can be considered of importance only insofar as its vegetation regulates streamflow and prevents erosion. Three forest types, however, are of great economic importance from a forestry standpoint. They are:

1. The tropical rain forest.- This forest type is found along the eastern half of the north coast, centering about the peninsula of Samaná and extending inland at this point. Here where precipitation varies from 60 to 120 inches per year, the climax forest is quite mesophytic, and the characteristic tree is yaya (Oxandra lanceolata (Sw.) Baill.). Throughout this forest type the best Dominican mahogany, satin-wood, and lignum-vitae is found; and although much of the forest has been exploited, there are still areas of untouched timber within this region -- especially on the peninsula of Samaná itself. This is so principally because in this part of the Republic transportation facilities are still undeveloped; and only that part of the timber near the coast can be economically logged.

2. The xerophytic thorn-hardwood-softwood forest.- This forest type is found along the southwestern coast of the Republic and extends inland throughout the provinces of Barahona and Azua. Characterized in the drier and lower portions by a thorn forest of giant cacti and bayahonda (Prosopis chilensis (Mol.) Stuntz), where precipitation is favorable -- especially back in the hills where the rainfall varies from 30 to 40 inches yearly -- many important commercial woods are found. Among these are bastard lignum-vitae, the dyewoods, native boxwood, and the "cedars". The supply of these, however, is being exhausted rapidly. This is due to the relative ease of transportation throughout this region, its proximity to important seaports, and the sparse, park-like growth habit of the trees. Moreover, unlike other tropical tree species, those classed as xerophytic or semi-xerophytic are relatively slow growers, seed scantily, and often do not coppice.

3. The pine-hardwood forest.- This forest type is found along the windward slopes of the Cordillera Central in the provinces of Trujillo, La Vega, and Santiago at an elevation ranging between 1,500 and 7,000 feet above sea level. Santo Domingo pine is the dominant tree throughout, with an understory of pomarrosa (Eugenia jambos L.) occurring in the moister and more protected situations. The pine resembles in growth habit and size the pines of the southeastern United States and, like the latter, provides excellent structural material for local consumption.

As one of the principal highways in the Republic is through this region, much cutting has occurred here during the past 15 years; and, at the present rate of exploitation, the remaining stands of pine can last little longer, except in highly inaccessible locations. It is not, however, so much the amount cut as the accompanying bad practices, that endangers the forest type -- such practices as clear-cutting large blocks of timber with no thought to the growing stock or reproduction and allowing fires to burn over the mountain sides unchecked.

Forest Legislation.- Public forestry is carried on under the leadership of the Secretary of Agriculture; but no true Forest Service exists and relatively little forest legislation has been enacted. A law was passed, however, in 1934 "concerning the conservation of forests and waters." This law, containing 15 articles, is in brief as follows:

Article 1.- The following are declared and designated as Forest Reserves of the Republic.

(a) All unreserved Public Domain lands now in forest or capable of supporting a forest.

(b) All future acquisitions of land by the National Government when such land either already be in forest or be deemed unfit for other purposes.

Article 2.- The following lands are to be deforested under no circumstances:

(a) The upper portions of the several mountain ranges in the Republic.

(b) The banks of all rivers and streams for a distance of 20 meters back from either side and the edges of all gulleys and "arroyos" for a distance of 10 meters back from either side.

(c) Lands lying within a radius of 150 meters of river and spring heads and at the heads of all "arroyos".

(d) Areas 20 meters wide around all lakes and lagoons.

(e) The summits of all hills under agriculture for a distance down on all sides of at least 10 meters.

For any infraction of the above a person is liable to a fine of from $5.00 to $200.00, a term of from one to six months in prison, or both.

Article 3.- One year is given all agriculturists now farming land dealt with under Article 2 to either abandon it or show that its cultivation is indispensable to their livelihood.

Article 4.- All lands under cultivation upon abandonment must be re-forested in conformity with rules and regulations as laid down for such cases.

For any infraction of either Article 3 or Article 4, a person may be liable to a fine of from $10.00 to $50.00 and furthermore may be made responsible for any sums of money the Government deems necessary in restocking such lands. Moreover, such reforested lands must be cared for by the party concerned.

Article 5.- It is prohibited to:

(a) Fire the woods.

(b) Light fires in areas within the pine forests which might endanger these.

Article 6.- Trees along public roads and highways are not to be cut unless they interfere with the maintenance of said roads and highways.

Article 7.- No block of land larger in area than 200 hectares can be deforested for agricultural or other purposes without special permission from the Secretary of Agriculture.

Article 8.- When land is cleared for pasture, five trees in semi-arid localities must be left per hactare.

Article 9.- "Precious woods" such as caoba, espinillo, guayacán, cedro, roble (Macrocatalpa longissima (Jacq.) Britt.), Capá (Cordia Gerascanthus L. and Petitia domingensis Jacq.), nogal (Juglans jamaicensis C. DC.), ébano (Gymnanthes lucida Sw.?), and others can be cut only if for each tree taken twenty of like species are planted in its place.

Certain minimum requirements as to diameter of trees cut will also be enforced, along with the time for such cuttings to take place.

Article 10.- Only under special justification can trees bearing fruits of commercial importance or palm trees be cut.

Article 11.- All trees to be used for firewood or in the manufacture of charcoal must be cut at least two feet from the ground line, thus permitting ample opportunity for coppicing.

Article 12.- The National Government may take all measures necessary for the reforestation of forests whenever and wherever such measures become necessary.

Article 13.- This law in its entirety may be enforced by any and all law-enforcement bodies of the National Government, and especially by a body of "Forest Guards" under the direction of the Secretary of Agriculture.

Article 14.- A fine of from $5.00 to $100.00, a prison sentence of from five days to three months, or both,may be inflicted for the infraction of any of the above articles where special punishment has not been duly prescribed.

Article 15.- The present law supersedes and invalidates all previous laws dealing with the conservation of forests and waters in the Republic.

The above law furnishes an excellent beginning in forest legislation and control; however, there is still much to be done. Moreover, due to a lack of responsibly trained foresters and of proper public cooperation, the above law has fallen more or less into neglect and is seldom enforced.

A law, however, passed in 1937 dealing with "a tax on wood sawed either for sale within the country or to be exported, and the modification of the Industrial Tax Law" has been enforced rather rigidly. In brief it states that:

Article 1.- A tax of $5.00 per 1,000 board feet is placed on all timber

sawed for structural purposes, and of $2.00 per 1,000 board feet on all wood to be used for the manufacture of boxes and crates.

Article 2.- Woods to be exported are subject to the following duties:

(a) On caoba, cedro, espinillo, roble, sabina, and ébano -- $5.00 per 1,000 kilos.[2/]

(b) On bera, guayacán, and capá -- $2.50 per 1,000 kilos.

(c) On other woods and plants -- $1.00 per 1,000 kilos.

Article 3.- Customs officials are empowered to withhold shipment of all material listed in Article 2 until the proper export duties have been paid.

Article 4.- Infractions of the above three articles are punishable by penalties as prescribed in Law No. 855.

Article 5.- The Industrial Tax Law is to be modified as follows:

(a) A yearly assessment on sawmills powered by steam or motor of $25.00 -- excepting those engaged in the manufacture of boxes and crates, in which case an assessment of $15.00 per year is made.

(b) A yearly assessment on lumber yards and warehouses of $10.00.

Passed primarily to gather revenue for the National Government, the above law has discouraged greatly the local milling and exporting of timber. In one respect, however, this has had a beneficial effect upon the forests of the Republic; for it has fostered natural or involuntary forestry -- the extent of such natural forestry varying in inverse ratio to the margin left for stumpage. On the other hand, the price for local construction lumber has necessarily remained well above the financial means of the average citizen -- an undesirable situation. There has been, therefore, recent agitation to modify the law and thus open the way for further development in lumbering.

The future of forestry in the Dominican Republic.- Still rich in forests of valuable woods, the Dominican Republic -- unlike several of her less fortunate neighbors -- is in an enviable position and may become easily a leader in Caribbean forestry. Her ability to assume such leadership, however, depends largely upon her attitude toward her forests during the next few years; for there are definite steps that must be taken to insure their future maintenance and development. The most pressing of these are:

1. A fuller use of the forests as a whole. This means that markets must be created for many woods now cut and left in the forests by those interested solely in exploiting the better-known species, such as mahogany, satin-wood, and lignum-vitae. The creation of such markets, however, should not be too difficult as many of the lesser-known species of tropical woods seem to offer great potentialities and need only to be properly introduced to the consumer.

2/ One kilo is equivalent to 2.2046 lbs.

2. Further development in forest legislation. Such legislation, however, should not be conceived and passed arbitrarily, but should be based rather on proper management and silviculture as developed locally.

3. The development of forest-consciousness in the average citizen. He must be made to understand the importance of this natural resource and to realize that in many localities unfit for other uses the forest may furnish the only means of obtaining from the land a future sustained income.

4. The expansion of the existing Forest Service. Such a branch of the Government, under the direction of responsibly trained foresters, would assure the future of forestry in the Republic and would more than pay for itself in a few years.

If such steps are carried out, forestry in the Dominican Republic will begin to play a greater and greater role in the economic welfare of the nation. However, such remedial action should be taken at once lest irreparable damage be done in the meantime.

Summary

The forested area of the Dominican Republic is estimated at 3,007,000 hectares or 60 percent of the total area. The ten most important species are listed as caoba, espinillo, guayacán, bera, mora, campeche, baitoa, cedro, sabina, and pino. Wood imports have dropped off in recent years owing to a decrease in construction and increased utilization of native species.

The three forest types of greatest economic importance from a forestry standpoint are the tropical rain forest along the eastern half of the northern coast, the xerophytic thorn-hardwood-softwood forest along the southwestern coast and extending inland throughout the provinces of Barahona and Azúa, and the pine-hardwood forest of the central mountains in the Trujillo, La Vega, and Santiago Provinces.

A brief of the forestry legislation is given and definite steps most needed for advancing forestry are suggested as follows: A fuller use of the forests as a whole, further development in forest legislation, the development of forest-consciousness in the average citizen, and expansion of the existing Forest Service.

Resumen

El área forestal de la República Dominicana se estima en 3,007,000 hectáreas o el 60 por ciento del área total. Las diez especies más importantes son: caoba, espinillo, guayacán, bera, mora, campeche, baitoa, cedro, sabina y pino. Recientemente, la importación de madera ha disminuído considerablemente debido a la construcción limitada y a la mayor utilización de las especies nativas.

Los tres tipos forestales de mayor importancia desde el punto de vista silvicultural son: la selva pluvial tropical en la mitad oriental de la costa norte, la selva xerófila o seca a lo largo de la costa suroeste extendiéndose hacia el interior a través de las provincias de Barahona y Azúa, y los pinares en las montañas centrales de las provincias de Trujillo, La Vega y Santiago.

Se incluye un resumen de la legislación forestal, sugiriendo los pasos más necesarios para el progreso de la silvicultura, como sigue: un uso más intenso de los bosques en general, mayor desarrollo de la legislación forestal, el desarrollo del conocimiento forestal en el ciudadano promedio, y la expansión del Servicio Forestal actual.

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La Base de Toda Economía Nacional

Dos puntales básicos soportan la plataforma sobre la cual descansa toda economía nacional, a saber: 1. El Elemento Humano 2. Los Recursos Naturales. Ambos factores son importantes. Una perfecta correlación de ellos constituye el estado económico ideal.

1. El Elemento Humano.- La prosperidad de un país reside más en el número y en la calidad de los hombres que lo pueblan que en la abundancia de sus recursos naturales. Allí donde factor humano escasea no existe competencia, y donde no hay competencia no puede haber progreso.

2. Los Recursos Naturales.- Los recursos naturales alimentan la industria moderna en la forma de materiales en bruto. Ellos constituyen la fuente de energía que mantiene en movimiento la maquinaria económica. Ellos suministran al hombre la fuerza financiera que lo habilita para llevar a cabo sus ideas.

Los recursos naturales pueden ser clasificados en la forma siguiente: A. Tierra B. Aguas C. Clima.

Los recursos naturales terrestres pueden, a su vez, ser subdivididos así:

TIERRA:
- Reino Mineral: Productos Minerales
- Reino Vegetal: { Productos Agrícolas; Productos Forestales }
- Reino Animal: Animales y sus productos.

Las fuentes principales de estos productos son tres: granjas o haciendas, bosques y minas.

Nuestra Mayor Riqueza

Los recursos minerales, en general, constituyen un factor transitorio en la economía de cualquier país. Su existencia es limitada y su renovación es imposible. Además, su explotación está sujeta a las más extremas alternativas del comercio internacional. Sin embargo, en términos generales, la existencia de minerales visible en la actualidad parece ser suficiente para abastecer la industria por varias centurias. Petróleo constituye la excepción; la existencia visible y probable puede agotarse en veinte o treinta años.

La sabiduría y la bondad de la pródiga naturaleza no pueden ser más patentes. Ella guarda solícita escondidas en sus entrañas riquezas inmensas, como temerosa de exponerlas al alcance de la avaricia humana; debido a ésta, esas riquezas ocultas han acarreado a la humanidad casi tantos sinsabores como beneficios. Pero su más preciado tesoro, aquello que es absolutamente necesario para nuestra subsistencia, lo muestra palpable en cade pliegue de su rugosa piel, al alcance del pobre y del rico, como convidando a disfrutar de sus beneficios. Sus trigales de oro, sus bosques de esmeralda y sus manantiales de plata, son ciertamente la más alta expresión de su magnanimidad sin límites y es en su conservación hacia donde nuestros esfuerzos deben particularmente encaminarse.

Los bosques, en particular, a diferencia de los productos minerales, pueden ser renovados por las mismas fuerzas naturales que los han producido en el pasado; sin embargo, estas fuerzas naturales en su acción constructiva, requieren la colaboración orientadora del hombre.

La Situación de Venezuela

Comoquiera que Venezuela "ha edificado su casa sobre petróleo", está expuesta a la suerte de tan incierto flúido. El gobierno actual está al tanto de este hecho, y en consequencia, ha comenzado a "reedificar sobre roca", ha comenzado a "sembrar el petróleo". El Plan Trienal Venezolano incluye la intensificación de la Agricultura y la conservación de los Recursos Forestales. La palabra "conservación" tiene dos acepciones: la que le da el artista o el amante de la naturaleza, y la que le atribuye el economista. En este último sentido, indudablemente el más importante, conservación significa, no el encadenamiento de los recursos forestales, sino su "uso sabio". El presente artículo, que es un retoño del Plan Trienal, persigue esta última finalidad.

Los Recursos Forestales Venezolanos

Su Valor Económico Presente Y Probable Futuro

Hoy.- La contribución actual de Venezuela a la economía mundial de productos forestales es ciertamente muy mezquina. La industria maderera venezolana, en particular, es incipiente. Venezuela exporta un puñado de maderas para usos especiales, viéndose precisada a importar la mayor parte de su consumo doméstico. La exportación de productos forestales menores, tales como balatá y sarrapia, ha decrecido ultimamente. En pocas palabras, la industria forestal está en mantillas y su contribución a la economía venezolana es insignificante.

Mañana.- Existen argumentos en pro y en contra relativos al papel que los bosques tropicales están llamados a desempeñar, en el próximo futuro, en la economía mundial de productos forestales. En contra se destacan: la escasa población de los trópicos, la naturaleza heterogénea de los bosques ecuatoriales, la falta de vías de comunicación, la inestabilidad de los gobiernos de la América tropical, etc. En favor figuran: la naturaleza virgen de dichos bosques (solo ellos pueden producir maderas de primera calidad), la existencia de ciertos productos absolutamente necesarios a la industria moderna y que no existen en otra parte del mundo, el uso creciente del "enchapado" (que permitirá el uso de las especies de segunda calidad), etc.

Pesando ambas series de argumentos en la balanza de la lógica y teniendo en cuenta que el mundo está comenzando a sentir "hambre de madera", la conclusión parece ser que no está lejano el día en que los bosques tropicales desempeñarán un papel importante en la economía mundial forestal. Me inclino a creer que en la segunda mitad de esta centuria, los países de la zona templeda limitarán sus actividades a la explotación intensa de las Coníferas (Softwoods) y dejarán al trópico la tarea de suministrar las Angiospermas (Hardwoods).

Cuando esto ocurra, si ocurre, los bosques de la América tropical tendrán indudablemente un puesto de preferencia, especialmente los bosques de la región de Caribe—por lo menos, en lo que atañe a los Estados Unidos de Norteamérica.

Entre los países adyacentes al mar Caribe, Venezuela está llamada a desempeñar el papel principal. Con excepción del valle del Amazonas en el Brasil, no existe probablemente en los trópicos otra región más rica en recursos forestales que la del valle del Orinoco en Venezuela. La región adyacente al Lago de Maracaibo no se le queda muy atrás.

Existen otras razones para considerar los bosques venezolanos como los más importantes en la región del Caribe. La explotación de productos

forestales envuelve un número de consideraciones fuera de la existencia forestal misma. Fundamentalmente es una cuestión de costo de transporte al mercado, de accesibilidad. Como acabamos de apuntar, las regiones forestales más ricas de Venezuela están situadas alrededor del Lago de Maracaibo y adyacentes al Río Orinoco. El primero está conectado directamente con el mar Caribe. La importancia de este hecho ha sido sentida por las Compañías Petroleras que operan en esa región. El Río Orinoco atraviesa de oeste a este el territorio venezolano, es navegable por grandes embarcaciones por más de mil kilometros y desemboca en el Oceáno Atlántico. Por otra parte, el actual systema de carreteras de la Republica está siendo aumentado y elaborado y el gobierno venezolano contempla la construcción del Ferrocarril de Los Llanos que conectará el sur con el norte del país. La explotación de los bosques del sur justificará, en parte, la construcción de este ferrocarril, pudiendo ser una de las principales actividades de éste el transporte de productos forestales, particularmente maderas, para uso doméstico. Los bosques, a su vez, podrán suministrar al ferrocarril las traviesas o durmientes y demás material forestal que su construcción y mantenimiento requerirán. Otra ventaja que presenta Venezuela es su magnífica situación financiera, única en la América Latina.

Política Forestal Que Debiera Seguirse

Debido a que las vías de comunicación son todavía insuficientes, a que el país no cuenta con un personal forestal debidamente entrenado, a que la mayoría de los productos forestales son desconocidos en el mercado mundial y a que el público no está acostumbrado a estos productos, la política forestal que en mi concepto debiera seguirse, debe perseguir ante todo el remedio de estas deficiencias.

La mayor parte y los mejores bosques venezolanos pertenecen a la nación. Esta puede darse el lujo de invertir considerables sumas de dinero en ellos sin esperar inmediata retribución. Puede aguardar a que esos bosques sean estudiados y su riqueza determinada, y a que los productos forestales sean debidamente ofrecidos al mercado internacional antes de someterlos a una explotación intensa. Indudablemente que una explotación inmediata conduciría a una selección despilfarradora.

A mi modo de entender, sólo existe un plan estratégico de ataque que comprende dos operaciones principales, a saber:

(1) Defensiva.- Restringir la explotación de maderas en los bosques nacionales hasta tanto no se elaboren planes técnicamente orientados y leyes acordes que regulen dicha explotación. Intensificar la conservación de los bosques protectores.

(2) Ofensiva.- Dar a la Ciencia Forestal en su acepción moderna, el puesto de preferencia que le corresponde en el país. Para ello es necesario

crear un Instituto Forestal que comprenda: (a) Una Escuela Técnica Forestal, y (b) Una Escuela de Guardería Forestal. De esta manera podría emprenderse el estudio de los bosques comerciales. Con el tiempo este Instituto podría ampliarse y ser elevado a la categoría de Instituto de Conservación que incluiría el estudio de la fauna así como el de la flora y problemas relacionados.

Summary

Two major factors constitute the platform upon which any national economy rests, namely, the human element and the natural resources. Both are important and a perfect correlation of the two constitutes the ideal economic status. The natural resources may be divided into three broad classifications: land, water, and climate. Again, the land resources may be subdivided, as follows: 1. Mineral kingdom - minerals, 2. Plant kingdom - food products and forest products, and 3. Animal kingdom - animals and animal products.

The mineral resources are, in general, a transitory factor in the economy of any nation because their supply is limited. On the other hand, the plant and animal resources are renewable. The forests in particular may be reproduced through the collaboration of man with the natural forces.

Venezuela contributes very little at present to the world's timber requirements. However, if and when a wood-hungry world turns to the tropics, the forests of tropical America and especially those of the Caribbean region will play a leading role, at least from the standpoint of the United States. Among these forests of the Caribbean region, those of Venezuela are probably the richest in resources and a sound national forest policy may very well add a great source of income to future Venezuelan economy.

THE USE OF GEOMETRIC FIGURES IN ECOLOGICAL DESCRIPTION

I. T. Sanderson, B.A. (Cantab.) F.L.S.

The recent attempt to correlate the nomenclature of tropical vegetation types by Burtt Davy (1938, Imp. For. Inst., Oxford, Paper No. 13), and the introduction by Huxley (1938, Nature 142,219) of the conception of "clines" into taxonomic zoology, have provided a great stimulus to ecological field work in botany and zoology respectively.

There is, moreover, a very close linkage of clinal variation in animal groups to the zoning and/or local distribution of plant formations and their included associations. This linkage may in fact prove to be complete and the origin of clinal variation in land animals be found to be entirely dependent upon the progressive spread, evolution, and differentiation of vegetation types.

Much plant variation is itself demonstrably clinal in character, being in a like manner closely linked with such factors as the zoning of soil facies, rainfall, humidity, temperature and altitude, geographically with latitude, etc. Exact and detailed information recorded in the field upon the incidence and distribution of any one of these groups of related factors will therefore assist in the elucidation of the others provided their close linkage has been demonstrated and proved.

The recording of ecological data is at present sadly lacking in cohesion. Local disturbances of fauna and flora are noted, rehabilitation successions worked out, and isolated clinal variations mapped but the observations are seldom integrated. A complete picture of universal trends, preferences, and possibilities is neglected. In short the accumulation of records is not systematized, more especially in zoology.

In describing the biological ecology of a given area both as a theoretical guide prior to observation in the field and as a subsequest framework upon which to classify, integrate and describe factual findings, a somewhat precise empirical method has been devised. This has now been in use both in the field and in subsequent laboratory analysis for some time.

The essence of this method is the use of Geometric Figures as descriptive diagrams. The exact form of these figures depends primarily upon the number of counteractive factors that are required to be taken into account. Their object is to obviate the overlooking of possible combinations of factors which would provide environmental conditions or circumstances of an obscure nature.

As a result of the adoption of this practice, it has been found that there is a basic octagon wherein the interrelations of the three fundamental counteractive forces affecting animal life are displayed in their entirety. This appears to underly the whole of biological variation and, being a simple example, may serve to demonstrate the whole method.

In fig. 1 degree of light, temperature, and humidity are combined in such a way that all possible variations of their interaction may be included and, if so desired, be assigned a mathematically precise definition. Thus, if each of the three planes be calibrated, any degree of say cold-wet-darkness may be read off as C.3-W.10-D.2, commencing from the absolutely neutral intersection of the planes. Normal methods of temperature, humidity, and light intensity may then be substituted.

Proceeding from this point it will be discovered that the differentiation of the surface of the earth into major climatic zones may be expressed exactly by this method, certain of the factors being combined. It is, however, primarily essential to discover the particular combinations of the axes and then to orientate the resultant figures to coincide. If this is done all possible combinations may be read off and none will be excluded.

It will be found that in the polar regions when the temperature and humidity axes are combined, the dry-cold and wet-hot "poles" coincide whereas in the tropics the dry-hot and wet-cold do so. (Fig. II.)

Further, when two basic factors are thus combined, place is found for the inception of a new factor -axis x-y- in the picture, or conversely, the figure may be employed to demonstrate more completely intermediate conditions combined with trends and possibilities in cases of change or alteration.

Taking the word "damp" to mean 50 percent humid with a tendency to "dry", "moist" to be "50 percent humid" with a tendency to "wet", "cool" as to mean between hot and cold with a tendency to "cold", and "warm" as to mean between hot and cold with a tendency to hot, fig. III may be constructed for the tropics.

Upon this the remaining basic factor (i.e., light) may be imposed, but here it will be found that it is not possible to superimpose all the axes if a true picture of natural environmental conditions be aimed at. Also, the intermediate position in nature between maximum light intensity and total darkness may not only be expressed as half-light with a tendency either to more or to less light; it may also be of two other principal types, i.e., diffused or filtered (as through water), or broken half-light (as in shadows). These are the more effective factors regulating animal differentiation.

The octagon may therefore be empirically constructed as in fig. IV. Herein it will be observed that certain possibilities of combination are totally excluded, thus in the arctic, wet-hot-broken-light is absent; in the tropics, wet-cold-broken. If they do occur, they will only be relative to the surroundings and not to the complete geographical environment. The reason for this becomes plain if the hypothesis is pursued.

The apices of these octagons represent a number of possible environmental conditions. Moreover, they represent actuality insomuch as we may choose to select the three factors of light, heat and humidity to define them. Such conditions should therefore be recognizable in nature.

Many, if not all of them, are so, but in arranging them empirically to suit this mathematical representation of their incidence, several facts of prime importance to ecology and the description thereof come to light.

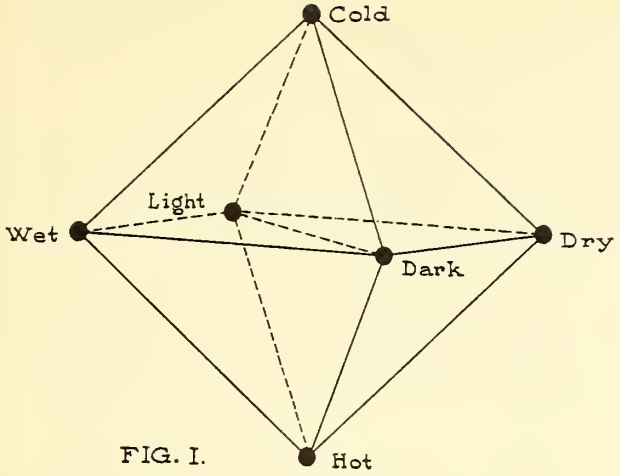


FIG. I.

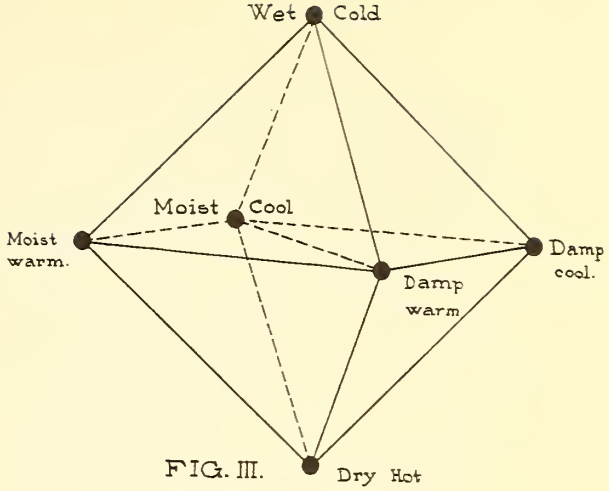
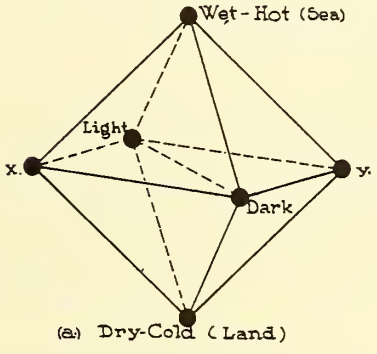
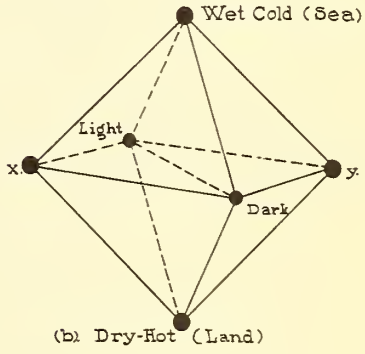


FIG. III.

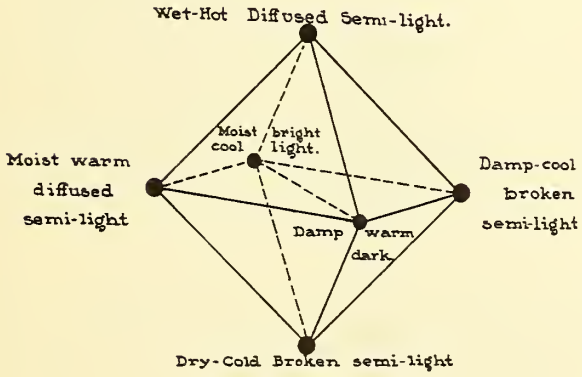


(a) Dry-Cold (Land)

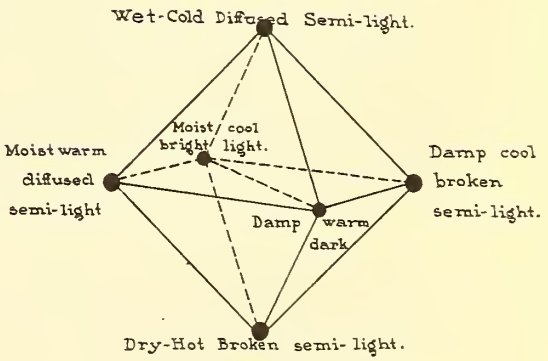


(b) Dry-Hot (Land)

FIG. II.



(a) Arctic.



(b) Tropic.

FIG. IV.

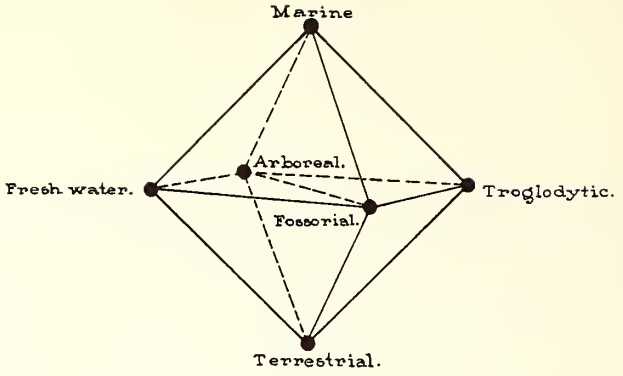


FIG. V.

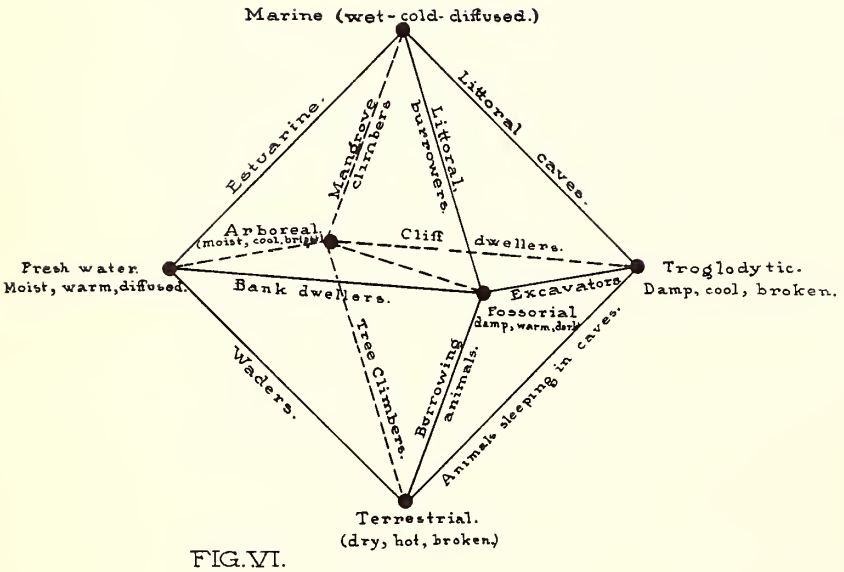


FIG. VI.

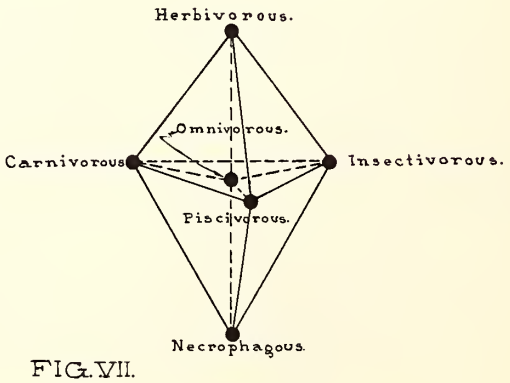


FIG. VII.

If animal and/or plant life be taken to represent an axis with polar extremes represented by submarine and terrestrial facies, various geometric representations may be built up solely dependent upon the number of related counteractive sets of qualifications that are taken into account.

Thus, for animal life a radial specialization of habitat may be singled out as in Fig. V. (Herein the incidence of animal parasitism is excluded altogether or taken as being included in the other types—endoparasitism as "fossorial" or "freshwater" according to the life histories and phylogeny of the type; ectoparasitism as exemplified by the habitat of the host.)

This diagrammatic representation of animal specialization in habitat may be fitted onto the octagon for micro-climatic environmental conditions—either tropic or arctic. From this combined figure, moreover, clines may be read off as shown in Fig. VI.

Here may be found all types of animal life both catholic and specialized and a place may be assigned to any intermediate types combining preferences for two or more habitats either perpetually (e.g., mangrove crabs), seasonally (e.g., squirrels breeding in holes) or temporarily (e.g., Parasol Ants which are terrestra-arboreal by night, fossoria-troglodytic by day). Furthermore, there are no other habitats possible, since, for instance, no animal is known to complete its life-cycle and live perpetually in the air.

The fact of primary importance to ecological description is that, if the marine condition is a corollary to the terrestrial as it must be in the tropical climatic environment, while arboreal is the obvious antithesis of a purely subterranean existence, the freshwater must be opposed to the troglodytic. That this is so insofar as their micro-climates are concerned with opposed types of semi-light and precipitation due to the dampening-warming effect of the one, the moistening-cooling effect of the other, is clearly demonstrable.

In studying the distribution of a clinal variation of a species or group, more relevant facts become apparent if the method described be employed. If a species be studied that leads a purely cursorial terrestrial life far from the sea, it will probably display characters suitable to the retention of body moisture, colours for the reflection of heat, and markings suitable to broken light of medium intensities. As this species is followed to river banks or lake sides, it will meet with moister, cooler conditions though the light will remain little altered unless it adopt a purely aquatic life there. Its characters might be expected to (and in many cases which have been investigated, have proved to) alter accordingly. Should its range approach the sea, more drastic changes will become apparent. The latter instance is well known to animal taxonomists.

It would be interesting to know to what extent vegetation types or/and the variations of individual plant species may be synchronized and explained upon these principles. In the few instances that botanical clines have been studied by us during zoological surveys, major and minor clinal variation among animals and plants appeared to march hand in hand.

The greatest use of the figure combining habitat, light, temperature, and humidity has been displayed in guiding field work. Herein a prior knowledge of the fundamental reasons for which any particular animal has sought and taken up residence in an unusual environment has time and time again led both to a rational explanation of its morphological variations and, conversely, to an elucidation of breaks or lacunae in its distribution.

The use of geometric designs is very widely applicable. Thus, the food-enemy relationship of animal ecology may be expressed by a sexagon, fig. VII. From this figure all types of food preferences may be read off. Changes in diet due either to natural or other causes—i.e., the alteration of associated types through change of vegetation—may be followed. The human species may have originated as a type at the herbivorous apex, thence moved towards the necrophagous and subsequently been deflected to the omnivorous of modern civilized man via the piscivorous or even carnivorous apex. At the present time, the food preference of Europeans is perhaps tending towards the herbivorous once again.

The colouration of animals is often closely linked to environmental factors, i.e., green arboreal, yellow desert, black riverain, etc. An octagon for colour is already in common usage, wherein maximum light (white) and total absence of light (black) form one axis with neutral grey holding a median position; the other planes having green and red, blue and yellow apices respectively. It seems possible that this may be fitted upon fig. VI in determining the possibilities of basic colouration in animals. The necessity for superimposing arboreal and green, blue and marine, and the well-recognized melanistic tendency of the riverain habitat makes the matter one of considerable complexity, calling for a considerable amount of research. It is possible that various (as yet undetermined) groups of animals require the association of specific axes. The two figures have been found to be combined as follows for the description of reptilian colouration: White-troglodytic; green-arboreal; red-fossorial; yellow-terrestrial; black-freshwater (or riverain) blue-marine.

The method at present under review, however, is not designed as an hypothesis to explain the incidence of colour variation nor the selection of habitat, nor does it purport to be a graphic exemplification of natural laws. It is designed primarily as an empirical guide to the recording of ecological facts and as an aid to the understanding of interplay between habitat and other variations.

It is felt that the method may prove useful to ecologists, especially foresters who are so constantly faced with marked distributional changes in vegetation which are dependent upon a number of reciprocal factors. At the same time it may serve to focus attention upon the very close linkage between the distribution and minute variation of floras and faunas.

Previous work of our own (Sanderson: P.Z.S. 1936, and Trans. Zool. Soc. Lond. Vol. IV (in press)) has shown the dependence of fauna upon the distribution of vegetation types. Work at present in progress is partically designed to show the use of animal indicators for preliminary spotting of vegetation types.

In describing the ecology of a given area, it is essential to know all the possible environments created by the interplay of a given number of

factors. It is better that the list of possibilities is mathematically exhausted at the outset, lest unusual phenomena be overlooked or misinterpreted in the field.

Summary

Davy's nomenclature of tropical vegetation types and Huxley's conception of "clines" in taxonomic zoology have provided a great stimulus to ecological field work. There is a close linkage of clinal variation in animal groups with vegetation, and in the case of land animals this may prove to be entirely dependent upon the progressive spread, evolution and differentiation of vegetation types. It may be found eventually that animal indicators may be used for the preliminary spotting of vegetation types.

However, present recording of ecological data lacks cohesion, and complete integrated pictures are not obtained. The use of geometric figures with opposite axes representing counteracting factors, the combination of related axes by rotation, with addition of other factors, permits the representation of environmental conditions, precise mathematical definition of intermediate points, and obviates the possibility of overlooking some environment of an obscure nature. The method, which should prove useful to foresters, is designed primarily as an empirical guide to the recording of ecological facts and as an aid to the understanding of interplay between habitat and other variations.

Resumen

La nomenclatura de Davy sobre los tipos de vegetación tropical y la concepción de Huxley sobre los "clines" en la zoología taxonómica han estimulado grandemente el trabajo ecológico de campo. Hay una estrecha relación entre la variación clinal en los grupos animales y la vegetación. En el caso de animales de tierra puede ser que dependa totalmente de la diseminación progresiva, evolución y diferenciación de tipos de vegetación. Eventualmente, puede ser que los animales sean usados como índices preliminares para señalar los tipos de vegetación.

Sin embargo, el registro de datos ecológicos de hoy día carece de cohesión por lo cual no se pueden obtener cuadros completos e integrados. El uso de figuras geométricas con ejes opuestos que representan factores contrarios, y la combinación de ejes afines por medio de rotación, con la adición de otros factores, permite la representación de condiciones ambientales, la definición matemática precisa de puntos intermedios, y además elimina la posibilidad de pasar inadvertidamente cualquier medio ambiente de carácter indefinido. El método, que debe ser útil a los silvicultores queda diseñado primordialmente como una guía empírica para el registro de hechos ecológicos y como una ayuda para la mayor comprensión de la interacción entre la localidad y otras variaciones.

Schiller Nicolas, Service Technique

Even though unorganized and systematically preyed upon by blind human agencies, the forests of Haiti have contributed tremendously to our past and present economic needs in addition to their beneficial climatic and hydrographic influences. No statistical or descriptive literature of any value exists to give us an idea of the approximate quantitative and qualitative utilization of woods from colonial times up to the present. We do know that considerable quantities of our valuable woods were employed for maritime, residential, and furniture construction. Some of these, such as chÿole, mahogany, laurel, West-Indian oak, satin-wood, fustic, and ebony, were exported to a certain extent, while the dyewoods and lignum-vitae were the objects of a regular and important trade with the metropolis and other countries. During the Haitian period, up to 1938-39, logwood and lignum-vitae have been the two capital forest-export products but trustworthy statistics can be obtained for only the years since 1920.

Between 1920 and 1938, the average annual export of logwood amounted to 26,386,560 kilos. Previous to the American occupation, the amount shipped was much greater and of excellent quality, and as Haiti was the largest exporter of the western hemisphere from the time of the French occupation up to recent years, it is easily surmised that the stands of this species were very extensive. The wanton cutting without replacement has so depleted it that we are now far back in the list of exporters. What is left and readily accessible consists of second-growth, irregular, knotty, fluted logs, very much depreciated in value on the markets. From an original, thick stand of about 350,000 to 400,000 has., there remains in Haiti approximately 90,000 has., of which a good portion is inaccessible.

Lignum-vitae has had a worse fate, although its range comprised all of the semi-arid valleys and plateaus of Haiti. Its slow natural regeneration and the uncontrolled grazing of cattle have favored its more appalling exhaustion. From a total of 5,537,000 kilos in 1920-21, exports have fallen to 229,296 kilos in 1937-38. It is presumed that exports will continue to drop off, since the logs of 10-12" girth which are required by the markets are practically unobtainable, except for a limited quantity in rugged, inaccessible places. The difficulty of transportation has been the only factor to prevent its complete extinction.

Mahogany and cedar have no actual commercial importance as they are found only individually and very scattered. The central mesas and the island of La Tortue did bear rather extensive stands, often in association with logwood, but the few trees remaining which are used for local furniture are young and comprised largely of sapwood.

As for the other precious woods, such as West-Indian oak, fustic, tavernon (Lysiloma latisilique), satin-wood, ebony, acomas (Sideroxylon),

prunus, bayrhum, and crabwood (Gymnanthes lucida), their commercial value is limited and strictly local, due to the small volume to be found.

In addition, Haiti, which previously had a bountiful supply of fence-posts, beams, poles, cross ties, and fuelwood, has been experiencing an incredible shortage of these items. In fact, there are many districts where the natural stands have been so abusively depredated that the local population is undergoing real hardship, being obliged either to cut down immature trees whose timber is easily damaged by borers and termites or to pay costly transportation in order to obtain better material. Owing to the use of immature wood, the insect and weather damage, and the lack of use of any preservative, the consumption of building and fencing materials is disproportionately squanderous. The visualization of the tragedy is more dreadful when one recalls that the downtrend is cumulative owing to recurrent damages by fires, unrestricted grazing, and no replanting.

The only forest stands in the coastal flats which have not been devastated are the mangrove swamps and this is chiefly due to the small development of the tanning industry.

The pine stands constitute our forest resource of greatest potentiality, not only as a business proposition but also as a modifying climatic factor in a country where damage due to floods, droughts, and winds annually exceeds the million mark. Although more than three-fourths of its original stands have been displaced by agriculture or destroyed by fire, especially at lower altitudes, this species, Pinus occidentalis, still occurs in fairly dense stands over some 300 square miles. This total area is located in four distinct forests, as follows: a little-known, inaccessible area in the southern peninsula at elevations from 1,200 to 2,500 m. above sea level, an area of 212 square miles in the eastern center of Haiti at altitudes ranging from 450 to 1,200 m., a small area, not surveyed, near a road in the north center of Haiti, at elevations of 300 to 900 m., and an area of 40 square miles, southeast of Port-au-Prince and accessible by car at high altitudes, between 1,300 and 2,500 m. All except the first area, where the precipitation is abundant, may be classified as semi-arid. They receive from 1,300 to 1,700 mm. of rainfall annually with a definite dry spell in the winter and a wet season interrupted by short droughts during the spring, summer, and autumn. The volume of these forests is estimated conservatively at 350 million board feet.

Haiti imports annually an average of 3,820,500 cu. ft. of low-grade construction wood which is sold here at 6 cents per board foot. Average yearly imports of turpentine reach 42,000 pounds, which is sold on the local market at $1.50 per gallon. Annual imports of rosin average 269,000 lbs., which brings a price of 10 cents per pound. The total drain of these various importations could be stopped easily in a short time and Haiti even could become an exporter of these items.

The trouble with Haiti is that political policies have never been based on examination, study, and consideration of the natural economy of the country. In colonial times, when the population was less than one-sixth of the present and better agricultural practices as well as more appropriate land use were the rule, Haiti was the "pearl" of the West Indies. As a matter of fact, the

topography, the climate, and the nature of the soils make the forests the palladium of this country. More than 50 percent of the mountainous areas which have been shifted to agriculture never should have been cleared because of the aridity of the climate, or the superficiality of the soils and their scanty supply of organic matter. In the semi-arid valleys where a substantial living can be obtained without irrigation, more than 30 percent of the land should have been left in forest. In both the mountains and valleys, cattle raising and wood industries could have furnished millions of man-days of labor instead of the contrasting pitiful sights, which greet the traveler, of thousands of abandoned farms resulting from the exodus to cities and neighboring countries. The regulation of local climate and waterflow, and the control of floods through the influence of forest stands, would insure a prosperous agriculture in the valleys and on appropriate hillsides.

About two-thirds of the territory is hilly and semi-arid, being swept by dry, permanent trade winds during the winter months. In the valleys and savannas, where scarcely 15 percent of the area enjoys a humid climate, farming, without irrigation and with the primitive tools and knowledge at the disposal of our rural communities, leads to exhaustion of the soils. Discriminate land use is a crucial problem for Haiti, as Nature clearly demonstrates that very little area is appropriate for permanent agriculture and cultivated crops, and that the conservation of soil and water as well as protection from wind can be secured only through the maintenance of a greater portion of the territory in forests.

The proper adjustment of our economic and social structure to a proper use of our lands will inevitably bring about great changes in our political system and land tenure, but it must not be delayed, as the alkalinization of the valleys and the approach to a desert climax on the hills and in the valleys are tending to stifle any dreamed-of progress.

Resumen

A pesar de la falta de organización que ha predominado en tiempos pasados, los bosques de Haití han contribuído notablemente a la economía del país, además de ejercer una influencia bienhechora sobre el clima y las aguas. La exportación de campeche, guayacán, y otras maderas preciosas ha constituído una fuente estimable de ingreso. Sin embargo, posteriormente la exportación ha disminuido grandemente y algunas secciones del país han comenzado a resentir la falta de maderas de construcción.

La exportación desmedida de las angiospermas deja a los pinares como el único recurso forestal de gran importancia. Estos pinares, explotados cientificamente, podrían suplir al país de madera y productos resinosos que hasta ahora ha venido importando.

El uso apropiado de la tierra exige imperiosamente la repoblación de los terrenos forestales que han sido invadidos por la agricultura. Es necesario devolver a los bosques al sitio que les corresponde en el cuadro económico del país.

SOME NOTES ON FOREST ENTOMOLOGY

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The Spanish Elm Lacewing Bug

During the winter months of this year, a heavy infestation of the Spanish elm lacewing bug, Monanthia monotropidia Stal, was noticed on Spanish elms or "capá prieto" trees, Cerdana alliodora R. & P. = (Cordia Gerascanthus Jacq.) at Cayey and Salinas both at sea level and at high altitudes. Monanthia monotropidia Stal (Tingididae, Hemiptera), a small, dark brown tingid, was reported for the first time in Puerto Rico by Mr. F. Sein, of this Station, as attacking, at Lares, a small tree, which was not identified. Nothing was heard again of the insect until now, when it appears as an important pest on one of our best forest trees.

A careful examination of the leaves of an infested tree shows small nymphs and sometimes adults, crawling on the undersides of the leaves and feeding on the plant juices. Such attack causes a chlorotic condition of the leaves and subsequent defoliation. Many trees in the infested areas had been completely defoliated owing to the intense attack and the immense quantity of nymphs and adults on the leaves.

The Bean Lacewing Bug

The bean lacewing bug, Corythuca gossypii Fabr., which has been reported in Puerto Rico on a large list of host plants, among them sword beans, castor beans, lima beans, lemons, oranges, soursops, etc., is now a pest of forest trees. In February 1939, an infestation of this insect on the undersides of the leaves of several West-Indian satin-wood or "aceitillo" trees (Zanthoxylum flavum Vahl.) was observed for the first time at the Cayey nurseries. The leaves were turning yellow and several weeks later they were shed. Later on, during July 1939, a heavy infestation of the insect was recorded on several young "aceitillo" trees at Santurce. The pest was more numerous than at Cayey and the attack, of course, more intense. The insect seems to persist, for when the old leaves were shed and new leaves appeared, the insect began to attack the trees a second time.

Upon examination of "aceitillo" trees at the Guánica Insular Forest, the same insect was noticed. Here, the damage was of no importance apparently, but nearly every tree was infested out of a group of 25 which were examined.

On March 10, 1940, the same insect was observed attacking "carubio" or yellow prickle trees, Zanthoxylum monophyllum (Lam.) P. Wilson, at Juana Diaz on the south coast and at Isabela on the northwestern coast of Puerto Rico. In both cases the attack was so severe that the leaves of the trees were completely chlorotic. At Isabela, several large trees of "espino rubial" (Zanthoxylum caribaeum Lam.) were infested by the tingid. No damage of considerable importance was noticed on this particular species of tree.

The Long Scale, Ichnaspis longirostris Signoret

Ichnaspis longirostris Signoret, which has quite a long list of host plants, has added one more to it. I refer to the Honduras mahogany (Swietenia macrophylla King). At El Verde (Caribbean National Forest) a large plantation of S. macrophylla is attacked by this scale. The parts of the trees mostly attacked are the lower branches and leaves. The scales are concentrated near the midribs and veins of the leaves. The result of the insect attack on the leaves is a heavy chlorosis and later on, defoliation. Some of the trees show defoliation of the lower branches.

The Mealybug, Pseudococcus nipae Maskell

Pseudococcus nipae Maskell is by far the worst pest of "anacaguitas" or Panama tree, Sterculia apetala (Jacq.) Karst., in many places on the island. S. apetala is planted extensively along the roadsides on the south coast. At Guánica, the mealybug is attacking large trees. The infestation is mostly on the undersides of the leaves, but also the branches and even the fruits are infested. In some cases, especially in large trees, the damage is not noticeable, but when the insect attacks young trees, sometimes these are killed. This case had been observed at Juana Diaz. At Salinas, also, large trees are heavily infested and young trees are nearly dead. Only in one instance, and this was at Ponce, were coccinelid beetles found attacking the coccids. These were: Hyperaspis apicalis Mulsant and Scymnillus nunenmacheri Sicard. These beetles were very abundant, the young larvae feeding voraciously on the mealybugs.

Years ago, in the area near Rio Piedras, P. nipae attacked "bucare" or "bucayo" trees, Erythrina glauca Willd., in such a way that year after year these trees were completely defoliated. Since the introduction to Puerto Rico of the lady-beetle, Cryptolaemus montrouzieri Mulsant, which feeds extensively on this coccid, the ravages of the pest have stopped and P. nipae still occurs on "bucayos" but now it is of no economic importance.

Resumen

El hemíptero, Monanthis monotropidia Stal, está alimentándose en los árboles de capá prieto, Cerdana alliodora R. & P., en las cercanías de Cayey y Salinas. El insecto es de gran importancia económica debido a la gran defoliación causada por la acumulación de ninfas y adultos en las hojas, los cuales chupan toda la clorófila.

C. gossypii Fabr. ha sido encontrado chupando la parte inferior de las hojas del aceitillo, Zanthoxylum flavum Vahl. El insecto causa defoliación. Este también ataca al "carubio", Zanthoxylum monophyllum (Lam.) P. Wilson, y al espino rubial, Zanthoxylum caribaeum Lam.

La gueresa larga, Ichnaspis longirostris Signoret, ataca en gran escala a la caoba de Honduras, Swietenia macrophylla King, en las plantaciones de El Verde (Bosque Nacional del Caribe). La chinche harinosa, Pseudococcus nipae Maskell, es un factor importante en el crecimiento de la anacaguitas, Sterculia apetala, en muchos sitios de la isla. La chinche destruye especialmente los árboles pequeños. Ataca también el bucare, Erythrina glauca Willd. Los coccinélidos, H. apicalis Mulsant, S. nunenmacheri Sicard y C. montrouzieri Mulsant, son predáceos en la chinche.

THE POSSIBILITY OF CLOSE COOPERATION FOR MUTUAL BENEFIT BETWEEN AGRICULTURE AND FORESTRY IN THE AMERICAN TROPICS

L. R. Holdridge, Associate Forester

The story of the reduction of Puerto Rican forests to their present remnants before the onslaughts of such destructive weapons of an increasing population as the uncontrolled ax and shifting agriculture is an account which is being repeated in many other parts of tropical America or which will come to be true unless proper steps are taken to protect existing forest resources by uniting the various forces in action into an appropriate program of land use. Protection alone without utilization would be purposeless and protection at the expense of growing agricultural needs of a nation would be misdirected purpose. The best solution should be found in due consideration by and for each other of the two main land uses—agriculture and forestry. Each country presents a distinct problem comprising many factors such as extent of forest areas, population pressure, other resources of the nation, types of agricultural crops, prevailing land-use practices, land policies, climate, and topography; but since the majority of the countries of this region are dependent on the use of the soil, it is easy to foresee that the future prosperity of the people depends upon successful formulation of a balanced land-use program. Agriculture and forestry will each attain their highest development by maintaining a symbiotic relationship with each other.

Undoubtedly, there are many who would point to the vast reaches of virgin forest on the continental land masses and scoff at the need for any alliance with agriculture to make of forestry a going enterprise in those countries blessed with extensive forests. True enough, there can be no doubt about the extensiveness of the mixed tropical forest in the western hemisphere, estimates of which run into millions of acres. Why then has there been such a definite lag in the development of tropical American forestry, if, as we know very well, thriving communities existed in this region long before the first log cabins were erected within the boundaries of the United States? Based on years of personal experience in tropical forestry and extensive travel in both hemispheres, Major Oliphant[1/] has very adequately attributed the backwardness of tropical-forestry development to the following four factors:

1. Wood is a commodity of low value per bulk and only high-priced woods can bear transportation costs to distant markets.
2. Virgin tropical forests contain a much lower percentage of high-grade wood than those of temperate zones.
3. Local demand is small per capita.
4. Technical backwardness in utilization and transport.

The truth of the first factor may readily be checked by a consideration of the number of tropical American timbers which are presented for sale in northern markets. Only a very few species are well known and this fact is still more striking if considered in the light of the immense number of tree species existent in tropical regions. As an example of this complexity of flora, the island of Puerto Rico, which is roughly 105 miles long by 35 miles wide, contains over 500 native tree species.

1/ Oliphant, J. N., Director, Imperial Forestry Institute. The Development of More Intensive Use of Mixed Tropical Forest. Empire Forestry Journal 16 (1). 1937.

Among this great number of species, we find many more producing timber of high value in the forest than in northern markets, but, nevertheless, the majority of the individual trees to be found in virgin forests are of little value, even when close to a market. Silvicultural operations to convert a virgin stand of this nature into one more similar to those of temperate regions is possible, but is being carried out in very few places in the American tropics. The widespread system of culling forests of the better species, followed by invasion of weed species, always results in an inferior forest, and one with which it is very difficult to carry on silvicultural operations without large expenditures. Oliphant says of this, "One of the most difficult problems of tropical forestry is that of securing release from interests vested in selective exploitation, so that this tragedy of misuse may be brought to an end, a process that must of necessity be very gradual." Although the necessity for discontinuing such culling of the forests is perfectly obvious, it is extremely doubtful that such can be obtained on any considerable area, unless a rapid realization occurs on the part of the officials of the various countries represented.

The third factor of the small per-capita local demand is readily appreciated when one considers the large class of poor people in the tropics who have little need for and less money to purchase timber or wood products. Also, the climate combines with poverty in obviating necessity for wood consumption. Shelter can be provided with a thatching of grasses or other nontimber material over a framework of small poles, and firewood can be obtained from brush if larger material is not available. Since illiteracy is common, products from wood pulp, such as newsprint or paper, are relatively low and it is doubtful that the general per-capita consumption will be greatly increased in the near future. As a matter of fact, other materials such as concrete and sheet iron are giving strong competition with wood products right up to the edge of the forest.

The last factor, that of technical backwardness in utilization and transport, ties in closely with the first and second factors. Naturally, with a low percentage of high-grade woods per unit area, it is impractical to establish expensive systems of transportation. Along with this go such factors as the difficult topography encountered in so many sections of the tropics, the heaviness of the wood of many species which makes water transportation impossible, and the great distance by steamer to northern markets. As for utilization, local markets are often well informed by experience as to the relative values and uses of a great many species occurring in the surrounding forests, but, as far as northern markets are concerned, very little progress has been made in the introduction of other than a few already well-known species. The task of making requisite studies of utilization and introducing a new species to an always doubtful public is rather heavy for any private corporation to undertake, and leadership by governmental agencies of either the importing or exporting countries is necessary to establish such a product on a steady market.

Now that we have considered a few of the reasons which tend to retard the growth of tropical forestry, let us turn to a brief consideration of tropical agriculture. For a great many generations, the raising of food crops has been a going concern in the American tropics and the extent of land surface worked over for this purpose is still expanding due to two factors: the increase in population and the search for newer and better soils. As we have already noted, the per-capita consumption of wood is very low in the tropics, but the consumption

of food, based as it is on more essential requirements, cannot be varied to any great extent no matter where the individual is located. Therefore, agriculture is relatively much more important to the poor man here than in the north, since shelter is easily provided, clothing requirements are fewer, and food stands out as the most important of needs. Thus, a predominantly rural population may go on increasing and spreading over the land area of a tropical country without any apparent change in its status.

This process, providing as it does an adequate labor supply for the support of the upper levels of society of the country, seems like a perfectly healthy growth until a point is reached where new and fertile soils for agricultural expansion are not available. At about this same time, concurrent with their increasing scarcity, comes a realization of the importance of forest resources. But, because second-growth forests can still supply the essential wood requirements, even though of poorer quality, the main feeling of loss probably is connected with the remembrance of the fertile soils which were made available by the felling of virgin forests. From that point on, the depreciation of soils, diminishing of forest resources, and lowering of living standards of the people go hand in hand and the money and energy which must then be expended by the government to bring about a stable land-use program is out of all proportion to that which would have been necessary if sufficient foresight had brought about proper action in previous years.

One could contradict such dire predictions by referring to the fact that foresters of the United States of America have been pointing out for decades a rapid local exhaustion of timber supplies and yet their sawmills still go on cutting at the same rapid pace. However, regardless of whether or not that country is approaching a timber shortage, the two cases are not exactly comparable because in the United States the forests were felled mainly for the production of timber whereas in the tropics the greatest force acting against the forest seems to be that of shifting agriculture, a system which makes little use of the timber supplies felled and which adds little or nothing to the permanent prosperity of the country. There is another difference too in the rapid increase in population in tropical countries where health standards are raised.

The sketching of this brief and rough picture of land use is not intended as a prophecy of soil deterioration and timber shortages of nations but rather as an attempt to point out the role that forestry may play in the economy of tropical countries. As distinct from the prime emphasis on timber production in temperate zones, forestry in the tropics may well find itself concerned chiefly with the problem of amelioration of soils which have become "worn out" by too consistent agricultural use.

True enough, there are vast areas of fertile lowlands, either with abundant water or potentially irrigable, which are now or will be dedicated to prosperous, permanent, and continuous agricultural use. On the other hand, there are extensive areas of high mountain forests, arid or swampy woodlands, and other areas too rocky for either cultivation or grazing which will fall naturally into a classification of permanent forest sections. Between these two distinctly demarcated zones stretches a vast intermediate zone, usually comprising the major part of the country. This zone cannot support continuous cultivation without deterioration because of the nature of the soils, the topography, and the climate; also, because of its extent and under pressure of population, it cannot serve its highest purpose by dedication to permanent forestry.

This is the zone where land-use evils first come into focus, where the farmers recall the "good old days" of fertile soils, the soil expert frowns at the soil erosion in progress, the forester points out the felling of the forests as the source of the evil, and most all unite in pointing at the system of "conuco" or shifting agriculture as a prime evil which must be abolished at all costs.

But the tiller of the soil has no evil intentions in the back of his mind while sweating at the repeated, arduous task of clearing and breaking up new ground. His purpose of providing food for himself and his family is a most honorable one, and his ancestors found out in the long-distant past that this was the most practical system of agriculture for such a zone. In new, rich country, the garden patch may be abandoned because of the invasion of grasses and weeds, but where population becomes dense, erosion and leaching of the soil are the reasons which cause him to turn to a new clearing; and this may now be to the site of a previous clearing where, following abandonment, grasses and lush herbaceous growth thrived, to be invaded later by brush and then by weed-tree species, so that, when he does return, he finds the soil considerably built up through the process of Nature's tending. Doesn't Nature herself, then, point out the obvious practice of an alternation of field crops with a forest crop as the most practical method to follow within this zone? Such procedure would require no radical change in a cultural system built up through many generations and it would seem to offer a definite advantage to the cultivator to find ready for clearing, not a patch of brush and weed-tree species, but a real, planned forest crop convertible into cash.

The agricultural scientist is striving along many angles to work out the maintenance of soil fertility in this zone, yet allows Nature to sow haphazardly the woody species which help to build back the soil in abandoned fields. On the other hand, the forester is already using, in several places, intercultivation with agricultural crops as the most practical and least expensive of methods for establishing forest plantations. When will these two workers, from two sciences rooted in the soil, get together and work out a real program of land use which will benefit mutually their respective fields and the people of their country in general?

Thus, the agriculturist can go a long way towards solving his soil problems, can assure for his farm an adequate supply of construction timbers, fence posts, and firewood, and add an additional cash crop to his produce. The forester can overcome those factors which were listed early in the paper as retarding the development of tropical forestry, by producing stands with a large percentage of high-grade woods, sufficient to supply local needs and also to insure northern markets of a continuous supply of first-quality woods which could be transported readily over the same routes which agriculture uses.

The breadth of the problem involved in this paper is too great to allow for more than the rough outline presented, and details of application would necessarily be different for each locality with its correspondingly distinct set of local factors. In Puerto Rico some progress is being made along this line which will be described in later articles. It would be extremely interesting to learn of any similar work in progress in other countries.

Summary

Major Oliphant has attributed the lag in tropical-forestry development to the following factors:

1. Wood is a commodity of low value per bulk and only high-priced woods can bear transportation costs to distant markets.
2. Virgin tropical forests contain a much lower percentage of high-grade woods than those of temperate zones.
3. Local demand is small per capita.
4. Technical backwardness in utilization and transport.

The other great land use, agriculture, thrives within a nation until population pressure and deterioration of the soil begin to exert their depressing effects on the living standards of the people.

It is suggested that the agriculturist and the forester unite their efforts within that zone between permanent agricultural and forestry lands and change the system of shifting agriculture to one of alternations of agricultural and forest crops for the mutual benefit of the country through such development of a more balanced land-use program.

Resumen

El Comandante Oliphant ha atribuido lo rezagado de la silvicultura tropical a los factores siguientes:

1. La madera es una comodidad de valor bajo por volumen y solamente las maderas de precio alto pueden soportar el costo de transporte a los mercados lejanos.
2. Los bosques vírgenes tropicales contienen un percentaje mucho más bajo de maderas de alto grado que los de las zonas templadas.
3. La demanda local es poca por cabeza.
4. La torpeza técnica en la utilización y el transporte.

El otro uso grande de la tierra, la agricultura, prospera en una nación hasta que la presión de población y el deterioro del suelo empiezan a ejercer sus efectos deprimentes sobre las normas de vivir de la gente.

Se sugiere que el agricultor y el silvicultor unan sus esfuerzos dentro de la zona de las tierras agrícolas y forestales permanentes y reemplazen el sistema de agricultura cambiante a uno de alternaciones de cosechas agrícolas y forestales para el beneficio mutuo del país con tal desarrollo de un programa más balanceado en el uso de la tierra.


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ATLANTIC OCEAN

THE CARIBBEAN FORESTER

It is my pride and joy to be the shepherd of my country's trees.

TROPICAL FOREST EXPERIMENT STATION,
UNITED STATES FOREST SERVICE,
RIO PIEDRAS, PUERTO RICO

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THE CARIBBEAN FORESTER

This journal is planned as a medium of exchange of knowledge between those interested in forestry in the islands and countries in or near the Caribbean Sea. Invitations to cooperate in this project have been sent to forestry and agricultural officials in the following places:

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It is planned to present this journal quarterly. Material for publication should be submitted at least two months before publication date and be addressed to the Director, Tropical Forest Experiment Station, Rio Piedras, Puerto Rico.

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A LIST OF WOODS ARRANGED ACCORDING TO THEIR RESISTANCE TO THE ATTACK OF THE "POLILLA", THE DRY-WOOD TERMITE OF THE WEST INDIES, CRYPTOTERMES BREVIS WALKER

George N. Wolcott, Entomologist
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"The Comparative Resistance of Woods to the Attack of the Termite, Cryptotermes brevis Walker", Bulletin No. 33 of this Station, was published in August 1924 and has long been out of print. Aside from practical experience, however, up to the present time it has remained the only guide available to the local public to aid in the selection of woods for furniture or in building which would prove resistant to this common dry-wood termite, the "polilla" of Puerto Rico. The former paper, and this present paper, are concerned with the results of tests conducted with only this one species of termite, the "polilla de madera" or the common dry-wood termite of the West Indies, Cryptotermes brevis Walker. This termite occurs throughout the West Indies and in the tropical parts of Mexico, Central America, and northern South America, but in the United States it is found only in the extreme southern tip of Florida. The results do not and cannot apply, therefore, to termites and termite control in the United States generally, or even to other kinds of termites in the West Indies. They should be considered, however, by manufacturers of furniture in the United States, or elsewhere, producing for sale in the American tropics, and most especially by manufacturers of radio cabinets, which are especially susceptible to termite attack because of their internal illumination when in use.

The seriousness of the threat of this insidious enemy of woods in Puerto Rico (and of the neo-tropics in general) is well shown by the scarcity of old buildings here, or even of old furniture, unless of mahogany or some other native hardwood practically immune to its attack. The damage caused by hurricanes is increased immensely by the structural weakness of timbers in polilla-infested buildings, and the ease with which roofs of zinc sheets are loosened and blown about is largely due to the inability of fastenings to hold to rafters hollowed out by termites. The polilla is no respecter of the property rights of man, or of the architectural impressiveness to us of a large building. If it contains furniture or structural members of a wood subject to attack, sooner or later such furniture or wooden members will be destroyed by termites. Lights left burning inside during late spring, when dispersion flights of the adults occur, or mere proximity to old infested buildings at such a time, may result in extensive infestations in new buildings, only a few months old.

Aside from the use of concrete, metals, and glass in permanent construction, and of termite-proofing woods liable to be attacked, certain kinds of wood can be used for furniture or in construction which are practically or absolutely immune to termite attack. The ausubo and capá prieto beams recently removed from La Fortaleza, untouched by termites despite the hundreds of years they have been in use, is a pertinent recent example. The first cost of such woods is often more than of others suitable for the purpose but lacking this characteristic, but for permanence of construction or of furniture, the termite-immune wood will prove to be the cheapest in the end. For many uses, a wood which is at the most only

somewhat termite-resistant may seem to be entirely adequate, but eventually will be a bitter disappointment. Infestation is most likely to develop in furniture rarely used, or kept in storage, or when papers remain piled on it for months, or when partly covered with wicker, caning or rattan (see fig. 1) under any of which conditions the termites find an opportunity to burrow in, and once in, to penetrate to far distant parts.

The woods which are least resistant to termite attack can be used for construction only of the most temporary character, and hardly at all for furniture. It is the purpose of this investigation to list as many as possible of the common woods and some others of special interest in the order of their experimental resistance to "polilla" attack, so that a suitable selection may be made for any purpose in which this characteristic is important.

Methods.- Profiting by the experience gained in making the previous tests in 1923-24, those initiated in 1936 and continued to date made use only of samples of woods of unquestioned authenticity and authoritatively determined. To all persons furnishing the wood samples: Mr. George C. Morbeck of the Forest Products Laboratory at Madison, Wisconsin; Mr. Charles Z. Bates, Mr. George A. Gerhart, and Mr. Leslie R. Holdridge of the Forest Service at Rio Piedras, P. R.; Mr. B. R. Ellis, Secretary of the Southern Cypress Manufacturers' Association; and to the furniture makers at Rio Piedras, Port-au-Prince, Haiti, and at Belem, Pará, Brazil (the latter all checked with the large samples in the Industrial Museum at Belem), the writer is most grateful for their interested cooperation, and to those supplying furniture or timbers infested with termites, a seemingly humbler, but no less essential element in the experiments, he hereby expresses his even greater thanks.

All samples were carefully differentiated as to whether they were of sapwood or of heartwood. While some variation in the composition of sapwood may be due to the time of year at which the tree was cut, no significant variation due to this factor is to be expected in the case of the heartwood. In every wood tested, the sapwood is somewhat to very much more susceptible to termite attack than is the heartwood.

Whenever possible, the samples were an inch and a quarter long, an inch wide, and one-quarter of an inch thick. The exceptions were some of the cypress samples which could not be cut to this size, and being themselves immune to attack, were most useful in wedging into position the larger samples of other woods which might not exactly fit the container. Each selected sample must be of straight grain, without knothole, knot or other imperfection, and sandpapered on all sides until it offered no usual or exceptional point of attack by termites. To twelve such samples a number was assigned and punched into both sides, and to each of the twelve a different letter written on with India ink. All were weighed in immediate succession and two selected of most nearly the same weight, which were checked again by weighing against each other. Of these two, the one which weighed slightly more was used for the test, the other remained as check.

Petri dishes holding eight or nine such samples of different woods were used, the samples being tightly wedged into place and resting evenly on the bottom (see fig. 2). From one hundred to two hundred termites, from nature or from previous experiments, were used for each test, the test normally lasting a month or longer, during which time the petri dishes, separated by cloth towels, were kept in a light-tight tin box. The tests were examined daily at first, to remove any dead

termites, and afterwards at longer intervals, until the termites had eaten enough of one sample (or of two, or more, if crowded, or if several of the samples were of approximately the same palatability) to show an unquestioned preference. When the test was finished, each eaten sample was weighed against its check to determine the amount eaten, and the excrement weighed for digestibility. Such eaten samples were retired from the tests, and fresh samples selected for further tests of that kind of wood.

Discussion.- In comparing the new list with the original 1923-24 list, certain apparent inconsistencies will be noted. Most of these are presumably due to the incorrect identification of the original wood samples, none of which are now available for critical examination and re-identification. The "laurel" given as Magnolia splendens, so far down on the list, was presumably "laurel de la India", or Ficus nitida. The "cedro", also well down on the list, was not Cedrela odorata, but "cedro macho", a name applied to several different trees. Judging also by the recent results, the samples of "almendra" were confused with those of "guaraguao". The low position of what was listed as "white oak", as compared with later results, is presumably because all samples of oak were not identified to species, but submitted as "white oak, commercial species" and "red oak, commercial species". Having made these corrections in the old list, it will be noted that the parallelism between the two, although not exact, is reasonably close, and minor variations are to be expected with an entirely different series of wood samples. While one cannot be sure that all of the samples used in either of these series of tests were typical of the species, the error due to this factor is naturally less in woods of most uniform composition.

A source of possible error much more difficult to eliminate without infinitely more tests is that of accurately placing each wood relative to all the other woods most similar to it in termite resistance. Of two such woods, the termites might choose one kind of wood in the first test and reverse their choice in a second, thus making a decision regarding which there is no appeal. It should also be remembered that each test placed only one wood (the eaten one) in comparison with seven or eight others, and it was only by accident or good luck that later tests showed any more. Thus the positions assigned in the list for each wood are relative only to some of the other woods, not absolute for each of the other woods. It is believed that this is only a minor error in any case, as new tests with fresh samples in critical cases have nearly always merely confirmed the previous assignment.

Gum and Grain.- While minor variations in the reactions of termites to samples of the same wood from different trees of the same species are possibly to be expected, major variations are to be noted only in the case of a few conifers.

At the same time that the first tests were being conducted, Professor R. E. Danforth of the College of Agriculture at Mayaguez was running similar tests, the results of which were never published and even the MS report on which has by now disappeared. For these tests he used mainly common building woods from the States, especially as wide a variety of samples of the same kind of wood as could be obtained. Of all the samples, he found that a very heavy and gummy piece of yellow pine was more resistant to termite attack than any other. The variation in the amount of gum in various samples of yellow pine is often considerable, and is a decisive factor in determining the extent to which it is attacked by termites. One sometimes sees buildings in Puerto Rico constructed of yellow pine in which

the sapwood parts of the boards have been almost or completely destroyed, and of the heartwood, the part between the grain eaten away, leaving only the gummy portions. Finer grained or more completely gummy yellow pine is rarely attacked.

The same is true of southern cypress: the somewhat gummy and fine grained or the very gummy heartwood is entirely immune to termite attack. Less gummy and especially the coarser grained heartwood are even lower in the scale. Cypress sapwood is very susceptible to polilla attack. Thus the use of cypress in construction requires very careful inspection of each board to make sure that no sapwood is present, and that the heartwood used is either very fine grained or quite gummy. When carefully inspected, however, a structure made of southern cypress should be absolutely and permanently immune to termite attack.

Other species of conifers of commercial importance ordinarily show no such wide variations in the amount of gum present and the fineness or coarseness of grain as do yellow pine and southern cypress, thus the reactions of termites to different samples of other conifers are more uniform. While the presence of gum and the fineness of grain in the conifers may mask the essential susceptibility of these woods to termite attack, the non-conifers, with few exceptions, have no such protection. The tabonuco tree, Dacryodes excelsa, which exudes large amounts of resinous gum, but has little in its lumber, is very susceptible to termite attack. The West Indian cedar, Cedrela odorata, exuding no gum, but with wood of an oily feel and powerful odor, is markedly resistant. It should not be supposed, however, that an odor which seems powerful to us will have any definite effect on termites, for they readily attack eucalyptus and red cedar. Nor is hardness of the wood of any appreciable effect on the termites, for hard maple is almost the exact equivalent of willow so far as being eaten by termites is concerned.

Lignin.- In the preliminary experiments of 1923-24, it was noted that the woods which were most susceptible to attack were those which were most digestible, as from them was produced the smallest amount of excrement in proportion to the weight of wood eaten. The eaten part of those most resistant to termite attack, on the contrary, often resulted in an amount of excrement weighing 90% of the weight of the wood consumed by the termites.

According to the analysis made by Messrs. F. Ramírez Silva and A. Rivera Brenes, under the direction of Dr. J. A. Bonnet, of the Division of Soils of this Station, nearly two-thirds of the excrement of Cryptotermes brevis consists of lignin. It might thus appear that the lignin content of wood is largely or entirely unavailable to these termites for food. Cryptotermes brevis cannot eat, and indeed is repelled by the wall-board plastic (manufactured by the Marathon Chemical Co., of Rothschild, Wisconsin) largely or entirely consisting of lignin. The woods of high lignin content, so far as analyses are available and tests have been conducted with these termites, are invariably very resistant or immune to termite attack, while those with the lowest lignin content, such as willow and hard maples (20 to 23% lignin) are most susceptible. Lignin is primarily a heartwood constituent, and presumably is the most important factor in the greater termite resistance of heartwood as compared with the sapwood of any kind of lumber. According to analyses made by Dr. Bonnet, which report lignin plus ash, plus protein (these two latter being less than 1% of the total), mahogany heartwood contains 46.12% and mahogany sapwood 34.65%. While the direct relationship between resistance to termite attack and very high or very low lignin content is obvious, in the case of some woods with

intermediate lignin content, it may be masked by their individual idiosyncracies. Thus it is not possible in advance to place exactly the termite resistance of any wood by first determining its lignin content, although for most non-conifers, especially with those at the extremes, it may be almost as definite as testing directly with the termites themselves.

IMMUNE OR VERY RESISTANT WOODS

The dark heartwood of lignum-vitae or "guayacán", Guaiacum officinale, appears from all tests to be entirely immune to attack by Cryptotermes brevis; the termites never cluster on it, and the samples remain clean and polished no matter how long they have been exposed to the termites. Mangrove, cobana negra, and West Indian cedar or "cedro", which are immune to very resistant, become spotted with liquid excrement or saliva from the termites, and are not avoided by them as is lignum-vitae.

Two beautifully grained, dark red woods from the Amazon basin, muirapiranga, Brosimum paraense, and macacahuba, Platymiscum ulei, are practically immune, while the dark brown acapú, Vouacapous americana, pau santo, Zollernia paraensis, and sapupira, Bowdichia brasiliensis, are almost as resistant. In Belem, these latter three are often used as alternating floor boards with pau amarillo, Euxylophora paraensis, a bright yellow hardwood which becomes almost white with use, also very resistant to termite attack. Two other Brasilian woods, freijo, Cordia goeldiana, and piquiá, Caryocar villosum, are but little eaten by termites. Any one of these listed is almost or even more than the equivalent of mahogany, and may be used with equal assurance.

Mahogany or "caoba", Swietenia mahagoni, is ordinarily considered immune to the attack of termites, and for this reason has been extensively used for furniture or specified for the finish and interior trim of concrete buildings of the best construction. This reputation is well merited, but the most recent tests show that it may be eaten to a slight extent, and that the sapwood of mahogany is by no means especially resistant, being below California redwood heart, for instance. Thus persons purchasing mahogany furniture should make sure that sapwood has not been used in places where it will not show: the back, or under caning, or in drawers. They should insist on solid mahogany heartwood throughout, and may well expect absolute immunity from injury by termites if no sapwood is present.

The reputation of mahogany should not obscure the value of a native Puerto Rican tree, the maga, Montezuma speciosissima, which most recent tests have shown to be slightly superior: maga heartwood slightly more resistant than mahogany heartwood, and maga sapwood considerably more resistant than mahogany sapwood. The maga grows much more rapidly than mahogany, and from the standpoint of the cabinetmaker is equally desirable. Unfortunately, little maga is commercially available as compared with mahogany, as practically all of the mahogany used in Puerto Rico is imported.

West Indian cedar, or "cedro", Cedrela odorata, is very resistant to termite attack, the heartwood little more resistant than the sap, but termites do make short holes in it and daub it with liquid excrement when nothing else to eat is available. It is hardly to be expected that termite colonies can be started in cedro, and its increasing use in mahogany furniture is indicated as a lining, or for drawers or shelves.

Not quite so desirable as mahogany or maga from the standpoint of resistance to termites, but nevertheless little likely to be attacked, and valuable for other characteristics, are the following native hardwoods: aceitillo, moralón (ortegón), hucar, ausubo, guaraguao, granadillo, caracolillo and ausú. In this division also belongs a single furniture wood from the States, black walnut, and from Brasil, angolim rayado, Pithecolobium racemosum, which is about equivalent in termite resistance to heavy gummy southern pine.

In the following list, the results of the 1923-24 tests are given parallel to those of 1936-39. Because of changes in the scientific nomenclature since the earlier tests, the scientific names there given are omitted as being more confusing than useful. Mistakes in spelling have been corrected, the omissions of black walnut and cedro (which should have been cedro macho) supplied, and doubtful identifications of samples indicated. For the 1936-39 tests, the common name in English, Spanish, Portuguese or French, is followed by the scientific name as given by the person or organization supplying the sample. The Brasilian woods were checked against the large samples in the Industrial Museum at Belem, and rechecked by the Forest School, Yale University. Following the scientific name is given the country of origin of the sample used in the tests.

Immune or very resistant woods listed in order of resistance to Cryptotermes brevis. Heartwood unless otherwise noted.

1923-24 Tests	1936-39 Tests
	Lignin plastic (Marathon Chemical Co., Rothschild, Wis.)
Cypress	Southern cypress, Taxodium distichum, very gummy (Palatka, Florida)
	Lignum-vitae, guayacán, gaiac, Guaiacum officinale (Haiti)
	Mangrove, mangle, old, swamp-seasoned (Puerto Rico)
	Muirapirange, Brosimum paraense (Brasil)
	Macacahuba, Platymiscium ulei (Brasil)
	Southern cypress, very gummy (Ponchatoula, Louisiana)
	Acapú, Vouacapous americana (Brasil)
	Pau santo, Zollernia paraensis (Brasil)
	Maga, Montezuma speciosissima (Puerto Rico)
Mahogany	Mahogany, caoba, Swietenia mahagoni (Santo Domingo)
	Sapupira, Bowdichia brasilensis (Brasil)
Cobana	Cobana negra, Stahlia monosperma (Puerto Rico)
	Aceitillo, Zanthoxylum flavum (Puerto Rico)
Mangrove	Pau amarillo, Euxylophora paraensis (Brasil)
	Freijo, Cordia goeldiana (Brasil)
	Piquiá, Caryocar villosum (Brasil)
	West Indian cedar, cedro, Cedrela odorata (Cuba, Haiti and Brasil)
Ortegón	Moralón, (ortegón) Coccolobis grandiflora (Puerto Rico)
	Southern yellow pine, not typical, very gummy (U.S.A.)
	Angolim rayado, Pithecolobium racemosum (Brasil)
	Ucar, Bucida buceras (Puerto Rico)
Ausubo	Ausubo, Manilkara nitida (Puerto Rico)
	Guaraguao, Guarea guara (Puerto Rico)
Maga	Granadillo, Buchenavia capitata (Puerto Rico)
Black walnut	Caracolillo, Homalium racemosum (Puerto Rico)
	Ausú, Amomis grisea (Puerto Rico)

LESS AND LEAST DESIRABLE WOODS

The beautiful grey, fine-grained heartwood of the Haitian oak, Catalpa longissima, is only as resistant to termite attack as is the sapwood of lignum-vitae. Even this is better than the best of white oak heartwood from the States, or masonite pressboard, and, surprisingly enough, poplar heartwood. Below these are the popular laurel sabino, mauricio and capá blanco of Puerto Rico, none of which, according to these tests, should be considered for furniture. Down among the sapwoods of the more desirable woods, one finds masa, hueso blanco, roble, nuez moscada, tabonuco, Philippine mahogany, almendra and maría. One should be especially warned against using tabonuco for the backs or drawers of mahogany furniture, or of allowing the substitution of the so-called Philippine mahogany. Even lower in termite resistance are red oak and red gum, the latter being extensively used for cheap furniture in Puerto Rico. Quite hopeless are yellow birch and hard maple, excellent for use in the States, but most disappointing for the tropics.

Less and least resistant woods listed in order of resistance to Cryptotermes brevis. Heartwood unless otherwise noted.

1923-24 Tests	1936-39 Tests
Yellow cedar ----------	Red cedar, Juniperus virginiana (U.S.A.)
	Ponderosa pine, Pinus ponderosa (U.S.A.)
White pine ----------	Western white pine, Pinus monticola (U.S.A.)
	Lignum-vitae SAP (Haiti)
Royal palm	
	Cedro macho, Hyeronima clusioides (Puerto Rico)
Cocorrón	
	Cacao motillo, Sloanea berteriana (Puerto Rico)
	White oak, commercial species (U.S.A.)
	White oak SAP
Almendra (?)	Masonite Pressboard (U.S.A.)
(possibly should	Yellow poplar, Liriodendron tulipifera (U.S.A.)
be guaraguao)	Pau roxo, Peltogyne lecontei (Brasil)
	Jácana, Lucuma multiflora (Puerto Rico)
	Laurel sabino, Magnolia splendens (Puerto Rico)
	Aquilón, Laugeria resinosa (Puerto Rico)
	Capá blanco, Petitia domingensis (Puerto Rico)
	Capá blanco SAP
	Mauricio, Magnolia portoricensis (Puerto Rico)
California redwood ----------	California redwood, Sequoia sempervirens (U.S.A.)
	Leche prieta, Micropholis curvata (Puerto Rico)
Casuarina	
	Aquilón SAP
Ucar	Maga SAP
Uvillo	
Seagrape	
Mango	
Mangle botón	
Yellow pine ----------	Longleaf pine, Pinus palustris (U.S.A.)
Douglas fir ----------	Douglas fir, Pseudotsuga taxifolia (U.S.A.)
Avispillo	Mahogany SAP
	Southern pine SAP

1923-24 Tests	1936-39 Tests
	Guaraguao SAP
	Cacao motillo SAP
	Hueso blanco, Mayepea domingensis (Puerto Rico)
	Jagua, genipapo, Genipa americana (Brasil)
	Mauricio SAP
	Western white pine SAP
	Masa, Tetragastris balsamifera (Puerto Rico)
	Roble, Tabebuia pallida (Puerto Rico)
Cedro (?)	
possibly cedro macho	Cedro macho SAP
	Southern cypress, coarse-grained
	Nuez moscada, Ocotea spathulata (Puerto Rico)
	Nuez moscada SAP
Hemlock	
	Ponderosa pine SAP
Larch	California redwood SAP
	Tabonuco, Dacryodes excelsa (Puerto Rico)
Coffee	
	Longleaf pine SAP
Mamey	
	Philippine mahogany, Shorea negrosensis (Philippines)
Laurel (?)	
(Laurel de la India)	Marupá, Simaruba amara (Brasil)
	Almendra, Terminalia catappa (Puerto Rico)
Guava	
	María, Calophyllum antillanum (Puerto Rico)
	Laurel sabino SAP
White oak (?) ----------	Red oak, commercial species (U.S.A.)
Cupey	Douglas fir SAP
	Yellow poplar SAP
Rubber	
	Red oak SAP
Orange	
Inga vera	
Red gum ----------	Red gum, Liquidambar styraciflua (U.S.A.)
	Red gum SAP
Eucalyptus	
Hard maple	
Bamboo	
Almácigo	
Guaraguao (?)	
(possibly roble)	
Guara	
Silver oak	
Yellow birch	
Jobo	Humboldt's willow, Salix chilensis (Peru)
Jaguey	
Palo de pan	
Chinaberry	
Pomarrosa	
Sitka spruce	Red cedar SAP
Flamboyán	Southern cypress SAP

Summary

This paper supplements a previous bulletin, "The Comparative Resistance of Woods to the Attack of the Termite, Cryptotermes brevis Walker", published in 1924 and a list of woods in the order of their resistance is included and compared with previous results. Tests were carried out with only one species of termite, the dry wood termite of the West Indies, which is found throughout the tropical Americas, but only in the southern tip of Florida in the United States. Results, therefore, cannot be used for termite control in the United States, but may be of value to manufacturers of furniture producing for sale in the tropics.

All samples tested were carefully differentiated between sapwood and heartwood. In every wood tested, the sapwood was more susceptible to attack than the heartwood. Petri dishes holding eight or nine samples of different wood and from one hundred to two hundred termites were used in each trial. The test normally lasted a month or longer, being continued until there was an unquestioned preference.

It is difficult to accurately rate each wood relative to other woods similar to it in termite resistance, so that the positions in the list are only relative and not absolute. Inconsistencies between the two experiments are believed to be largely caused by incorrect identification of the original wood samples. Correct identification of current wood samples was assured by using only those of unquestioned authenticity. Results would indicate that the lignin content of wood is largely or entirely unavailable to these termites for food. Woods of high lignin content are invariably very resistant or immune, which probably accounts for the greater resistance of heartwood as compared to sapwood.

Resumen

Este artículo suplementa el boletín titulado "The Comparative Resistance of Woods to the Attack of the Termite, Cryptotermes brevis Walker", publicado en el 1924, e incluye una lista de las maderas en su orden de resistencia comparándose a la vez con resultados anteriores. Las pruebas se llevaron a cabo con una sola especie de polilla, la polilla de la madera seca de las Antillas, que se encuentra por toda la América tropical, pero en los Estados Unidos se encuentra solamente en el extremo Sur de la Florida. Por lo tanto, los resultados no pueden ser utilizados para dominar la polilla en los Estados Unidos, pero sí pueden ser de valor a los fabricantes de muebles para la venta en los trópicos.

En todas las muestras probadas se diferenció cuidadosamente el corazón de la albura, siendo ésta última la más susceptible al ataque. Ocho o nueve muestras de distintas maderas en platillos de Petri y como de 100 a 200 polillas se usaron en cada prueba. Normalmente, la prueba duró un mes o más pero se continuó hasta que hubo una preferencia decidida por alguna de las muestras.

Es difícil evaluar con exactitud cada madera en relación a otras similares en resistencia, de manera que sus posiciones en la lista son solamente relativas y no absolutas. Se cree que las contradicciones entre los dos experimentos fueron debidas mayormente a la identificación errónea de las muestras originales. Se aseguró la identificación correcta de las muestras comunes usando solamente las de una identidad auténtica. Los resultados indican que el contenido de lignina de la madera no es aprovechable como alimento por la polilla. Las maderas que contienen gran cantidad de lignina son muy resistentes o inmunes, razón probable de la mayor resistencia de la madera de corazón comparada con la de albura.

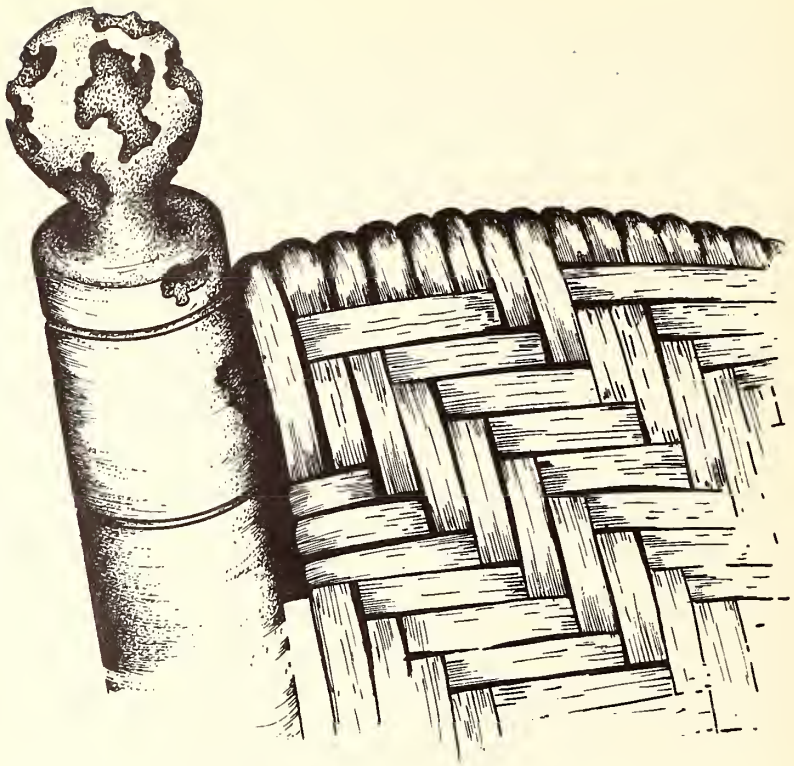

Fig. 1—Knob on rocker of hard maple, infested with termites despite constant use and daily handling. The wicker of the back of the chair protected the termite adults and gave them an opportunity to burrow into the wood practically undisturbed.

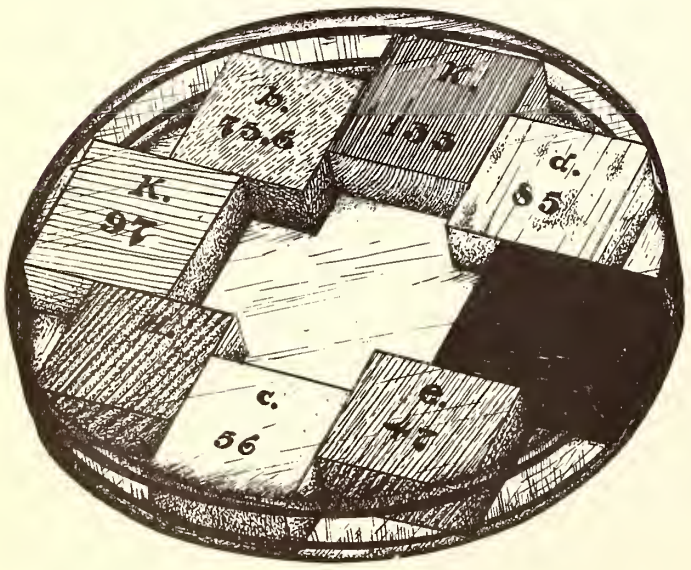

Fig. 2—Method of keeping, tightly wedged together in petri dish, the samples of different woods being tested for resistance to termite attack. The termites themselves, of which one to two hundred are used in each test, are not indicated. A series of such petri dishes, separated by towels, are kept in a light-tight tin box while the tests are in progress.

BLUE MAHOE OF JAMAICA

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The Blue or Mountain Mahoe, Hibiscus elatus Sw., is a tree of considerable importance in Jamaica and promises to be one of the most valuable species for afforestation purposes owing to its rapid growth and relatively wide range of habitat.

Range.- According to Record, Mahoe "is fairly common throughout the Antilles and of unknown, though probably very limited, distribution on the Spanish Main. The tree makes its best development in the mountains of eastern Cuba. .... In very dry situations it is small and crooked, but in better sites it attains a height of 60 feet, with a long, clear stem usually between 12 and 18 inches in diameter and occasionally much larger".

Habitat in Jamaica.- Mahoe ranges in Jamaica from 500 ft. in the damp limestone districts to nearly 4,000 ft. in the Blue Mountains on shales and residual volcanic soils. Normally it occurs in areas where rainfall varies from 70 to 150 inches, but it is also grown on the dry alluvial plains with a rainfall of 40 in. or less. It avoids dry sandy soils and has failed to establish itself on rocky and eroded ridges. It is also intolerant of exposed situations and is susceptible to wind damage under such conditions.

Silviculture.- Seed ripens in March - April, when the ripe capsules are picked or beaten off the trees just prior to opening, then laid on canvas in the sun and allowed to open. The capsules are then separated from the seed by shaking. There are approximately 1,500 to 1,600 seeds to the ounce and 10 ounces to the quart. It is by no means easy to procure adequate seed supplies.

With properly matured seed, germination is up to 80% and is well maintained up to 4 months in storage, falling off slightly up to 6 months. Data beyond this are not available. Seed is sown in nurseries and seedlings transplanted to the field when about a year old. The plants should be 18 to 24 inches high with a sturdy, woody stock, as small and whippy plants are unsuitable. The large cordate leaves should be cut back before planting. There is a tendency for the leading shoct to die back for a few inches and for an axillary shoot to take its place. Experiments with "stumping" are being made.

The question of optimum spacing is of considerable importance, since Mahoe is very liable to forking and excessive side branching. Even with a 6 ft. x 6 ft. spacing, hand pruning is necessary in the early years, while it appears that full crown development is necessary to maintain maximum growth. It appears that a wider spacing may have to be considered, coupled with close attention to early pruning to improve stem form.

Rate of growth is relatively rapid, once the plant is established, though there may be a lag of 6 months before appreciable height growth begins. Data are very meagre but the following gives some indication: plantation 10 ft. x 10 ft. on brown clay overlying limestone, elevation 1,000 ft., rainfall 30 to 50 inches,

age 17 years, average girth 27 inches, maximum girth 38 inches, height 70 ft.

Timber.- Mahoe has been very badly overcut in Jamaica and there is but little mature and well-grown timber available. The wood when freshly cut is banded with dark green and bluish streaks, alternating with streaks of lighter color. It darkens slowly on exposure to brown and olive green, though it seems probable that, if sprayed with a cellulose spray, oxidation may be prevented. Color and figure are extremely variable and it is difficult to secure matched wood from existing supplies. The wood is hard and durable, of medium weight (44 to 49 lbs. per cu. ft.) and works and polishes well. It is in great demand for cabinet-making and furniture, its principal use today. Formerly, when more abundant, it was used for house framing, flooring, panelling, carriage and cart-work, gum stocks, ships' knees, fishing rods, railway sleepers and roofing shingles.

This unusual range of utility makes Mahoe a particularly interesting species.

Resumen

El Hibiscus elatus Sw. es una especie de importancia en Jamaica, especialmente para fines de repoblación forestal. Es bastante común en Jamaica y Cuba, alcanzando en buenos sitios alturas de 60 pies y diámetros de 18 pulgadas o más. Localmente, se encuentra desde 500 pies en zonas calcáreas húmedas hasta 4000 pies en los "Blue Mountains", adaptándose normalmente a una precipitación pluvial de 70 a 150 pulgadas.

Las cápsulas que maduran en marzo y abril se recolectan poco antes de abrirse, secándose al sol y luego sacudiéndolas para extraerle la semilla. En una onza entran de 1500 a 1600 semillas. La germinación de semilla buena es hasta de 80%, conservándose hasta 4 meses antes de empezar a decaer. Las plántulas se siembran aproximadamente al año y deben tener de 18 a 24 pulgadas de alto con un tallo vigoroso. Las hojas son grandes y deben podarse al tiempo de la siembra.

Para mantener un máximo de crecimiento se necesita un espacio bastante amplio entre los árboles, lo cual hace necesario recurrir a la poda durante los primeros años. Datos de crecimiento son muy escasos aunque en una plantación se obtuvo una circunferencia promedio de 27 pulgadas y una altura de 70 pies a los 17 años.

La madera es durable, dura, fácil de trabajar y toma bien el pulimento. Tiene demanda para trabajos de ebanistería y se adapta a muy diversos usos.

NOTES ON THE YAREY PALM OF PUERTO RICO AND THE STRAW INDUSTRY DERIVED FROM IT

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The yarey palm or "palma de sombrero" is scientifically known as Sabal causiarum (Cook) Beccari, of the family Arecaceae. Its smooth, grey trunk grows to about thirty feet high and twenty inches in D.B.H., with palmately divided leaves forming the crown.

This palm is endemic to the island, occurring in two localized sections in the southwest and northwest corners of the island, with a few scattered individuals outside of these areas. The northwest section extends from Aguadilla to Isabela, with the greatest concentration of palms in Barrio Malezas, and in the southwest it occurs around the village of Joyudas.

In the Aguadilla section, the soils are shallow to medium in depth, friable or plastic rendzinas, mostly derived from limestone. It is an agricultural area given over mostly to subsistence crops, cane and pasture land. The Joyudas area can be classified as coastal plain or lowland with medium to deep, friable, sandy loam, agricultural in use, mostly given over to coconut, cane, and subsistence crops. The palm grows in this section very close to the beach in the "beach palm sand" type.

The mean annual rainfall around Joyudas varies between 60 to 80 inches as compared with 40 to 60 inches in the Aguadilla section. Both areas range in elevation from sea-level to about 500 feet.

The palm regenerates naturally. The seed germinates profusely below the mother palm and is also dispersed by birds. The palm fruits profusely, the fruit being a one-seeded, globose drupe about 1 cm. in diameter, brown in color, smooth, hard, with a bony endosperm, a thin epicarp and a fleshy pericarp.

Most of the palms now growing are from natural regeneration, but several years ago some spots were artificially sown. The soil was plowed once and prepared and the palms planted about four feet apart. To this close planting, the name of seedbeds was given. No transplanting was done and the palms were left to grow in the seedbed. The seed for the sowing was gathered from the ground or collected when well matured from the palm. The seed takes from two to three months to germinate. Cultivation consists of one plowing and one weeding a year and where space permits, minor crops such as sweet-potatoes, yuca, etc., are raised between the trees. In some instances the area is used for grazing.

The palms at Joyudas yield straw of better quality than those from the Aguadilla section. This has led to the manufacture of high-quality hats in Joyudas and of cheaper articles such as baskets, mats, hats, "pavas", etc., at Aguadilla. Even within the Joyudas section, there are palms that yield better straw than others. Those growing close together away from the beach and particularly where the soil is moist and rich in humus yield a straw of higher quality than the trees nearer to the beach or growing far apart. Old palms do not produce as high-quality products as more thrifty fast-growing younger trees.

In general, it can be stated that the closer together the palms grow, the better the quality of the straw.

At ten years of age, the young palm begins to produce straw for the manufacture of hats. When the palm is young, an unopened leaf or "cogollo" is cut every six months, so as not to retard growth. When the palm is mature, an average of a leaf a month may be cut. For tall palms, a ladder is used to facilitate cutting the "cogollo".

Fully opened green leaves are used for thatching houses of poor people. This roof has to be replaced every four years. The wood of the palm is used as fuel for lime furnaces, but is not very good for this purpose. The palm is attacked by the bud rot, Phytophtora palmivora Butler.

The straw used for the manufacture of hats and other articles is taken from the "cogollo". An important point in the cutting of the "cogollo", especially if it is to be used for hat manufacture, is to cut it at the right time. If it is left to open naturally, it becomes green inside and is worthless. The leaf is cut when the petiole appears and is approximately 6 inches long. When the pleated, immature leaf is examined, the "leaflet" sections are of a cream color. A good quality leaf is valued at 35 cents while a medium quality leaf is only worth 10 cents.

After the leaf is cut, it is split into "leaflets". This step is called "tarjar la rama". This is accomplished with the fingers working from the stem to apex so that each "leaflet" consists of a single fold. All are left attached to the stem which is then spread in the sun to bleach for 5 days. During the night, or when it is raining, they are put under cover except for the last two nights when they are left out for about two hours so as to give the straw flexibility. After the bleaching process, the leaflets are cut from the stem and unfolded. This is called "planchar la hoja" or literally, to iron the leaf. In doing this, the fold is taken between the thumb and index fingers, and spread open from base to apex. Then, tied in bundles, they are hung from a nail or put in some other place in the house until needed.

Next, comes the splitting of the "leaflet" to obtain the straw. This is called "tarjar la hoja" and consists of splitting the "leaflet" lengthwise with a small blunt knife with a blade about 3 inches long. The knife is thrust through the "leaflet" at the base, taking the desired width of straw and with the tip of the knife split lengthwise from base to apex. The width of the straw depends on the kind of hat to be woven. If a first quality hat is desired, a good quality leaf is split into strands about 1 mm. wide. On the average, a whole leaf will supply sufficient straw to make a hat. Cheaper hats, mats, baskets, etc., are made from wider straw varying according to requirements. After splitting, the straw is again tied in bundles, ready for weaving. No chemical treatment is given the leaf either for bleaching or in preparation of the straw.

The straw has to be woven during humid days (cloudy or rainy days) or at night. On dry, bright days, the straw breaks during the weaving. In the weaving of hats no braiding is done. All the work is done by hand. The first step in weaving a hat is the "estera" or the start. Then come the growths of

which eight or ten are woven in, depending on the size of the hat. When this point is reached, no more additions are made until the crown is completed. Then, the crown is turned inside out and two more growths are woven in to turn the brim. After finishing the brim, the last straw is inserted to finish the edge.

Most of the weaving is done by women. Very expert and fine weaving is done for the high-quality hats. No attempt has been made to devise methods of maintaining moisture in the straw such as the reported weaving of Panama hats under water. As already stated, all weaving is done during rainy weather or after sundown. A good quality hat untrimmed and unblocked sells for around $5.00.

In the Aguadilla section, there is another type of this industry. Here, baskets, brooms, mats, luncheon sets, school, market and hand bags, straw fans, tables, big hats ("pavas"), etc., are made. This is because the straw from the palms is of a poorer quality. All these articles are also woven by hand. The leaves are cut and bleached in the same way as explained before. Beautiful color designs are woven in all this work.

For coloring the straw, aniline dyes are used. The colors employed are orange, yellow, bright blue, green, violet, and brown. The brown is obtained by the mixing of the orange and violet. The proportion used is: 1/8 oz. of the dye dissolved in about 3 gal. of warm water, except for green, yellow, and blue when 1/4 oz. of dye, in the same quantity of water, is used. After thoroughly dissolving the dye, the straw is immersed and left there until the desired depth of color is obtained. Then, it is taken out and hung to dry in the air. Various shades of brown are obtained by the length of time the straw is left in the solution; a close watch should be kept to obtain the desired shade. Care should also be taken to see that the straw takes the color uniformly.

Two methods of weaving are used. One called "canutillo" that is a sort of braiding in which the straw is woven in long, round strings and then sewed into different articles. Most of the articles made in this manner are waste baskets, tables (for which a wooden frame is made first and then covered with the braided straw), serving trays, etc. The articles made with this kind of weaving cost more than those made by the other method, or the one called "de petate". In this, the straw is interlaced by passing one straw below the other. Beautiful colored designs are made by this method.

The straw industry as a whole has been diminishing in the last few years. This has been especially serious in the weaving of quality hats which has been stopped almost completely due to lowered prices and lack of steady market resulting from outside competition. This has resulted in the felling of some palms to make way for more lucrative crops. This industry is of importance locally and is capable of supporting many people who through this cash income in combination with subsistence crops, could earn a satisfactory living. Every effort should be made to revive this interesting and locally important industry.

Summary

The hat or yarey palm, endemic to Puerto Rico, is largely restricted to the northwest and southwest sections. The soils are deeper and rainfall heavier in the latter section and produce a better quality of straw. The southwest area produces fine quality hats whereas the northwest section produces beach hats, baskets, floor-mats, brooms and other cheap articles.

The palms occur in natural stands with the intervening spaces devoted to grazing or the cultivation of minor crops. When ten years old, the palms begin to produce leaves suitable for hats. Leaves are cut just before opening, dried in the sun for five days and then cut into strips for weaving. To avoid breakage of the straw, weaving is done on damp days or at night. Aniline dyes are used for tinting the straw.

Resumen

La palma de sombrero o yarey, de la familia de las Arecáceas, es endémica de Puerto Rico. Crece particularmente en la sección noroeste y suroeste de la isla, con algunas que otras fuera de estas dos áreas. Los suelos de la sección suroeste son mejores y más profundos que los de la otra sección, teniendo la primera una precipitación pluvial de 60 a 80 pulgadas y la última de 40 a 60 pulgadas. En ambas secciones la elevación varía desde el nivel del mar hasta los 500 pies.

Casi todas las palmas que se encuentran actualmente son de reproducción natural, aunque en años atrás se sembraban pequeñas áreas. Debajo de las palmas donde el espacio lo permite se cultivan frutos menores y se lleva a cabo algún pastoreo. La paja de la sección suroeste es de una calidad superior a la de la sección noroeste. Por lo tanto en la primera se han dedicado mayormente al tejido de sombreros finos, mientras que en la otra al tejido de artículos baratos, como esteras, pavas, canastas, etc.

La palma empieza a producir cogollo para sombreros a los diez años. El cogollo se corta cuando está completamente cerrado. Tan pronto empieza a abrir se pone verde. Después de cortado se abre y se pone al sol por cinco días. Luego, se tarja la hoja para obtener la paja. Obtenida la paja, se procede a tejer el sombrero. El tejido se hace en días húmedos o de noche para evitar que la paja se parta.

En la sección noroeste se hacen tejidos en colores usando tintes de anilina. La paja se sumerje en el tinte y luego se seca al aire. Se usan dos métodos de tejido; uno llamado "de petate" y el otro "de canutillo". Esta es una industria local que debe estimularse.

THE USE OF THE CONICAL SPADE

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The Spade.- The conical spade, as used in Trinidad, consists of a split cylinder of mild steel some 10 inches long and about 3 inches in internal diameter. The split runs the whole length and is about 1/3 of an inch wide. On one side of the split, the steel is sharpened to a cutting edge, while on the other side the edge is blunt. The spade is attached to the wooden handle by means of two steel rings bolted to the cylinder. The appearance is somewhat like this:

Front View

Side View

This size of spade suffices for most 1-year-old seedlings, but larger spades may be used for larger or older plants.

Method of use.- The first operation is to drive into the soil of the nursery a number of short posts, the tops of which stand about 2 feet above ground level, the diameter of the posts being slightly less than the internal diameter of the spade. A quantity of the leaves of the Balisier plant (Heliconia bihai), a species of wild banana, and some vines for tying, are then collected and placed in a convenient position near the posts. Taking the conical spade, the laborer places it directly over the plant, and carefully lowers the spade until it rests on the soil, with the stem of the plant in the center. By pressing downwards the spade is driven into the nursery bed to its full length. The spade is rotated through 180°, when the cutting edge severs the cylinder of earth, and gently rocked, after which it can be drawn up containing the plant and a cylinder of earth. The loaded spade is now placed on the post, and pressed downwards, when the plant and earth are driven up through the top of the spade. As the plant emerges a second laborer wraps a leaf round the cylinder and ties it with vine. The wrapped plants are then ready to be taken to the scene of planting operations.

Before planting, the leaf wrapping is, of course, removed.

The Cost.- The use of the conical spade is a comparatively expensive method, and is confined to plants which cannot be successfully planted with bare roots or as stump plants. In Trinidad, the conical spade is invariably used for transplanting galba (Calophyllum), which does not respond well to other methods of planting. With a laborer's wage rate of 60 cents per day, the cost of extracting the galba seedlings with the conical spade, carrying them up to 1/4 mile and replanting averages about 1-1/2 cents per plant, but has been brought down on occasions to 1-1/4 cents per plant. With adequate care and good planting weather the survival percentage is high, being up to 95%, and this justifies the cost.

Limitations of the Conical Spade.- The first essential is that the nursery soil should contain a fair proportion of clay, so that the soil binds well. The conical spade is of little use in pure sandy soils as this type of soil falls away from the roots when the cylinder of earth is pushed out of the spade.

The second essential is that the species to be lifted should have a reasonably compact root system. A very long taproot is usually a disadvantage as the end of the root is almost certain to be broken, though some species can withstand damage of this type. Again, a wide surface-rooting system, such as is found in Cedrela, renders the conical spade useless, as the bulk of the roots are inevitably cut by the spade. Calophyllum seedlings have a rather narrow root system of moderate length, and therefore are well adapted to the conical spade. Success has been obtained also with Swietenia and with Tabebuia pentaphylla.

Resumen

La pala cónica usada en Trinidad para sacar plántulas con una bola de tierra consiste de un cilindro cónico de acero dulce como de 10 pulgadas de largo y 3 pulgadas de diámetro con una ranura poco más o menos de 1/3 de pulgada de ancho a todo el largo. La pala está pegada a un mango de madera por medio de dos anillos de acero atornillados al cilindro.

La pala se introduce en la tierra de manera que el tallo de la plántula quede en el centro del cilindro, se hace girar un poco hacia ambos lados, y se saca con el arbolito y su bola de tierra. La plántula con su bola de tierra se separa del cilindro haciendo presión hacia abajo con éste sobre una estaca de madera clavada en la tierra. Al sacar la bola de tierra, ésta se envuelve en una hoja grande, amarrándola con un bejuco.

Este método se usa invariablemente con el género Calophyllum y pagando jornales de 60 centavos diarios, los costos de saque, acarreo hasta 1/4 de milla y resiembra, salen a centavo y medio por planta. Con una época de siembra favorable y un trabajo cuidadoso, es de esperarse resultados de hasta 95% de exito.

Es esencial que la tierra contenga alguna arcilla, la cual le dá cohesión. También, la especie a sacarse debe tener un sistema de raíces compacto. Además del género Calophyllum, esta pala se ha usado con buenos resultados con Swietenia y Tabebuia pentaphylla.

SOME NOTES ON THE MANGROVE SWAMPS OF PUERTO RICO

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The mangrove swamps or manglares constitute a small percentage of the total land area in Puerto Rico and yet are important to the forester because such areas are highly productive and regenerate naturally, thus lending them suitable for profitable management. Probably no other forest areas in Puerto Rico have been as productive in cash crops as these.

The manglares of 100 years ago must have comprised a much greater total acreage than at the present time. The reduction can be attributed almost entirely to the influence of man and especially so to the sugar-cane growers. For example, the Loiza Sugar Co. has installed a system of large drainage ditches and power pumps in the San Juan District which allows them to cultivate cane on hundreds of acres of formerly marshy land.

Recently, an additional project of felling manglares and draining of land was in process east of Ponce on the south coast. Dredging of the bay at San Juan with the dumping of the silt on former manglares and various garbage dumps close to the metropolis have eliminated an additional acreage which is being taken up as building sites. Wherever manglares occur adjacent to population centers, the poor people recognize the swamps as the cheapest or free building sites and raise cheap wooden structures on stilts, connecting them with dry land by a ramp of earth or if at a greater depth, by flimsy wooden bridges. Around Santurce, which is the eastern extension of San Juan, these concentrations are especially noticeable and in all such, the rapid increase in population of this class of people coupled with the effects of the economic depression has given rise to an extraordinary augmentation of such sections in the last few years. The accumulation of rubbish thrown out the window or door will eventually build up these marsh settlements to dry land.

Considering natural succession alone, the mangroves are known as land-builders. This, they accomplish by advancing into the sea or tidal lagoons and accumulating sediment and vegetative trash about their root systems. They can advance into the sea only where such formation is protected from strong seas and where silt or fertile soil accumulates on the bottom. In Puerto Rico, such advances can be made only on the eastern and southern coasts. On all sides there is some building out into the lagoons, the latter probably more rapid in recent decades due to increased agricultural use of highlands with the coincident increase of eroded materials discharged by the streams at their mouths. However, such gains, and also the natural change from manglares to dry ground, are very slow natural processes and their effects in terms of acreage in Puerto Rico are negligible.

The present acreage of manglares in Puerto Rico is estimated to be about 16,000 acres, of which the Insular Forest Service owns 10,800 acres, the Insular Department of Interior an approximate 1,000 acres, and private landowners the remainder.

The areas of the Department of the Interior are located around and close to San Juan and have been most affected by the reclamation for building sites.

The Insular Forest Service controls 5 manglare districts named for the towns adjacent to same, with acreages as follows:

San Juan	1,985 Acres
Ceiba	3,092 Acres
Aguirre	2,200 Acres
Boquerón	2,820 Acres
Yauco-Guánica	798 Acres
Total	10,895 Acres

The privately owned manglares are mostly adjacent to the above and considerable litigation has been existent since the founding of the Forest Service in an attempt to definitely locate the boundaries.

There are four species of mangroves which occur in Puerto Rico and which also have a wide distribution in the world. They are as follows:

Family	Scientific Name	Common Names
Rhizophoraceae	Rhizophora mangle L.	Mangle colorado, red mangrove, zapatero.
Terminaliaceae	Laguncularia racemosa (L.) Gaertn.	Mangle blanco, mangle bobo, white mangrove.
Terminaliaceae	Conocarpus erecta L.	Mangle botón, botoncillo, buttonwood, button mangrove.
Verbenaceae	Avicennia nitida Jacq.	Mangle negro, mangle prieto, siete cueros, salado, black mangrove, olive mangrove, salt pond.

A simple key to differentiate these four species by vegetative characters alone is as follows:

Leaves alternate	Conocarpus erecta
Leaves opposite	
Leaves gray or finely canescent beneath	Avicennia nitida
Leaves green beneath	
Leaf tips obtuse, trees with stilt roots	Rhizophora mangle
Leaf tips rounded or emarginate, trees without stilt roots	Laguncularia racemosa

Other trees which are found occasionally in the same type are Pterocarpus officinale Jacq. - palo de pollo, Anona glabra L. - coyure or pond apple, Bucida buceras L. - úcar, and Drepanocarpus lunatus (L.F.) G.F.W. Meyer - escambrón or palo de hoz, the latter name referring to the flat, sickle-shaped pods. The Pterocarpus can easily be identified by its buttressed base and the exudation of a blood-red sap from the cut or bruised bark which gave rise to its Venezuelan name sangre de drago (dragon's blood). The alternate simple-leaved Anona is usually found with some of its ovoid, inedible fruits about 4 inches long. The wood is weak but the bark is quite fibrous. The úcar can be distinguished by the clustering of the leaves at the ends of the twigs. The Drepanocarpus usually commands one's attention quite forcefully with its curved stipular spines. It has

pinnately compound leaves and small pea flowers of a purplish color. Along the edges of the mangrove swamps and on the upland areas within the manglares, the latter called "islotes", one finds native trees typical of the surrounding upland types, although commonly such areas are used for pasture and coconut groves. Practically all such areas occurring within the boundaries of the Insular manglares are rented to private individuals. Rents range from $2 to $5 per acre per year.

Agati grandiflora (L.) Desv. - gallito or báculo has been noticed seeding in open areas near the edges of the swamps with thousands of seedlings in dense stands and attaining heights of 4 to 8 feet. However, the first high tides which submerge the roots of the seedlings in salt water effect complete mortality.

The timbers of the palo de pollo, coyure, and palo de hoz are of very little value. The coyure wood, being of very light weight, finds some use as floats for nets or in rafts. The light brown or nearly white wood of the úcar is durable, hard, heavy, strong and tough and finds considerable use.

Within the common site of the manglares, one finds a partial sub-typing due to the requirements of the individual species. Thus, mangle colorado is found most commonly along the banks of the streams and lagoons and also directly in the water. It is the only species which invades sites which are under water the year round. Directly opposite to this species, we find the mangle botón growing in the driest parts of the manglares. It is the only species which is found growing above the high water mark on dry land. In between, we find the other two species growing pure or in mixture. It is difficult to know how these species were arranged previous to man's intervention, but apparently mangle negro more closely approaches mangle colorado in the ability to thrive on wetter sites because it has a special adaptation in the form of upright pencil-like aerating roots, pneumatophores, which enable it to withstand submergence.

In order to give an approximate idea of proportion by species in the manglares of Puerto Rico, the following percents are given although it must be remembered that they have no claim to accuracy, being based on a few observations in scattered parts of the mangrove swamps for present-day figures, and estimates alone for previous figures:

	Present-day percent	Percent previous to intervention by man
Mangle blanco	50	30
Mangle negro	25	30
Mangle colorado	20	30
Mangle botón	5	10
	100	100

The mangle colorado is always more or less restricted to the wetter border of the manglares, which in our areas of not too great width would have amounted to about 30% in the original stand. Its wood was well esteemed which would have lent speed to its exploitation. Coupled with this is the fact that this is our only species of mangle which does not sprout from the stump. Areas clear cut were probably invaded by mangle blanco or mangle negro. Retarding factors in such invasion would be too much water and some mangle colorado seedlings already started.

The mangle botón was probably even at its best, only a swamp border tree. Its fine seed would not give it much competing ability with the larger seeds of the mangle negro and blanco. Where it grew on dry land it was subject to removal by agriculturists. In addition it is a good timber, which being on the border was the most accessible for exploitation.

The mangle negro must have been selected more often than the blanco and the lighter wood of the latter indicates a faster growth and a better chance for its off-spring to beat out the negro.

Before proceeding, it might be well to give a little resumé of wood characteristics in order that one may better picture the relative values of each species. The following is a table giving the source of information:

Species	Red Mangrove	White Mangrove	Black Mangrove	Button Mangrove
Color	Brown[1/]	Yellowish brown[1/]	Dark brown[1/]	Brownish[1/]
Sp. Gravity	1.16[1/]	0.86[1/]	0.9[1/]	1.00[1/]
General characteristics	Very hard, grain variable from straight to very irregular. Texture fine. Wood hard to cut, rather harsh & splintery, takes a good polish. Strong & durable.[2/]	Heavy, hard and strong.[2/]	Heavy and hard. Grain irregular. Texture coarse and uneven. Wood not easy to work not suitable for lumber on account of laminations of unlignified tissue, which upon disintegration allow the fiber layers to separate.[2/]	Fine textured, heavy, hard and strong.[2/]
Uses	Venezuela: Fencing posts, poles for house construction, fuel. Ecuador: Boat and miscellaneous const. posts, piling, railway ties, charcoal and fuel.[2/]	Locally for fuel and misc. purposes in the round.[2/]	Sometimes locally for fuel.[2/]	Fuel and charcoal. Rarely for construction.[2/]

Formerly, mangle negro and mangle colorado were used for boat building, house foundation posts and construction timbers; mangle botón was used for general construction; while mangle blanco was not esteemed because it is subject to termite attacks. Now, the mangles are used for charcoal, fence posts or other miscellaneous purposes as small material in the round.[3/]

1/ Local opinion.
2/ "Botany of Porto Rico and the Virgin Islands" Britton & Wilson.
3/ "Timbers of Tropical America" S. J. Record.

Local opinion varies somewhat relative to the ratings of mangrove wood. Most all use of the wood has been in the form of round material or squared timbers. Since, at the present time, there is little mangle timber of any size and since small material of all species, being composed mostly of sapwood, does not last long, there is less appreciation of the various mangroves than was true formerly. Most concur that mangle blanco has the poorest wood but because of its straight growth is good for handles, etc., which are not exposed to soil and weathering.

An interesting note is their firm belief that timber or poles cut at the time of the new moon are heavily infested with "polilla" or termites in short order, whereas the same cut during the waning of the moon are attacked to a much lesser degree and correspondingly last much longer. However, they state that by cutting a pole and immediately burying it in the mud of the salt marshes or lagoons, wherein it is left for 10 or 15 days, it becomes cured and is not attacked by the "polilla". It would be interesting to know the scientific bases for these beliefs, if true. We do know that logs or pieces of mangle called "canillas" removed from the bottoms of the lagoons and canals are practically immune to all rots and insect attacks and such pieces are highly valued for fence posts or other uses where durability is essential.

All four species of mangrove reproduce readily from seed and, as mentioned previously, all except the colorado, by means of stump sprouts. It is this reason alone which has maintained a forest stand on the areas in spite of the heavy cuttings in the past. However, there is considerable acreage previously stocked but now devoid of mangroves which has to be considered in the light of possible reforestation. These openings fall into the four following categories:

1. Temporary openings.- Occasionally an opening is made in the manglares due to clear cutting of mangle colorado, to charcoal-pits, or other reasons, where no natural reproduction is present. When conditions for seeding in of the area are favorable prompt natural regeneration of the areas occurs and, since this usually happens in less than a year, little notice is taken and such an opening is of correspondingly little importance from the angle of artificial regeneration. However, the creation of any such areas of appreciable size should be avoided because they may possibly develop into the following two classes.

2. Areas similar to temporary openings which do not regenerate readily.- Certain areas which appear very similar to the above fail to regenerate and even artificial reforestation by planting is sometimes difficult. The reason is not readily apparent but it seems to be dependent in some measure on the water level. In the above temporary openings it appears that the normal high tides do not cover at all or cover only part of the surface. The abnormal tides which come in September and October occasionally cover the whole area and, since the dropping of seeds corresponds with such high water, an excellent job of direct seeding is accomplished. In the areas which do not regenerate readily the normal high tides apparently cover all or a large part of the areas. Thus, when seeds are brought with the abnormal tides, they are very apt to be carried away by the same water.

During normal tide periods there is considerable shallow water left in shallow pools. This water and the wet mud is said by the natives to heat up by insolation enough to kill the trees. There may be some basis for this belief or it may be that here similarly to the later discussed "salistrals", there is a high concentration of salt, toxic to young mangles. Attempts to reforest with

seedlings of black and white mangrove, as mentioned above, have not been very successful. More recent plantings with red mangrove appear satisfactory.

3. Marunguey or marsh fern areas.- The most conspicuous herbaceous plant found in the manglares of Puerto Rico is a fern, Acrostichum aureum L., which is locally called marunguey. Normally, a few plants of this species are found scattered through the manglares and as long as a forest canopy is maintained, they are kept under control. But if heavy cutting of the mangroves occurs, admitting abundant sunlight, the marunguey finds conditions excellent for growth and may overrun the whole opening. In such a patch, the sterile fronds grow up to a height of 6 feet or more from large tussocks of rhizomes and root-masses. The dead and half fallen fronds soon make a dense thicket.

With the advent of the high tides bearing mangrove seeds, the same masses of fronds effectively keep out the floating seeds. The mangroves could undoubtedly recapture these areas but it would be a slow centripetal movement brought about by border shading and seeding in amongst the resulting less vigorous ferns. The number of years for such a succession to take place might run into a great many decades dependent on the initial size of the opening. Such areas are rather extensive in the San Juan District and have undoubtedly resulted from overcutting in the past.

Since conditions for mangrove growth are satisfactory except for the competition of the marunguey, there is a possibility of reforestation. The main problem is, of course, the removal of the dense fern cover. Project work in the San Juan District during 1937 showed that such removal can be done most effectively in the following manner:

Between January and April when the dry season is in progress, set fire to and burn through the patches of marunguey. Fortunately, the fire will not burn into the manglares at even the driest time of year but a border strip should be cleared previous to burning to prevent heat injury to existing trees, or the passage of fire to drier land in the event that the marunguey areas are located on the swamp borders. Complete consumption of the green fronds is not attainable but such a large proportion of the material is burned that later clearing with a machete is greatly facilitated.

The next step is the clearing or "talado". The most important operation to be carried on, which should be firmly impressed on the workmen, is the cutting through of the fern rhizomes as far back from the growing point as the earth permits, since the rhizomes are only partly epigean.

The cost of cutting border strips and burning varies in accordance with the size of the openings but should run less than $3 per acre. Machete work will average between $5 and $8 per acre. The same process carried on at another time of the year will probably be more expensive due to poorer burning. A second going over the area with machetes should take place about two months after the first clearing to cut back any rhizomes missed the first time, which will be indicated by new leaves. This should cost less than $1 per acre. All labor costs given are on the basis of $1 for an 8-hour day.

The remaining cleared area may be planted direct with seedlings to be discussed later or left for natural seeding by the high tides in September and October. Once established the area should need very little care until the time for the first thinning.

However, on the basis of these ecological observations, future cutting plans should be drawn up with due consideration given to the marunguey. Where it occurs in the understory of a stand any cutting done should be lighter and more frequent or some cutting back of the fern should be carried on contemporaneously with the mangle felling.

4. "Salitrals" or areas of high saline content.- Along the south coast and more especially in the Boquerón district, one finds areas within the mangrove swamps devoid of all vegetation. These vary in size but sometimes comprise an area of over 10 acres. Here there is no doubt that the lack of plant life is due to the toxic effect of a high saline content of the soil. Walking across the area in full sunlight, one notices the dazzling brightness caused by the reflection of the light from myriads of crystals.

These areas usually border the higher ground above the tides and are evidently one stage in the land-building process of the mangles. Due to the accumulation of silt and organic matter, the soil level about the roots of the mangroves is being built up gradually towards the high-tide mark. With the attainment of each unit of height there is a correspondingly greater length of time of exposure above water and a longer period of evaporation from shallow water and the wet mud. In other parts of the island due to heavier rainfall there is less insolation and a greater precent of fresh water coming from the land side which tends to counteract the process by less evaporation and solution of the salt. In this region, rainfall approximates 40 inches per year, more or less concentrated in the months of August to October, which at our latitude results in arid conditions. It is along the same coast on the southwestern corner of Puerto Rico that one finds the commercial extraction of salt by means of solar evaporation of sea water being carried on. As the concentration of salt increases, the trees are slowly killed, due to their inability to obtain water and food solutes. The curve of tree death is graphically depicted on the borders of the areas where tall mangles are fronted by trees of gradually decreasing height and increasing weakness to the point zero where mangle growth is impossible. Such areas must start at focal points along the shore or dry land, spreading slowly towards the sea and more rapidly along the coast because most all of the areas have a much longer dimension parallel to the dry land.

Undoubtedly, these areas are impossible to reforest and there is little that can be done to restrict their increase in size. In the future, eroded soil will gradually wash down from the highlands to spread a layer of fresh soil over the salt and eventually nature will again use a gradually increasing portion of the area for the growth of dry-land vegetation.

Direct seeding

The red mangrove possesses a most peculiar fruit especially adapted to the environment of this species. The fruit itself is small, about 1 to 2 inches long, but from this is developed, while still attached to the tree, a pencil-shaped, acute-pointed radicle from 6 to 15 inches in length. This accounts for their local name "tabacos" or cigars, and the tree name "chifle de vaca" or "cow's horn" used in the Guánica section. When mature the embryo literally drops out of the fruit. If it falls on a muddy surface, the point of the radicle is driven into the silt and rooting and growth takes place immediately. If it falls into the water, it floats vertically, with the tip of the radicle downwards, and may strike root when it comes in contact with mud in shallow water.

Whether these seeds become heavier than water after some period of floating and sink to the bottom, and if so, whether they are still capable of rooting and growing is not known, but such might account for clumps which become established separately in deep water.

Such a seed as this lends itself exceptionally well to direct-seeding purposes. It fruits quite abundantly, can easily be collected from a boat along the water edges, and is planted without benefit of tools by simply pushing the pointed radicle into the mud or soil. The lower portion of the radicle becomes russet-brown in color when mature. Several thousands of this fruit have been planted in the San Juan Manglare District, some in open places along the canals and others in clear patches of mud where reproduction was absent. Germination and survival obtained was over 90%. At Cayo Santiago, near the Playa of Humacao, a very small plantation was made in shallow water where at no time in the year is the mud exposed to the air, and there too survival was exceptionally high. The direct seeding of the mangle colorado is a cheap, practicable method of reforesting normal open spaces in the manglares where no other vegetation is present and where the water level is predominantly high and can be used for reforesting the shallow waters of lagoons or other bodies of brackish water if protected from high seas and provided the bottom is more or less at rest.

The seeds of the mangle botón are considered too small to make any direct seeding practicable with this species.

Mangle blanco and mangle negro might possibly be used in direct seeding, although up to the present time, no trial or experiment to determine such possibility has been undertaken. The fruit of the mangle negro looks and is similar in size to the seed of lima-bean. It starts to germinate while still attached to the tree and floats readily on the surface of the water. Mangle blanco fruits are one-seeded, grey in color and slightly smaller than the mangle negro. They too float in water and are widely dispersed by such means. Natural seeding of this species occurs much more readily than in any of the other three. Some of the marunguey areas which were cleared and planted were later seeded naturally during the period of high tides by this species and the present resulting stand consists of thousands of these seedlings per acre. They averaged between two and three feet in height when not quite one year old. Farther back from the canals, in the same areas, such seeding was much lighter probably because the water did not cover such areas.

Planting with natural seedlings or wildlings

Planting of natural seedlings of both mangle blanco and mangle negro was carried on in the San Juan District. These seedlings occur in natural beds throughout the manglares or in the small, open patches, and due to the softness of the soil, can be pulled out by hand without much damage to the roots. These trees were transported the short distance to the open areas and planted 8 ft. x 8 ft. in a regular hole dug by a mattock. Reexamination of some of these areas during August or about 10 months after planting showed excellent survival and rapid growth of the mangle blanco. The average height of the trees when planted was about 2 feet, some of which were already 5 feet in height at 10 months. Surprisingly, some of these trees 10 months after planting, or less than two years old from seed, are already flowering and seeding.

The mangle negro gave very poor results and further general planting with this species should not be carried out without previous experimentation to determine whether lifting with a fork to prevent damage to fine roots or any other technique is necessary to obtain a satisfactory survival.

Growth and yield

Mangrove growth or at least that of seedlings and saplings is rapid and, considering the purity of the stands and the high number of stems per acre, the yield should be high. However, no definite figures for growth or yield of Puerto Rican stands are available. Cuttings in later years have been in the order of clear cutting for charcoal or the removal of selected material for special uses, such as fence posts or hoe handles. No definite management or cutting plans have been in force. Whenever a certain amount of charcoal or posts were to be cut, a site was selected which contained the largest material. Income from the manglares for the last 10 or 15 years is bound to be misleading due to the fact that a part of this income represents a depletion in stock. How far this depletion has gone can readily be seen in the San Juan District where one would have to cover a large area in order to find a 6-inch D.B.H. tree. It is hard to believe that the most profitable time to cut a species, which at maturity attains a diameter of 2 feet or over, would be when the tree had not attained a D.B.H of 6 inches.

To give a better picture of the conditions of the stands, let us consider for a moment the counts obtained in setting up a thinning and growth experiment in the San Juan District in 1938. Tally of the stems on 5 quarter-acre plots in a typical repeatedly cut stand, now largely composed of mangle blanco, gave an average of over 17,000 stems per acre. Of these, about 60% were less than one-half inch in diameter and the largest stem was only 3.7 inches D.B.H. On the basis of examination of these plots and the manglare in general, the following cutting plans are suggested for initiation of management plans until more data on growth and merchantable age can be secured.

Assume a growth rate of 2 inches in diameter in every 5 years which should approximate the average on the island. Divide each manglare district into 5 blocks or compartments on the basis of acreage and natural boundaries such as lagoons, canals, etc., with a cutting cycle of 5 years and set a rotation temporarily of 25 years. Thinnings and selective cutting are possible due to local markets for all sizes and the abundant labor available. Consider the stand by 2-inch diameter classes such as 1.1 to 3.0 inches, 3.1 to 5.0 inches, etc., which roughly correspond to the desired sizes of saleable material and thin out approximately the same percent from each diameter class present to leave a satisfactory density of stand for growth during the following 5-year period.

During the first rotation, sufficient data could be accumulated to work out exact figures on growth, merchantable age, etc., and such refinements as percent of the various species to be left, etc. The system is proposed as a safety measure to prevent overcutting and as a means of increasing production. It is felt that if such a cutting plan is put into effect the manglares will be considerably more productive following the first two cutting cycles.

Protection

Trespass.- Due to the location of the manglares in the lowlands, adjacent to heavily populated districts, a strict vigilance is necessary to prevent timber theft. The present system of guards appears to be efficient and adequate although sometimes local courts are very lenient to trespassers and tend to propagate a disregard for boundary lines. Possibly some educative material, respective to the value of these areas for Insular prosperity, would help to remedy the latter situation.

Diseases.- At the present time, no important disease is known to affect the various species of mangroves. Removal of material infected by secondary wood rots during silvicultural operations might lessen somewhat the loss of timber from this source.

Insects.- Termite damage to living trees is very common in the manglares. The nests of these insects are found above ground, attached to the stems of the trees, and can easily be poisoned. Best control is secured by making a hole in the nest and inserting Paris green. It is not always effective and a later check-up should be made.

There are two species of insects which cause considerable damage in their larval stage by boring through the mangle stems. These are a buprestid beetle, Chrysobothris tranquebarica Gmelin, and a lepidopterous borer, Psychonoctua personalis Grote. Little data as to the extent of their damage is available except that personal observations show a rather high percent of infected stems.

Summary

The mangrove swamps of Puerto Rico, comprising an area of approximately 16,000 acres, are highly productive and suitable for profitable management. About 11,000 acres are administered by the Insular Forest Service.

White, black, red, and button mangrove make up the greater part of the stand. The red mangrove occurs in the wettest spots or even in the water, the button mangrove on the dry edge of the swamps or on the adjacent high ground with the black and white mangrove in the swamp areas between the former two species. The woods are not of high value, but find a ready market for miscellaneous uses.

Various openings in the mangrove swamps consist of areas of clear-cut red mangrove, the one species which does not sprout readily from the stump, of areas covered with the fern, Acrostichum aureum, or of highly saline areas in the drier parts of the island. The first areas may be reforested by direct seeding with red mangrove while burning and clearing of the fern areas followed by planting with wildlings of the white mangrove has given excellent results.

Based on the local market and an estimated growth of 2 inches in 5 years, a selection system of cutting with a 25-year rotation and 5-year cutting cycle is recommended.

Protection from timber theft is necessary due to the adjacent concentrations of people. Diseases and insects present no severe problems.

Resumen

Los manglares de Puerto Rico, que comprenden aproximadamente 16,000 acres, son sumamente productivos y apropiados para una explotación lucrativa. Cerca de 11,000 acres son administrados por el Servicio Forestal Insular.

La mayor parte del rodal está formado de mangle blanco, negro, colorado y botón. El mangle colorado se encuentra en los sitios más húmedos y hasta en el agua, el mangle botón en las orillas secas del pantano o en los terrenos elevados adyacentes, y el mangle blanco y el negro, en las áreas pantanosas entre las dos primeras especies. Las maderas no son de un gran valor, pero tienen buen mercado para usos diversos.

Los diferentes claros en los manglares consisten de áreas en donde se ha cortado el mangle colorado, la única especie que no retoña después de cortada, de áreas cubiertas del helecho Acrostichum aureum, o de áreas demasiado salinas en las partes más secas de la isla. Las primeras áreas pueden repoblarse con semilla de mangle colorado por medio de siembra directa, mientras que quemando y limpiando las áreas de helecho, seguido de siembra con plántulas silvestres de mangle blanco, ha dado excelentes resultados.

Basado en el mercado local y un estimado en crecimiento de 2 pulgadas en cinco años, se recomienda un método de selección bajo una rotación de veinticinco años y ciclo de cortas de cinco años.

Es necesario la protección contra el robo de madera debido a la aglomeración de personas en los sitios adyacentes. Las enfermedades e insectos no presentan un problema serio.

NOTES ON THE PACIFIC COAST REGION OF NICARAGUA

R. E. Harding, Managua, Nicaragua

Nicaragua may be divided roughly into three zones: (1) the Pacific coast, (2) the highlands of the interior, and (3) the wet Atlantic coast.

The Pacific coast region comprises a long, wide plain extending from the Gulf of Fonseca on the north to the Costa Rican boundary on the south. Down the center of the plain and dividing it into two parts stretches a chain of detached volcanic mountains. They attain their highest elevations in the volcanic peaks of El Viejo in the north, and Ometepe in the south, both of which reach an altitude of 6,000 ft. above sea level. Between this volcanic range and the sea, there is a line of hills of high elevation in the center but low to the north and south. The highest elevations of approximately 3,000 ft. are reached in the Sierras de Managua.

The climate is dry in the center of the area with greater precipitation in the north, Chinandega, and in the south, Rivas, although neither of the latter may be called wet areas. The seasons are well defined, with the rainy season from May to November and the dry season from December to May.

The plain has been largely deforested and is now made up of pastures, secondary forest growth and large areas of "jicarales" or gourd plains. These "jicarales" are covered with a rank grass growth and spiny plants. The ground is swampy during the rainy season and becomes dry and cracked in the dry season, making it unfit for agricultural use. In other parts of the plain, especially in Chinandega, León, and Rivas, the soils are very fertile and large crops of maize, rice and beans are grown.

The richest parts of the Pacific coast section are the Sierras de Managua and the high tableland of Carazo. Here, the chief crop is coffee, the ground is fertile, and the climate is cool, averaging from 60° to 65° F.

The Sierras are well wooded in the valleys, but a mistake has been made in cutting the trees on the ridges causing the rainy seasons to become erratic. For the last three years we have had no real rainy season. Nothing is being done to correct this situation and deforestation continues. There is a large number of tree species in the region, the chief kinds being cedar - Cedrela odorata L., mahogany - Swietenia mahagoni Jacq., guapinol - Hymenaea courbaril L., panamá - Sterculia apetala (Jacq.) Karst., ojoche, and several kinds of Ficus.

I have planted cedar, roble, and other trees, but owing to the lack of rains in the last two years, they have not done very well. At first, direct seeding was tried, but most of the trees dried up or were trodden down. Now, seedlings are raised in nurseries and transplanted when they are about thirty inches high.

For coffee-shade trees, I am planting Inga and Erythrina. The former seem to be the best for Nicaragua as the Erythrinas lose their leaves during the dry season and have spiny trunks. Other shade trees used in Nicaragua with

varying success are: madero negro - Gliricidia sepium (Jacq.) Steud., guanacaste - Enterolobium cyclocarpum (Jacq.) Griseb., pisquin - Albizzia moluccana Miq., and the original forest trees.

One species that I have found to be a wonderful shade tree is a kind of Ficus, locally called "copel". I am sorry I am unable to give the specific name for this tree, but as far as I know, the "Ficus" group has never been studied here and it is not mentioned in Goyena's "Flora Nicaraguense". The leaves are a light laurel green in color. The tree is propagated from branch cuttings and grows very fast. It is the only coffee shade tree here which will resist the effects of volcanic fumes and ashes. This may be of interest to planters in Hawaii and the Philippines where they are bothered by volcanic activity. Coffee grows very well under this tree, always looking fresh and bearing evenly. The extreme height to which this shade tree grows is probably its only defect.

Resumen

La región de la costa del Pacífico de Nicaragua está compuesta de una llanura larga y ancha dividida por una cadena de montañas volcánicas con montes más bajos entre éstas y el mar. El clima es seco y las estaciones del año bien definidas.

La llanura tiene grandes áreas inservibles para la agricultura. La tumba del bosque en las laderas de las feraces Sierras de Managua, donde el café es el producto principal, es muy seria. La región es fecunda en árboles tales como cedro, caoba, guapinol, ojoche, panamá, y varias especies de Ficus.

El que suscribe está sembrando árboles forestales y de sombra para el café. El copel es un árbol de sombra de interés, el cual se propaga por medio de esquejes de ramas y resiste muy bien las cenizas y vapores volcánicos.

SELECTION OF SPECIES FOR REFORESTATION

The selection of tree species for reforestation purposes constitutes one of the first problems which confront the forest worker in this region. Too often in the past there has been a tendency to use a high percent of exotic species in preference to local trees, probably because printed data on the technique of handling and favorable results of plantations in other regions were available for the former.

The following observations are so fundamental to the proper selection of species and so well expressed that they merit more attention. They are copies verbatim from the "Report on the Forestry Problems of Jamaica" by A. Wimbush, Chief Conservator of Forests, Madras and Forest Advisor, Jamaica, 23rd December, 1935:

> "It is necessary to be very chary of trying to lay down the species of tree to be grown in any special locality. Experiments are required, and this is one of the main reasons why a trained Forest Officer is necessary. A few commonsense rules may, however, be laid down:-
>
> (1) Consider first the object of management. If it is merely to clothe an area for protective purposes, the species most easily and quickly grown are indicated. In the catchment area roseapple (Eugenia Jambos) and bamboo appear to grow like weeds, and Cassia siamea would also grow quickly from seed, if the soil were loosened.
>
> (2) Study the species growing in the locality naturally, and choose those which are doing best. Height growth is an indication of the depth of soil, and if the existing trees on any area are all stunted and small, it is not a bit of use expecting that planted trees will do any better.
>
> (3) Invariably consult the old, local, residents, however humble.
>
> (4) Realize that it is no more reasonable to expect a bad seedling to grow into a good tree, than it is to expect a half-starved, stunted slum child to grow into a fine man. Thus if poor, lanky tree seedlings, with an undeveloped root system, are obtained from a nursery and then have their roots exposed to the air, and are then planted with their roots doubled up in too small a hole, they cannot be expected to flourish.

SELECCION DE ESPECIES PARA REPOBLACION

(Traducción del artículo anterior)

La selección de especies de árboles para fines de repoblación forestal constituye uno de los primeros problemas con que se confronta el silvicultor en esta región. Muy a menudo en el pasado ha habido tendencia a utilizar un alto por ciento de especies exóticas en preferencia a las nativas, probablemente debido a la influencia de literatura al efecto y de los resultados favorables de plantaciones de tales exóticos en otras regiones.

Las siguientes observaciones son tan fundamentales para la propia selección de especies y han sido tan bien expuestas que merecen más atención. Se han copiado textualmente del "Report on the Forestry Problems of Jamaica" por A. Wimbush, "Chief Conservator of Forests, Madras" y "Forest Advisor, Jamaica", y fechado a 23 de diciembre de 1935:

> "Es necesario ser muy precavido al escoger las especies de árboles a sembrar en cualquier localidad. Esto requiere experimentos, lo cual hace necesarios los servicios de técnicos forestales. Sin embargo, se pueden adelantar algunas reglas lógicas:
>
> (1) Considérese primero el objetivo en mente. Si éste es meramente cubrir cierta área con fines de protección, se recomiendan aquellas especies de desarrollo más fácil y rápido. En el área de recogimiento de los arrastres, la pomarrosa, Eugenia jambos, y bambú parecen crecer con gran rapidez y Cassia siamea desarrollaría igualmente de semilla si el suelo recibiera cultivo.
>
> (2) Observe las especies que crecen espontáneas en la localidad y seleccione las mejores. El crecimiento indica la profundidad del suelo y si los árboles existentes en cualquier área están estacionados y pequenos, no es de esperarse que los que se siembren crezcan mejor.
>
> (3) Invariablemente consulte los vecinos de más antigua permanencia no importa lo humilde que sean.
>
> (4) Considere que no es más razonable suponer que una plántula inferior desarrolle en un árbol fuerte, que un niño desnutrido y poco desarrollado se convierta en un hombre vigoroso. Así, si a arbolitos endebles con un sistema radical poco desarrollado, se le exponen éstas al aire y luego se siembran con las raíces dobladas en un hoyo muy pequeño, no es de esperarse que tales arbolitos prosperen."


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