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Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

Introduction

The following report attempts to summarize observations made during a stay in Colombia from December 29,1943 to March 26,1944, but only those observations which relate to: The existing Federal Experiment Stations, those other stations to which the writer was taken and finally those sites where future stations are projected.

The stations and sites were examined with the intent of recording their present organization as it related to operation, and of considering possibilites of future operations and developments. Certain of the sites could be axamined only as related to their potentialities.

Only such additional comments are made as seem necessary to explain the approach or as seem pertinent to an orientation for future developments.

In addition to this rather objective reporting, there are many data gathered after the writer's return to Washington,D.C. in an attempt to summarize material already published which relates to specific problems presented by colleagues in Colombia or general conditions observed by the writer. In the preparation of these portions the writer has had the assistance of various colleagues all of whom are mentioned in the appropriate places and whose assistance is gratefully acknowledged here.

It may well be regarded that there are other factors in the development of Colombian agriculture that must be considered in any general study but which lie entirely outside of the present considerations, of which the writer is keenly aware and which must be considered before changes are made in the program of experimentation and station development, not the least of these being the system of transportation and intercommunications between markets.

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General Discussion of Existing Stations

and other Agricultural Centers

Federal Experiment Stations

There are now in operation the following stations: Armero, Palmira, La Picota, Sevilla. At the time of leaving Bogotá (March 25, 1944), no decisions had been reached as to the possible sites for the remaining stations, contemplated as necessary to occupy other altitude zones, as indicated by Dr. Lopez during his conversations in Washington in 1943. They are, as conceived, a station for the páramo (alt. 3000 m); a station between 1500-2500 m which Dr. Lopez usually assigns in conversation to the Santanders; a new station possibly to replace Sevilla which does not have adequate land and a station with an elevation similar to that of Sevilla but a wetter climate.

No reference is made at this time of sub-stations, some of which will be discussed later.

In approaching the study of the experiment station, it might be recalled that all of these stations are now operated by the Ministerio de Agricultura, which is within Economía Nacional, just as is the newly created Sección de Fomento created to administer the present loan for agricultural development.

At no time was there any suggestion of non-cooperation between the sections, but there was also no indication that the older section, which has much smaller appropriations, had been consulted in formulating the general scheme as finally presented in Dr. Lopez' report to the President dated June 30, 1943. The only occasion when the writer was present at a joint meeting (February 16) of representatives of Agricultura and Fomento was indicative of difficulties which might arise in a similar fashion in working out the attempted bases of cooperation.

It had come to the attention of Fomento that Agriculture was about to undertake on a commercial scale the increase of seed stocks of rice, sesame, cotton and wheat, using as planting stock the basic stocks developed at their own stations. The Fomento indicated its willingness to take over this program, relieving Agriculture of all responsibility save technical advice. This was neither declined nor accepted at that meeting, but the writer asked as an aside if such a transfer might not liberate the funds of Agriculture for some other project and was told that it would not, which leaves Agriculture with no obvious advantage since their limited personnel would be equally busy under either arrangement.

This instance is cited only because it seems probable that the idea of relieving the present stations of the production of planting stock, by the creation of "Propagation Centers" presents definite problems for Agriculture.

It should be recorded further that the moneys received from the sale of planting stocks in some cases revert to the station for use on the station property. The new laboratory building at Armero was constructed from such funds and at the meetings held at Medellín, it was recommended that Armero be authorized to set aside from similar funds a sum to be used for sending members of their staff to foreign countries for study.

The functions of the experiment stations as they now exist fall into two general groups: the research activities of the entire staff with all the crops proper to the area, and the extension activities which comprise two sections, the furnishing of general advice and service and the production of high grade planting stocks for the public. Since both personnel and appropriations are limited, it is not difficult to understand why the production of planting stocks sometimes takes precedence over other work. It should be noted here that the extension activities do not supplant the special "campañas" for particular crops which are conducted by the agricultural services of the several "departamentos" (states), although there is often a more or less active cooperation in personnel.

Experimental Station at Palmira (Valle).

The site of this station, some twenty kilometers from Cali, is more or less typical of many of the farm sites in the Valle. It is practically level throughout with certain drainage problems which are aggravated in some parts by the presence of a hard pan that raises the water table seriously in long periods of rain, causing the failure of some trial plantings.

The plantings of importance are sugar cane and rice. There is an excellent collection of citrus, fair collections of avocados and mangoes, some miscellaneous tropical fruit, a rather indifferent collection of deciduous fruits, the beginnings of collections of grapes and pineapples, a small nursery for the production of miscellaneous trees (timber and others), trial plots of cotton (possibly not a permanent project), fique, African oil palms, a small collection of Aleurites montana, a trial planting of Hevea brasiliensis, a small area for vegetable tests, the beginnings of a cacao collection.

The buildings include a large laboratory and office building, director's residence, dormitory, seed-cleaning and storage building, machinery and tool shop, and storage building, small sugar mill (not yet completed), a special propagation unit for cacao, and various minor buildings. No record was made of the equipment related to animals and fowls.

In discussing the building situation, the chief need expressed was for other living quarters on the property in order to save workers time, for those who must now live either in Cali or Palmira, and for sufficient funds to complete various structures begun but not finished.

Projects. The Rice project consists essentially of the testing of introduced varieties, of which almost 200 have been studied by the station, the production of pure stocks in amounts sufficient to measure their commercial value and the increase of those few varieties that survive these tests. There appeared to be relatively little hybridization.

Sugar cane. This is an extension of the work initiated years ago by Sorenson and carried out in conjunction with the Division of Sugar Plants, Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture. There is an active hybridization program and an annual planting of new generations. There is also an active propagation program of materials for placement, but not in sufficient size to replace all the diseased cane even in the nearer areas of the Valle. The phyto-

pathologist of the station has more than enough to do for sugarcane work to keep him busy, and the station chemist, according to some, devotes more time to sugar than is reasonable for a general station.

This situation is perhaps understandable since the station was originally established as a sugar station.

Fruits. The citrus collections are extensive and contain most of the basic material, as well as a considerable number of excellent hybrids produced at Palmira which have not yet been put into general cultivation. Possibly the only crying need is for additional stock materials of citrus and citrus relatives suited for tropics. Swinglea is well represented. Plant sanitation poor.

The avocado and mango collections are good but incomplete and need many additions.

The miscellaneous tropical and subtropical collections are incomplete, although there are some unusual plants.

The deciduous fruits are almost without exception in very poor condition. It is the opinion of the writer that, if deciduous fruits are to be grown at Palmira, an extensive variety test must be carried on to discover if there are any varieties that will grow there.

The pineapple collection is not adequate in varieties but promises well. New varieties are badly needed and will be sent. Some definite collecting of Colombian forms should be undertaken, with importations from other centers wherever pineapples are grown.

Grapes. The grape collection, largely sent from the U. S. Department of Agriculture, has just been moved to a more suitable soil location on the station grounds. It is the center of much interest because of a commercial grape development farther north in the Valle. On the whole, the grapes appear to suffer from some of the same difficulties encountered by other deciduous fruits and, in the opinion of many, it remains to be seen how permanent the vineyards will be under commercial treatment, as compared to behavior of the same varieties under dooryard conditions.

Miscellaneous tropical and subtropical fruits. This is a section of unlimited possibilities for introduction, but a section which may or may not provide commercial outlet depending very largely upon the initiative of the individual as related to the local market and the export market.

Cacao. This is the subject of active interest in Colombia at the present time, largely as a result of the recent trip of Dr. F. J. Pound of the Agricultural Department, St. Clair, Trinidad, B.W.I. The Palmira station has a small group of trees, one of which has an unusual production record, growing in the open, without the usual high shade protection.

The project at Palmira includes a propagation scheme, based on Dr. Pound's methods, which is to include not only this desirable tree but also any others of quality and disease resistance. The details of this general survey for resistant, high quality trees had not been worked out at the time of the writer's visit.

Miscellaneous trees. This is a small separate project which could easily be combined with other nursery phases in the future. In the writer's opinion, it does not have adequate propagation structures or facilities.

Cotton. This is not an official project at Palmira and it is now assumed that cotton work will be concentrated at Armero for this portion of Colombia. Its success or failure as a crop without irrigation depends upon its proper development before the dry season checks its growth and the possible rains towards ripening. The opinion was expressed that, if timing was properly studied and a little supplementary water given as irrigation, cotton might become a successful crop in this portion of the Valle. The present season at Palmira has been excellent and there were fine blocks of Watson, Brazil Express, Delta Pine, etc.

Fique. This is planted at Palmira only as a matter of planting stock and excellent plants show its vigor.

African oil palms. There is an old grove of these on the station which are not being exploited beyond serving as a source of seeds for planters elsewhere in the country.

Aleurites montana. There is a small collection of these in good condition but with the appearance of having slowed down in development somewhat prematurely.

Hevea rubber. The planting is really represented by a nursery now overgrown. A limited number of the trees have recently been budded to known clonal stocks in spite of the fact that they were not in ideal condition for budding. The general conditions of the untouched trees suggest that Hevea is worth a second thought as a possible crop.

Vegetables. As conducted at present, the vegetable trials are too limited in scope and variety to be significant, but there was no discussion of what might have been carried out before the present time, so that no criticism is implied by the suggestion that this phase might be expanded.

Escuela Superior de Agricultura, Cali (Valle)

Although the school as it exists today is a small affair, inadequately housed and staffed, the Departamento del Valle which runs the school has just purchased a considerable acreage which is more or less contiguous with the property of the Palmira station and has plans for the reorganization of its curriculum in such a way that it can become a really effective organization.

Its present director, Dr. Vicente Velasco, graduate of Cornell and entomologist by training, working with Dr. Ciro Molino, Director of Agriculture for El Valle, will undoubtedly do a good job in working out the details of the working plans, and it is not impossible that some of the plant collections of the School could be substituted for those of the station, relieving the latter of various maintenance costs.

The School is using as a basis for its revision of curriculum the outlines prepared in Medellín by a subcommittee of which Dr. H. V. Geib was a member. The writer was unable to obtain a copy of this outline.

At the school there is in progress a reorganization of the library and the herbarium. The latter is under the direction of Dr. José Cuatrecasas who was absent on a collecting trip in the Chocó during the entire period of my visit in the area.

No discussions occurred to show the precise orientation of the training, but there is the feeling among the few Americans with whom the writer talked that the school may well become a healthy rival of Medellín and, since the lower altitude makes possible the better growth of many plants, their competition should not be harmful.

General trip through the Valle. Through the courtesy of Dr. Ciro Molino, the writer was given a long day's trip by auto: Cali, Palmira, Buga, Tuluá, Andalucía, Bugalagrande, Zarzal, Roldanillo, Bolivar, La Unión. This follows the eastern side of the Valle going north with a short trip in the western side in the neighborhood of La Unión and return by same route.

The general director of trip was Dr. Velasco, but the following members of Dr. Ciro Molino's group as companions: Dr. Jorge Echeverri (fibers), Dr. Guillermo Ortiz (tobacco), Dr. Carlos Sanclemente (Sanidad vegetal). At Buga we were joined by Dr. Lorenzo García, director of the Escuela Normal Vocacional.

The trip showed the correctness of the general statement often made, that the level lands of the valley floor are almost exclusively devoted to pastures for cattle and that the higher lands are cropped. The only conspicuous crops in the area visited are rice, sugar cane and corn. Small holdings, of course, show all the varied food crops needed for the maintenance of the family unit, and the markets showed the usual offerings of foodstuffs in small quantities for all items save corn, potatoes, citrus fruits, yuca and beans. The markets were essentially like country markets both in quality and amounts.

The large sugar plantations are chiefly in the regions outside and north of Palmira, and the one large producer of rice in the area, Dr. Carlos Duran Castro, lives in Bogotá.

In general discussions regarding the Valle, it was stressed that to insure regular production, controlled irrigation would have to be undertaken. There are many small streams which flow into the valley from the east which are now utilized in part according to the means of the land owners through whose properties they flow. It was the opinion of all that a series of reservoirs in the hills would eliminate any danger of scanty flow during the two annual dry seasons. Inquiry showed that those dams could be constructed on government-controlled public lands, but the writer was told that there is a considerable body of laws and regulations that control water rights, so it appears that some study of these must precede any development of irrigation schemes.

The writer was also told that there would be a large consuming market for electric power and current and some concern was expressed in the Embassy in Bogotá that some of these schemes might influence adversely the activities of the company that now furnishes electricity to Cali, a company with North American capital.

The specific reason for visiting the areas about the small towns of Bolivar and La Unión was to see the relatively new plantations of grapes. These are based entirely upon varieties that have grown in Colombia for centuries, reputed to have been brought in by early Spanish settlers. One is known as Maravilla de Francia, another Isabellina, and so on. All are of vinifera type, are propagated by cuttings, and are maintained in continuous growth and production. They are trained on trellises, the more common system being to train a single stem to the desired height and then spread the branches over a horizontal spread of wires supported on the arms of the cross member. There appears to be continuous spraying with Bordeaux, some thinning of the berries in the bunch and a limited bagging of bunches to protect from insect stings, chiefly wasps.

As compared with the vinifera grapes that reach our market from California, the bunches are smaller and the flavors are less sweet than the ordinary commercial strains.

It should be noted that grapes are being developed on the drier and somewhat warmer, western side of the Valle.

The entire production is taken up in Colombia, many of the grapes reaching the Bogotá market, but it is the hope of some of the men that eventually they can ship to the States in a season when we have no grapes.

Aside from the interest of Dr. Ciro Molino and of the staff of the Palmira Station, there seemed to be no special interest in trying other varieties and no one mentioned the possibility of hybridization, using these long acclimatized varieties as a basis.

In talking with Dr. Wilson Popenoe, whom the writer saw in Bogotá, the grape project in the Valle was mentioned since he had been consulted by the growers there and had expressed an opinion of doubt as to the success of the venture. He told the writer that his fears were based on the transformation of the grape into a plant of continuous production, which is not its normal habit, with a limited provision of chemical fertilizers, and even more limited experience on the part of the growers in developing a system of pruning.

One private planting was visited near Bolivar, where the work was under the supervision of Don Ceferino Gonzales, an elderly Spanish refugee who appears to have had considerable experience in Europe and reported himself entirely optimistic over the prospect.

On his property there were some small genetic experiments with wheat, tomatoes, castor beans, etc., under the care of Sr. Nino Ferrario, Ing. Agr., who appears to be on the payroll of the Valle and acts more or less as general advisor to farmers of the area, particularly those growing grapes, which were to be seen in small numbers in many small garden enclosures.

Escuela Normal Vocacional de Buga. This school has a dual function. It is intended to give general courses to teachers already trained and ready to teach or teaching, so they can add agricultural studies to their curricula, and to provide a general education plus agriculture to the small boys, 6-14 years, who do not live at the school but who work there over a long day with their own small gardens and then work with field crops and farm animals.

The school is modestly equipped but the responses are excellent, doubtless due largely to the skill and enthusiasm of the then director, Dr. Lorenzo García, a North American trained Puerto Rican, who has just moved to the Facultad de Agronomía in Medellín.

There is a very definite feeling in many quarters that the only way to accomplish a genuine agricultural reform in Colombia is by the creation of such vocational schools, but on a much more adequate basis and with the major attention focused on the boys rather than on the teacher-training program. Quite aside from a genuine lack of capital with which to work, the small farmer is often restricted in his growth by a conservative tradition inherited from the past. The children at the school accept the new routines and learn the advantages without being aware of any issue.

One small granja belonging to the Departamento del Valle was visited. It was immediately apparent that it had insufficient funds and personnel. Perhaps the most interesting crop was the small patch of excellent roselle.

Experiment Station at Armero (Tolima).

Of the national stations, this has the largest area of good land, with a large section of valley floor, some rolling land and a considerable acreage of higher rough land. The level area is devoted entirely to field crops, chiefly cotton, sesame and corn, with smaller plots of beans, soyas, crotalaria, etc., and is divided into a small section for varietal tests, a larger section for plot studies (fertilizers, times of sowing, etc.) and a major portion for large-scale seed production. The rolling land is the site of the present building group, the nurseries for the production of fruit trees, the permanent collections of citrus, avocados, mangoes, grapes and miscellaneous tropicals. At the base of the rougher higher land is the nursery of forest and other trees, part of which are to be planted by the station on the rougher parts of the station property as a reforestation study.

The land was reported by the station workers as deep and fertile, with adequate soil moisture. Irrigation is resorted to only when actually needed. The general appearance of the plots and fields was excellent. The citrus collection was the only planting of citrus seen which was clean and free of scale, etc., as well as the only collection seen in which the trees were trained with low heads and with careful trunk and branch pruning in order to assure the proper development of the crown and production of fruit.

There are small plots of roselle and an initial planting of Derris from material sent by Dr. Geib.

In discussing the problems of the workers as related to plant materials desired, they were outlined as extensions of their present projects: cotton varieties (using Delta Pine as an example of the present most successful variety), mango and avocado varieties of any and all sorts, miscellaneous tropical and subtropical fruits, corn varieties for small breeding project, sesame varieties if available. Data were requested in regard to bamboo, weed eradication, and the preparation of bacterial cultures for inoculating legumes.

It is obvious that if this station were relieved of bulk production of seeds (cotton, sesame, soy beans, etc.) there would be much more land available for work with hybrids produced on the station.

Experimental Station "La Picota", Bogotá (Cundinamarca)

The station is located about 45 minutes ride from Bogotá, on a property which has been seriously curtailed by a former ministry that took over a large portion for a school.

The station's work with plants is devoted entirely to cereals in the following order of importance: wheat, oats, barley, rye. Grasses and forage crops, chiefly legumes, are handled by the section of animal husbandry.

The major projects are the introduction and testing of varieties, the production of hybrids, and the multiplication of pure seed stocks for commercial planting (sales). There is the associated project in milling and baking.

Except for minor matters, the buildings and equipment are adequate. It is interesting to note that the equipment in the milling and baking unit is almost entirely German and that part of it is labeled as having been given to the station by the makers.

Land is definitely limited, so that the removal of the project for production of seed stocks on commercial scale would be a relief.

The station is well kept.

Visits near Medellín

Rio Negro sub-station. This is a small nursery station for the production of fruit trees, about two hours out of Medellín on the road to Rio Negro. It is a small station with few facilities, almost no staff, and a general atmosphere of neglect.

Apparently all fruits are propagated either by cuttings or are grafted on stocks which are raised from cuttings, quince or plum.

As a practice grafting takes precedence over budding and no effort seems to be made to keep the unions near the ground level. Stocks are irregular in size and apparently in age.

Cuttings are placed thickly in rows, the rows spaced about 5 inches apart, in "Dutch" beds raised slightly above the level of soil. No shade was given and no mulches are used to make the moisture conditions uniform. In "good" seasons practically perfect stands are obtained. The rooted cutting is then transplanted to nursery row for budding or grafting. Since there is no period in which the stock is dormant as we understand that term, the degree of success obtained is even more surprising.

There were a few citrus present, but no great number in propagation. A very fair number of figs from cuttings were the chief novelties. Small patches of lentils, garbanzas (chick peas), broad beans, and potatoes were the only side lines, although there were also some small patches of forage legumes.

The general impression of the station was that the propagator or caretaker was not "on the job 24 hours a day" as all good propagators should be.

On the way to find this small station, we stopped at a private place where apples are grown for sale of fruits.

The orchard was given almost gardenlike care, with the trees planted in cultivated circles cut in grass lawn. Each tree was trained so that its low head was spread outward from the central axis, the extremities of the branches being tied to a bamboo hoop about 2 feet from the soil level, like a little fence surrounding each circular plot. This enforced position was said to interfere with the free flow of sap and check the rampant growth of wood. To induce some degree of uniform flowering, it was the practice to strip the trees of leaves (in January at this place) so that the constantly flowing sap would make an immediate effect upon the flower buds on the fruiting spurs.

The trees were well sprayed and probably were well fertilized. Manure from their own stables and dairy barns was available. The only question that came to mind was whether or not a careful system of pruning might not have been of assistance in inducing the formation of a greater number of fruiting spurs, since these trees appeared to be old enough to be carrying more fruit than they showed.

No tree without training was noticed, but it is probable that all would have shown the almost Lombardy poplar-like habit which deciduous fruits show in many parts of Colombia.

Since there was a small "forest tree nursery" located in this area, a visit was made to observe the organization. Apparently all propagation was from seed in open nursery beds, with or without lath shade, mostly without. Judged from the usual practices in the States, there was very poor care. Seeds of quick germination were planted in the same bed as those of slow germination, no uniform moisture conditions were maintained, no variety of soil mixtures was provided, only common names were used to make sowings. Costs undoubtedly were at a minimum, but production was far below what might have been had with a very little additional care and preparation.

Envigado. A visit was made to a small commercial place which is said to supply the "quality" trade for Medellín in oranges and apples. This is located in the rich valley floor and not on the hillside where most of the Envigado places are situated. There is irrigation water. The only resident is apparently the manager. The place is not well kept although there is some attempt at clean cultivation in the groves.

The apples have not been trained as outlined above but have been pruned more or less as would be done here. They do not have sufficient spray to control disease and insects and the first-class fruit is gathered by culling very carefully. Some of the more promising fruits are bagged as we would bag grapes. There were about 250 trees.

The oranges, Valencia and Washington Navel, were also about 250 in number. As compared with the usual trees, they were low headed, but they did not compare with the trees seen later at Armero. Scale insects were present in abundance but were not as bad as seen elsewhere. The fruits were of good quality but not of the possible maximum they might have had under better culture.

In later discussions, the writer was told that the owner did not care to invest more money in maintenance because he made enough money from his crop under the present conditions.

This led to other questions, among them the degree to which production could be expanded without flooding the market. Nothing more than opinions could be offered, but it seemed to be the sense of those present that as long as fruit from dooryard trees came to the market at very low prices, it was highly problematical how soon a buying public could be created which would take only quality fruit. The writer is inclined to believe this after having watched the public buying in general markets. Individuals, who by their clothing and manners suggested the "married" customer, appeared to hunt for choice fruits or vegetables, but as often as not bought a mixture with maximum of good fruit and some that were practically culls from the North American standard. Vegetables, in general, were better graded and in better condition, as offered for sale. This is all related to the "bargaining" that seems as much a part of market day for the seller as for the buyer.

The alternative solution, shipment of quality materials to other markets, is particularly difficult in Colombia at present since there is no train service between some centers, shipments by air are too expensive and truck shipments are naturally reduced because of the general shortage, of tires rather than gas.

Experimental Station at Sevilla (Magdalena)

This station was not visited since Dr. Lopez indicated that no work would be done there. Dr. Geib reports that it has adequate and well equipped laboratory buildings but limited land with no opportunity of obtaining more land. It was common knowledge that it had been granted no operating appropriations for the current year.

In discussions with Dr. García Alvarez and Dr. Lopez, they expressed the opinion that Sevilla was not altogether typical of its area and was not located at a place which would be easily accessible to large farm populations which should be served by a station for the "dry tropics".

Experimental Granja at Chia (Cundinamarca)

This is a small station devoted almost exclusively to what we call "deciduous fruits". Its general aspect is that of a European nursery: apples, peaches, pears, plums, quinces (for stocks) are the major productions.

Stocks are almost uniformly produced from cuttings, the claim being made that there is almost no germination of imported seed.

Propagation is usually by grafting with two scions for each stock. The difficulties in grafting verylargely result from damage to the grafting wax before the union has healed. It is reported that bees carry off the wax almost as soon as it is applied.

Imported trees are planted and allowed to come to fruiting as planted, rather than being replaced immediately by trees produced on native stocks.

There was considerable difference in growth in various portions of the property, this being ascribed to faulty drainage.

There were no considerable collections either of varieties or of stocks, although the collection of stocks, recently sent from Glen Dale was seen.

Peaches showed the worst conditions of irregular foliation, plums next, apples probably next and pears least. Quinces had been sufficiently pruned for cuttings as to appear abnormal.

The station is well kept and actual grafting well done. Budding has not been sufficiently tried and spacing in beds and plots seemed unduly crowded; with evidence of certain disease conditions that inevitably follow such outlay.

Experimental Granja at Cajicá (Cundinamarca)

This is a small station devoted exclusively to potato studies. According to Dr. Camacho, it is poorly located as regards air drainage and has too heavy soils. The acreage is very limited for such an important crop.

Most of the work centers about the native potatoes, working through selection and in a smaller way by hybridization for the production of commercial varieties - working for better quality, greater uniformity, shorter periods for production, etc., all related to disease resistance and immunity.

There are also represented in the collections some of the more recent North American strains of Solanum tuberosum, but there are no materials from other Andean countries (except Ecuador), and great interest was expressed in contacts in Peru and Bolivia.

The station is well kept, but one has the impression that it is inadequate for the work that should be carried out with potatoes in a country like Colombia.

Preliminary Visits
to Páramo-like Areas

Studies related to Páramo.

In talking with the officials, it soon became clear that no decisions had been reached as to the area in which the, or a, station could be set up for studies under páramo conditions, but rather that there was a general concept that it might well be related to the La Picota Station outside Bogotá, since it would presumably concern itself with cereals, root crops and forages, all of which are studied under the same headings at La Picota.

In order to acquaint the writer with páramo conditions, three trips were arranged with Dr. Camacho as guide.

The first was a short trip out of Bogotá on the highway for Villavicencio, going only as far as the Boquerón de Chipaqui. These páramos are limited in extent as compared to many but are typical. The soil is made up of a surface layer of depth varying from about six inches to two feet, of the same general appearance of the peat soils of northern Ireland or Scotland, black in color, filled with roots and bits of vegetable matter in varying degrees of decomposition. Dr. Camacho reports that it is highly acid in reaction and very poor in minerals. The subsoil layers appeared to be a grayish sandy loam with fair amounts of broken rock. The general evidence is that water moves through the soil but rather slowly.

On the relatively level areas, there was little that approached the appearance of pastures or swards. Mosses and ferns were abundant, grasses not particularly abundant, some sedges and rushes, herbaceous plants, such as lupine, geranium, erodium, gentian, oxalis, lobelia, dandelion, castilleja, oncidiums, as well as many genera not recognized; many subshrubs including composites, what appeared to be hypericums, berberis, various ericaceae and taller shrubs including composites, and many plants not recognized. Dr. Camacho pointed out a shrub known as "uva" because of its edible fruits. This proved to be Macleania nitida H.B.K., a plant which is commonly said to "deserve study and improvement". The general mass of matted shrubs, some of them apparently of great age, suggested chaparral growths as seen in some parts of California.

The "frailejón"(Espeletia spp.), which is a conspicuous part of the vegetation, is perhaps not more abundant numerically than various other plants, but because of its growth in wide colonies and the conspicuous character of its gray, feltlike leaves always attracts attention.

In every place where the terrain provided shelter, vegetation improved and where water was running, there was also an increase in vegetation.

Dr. Camacho said that winds were not a difficult factor to be considered and the occasional tree did not show much evidence of misshapen trunks or crowns; on the other hand there were many trees and shrubs with sinuous formations in both trunk and branch suggesting slow growth.

The agricultural difficulties are said to be: (1) the all year low temperature range; (2) the six to eight months' period of rain, mist and general drizzle; (3) the essential poverty of the soil as such.

The population difficulties arise from the fact that "squatters" feel they have a right to burn and cut as they see fit.

The first areas examined here were on the left of the road as one drives away from Bogotá, and ascend gradually to the base of the peaks which are steep and have less woody and more herbaceous vegetation.

The areas on the other side of the road which present a more protected flank of the range were much more densely covered with woody vegetation and a fair number of species that reached the proportions of small trees. There were large areas of the weak bamboo known commonly as "chusque", which I was told always invades areas where there is more abundant soil moisture.

In coming away from this area (elevation about 9,500 ft.), it was interesting to observe that plantings of Eucalyptus globulus and various species of Cupressus survived up to about 8,000 feet but did not really thrive much above 7,000 feet, although both were seen at higher altitudes elsewhere in Colombia.

In the small patches barley, rye, cabbage, onions, radish were the only crops noticed until the road dropped well down toward the savannah level of Bogotá.

All the way to the highest elevation visited there were thickets of a wild Rubus which was probably R. choachiensis. This was in flower and yet had some immature fruit. The most nearly mature fruit examined was highly acid and seedy. It appears to have a hard, somewhat woody core.

La Represa. A second trip of some 50 kilometers outside of Bogotá, on the highway that passes La Picota Station and goes past the municipal water supply reservoir, was undertaken to show another area in which there is at present great agricultural activity with two major crops, potatoes and wheat.

The elevations are about the same as those of the first area visited, but the general aspect is different because the crests of all the hills are much more rounded, the areas in cultivation practically dominate the countryside, and cultivation has extended over so many years that the peaty surface layers no longer appear as such, although the upper soil is conspicuously darker on account of the humus content. The general appearance of the landscape was that which suggests a drier area, although there are no data to substantiate this.

One has the feeling that much too much land has been cleared for cultivation and that many slopes now cultivated by hand ploughs and sown broadcast might well have been left in their woody cover or planted to trees. Eucalyptus globulus does well in this area up to 3200 m and plants like Acacia dealtata were noted up to 3150 m.

On the basis of the conversations between the owner of the farm and Dr. Camacho, it would appear that potatoes and wheat in this area may or may not "make a crop" depending upon the weather and that the yield of the crop will depend upon the variety planted and the amount of fertilizer added.

There was no evidence of green manure practice, but apparently some fields are fallowed. In such fields there was the usual scattering of grasses, white clover in abundance, a low yellow-flowered clover that suggested bur clover, oxalis, abundant Rumex acetosella (which is said to be eaten with relish by cattle here), violets, daisies, lupines, several vetchlike plants, several dandelionlike plants and many of the usual weeds of the savannah, not a lush mixture.

As a geneticist's problem, the area needs crops that develop at low temperature levels and complete their cycle in six months or less. The present crops, as elsewhere, need nearer ten, with wet weather and frosts to damage early plantings and frosts to catch the maturing harvests.

One small farm was visited to see what was grown in the tiny garden patch: broad beans, onions, some sort of cabbagelike plant harvested like collards by cutting off the older leaves and allowing the stalk to continue; several herbs including rue, coriander, mint, and the Italian fennel "fennochio" (Foeniculum dulce) which was seen in many other places in and about Bogotá.

Most of the roadside vegetation was quite unknown, although the genera Baccharis, Viburnum, Alnus, etc., were recognized. The important thing, perhaps, is to note that there were thicketlike

hedgerows that developed more or less spontaneously along the highways and that the areas that had not been cleared supported a thick stand of woody species. Whether or not these could be supplanted by regular forest plantings is a question. There were a fair number of Eucalyptus globulus plantings in the area, some uncut and some representing second-growth sprouts from stumps.

Cocuey. The trip to this páramo was not completed for lack of time, since it was postponed until my last week and involved travel over "one way" roads. One takes the highway north from Bogotá which would go through Bucaramanga and Cúcuta for Venezuela. We went through Togansipá, Gachancipá, the Valle de Chocontá (said to be the center for many varieties of native potatoes and the cultivation of garlic), Villa Pinzón, Paipa, Tunja, Duitama, to Sucasón which is practically on the borders of Santander.

The general impression is that potatoes and wheat are essential field crops, with fields left in fallow between cropping. Trees are relatively few and are either those left standing in clearing fields or those planted, chiefly eucalyptus and cypress.

No stops were made save at Tunja where we visited a small farm where deciduous fruit trees were being propagated, chiefly plums and apples. Quince stocks raised from cuttings were used for apples and a few pears, and the beginnings of propagation of the "Eureka" apple stock in which Dr. Camacho is interested. Plums are propagated from cuttings.

Stops in passing at various "markets" showed nothing of particular interest.

Returning from Susacon to Duitama for the night, brought us once again into that area which is "famous" for its fruits, plums, peaches, pears and apples. Citrus was present in a limited amount.

All of this area showed pastures in valley floors but not as completely so as in the Cauca Valley. Corn, wheat, some oats, peas, and potatoes were the main crops. There were many areas with serious erosion.

One small holding was visited in which the young trees, apples, pears and plums, were carefully planted and the ground beneath was bedded down with strawberries. Everything was in beautiful condition, but the strawberries were not bedded on straw as is commonly done here for the best trade. Since strawberries are a luxury fruit for the Bogotá market (shipped daily by train), the additional cost could probably be carried.

The second day's trip, Duitama, Tibasosa, Sogamosa, Las Cintas, San Antonio (on the road to Toquilla) and return, followed a road through much higher country, rarely much below 3,000 meters, and with larger areas of even poorer subshrub vegetation than any seen before. The soil formation followed the same visual pattern; a surface layer of peaty soil, subsoils of varying permeability with far more broken rock and rock outcrops than had been seen before. Woody vegetation for the most part followed the water courses if these were in ravines or draws, never across open fields, and the general aspect of the open country is even poorer than any seen before.

Dr. Camacho remarked that the area was less foggy during the rainy season and that, if proper pastures could be developed, it might serve better for sheep than some of the areas we had seen before, this remark being a comment on the possible development of a sheep industry in the páramos.

Before finally leaving Duitama to return to Bogotá, a visit was made to a small private plantation of pears; Bartlett and Williams (?) were the only varieties. The trees were grafted on quince, had made good growth but appeared to be much too erect in growth. They had not been carefully pruned so that there was considerable crossing and overlapping of branches in the interior of each tree.

On the suggestion of the local "extension" man, the effect of "near dormancy" was achieved by increasing the water supply and fertilizing just as the September-December rainy season began. This so greatly increased the growth that it appeared like a regular spring flush of growth.

The fruits were rarely thinned but made good size and brought high prices in the market.

The ground was carefully sown to alfala and all details of maintenance were carefully followed.

The site was a warm and somewhat protected small valley and the garden areas (2) were completely surrounded by 8 to 10 foot mud walls (tapia) so that a high degree of protection was afforded.

What appeared to be a disease condition was developing at or near the graft union, which had been studied by one of the "government men", and diagnosed but not treated. Since a fair number of trees had died, the owner was concerned over the loss of his money-making scheme.

The general appearance was that sometimes loosely called a "canker" with death in the tissues spreading till the tree was girdled and died. No other obvious signs of disease were noted elsewhere in the plant.

Many of the alfalfa plants showed yellow leaves as if chlorotic.

General Discussion of Problems

In considering the fruit problems of the several stations, it should be pointed out that all such programs include:

(1) A variable collection for test
(2) A hybridization project
(3) A propagation program

Each of these three sections has its own particular activities and difficulties.

Varietal Collections. In the broadest interpretation, this includes not only the greatest number of varieties of any one kind of fruit, but also the greatest possible number of fruit species, of all those genera that may be grown in the particular area. In assembling a varietal collection at a station where hybrids are to be produced, varieties can not be excluded on the basis of commercial criteria alone, since it sometimes happens that an individual of poor market quality has genetic values for the worker that more than justify its maintenance.

The collection serves, therefore, not only as a direct source of material for the propagation program but also as the field laboratory for the geneticist and the demonstration area for the horticulturist who is concerned with orchard management.

Where space is limited, it is possible for many fruits to have from two to many varieties grafted upon a single tree, thereby reducing the area devoted to the collection.

The varietal collection should also include collections of all the suitable stocks for each fruit, both for test purposes and as sources for propagating material.

Hybridization program. In most countries, the varieties that eventually become the important varieties are those which have been developed either by selection or breeding from the varieties imported into or selected within the country. It is the general tendency to develop within a country varieties of plants that are peculiarly fitted to the country or, even further, to the conditions within certain areas within that country.

Propagation program. The general principles of plant propagation have been common knowledge for many years. Most progress has come either through improvements of the manual techniques or in the practices and apparatus that facilitate propagation.

As far as Colombia is concerned, it seems curious that so little attention has been paid to assembling in one or more centers, according to climate, all the materials already within the country whether they be of relatively recent importation or the result of importations brought about by the earliest Spanish colonists, with a view to establishing such a center.

If such a collection were to be undertaken, it should be based upon a critical estimate of the plant characters, overlooking only those which are strictly commercial. These latter factors should be applied only to the hybrids or selections which become candidates for the ultimate hybridization program.

The varieties that make up such a collection are (1) those which can be assembled from the country and (2) those which must be imported.

No matter how limited their value, the varieties which have persisted over long periods of time must be given some attention since they are usually, though not always, adjusted to the soil and climate of the country, something which no imported variety can be. This is particularly true for countries like Colombia which has climatic patterns rather distinct from those of the countries upon which she wishes to draw for material.

As a matter for specific discussion, one may well cite the apple.

The modern varieties of apple are not widely removed from their ancestors in quality and productivity but have reached their development in countries which parallel the climatic ranges and patterns of the ancestral home, altitudes between 1,000 feet and 3,000 feet, and weather patterns that provide a period of complete dormancy for three to six months as a result of cold. Such combinations do not exist in Colombia as far as is now known. The problem for the grower here is to find those kinds of apples that will grow with a minimum of complete dormancy and a tolerance of the lack of extremes of high and low temperatures.

The writer's personal suggestion would be an examination of the varieties developed in England, in certain parts of continental Europe and in certain areas in the Pacific Northwest of the United States, as well as such isolated sorts as have succeeded in the southeastern portions of the United States.

The site for this collection in Colombia should be one in which there would be a maximum of sunshine over as long a period as possible, and if such a locality exists, one in which there are as nearly two seasons a year as may be possible instead of the two wet and two dry seasons, recognizing that some supplemental irrigation may be needed.

The behavior of the varieties on the site or sites will undoubtedly give the clue to the breeding program to be undertaken.

Simultaneously, there should be assembled a collection of root stocks which will follow the same pattern but also should be judged for resistance to woolly aphis or any other difficulty peculiar to Colombian conditions.

Although there may be reasons which were not discovered that adequately justify present methods of nursery propagation of apples, it seems difficult to believe that the single difficulty of germinating seed for stock production can not be overcome until a source of seed can be developed within Colombia.

Unless the seed are definitely dead upon arrival in Colombia, the delays in germination can be obviated by the treatment given as follows:

"Handling of the seed is very simple. It is washed, air-dried and kept dry. (I usually keep small lots in envelopes in my desk.) Ten to twelve weeks before the date selected for planting they are placed in moist - not wet - sand and held in a refrigerator at temperatures between 33° and 40° F. (0.56 to 4.44° C.) until they are to be planted. From the time when stratification starts they should never be allowed to become dry. At the 10th week they should be examined and, if sprouting has begun, they should be planted at once; if it has not, the low temperature should be continued. When they are ready, they will sprout at around 40° F. They should be sown about 1/4 inch deep and the soil above them protected from drying out and rain compaction by strips of burlap or their equivalent. Caution is repeated against letting the seed become dry once stratification has started; if this happens, the seeds go into secondary dormancy and require another full stratification period. I have had this happen when seed were planted in dry soil; seed sown in dry soil one afternoon laid over until the second year, while sowings from the same lot made the next morning, after a moderate rain, germinated at once."

The unique advantage of a seedling over a cutting as a stock for budding is that it has a vigor that has not been checked. Seed is cared for in such a way that it is sown, just as it germinates, in

lines in the open nursery where it can grow without transplanting. Usually by the end of the first summer the whiplike growth is large enough to receive the bud. This heals in place before the winter dormancy begins, passes the winter in an inactive state and breaks into normal growth the following spring. If it is necessary to cut off the top of the seedling stock to force the growth of the bud, this can be done in one or two steps, but meantime the upward flow of sap is assured by the adequate top of the seedling. After the budded seedling has grown for a season, it can be transplanted for growing on.

In contrast with all this, the stock developed from a cutting has the first check in the actual rooting of the cutting. It is further slowed up by its transplanting to the nursery where it is to be budded or grafted.

Grafting, a practice based normally upon a union between stock and scion during their dormant season, requires a longer period of healing and tissue union than budding. Since complete dormancy appears to be difficult and rare in Colombia, the use of grafting rather than budding seems to bring about an additional difficulty for the plant. It has the further mechanical difficulty that the actual union between the two tissues of stock and scion is less perfect as compared to that resulting from budding.

For most routine nursery practices, grafting has been abandoned in the United States. If it is employed, it is usually a winter practice and, in many cases, the stock is represented only by the root of the stock plant without trunk tissue. For this purpose the root of a seedling is often employed, thereby avoiding the possibility of vegetative sprouts from the stock. What adaptations of these practices may be developed in Colombia can be proven only by trial.

Another propagation method, a modification of grafting which may require special study for tropical plants such as mango, is the approach graft or the inarch. This involves essentially the maintenance of two collections of plants in pots, one, the stock plants to receive the graft, the other, the parent plants that supply the scion for inarching. The one cultural difficulty in this system is the production and rapid utilization of the stock plants so that they do not develop root systems damaged by a long stay in the pot or container. This is merely a matter of planning, but it should be understood in advance that all stocks that have become pot-bound before inarching should not be used at all but rather discarded.

If, on the other hand, it proves feasible to grow the stock plants in nurs ery beds, from which they can later be transplanted, with a ball of earth on the roots, this danger can be eliminated.

Cuttings. The basis of a successful use of the cutting method must be a system which will maintain the cutting in sound condition until it has been able to produce its independent root system. With cuttings of deciduous material, this is relatively easy since there is little transpiration, but cuttings of plants from which the leaves can not be removed present an additional problem.

This problem of maintaining a leafy cutting has been met under our greenhouse conditions by special structures whose basic function is the maintenance of atmospheric humidity at such a degree that there is no excessive demand upon the leaf tissues as a result of changes in temperature and light. To this end various structures have been devised, small enough so that atmospheric moisture is kept at an even degree and provided with movable shades which temper the light as it may be necessary.

The writer recognizes that the development of special structures for propagation, to be used in the tropics, is a project for special study, but it is his considered opinion that the lack of such structures is one of the basic factors that contributes to the varying success es now obtained.

Another difficulty which the writer encountered, probably due to his own lack of information, turned upon his failure to discover the optimum seasons for each propagation practice. It is recognized that the program used in the United States is partly determined by the seasonal changes and conditions, but even within the conditions possible to us there are some periods that are more satisfactory than others for each process.

It is not impossible also that the propagator in the tropics will have to make some study as to how far and in what ways he may have to have recourse to low temperatures controlled by refrigeration. This will undoubtedly be important in those studies which treat of the introduction of deciduous fruits from countries which have cold winters.

As an example of our own use of such practices, it may be pointed out that on some occasions dormant deciduous fruit trees received during our summer from countries south of the equator have been kept dormant under refrigerator conditions until our autumn when they were planted in the open and developed normally the following spring in spite of their artificially prolonged winter.

Another practice which has proved its worth is the immediate propagation of all imported material as a safeguard against the possible failure of the original imported plant. It has often been the case that the young plant has grown vigorously and well, while the imported plant has never fully recovered from the shock of the long journey and the changed conditions.

The program. The actual details of establishing and maintaining a planned production of plant materials is not particularly difficult. Their placement will have to be determined by Columbians who know the country and who are sufficiently familiar with market conditions so that the local markets are not upset. The remarks included in the discussion of the orange and apple farm near Envigado are probably applicable in all parts of Colombia, and while the idea of replacing all existent fruit trees of indifferent value, with trees of known value, is an ideal worth working for, an orchard development which might come into production before transportation and consumption are ready for it would have a serious effect upon fruit growing for the country.

The writer of this report recognizes the questionable value of his opinion but feels it imperative to record his doubts as to the wisdom of a very rapid development of a deciduous fruit-planting program on the basis of the varieties which he saw in Colombia. The argument that average quality fruit is better than no fruit is open only to the criticism that in all fruit-growing operations it is very difficult as well as costly to replace an orchard in production with improved varieties. This has been the history in the United States, even with peaches which have the shortest life span of the commercial fruits.

He would also like to record as a reminder that the production of tropical fruits for export should always be made in relation to the quarantine laws of the importing countries. Some of the regulations are so exclusive that it seems hardly wise to consider certain markets.

Plant Propagator: Although there are some signs in the United States at present that suggest a change of ideals as to what sort of a person a plant propagator should be, a few general remarks may be in order since the propagator is the man who will control the success or failure of any program.

Part of his characteristics depend upon himself as a man and part upon his training. Since there is no way to give a training for the required characters, they must be looked for in the candidate. Above all else the man must genuinely like plants and like them to such a degree that he can not be kept from his nursery work or his own garden during all the twenty-four hours save those few that are needed for eating or sleeping. There are a great many people who profess to like plants who are not willing to consider propagation as a whole-time project. He must also be a man who likes to work and who believes that probably no one can carry out the work so well as he, an attitude which may be difficult at times but usually one that guarantees success.

The training of a really good plant propagator should be divided between actual apprentice training over a long time period and technical studies within a limited field.

The European system at institutions such as the Royal Gardens at Kew, England, permits the man to enter as a youth in his teens, work in all the departments of the institutions and to receive general schooling as well as specialized courses particularly in botany and in horticulture as a science.

Within the last decade, in the United States, horticulture and gardening have been receiving the attention of various scientists who appear most often to be interested in knowing the why for the traditional procedures rather than the how. As a result of their studies, many useful shortcuts have been discovered of which the practical man may take advantage, but there are many other projects that have little practical connection with the daily routine of the nursery.

The ideal man, after his years of personal contact, acquires not only his practical basis of book knowledge, his manual skills and dexterities, but also an acutely sensitive reaction to conditions so that he is able to tell intuitively what is needed without recourse to "cerebrations" or "statistics". This is the sort of knowledge that is communicated from man to man as they work together and can not be communicated from professor's desk or lecture room seats.

Apparently it is often forgotten that all propagation practices save seed sowing are entirely artificial, even those which are based upon natural phenomena peculiar to specific cases. Since the procedures

are artificial, their maintenance under optimum conditions is the least that can be asked.

The propagator, therefore, must be a man who can maintain all the various artificial optimum conditions required by whatever kind of plant he may be called upon to handle.

Structures. The usual concept of a greenhouse seems to be that of a building with extra heat, obviously not a condition needed in most parts of Colombia. There is justification for this idea in that, historically, greenhouses were devised in countries with cold winters for the protection of tropical plants.

The modern greenhouse and particularly the propagation greenhouse is rather a structure designed for maintaining the various optimum conditions desired in order to avoid the "weather" of the locality with all of its inevitable changes in light, heat and humidity, and moisture conditions.

In nature, rain can not be depended upon either in duration or degree; light may be excessive or the reverse; temperature varies not only during the twenty-four hours of the day but during the seasons of the year also. All of these features must be modified during the artificial practices of plant propagation, if the maximum returns are to be had from the experimental material.

As an example, there might be cited the natural seeding of forest trees, such as cinchona. The fact that cinchona has reseeded itself and has maintained the species in nature is obvious, but the number of seedlings that survive represents a very poor percentage if compared to the number of viable seeds that the tree produces. The problem for the horticulturist is to discover the system whereby this natural loss can be obviated. This has been worked out and the details of the routine have been reported elsewhere.

Propagation Methods, Etc.

In the course of many conversations with more than one person, there arose questions which the writer felt could be answered far better by other persons within the Department of Agriculture. The pages that follow, therefore, represent answers to questions proposed by the writer and answered by the several experts to whom the writer gladly acknowledges his debt.

Propagation methods, practices and staff for large annual production of avocados and mangoes:

The questions as proposed to Mr. Harold F. Loomis, Senior Agronomist, in charge of the U. S. Plant Introduction Garden, Coconut Grove, Florida, were briefly:

If you were to be asked to prepare a project that would have an annual output of 10,000 budded avocados and 10,000 budded, or is it grafted, mangoes,

1. How much land would you need, assuming that all trees would be moved as soon as safe;

2. How much time would be needed for the production of stock from sowing to budding;

3. How much time would elapse before the tree could be shipped;

4. How much help would you want;

5. What structures would you need?

Do you know of any instance in which the tree was shipped as a "budded stump" as has been done for Hevea?

Do we have any data on bare root shipments with or without defoliation?

All of this grows out of a hope that there can be several propagation centers, even if overland transportation facilities to planting areas are not ideal.

In your opinion and experience what are the best practices for avocados and mangoes ? Avocados are budded with a bud just ready to push? Mangoes, grafted or inarched?

Are there specific stock problems?

Mr. Loomis' reply is quoted as follows:

"With avocados, Guatemalan varieties apparently may be budded on any of the three races, but West Indian varieties are unsuccessful on Mexican stock; hence, I believe it would be advisable to always select stock similar to that of the scions intended for use. With mangoes, the largest nursery near us prefers turpentine stock for use with all varieties, the Philippine, Saigon or Cambodiana stock being least suitable.

"The largest and strongest seeds of both avocados and mangoes should be selected for planting. No special preparation of avocados is needed other than to have them fresh. Mango seeds should be removed from the shell for planting. Seeds of both species are germinated in the lath house in a special bed, composed of shavings or sawdust 4 or 5 inches deep beneath the seeds, with the seeds covered lightly with the same material. Avocado seeds should be placed in the germinating bed with the end uppermost which was nearest the stem of the fruit. When seeds show sprouts 2 or 3 inches long, they are ready for removal. Avocado seeds should be planted in regular avocado boxes, which are approximately 6 x 6 x 12 inches, where the seedlings will remain in the lath house until after budding or grafting. Six-inch cylinders of 30-pound asphalt building paper have been found suitable here but do not last over a year and in the tropics might not be as durable. Germinated mango seeds seldom are planted in boxes but are placed directly in field nurseries. On fertile, well watered soils in the tropics, mangoes probably should be planted in single rows, 4 feet apart with seeds set 2 feet apart in the row. Some economy of space may be had by planting in two rows separated by 2 feet with a 4-foot space between each set of double rows, as shown in diagram C enclosed. With us here, where soil is not so rich nor well watered, diagrams A or B would be suitable for field nurseries. Using diagram D for field planting of mangoes, approximately 2 1/2 acres of land would be needed. In order to be assured of 10,000 budded plants of either avocados or mangoes, 10 to 20 per cent additional plants should be grown. Avocado seedlings and budded plants should be kept in a partially shaded structure, such as a lath house or palm-covered shed until nearly ready for field planting, when they may be hardened off by more exposure to the sun. Arrangements for boxes in such a house are shown in the enclosed diagram. Possibly an arrangement intermediate between lath house diagram A and B might be found desirable, in which case a house of approximately 25,000 square feet would be needed for 12,000 seedlings.

"Little budding of avocados is now done in Florida, grafting of very young plants having superseded it. Avocados of 2 to 4 months of age are used in grafting, the scions being the tips of the last matured growth on branches just before a new flush of growth starts. These tips are inserted either as side grafts in a seedling or as cleft grafts, and grafted plants by this method should be ready for setting in the field in from 10 to 14 months after the date of

planting the seed. Some years ago shield budding of avocados was usual, but the stock has to be 6 or 8 months old and buds do not develop as rapidly as where tip grafts are used. Budded or grafted avocado plants never are shipped bare rooted and, so far as I know, their leaves are never entirely removed for shipment, although where shipment involves a long period, it certainly would be desirable to reduce the leaf surface materially.

"Mango seedlings are ready for budding or grafting in about 10 to 12 months from planting the seed. Well-matured terminal shoots are preferred as scions much as with avocados, although it is possible to split terminal shoots of mangoes to provide more than one piece of propagating material from each shoot. This scion material is tapered to a thin edge on one side only and inserted laterally under a flap of bark on the side of a seedling near the ground, the tip of the seedling sometimes being cut off at time of grafting or not until the union of stock and scion has been effected. Shield budding may be done but is less successful and is little used nowadays. Budded or grafted seedlings are not removed from the nursery until about a year old, as a well developed root system is a prerequisite for successful transplanting. In transplanting, a ball of earth on the roots is desirable, but bare-rooted plants have been shipped long distances with good results. Coral Reef Nursery reports such successful shipment to the Hawaiian Islands. In transplanting, some pruning back and reduction of leaves is desirable, the amount depending on method of transplanting and distance moved.

"Inarching of mangoes can be undertaken on small-scale projects, but on larger ones, less time, labor, and material would be expended in field grafting. Inarching also necessitates growing seedlings in boxes and with box-grown mangoes, root restriction seems to affect the seedlings and it is more difficult to get them into satisfactory budding, grafting, or inarching condition.

"Although I do not know of any attempts to ship either avocados or mangoes as "budded stumps", as is done with Hevea, the general opinion is that it would meet with failure, especially with field-grown mangoes. Shipment for short distances of freshly grafted or budded avocados probably could be done, but the tender tip grafts would require very careful handling to avoid breakage or injury.

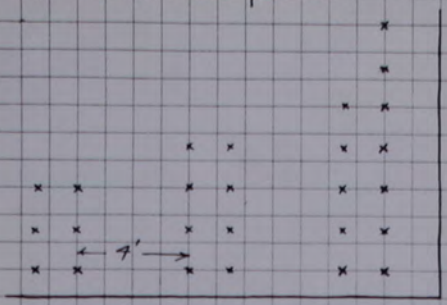
"The question of maximum safe age for stocks involves several considerations since both avocados and mangoes may be successfully grafted at any reasonable age of the trees, even after they have been in production many years. It is probable that it would be difficult to keep boxed avocados or closely-spaced nursery-grown mangoes in good propagating condition for more than 18 months to 2 years. Increased size of the older plants would add materially to handling and shipping costs.

"Necessary buildings for the program would be a lath house or similar structure provided with watering facilities. Watering facilities might also have to be provided for the mango nursery if long seasonal droughts occur in the region where established. Adjacent to the lath house, a well roofed, open or partly closed shed would be needed for boxing seedling avocados and budding them, for preparing shipments, storing fertilizers, sprays, tools, boxes, hose, etc.

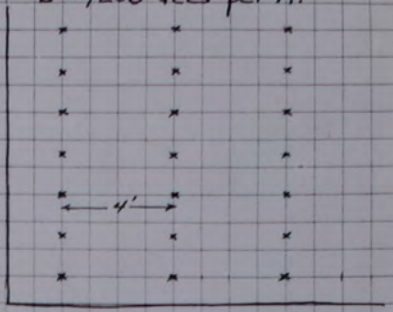
"Labor necessary for the first year of a continuous 20,000-a-year plant program reasonably might be limited to two plantsmen skilled in budding, grafting, and nursery practice, with one or two laborers to care for hoeing, planting, digging, watering, fertilizing, etc. In succeeding years a slightly increased force would be needed as the mango nursery would be at least double its first year size and other work would be increased."

Suggested Mango Nursery Planting Arrangements

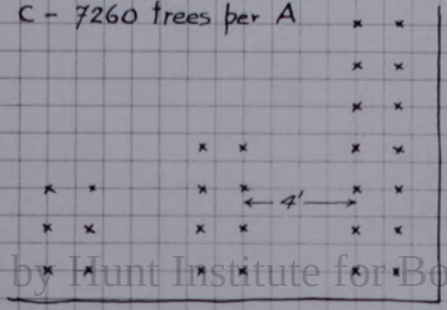
A - 9680 trees per A.



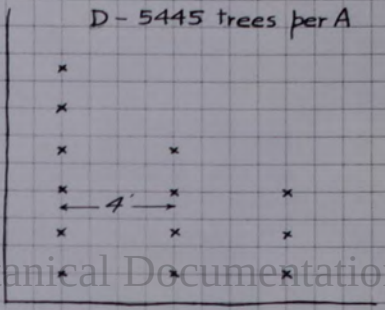
B - 7260 trees per A.



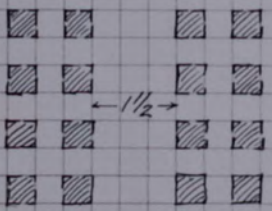
C - 7260 trees per A



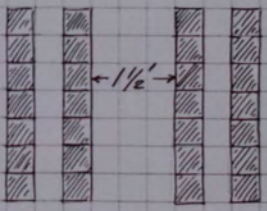
D - 5445 trees per A



Proposed arrangement of 6 inch Avocado boxes under lath shade



A = 10,000 plants
per 30,000 sq ft.



B = 10,000 plants
per 15,000 sq ft.

Because the writer is convinced that eventually all types of cultivated food plants for successful use in Colombia will have to be developed in Colombia on the basis (1) of native species, (2) of species from areas with similar conditions of soil and climate and (3) of imported species from any area which may have no other value than that of their germ plasm, he asked various botanists of the Division of Plant Exploration and Introduction for their technical assistance.

To the questions "Are there any species of Vitis native to Colombia? To other Andean areas?" Dr. S. F. Blake, Senior Botanist, Division of Plant Exploration and Introduction, replies as follows:

"The only well known species of Vitis in Colombia is Vitis tiliaefolia Humb. and Bonpl., of which V. caribaea DC. is a synonym. This species extends from southern Florida and northern Mexico south to the mountains of Colombia and Ecuador, and is found also in the West Indies. It is similar in general appearance to V. labrusca and has the same brownish or whitish tomentum on the lower leaf surface, but the purple berries are only about 8 mm. in diameter. It is represented in the United States National Herbarium from the Departments of Antioquia, Caldas and El Valle at altitudes from 1200 to 1800 meters. It flowers from August to December. The only other species described from the Andean region of South America is V. novogranatensis Moldenke, of which there is no material available. It was described from the central Chapon region of Colombia, altitude 1075 meters and is said to differ in having the leaves merely villous along the veins beneath."

A study of the grapes native to the Colombian area, no matter how unpromising they might appear in their wild state, seems of paramount importance and much more likely to give permanent results than the present "boom" in vinifera grapes, unless these latter varieties are considered (1) as breeding stocks or (2) as points of departure.

Under the latter heading, those varieties that have survived from Colonial days should be considered almost as important as the indigenous species, but the miscellaneous collections recently sent from the United States should be utilized in hybridization as quickly as possible.

Since Colombia does not differ greatly from many Latin American Republics in having only partial knowledge of her flora, some project might well be undertaken to determine if there are not other species or other variations from Vitis tiliaefolia Hunb. and Bonpl. mentioned by Dr. S. F. Blake. This should also be accompanied by a study of the chromosomes to determine with which group of cultivated grapes these might be combined in the first hybridizations.

A somewhat similar sort of study might be centered about the wild cherry (Prunus salicifolia HBK) known to the writer as the Capulín cherry, a name that seemed to evoke some doubt in Colombia.

The question was proposed here: "What are the relatives of the Capulín cherry (Prunus salicifolia HBK) that are most closely related to it? (The data will be used by breeders who are looking for larger, sweeter fruit). Are there any data on chromosome numbers for it and other Prunus?"

Dr. Rogers McVaugh, Associate Botanist, Division of Plant Exploration and Introduction, replies:

"The capulin cherry, Prunus salicifolia, belongs to the subgenus Padus, which is characterized by having its flowers and fruits in elongated racemes which terminate leafy shoots of the current season. There are, perhaps, 10 or 12 species of this subgenus, including the well known American chokecherry, P. virginiana L., the European bird cherry, P. padus L. Most closely related to the capulin cherry, however, are a group of so-called species native to America, all of which have relatively large fruits and a persistent calyx. Most conservative botanists consider all of these, including the capulin, to be forms of varieties of the one species, P. serotina Ehrh. If several species are to be recognized, they are chiefly as follows:

1. Petioles eglandular; leaves mostly 5 cm. long or less; fruit said to be up to 12 mm. diam., with thin juicy acrid flesh; New Mexico and Arizona, apparently an ecotype of semi-arid regions ... P. virens (Woot. & Standl.) Shreve

1. Petioles with two glands at base of leaf-blade; leaves mostly more than 5 cm. long ... 2

2. Young branchlets, leaves and inflorescences tomentose; little-known species of southeastern U.S.; fruits said to be 6 - 8 mm. in diameter....P. alabamensis Mohr., P. australis Beadle, P. cuthbertii Small

2. Young branchlets, leaves and inflorescences glabrous; fruits 8 mm. or more in diameter ... 3

3. Leaves mostly 2 - 3 times as long as wide, rather abruptly pointed at tip; fruit 8 - 12 mm. in diameter; eastern U.S. and probably as far south into Mexico as Zacatecas and San Luis Potosi ..... P. serotina Ehrh.

3. Leaves mostly 3 - 3.5 times as long as wide, gradually pointed at tip; fruit often 1.5 - 2.5 cm. across; Mexico to Bolivia; very probably a cultigen .... P. salicifolia HBK.

Offhand I should suppose that the most likely species for trial would be one of the above, but it is, of course, possible that crosses might be effected with some of the species with deciduous calyx, e.g., P. virginiana;

the fruits of this latter group are, however, mostly of small size. The normal haploid chromosome number in Prunus is 8, but counts as high as about 88 chromosomes have been made on some species. P. padus, P. virginiana and P. grayana, all very closely related members of the subgenus Padus, are known to be tetraploids. To date I have not been able to locate any figures on the chromosome numbers of P. serotina or P. salicifolia."

In so far as the writer can discover, none of these "related" species offer any advantages of size or flavor of fruit. Until some work has been done to study chromosome of this section of the genus, it will be a waste of time to attempt a program of hybridization with members of the other sections.

The only reports on chromosome numbers which have been discovered to date are those published by Prof. C. D. Darlington of the John Innes Horticultural Institution in The Journal of Genetics, Vol. 19, No. 2 (Jan. 1928). It seems not unreasonable to believe, however, that these must be later reports.

Plums. The general statement was heard that the "Japanese" plums did well in Colombia, the speaker referring to those plums so-called in the United States, and derived from Prunus salicina Lindl., but having no relation to the trees known in ornamental literature as Japanese plums, all derived from Prunus mume.

The questions as proposed: "What is the taxonomic background of the so-called Japanese plums? (Prunus salicina Lindl.) According to Bailey's Standard Cyclopedia of Horticulture, the species is Chinese. Do we know its original origin?

The latter question was advanced in the hope that there might be some geographical evidence for its well being in Colombia.

To this Dr. Rogers McVaugh replies as follows:

"Prunus salicina Lindl., the so-called Japanese plum, is a native of China according to all authorities, but I can find no statement as to its original range, except that its close relatives occur from Kashmir and Simla (Punjab) to central and northern China and Manchuria. Prunus simonii Carr. is very close to P. salicina, so that Schneider considered it scarcely distinct; it is a native of northern China. Taxonomically P. salicina belongs in the section Euprunus, with the well known P. spinosa, P. institia, P. domestica and P. cerasifera.

This is not yet a satisfactory reply but as yet no sources have been found for elaborating the range cited, especially to show the altitude range.

Rubus. No one going through the Latin American countries can fail to note the occurrence of blackberries of one sort or another. Of those noted in Colombia, one R. macrocarpus has had some publicity in the United States on account of the size of its fruits, but until quite recently no one has succeeded in germinating its seeds. There has not yet been time to show whether or not it has been successfully introduced in our hybridization programs. The other species which attracted the writer's attention was probably R. choachiensis Berger seen growing and fruiting at high páramo altitudes.

The questions as proposed were: "To what section of Rubus do the Colombian species, R. macrocarpa and R. choachiensis Berger belong? Is there any text that describes the fruit characters (for eating)?

To which Doctor McVaugh replies:

"Rubus macrocarpus and Rubus choachiensis both belong to the subgenus Orobatus, which is a group of about a dozen species, all Andean in origin except R. copelandi Merrill, of the island of Luzon. Orobatus appears to be related on one side to Ideobatus, the raspberries, and on the other side to Malachobatus, the group to which most of the southern Asiatic types belong. The only articles on fruit characters that I have found are the following:

Economic fruit-bearing plants of Ecuador, by Wilson Popenoe. Contr. U. S. Nat. Herb. 24: 113-114. 1924.

The Colombian berry or giant blackberry of Colombia, by Wilson Popenoe. Journ. Hered. 11: 194-203. 1920"

If it were possible to develop a complete study of the Rubus species native to Colombia, it is not unlikely that considerable improvement by mere selection could be accomplished rather quickly and that after the necessary chromosome counts had been undertaken a program of hybridization could be begun that would lift these plants from their present level of "wild plants whose fruits are collected for market."

If the factors related to production costs, sales, transport, market and consumption warranted, it would seem that the native species furnish the basis for a small fruit industry of considerable importance for high altitudes where fruit production is at present limited. Whether or not it would be economically sound is not a problem this writer could settle.

Vaccinium. No report can be given now in regard to Vaccinium for high altitude cultures, but they do exist, are suited to soil prevalent in páramo areas of certain types and should be amenable to routine improvements.

Studies Made in Washington on Phases of Work

Related to Páramo Station

In considering some of the problems of páramo agriculture, two features were mentioned to the writer: (1) the possibility of returning certain areas to forests and (2) of returning certain areas to grass, with the idea that in certain regions at least sheep might be made a source of revenue. The writer was reminded, however, that these latter areas would be limited to those in which the period of rain and fog was shorter than the maximum and where the terrain permitted a certain degree of draining.

Because there was mentioned to the writer the possibility of seeding certain areas without previous soil preparation, some effort has been made to discover opinions elsewhere. If the writer himself were to be responsible for the success or failure of the undertaking, he would not be willing to accept an assignment in which the soil had not been properly prepared in advance.

Inquiries were sent to the Forest Service and to the Soil Conservation Service of the U. S. Department of Agriculture, which can be understood from the following paragraph.

"In some of these areas the Colombians would like to establish sheep and appear to have the idea that suitable grasses might be sown broadcast without any preliminary preparations. Although I have had no personal experience in such matters, the general appearance does not suggest that such a procedure would be either successful or economical. Do you care to comment? Will you cite any literature that I should read or that I might obtain for my recent colleagues? Naturally I shall be happy to acknowledge the assistance."

The answers were not particularly satisfactory as to details. Well fortified by ifs and buts, the Soil Conservation Service replied that it might be possible. They refer also, however, to experiments already under way in Venezuela on a somewhat similar project. It is hoped that the data from Venezuela can be submitted later.

The Forest Service made no reply to the question of seeding without previous soil preparation, but submitted five publications, all of which touch on the subject, though none treats of exactly comparable conditions.

Farmers' Bulletin No. 1823, U.S. Dept. of Agriculture
"Reseeding Range Lands of the Intermountain Region"

Farmers' Bulletin No. 1924, U.S. Dept. of Agriculture
"Reseeding to Increase the Yield of Montana Range Lands"

Farmers' Bulletin No. 1948, U.S. Dept. of Agriculture
"Sagebrush Burning - Good and Bad"

Station Circular 159 - Agricultural Experiment Station
Oregon State College, Corvallis, Oregon. Jan. 1944.
"Reseeding Eastern Oregon Summer Ranges" by G. D.
Pickford and E. R. Jackman.

Research Paper No. 1 - Intermountain Forest and Range
Experiment Station, Ogden, Utah. June, 1943.
"How to Reseed Utah Range Lands"

These are attached to this report.

The writer is still certain that he would not undertake the project if no soil preparation were to be considered.

The following section of this report is included solely because it seems wise to show the type of search that has been made, and the various details of interest to the writer, which may also serve the Colombian group as keynotes for further development and inquiry.

The sections are grouped by countries and some general notations will be given later on for those points which seem valuable to the writer.

As a possible means of finding a short cut towards various problems related to pasture or to the use of trees in reforestation in the altiplano, it was decided to investigate such published reports as might be available in the libraries of the Department of Agriculture, in spite of the fact that periodical files are usually incomplete and that in the case of Latin American publications it is not always possible to be sure that one publication is supplanted by another or that either may have been definitely discontinued.

Bolivia

1. Revista del Ministerio de Colonias y Agricultura (after Vol. IV, called Revista del Ministerio de Colonización y Agricultura.)

The data from this journal are brief and usually lacking in details.

In Vol. II, No. 4 (1906) a report from Cochabamba reports that success was had with "Bromo de Hungaria, Esparcete, Trébol amarillo, alfa-alfa de Provenza, Avena Fromental y Sacalina." (These are respectively: Bromus inermis, Elyonurus bripsacoides or Stipa charruana, Melilotus officinalis, alfalfa, ? and probably Polygonum sachalinense.

All did well save "Sacalina" which did not germinate.

In Vol. II, No. 6. There is a report on various seeds imported from the United States, and sown in the coldest part of Quichuaya (elev. 13,000 ft.). Irrigation was reported but there were no details as to time and amount of water. Species mentioned: Arrhenantherum elatius, Bromus cathcarticus, Festuca ovina var. duriuscula, Lolium perenne, Poa pratensis, Dactylis glomerata, Bromus inermis, Festuca pratensis, Poa compressa. There are no details as to extent of sowings, duration, etc., and no further reference to this was found, either in this journal or others. Vol. III, No. 19, records success with Hordeum nuda.

Vol. V, No. 40/41 gives a short note on "pastos" but it is impossible to tell if this is a report on Bolivian experiences or a translation from some North American paper. There are mentioned:

Dactylis glomerata, Poa pratensis, Festuca ovina, Phleum pratense, Trifolium pratense, Bromus inermis.

In No. 43 of the same volume there is an extended article by Dr. J. Torreggiana "Discusión sobre los pastos y los forrajes por lo general existentes en Sud America", but this does not give areas of distribution. The botanical determinations were by Dr. Carlos Spegazzini "who has studied the Argentine flora and a large part of the Bolivian.***"

2. Anexos a la Memoria del Ministerio de Colonias y Agricultura. (1905 - 1910) La Paz.

These volumes give nothing to the present problem but present studies of interest in relation to the utilization of "baldías".

3. Lecturas Agrícolas, La Paz. Series I. (1905) (Ministerio de Colonias y Agricultura).

This volume represents the gathering up of articles apparently published elsewhere as a sort of extension service. They are written in popular style and are not documented.

There is a long article "El Cultivo Forrajero en la Altiplanicie Boliviana" (p. 186 et seq.) which cites the following species:

Plants supposedly native to Bolivia, but names brought to date and annotated:

Festuca rigescens (Presl.) Kunth
Stipa ichu (Ruiz & Pavon.) Kunth
Stipa mucronata H.B.K.
Agropyron repens (L.) Beauv. (introduced)
Cynodon dactylon (L.) Pers. (introduced)
Sporobolus bolivianus (cannot find this name)
Mibora minima (L.) Desv. (introduced)
Alchemilla pinnata
Bromus cathcarticus Vahl (introduced)
Rumex patientia (")
Chenopodium frigidum
Malvastrum capitatum
" peruvianum
" crispa (introduced)
" obcuneatum (introduced)
" borussicum
Trifolium peruvianum var. Pentlandii (not found)
Medicago denticulata (introduced)
Baccharis Tola

Introduced into Bolivia according to author:

Avena sativa
Arrhenatherum elatius (L.) Presl.
Bromus inermis
" pratensis - This may be either Festuca elatior or Bromus commutatus
" mollis
" secalinus
Dactylis glomerata
Lolium multiflorum Lam.
" perenne
Secale cereale
Sanguisorba minor
Lathyrus odoratus
" villosus
" cicera
Festuca elatior
Spergularia arvensis
Trifolium repens
" incarnatum
Achillea millefolium
Ornithopus sativus
Melica altissima
Polygonum sachalinense
Agrostis stolonifera
Trisetum flavescens

Cynosurus cristatus
Anthoxanthum odoratum
Alepocurus myosuroides Huds.
Atriplex semibaccata
Lotus corniculatus
Poa compressa
" trivialis
Cytisus proliferus
Iris pabularia (This is a horticultural name for L. ensata)
Hedysarum coronarium

No indications are given in this article to suggest where or how the plants were tried nor over how long a period. No indication is given to suggest if they were tested in plots, in single stand, in mixtures, etc. Some species are included which seem of questionable value.

The second series (No. II), published in 1907, gives no material of value for the pasture or forage problem, but includes (p. 135) a good brief article on "Los Pinos". Since only Spanish names are given, one suspects that there may possibly be some error in assigning the name Pseudotsuga taxifolia to "Pino de California o de Oregon. This may be Pinus

The list as given, with tentative identifications, follows:

Pino marítimo	Pinus ?
" silvestre	" sylvestris
" negro de Austria	" nigra var. austriaca
" Pinon	
" de California o) de Oregon)	Pseudotsuga taxifolia ?
" sabiniano	Pinus sabiniana
" de los pantanos	Larix europea ?

4. Revista de Agricultura y Ganadería: "Organo de la Dirección General de Agricultura y Ganadería La Paz."

Of this journal there are only a few copies available which is to be regretted since the subject matter is well diversified.

Vol. I, No. 2 (Nov. 1929) p. 27 gives a rather brief list of forage plants and starts a discussion of alfalfa which apparently was "continued" in issues not in our collection. The species mentioned are as follows:

Alfalfa (Turkestan, Arabian, Peruvian, Siberian); Trifolium pratense, "jedium", hibridum, repens, incarnatum; Pisum sativum; soy beans; Vicia villosa; Lespedeza striata; Stizolobium deeringianum; peanuts; Desmodium tortuosum; Lathyrus tingitanus; Dolichos lablab; Kudzu. Since some of these species are for temperate climates and others are for tropical climates, one is dubious as to the sources.

5. El Altiplano, Revista de Agricultura y Ganadería, Organo de la Sociedad Agropecuaria, La Paz.

This is represented by incomplete files in our library collection, with various issues between the years 1931 and 1937. Various items of interest were noticed, that bear in various ways upon the "páramo problem" of Colombia.

Vol. II, No. 20, p. 75-76, mentions Dactylis glomerata, Holcus lanatus, Poa pratensis.

Vol. II, No. 21, p. 135-137 (March 1937) gives a brief note on "La Cañagua", Chenopodium cañaguva, which is said to grow at higher altitudes than quinine and to have no saponin on hulls.

Vol. II, No. 25/26, p. 395, (July-August, 1937). Here is a note on Buddleia nicana, "Kishuara", which is said to grow up to 4700 m. in Bolivia. This should be compared with the Buddleia species noted at "Las Cintas" and elsewhere. This may be a good "nurse" tree, while even more valuable species are being established.

6. Colonización y Geo: organo oficial del Ministerio, La Paz.

Begins in 1936 and is incompletely represented in our library through 1940.

Vol. I, No. 2, p. 15, 18-20, gives "Monografia cultural de la Kañahua by Ing. Agr. Augusto Valdivia Altamirano. (Chenopodium Kañahui)

No. 16 (April-June, 1938) no pagination. "Forestación en las Regiones Frias de Bolivia", Ing. Agr. Augusto Valdivia A. is a very brief statement re Eucalyptus, as observed in Chile.

Eucalyptus gomphocephala said to do well in Chile up to 2500 m, and averages a height of 36 m.

E. goniocalyx
E. globulus

No. 18 (October-December, 1938) A series of brief notes on Dactylis glomerata, Festuca rubra, F. ovina, Agrostis alba but nothing to indicate that the report is based upon field studies.

No. 20 (September 1939) has similar brief notes on Melinis minutiflora, Andropogon rufus Kunth.

7. Revista de Bolivia, La Paz, is represented only by three numbers, none of which contains articles of value, either re forage or reforestation.

8. Memoria del Ministerio de Agricultura, Regadio, Colonización e Inmigración, La Paz, 1940.

Nothing of interest to our present report.

9. Agricultura, Ganadería y Colonización: Revista Oficial del Ministerio de Agricultura, Ganadería y Colonización. La Paz.

This is represented by issues in 1942, 1943.

In the issue for September/October 1942, there is an article "Flora y Fauna del Macizo Boliviano" by Jaime Mendoza in which are routine discussions of "papa, oca y lisa (Oxalis tuberosa), quinua (Chenopodium quinua) and several other plants of non-agricultural value.

In May/June 1943, p. 26, "El Pan de Quinua", is an article based upon the experiments carried out in the U. S. Department of Agriculture with flour mixtures, wheat and quinua, in cooperation with Sr. Jorge Alcazar, who was then on a fellowship in the United States.

Kenya Colony

A general review was made of the Annual Reports of the Department of Agriculture, Colony and Protectorate of Kenya for the years 1927 -1938 inclusive, since certain patterns of climate and altitude conditions seem to be common to Kenya and certain portions of Colombia. Their stations have been chosen, in part, for the altitude factor.

The reports which were most detailed and which came within our mutual interests are those that deal with cereals (particularly wheat), pasture and forage plants, with relatively little save the beginnings of the pyrethrum program in this time interval.

Wheat. The outline of the wheat-breeding program through this period is essentially the battle to find quality wheats resistant to both black stem and yellow rusts. At the altitude station in 1927 Equator and Golden Ball are the wheats most resistant to yellow rust but are not too high in quality. The story varies from year to year, complicated by the isolation of various strains of rusts and mitigated somewhat by the production of several series of wheats based on old resistant or semi-resistant, medium quality wheats, long grown in colony.

Undoubtedly by 1944, reports (not available at the moment) should give progress on high altitude wheats of better quality and higher resistance.

Grass and Forage. General tendency is to believe that "native" species of grass and legumes will be best for cover, hay, green manures, etc. Drought resistance seems important in some areas.

The species which were most praised: Cymbopogon afronardus, Hyparrhina hirta, Setaria aurea, Brachiaria brizantha, Paspalum kora, Setaria sulcata, Trifolium subterraneum, T. Johnstonii, New Zealand, Italian and Chilean strains of Red Clover; Panicum coloratum, Amphilophis pertusa, Setaria plicatilis, Sporobolus filipes; Panicum coloratum; Phaseolus aconitifolius (smoother crop); Calopogonium mucunoides, Phaseolus aconitifolius, Pueraria phaseoloides, Canavalia ensiformis, Centrosema pubescens, Dolichos Hosei (all last series as green manures); Kikyu grass (first mentioned in report for 1934); Dactylis glomerata, Lolium perenne, L. italicum, Festuca elatior (all for 9000 ft. elevation); Chloris gayana, Melinis minutiflora, Cynodon plectostachyum; from Australia sources, Paspalum dilatatum, Paspalum scrobiculatum, Phalaris tuberosa, Lespedeza stipulacea and S. striata (first references, 1934); extensive tests of Dolichos lablab and D. biflorus; Pueraria javanica, Coronilla varia; too weedy were Mucuna utilis, Calopogonium orthocarpus, C. mucunoides, Phaseolus lunatus; Indigofera tettensis ("useful but hard to establish"); best green manures, 1934, Dolichos lablab, Lathyrus sativus, Pisum sativum, Phaseolus lunatus; Stizolobium aterrimum; Phaseolus calcaratus; Medicago lupulina, M. denticulata.

A hasty examination of this list will show a preponderance of species useful under warmer conditions than one would find much above 1500 m in Colombia.

The pattern of work, however, is much the same that must be followed in Colombia for each crop, a pattern already in use in the wheat-breeding in Colombia, namely, the use of the so-called "native" wheats as the basis of breeding, using meantime all imported wheats as potential breeding stock if they show any resistance to diseases. This means extensive varietal collections with a minimum of each variety and a large breeding program from each successful basic stock.

Here again the writer believes that there eventually should be a series of gardens for the test of "pastos", whether they be grass or legumes. Possibly the high altitude garden should come first.

Although the writer saw a copy of Doctor Pound's report, only through the courtesy of Dr. Ciro Molina Garces, his recommendation that in the richer agricultural areas the growth of hay for cutting and feeding should be substituted for the present wasteful practice of keeping the rich valley floors in permanent pastures, is one that must be studied in the plans for changing agricultural practices.

In spite of the fact that the writer saw introduced grasses growing luxuriantly in many parts of Colombia, he still believes that a complete botanical survey of native grasses and legumes should be made for each area where work is to be done; that a grass garden be set up in each area where the grass introductions can be given optimum care and not left to fare as they may. The forage plot at La Picota approximates the idea but could be better done.

Among the annual government publications of the Colony and Protectorate of Kenya are Annual Reports of The Forest Department. Those available for examination cover the years 1927-1938.

Although there is no complete statement of the organization of the Forest Department, it would appear to be made up of an administrative officer, known as The Conservator, a Senior Assistant Conservator, Assistant Conservators (8 in 1934, 7 in 1939), one Accountant, Foresters (13 in 1934, 12 in 1939), 5 clerks, 150 Forest Guards and 20 probationary Forest Guards. (It should be noted that the present war had already affected the 1939 figures). These figures do not include additional field officers.

The activities of the Department appear to be the survey of sites, either for conservation or reforestation, which are then declared government forest lands; the maintenance of a varying number of nurseries for the production of seedling trees; the safeguarding of existing

reservations from fire, illicit grazing and woodcutting; the maintenance of a nursery and arboretum for seed production; the supervision of controlled cutting and milling; the relations with "native" populations and "squatters".

The materials coming to market are dressed timber, props and posts, poles including bamboo and brushwood, fuel, mangrove bark and tree seeds and seedlings. The major export item seems to have been "Cedar pencil slats" (The tree referred to as "Cedar" is Juniperus procera).

"Wood fuel" appears to be fuel for use by the Railway and for the most part is Eucalyptus of one species or another.

"Forest offenses", as suggested before, are chiefly theft of forest products, illicit grazing, but there are such headings as "damage to trees" without further explanation, "illicit honey hunting and careless use of fire,"etc.

There is an annual planting (and maintenance) program, varying in size and amount according to the District and the projects. Seedlings and not seed are planted and the usual types of trees planted are classified as:

Pencil Cedar (chiefly export)
Other Indigenous Timbers (both soft and hard)
Exotic Softwoods ("mostly Cypress")
Exotic hardwoods
Fuel ("Fast-growing Eucalypts and black wattle)

Some attention is paid to natural regeneration particularly of valuable species which reproduce themselves by stump sprouts or by suckers, sometimes at considerable distance from parent tree or stump. This is chiefly a thinning process and control of weeds and brush on forest floor.

Research problems do not appear in the reports until the later years after the basic organization had been set up and was operating with some degree of success, but at this time war was beginning and further retrenchments were inevitable.

In fact, nearly all the figures in the charts presented show the effects of world conditions even if only indirectly. The fact remains, however, that the project as such carried a deficit from 1930-1934 inclusive and produced a slowly increasing surplus from 1935-1939.

In this series of publications (1927-1937) there are no detailed discussions, since it is only a series of annual reports, but in Forest Department Pamphlet No. 1 "The Raising of Young Trees from Seed" by A. C. Sprunt, there is a series of photoengravings that shows a nursery, with enough of its organization, structures, etc., to show how an efficient working plan can be managed without elaborate structures or equipment.

A few points stand out: the concentration on a relatively few species, each adapted to a specific use; the employment for hire of "squatters" who live on the forest reservations; the return of parts of the income to the local organizations of "natives" and the utilization of the local populace - for the safeguarding of the plantations wherever possible.

In the Forest Department Pamphlet, already referred to, there is a very useful chart giving the number of days from sowing to germination, as well as the time interval from "sowing to planting out".

In the "Forest Department Annual Report" for 1927 (p. 22), there are several paragraphs of some possible significance in handling the question of "squatters" in future reforestation projects.

"The value of squatters in the forests is twofold. The first and greater value is that they prepare for planting felled forest and bush lands by clearing, cultivating and raising their crops on them. Each family is allotted a definite area where plantations are wanted, is made to clear that area efficiently and to keep it clear particularly of couch grass. After 18 months the land is planted with lines of trees among the native crops and for a further 18 months the family has to keep the trees clear of weeds. After that they are moved on to fresh areas.

"The result is low planting costs, probably as cheap as any in the world.

(The underscoring is mine. B.Y.M.)

"The second value is an assured and resident labour supply, as each squatter contracts for six months in the year for wages, in addition to the unpaid work of clearing and keeping clear his area."

Although of value only for the warmer parts of Colombia and in those areas which might more nearly approximate its climatic picture, the book, "A Text-book of West African Agriculture" by F. R. Irvine (Oxford University Press, London: Humphrey Milford, 1934) contains much that might be of use.

On page 84 one reads: "In many parts of West Africa two crops of corn are raised during the year. In those regions of two distinct rainy seasons, that is with main rains from April to July, and "small" rains from September to November, this is generally possible. Such regions are mainly in the closed forest country, but in coastal plains, for example, in the Accra and Cape Coast districts of the Gold Coast, the "small" rains can not always be relied upon, so that in dry years the second corn crop is generally a failure."*****"

There is little discussion of varieties of corn or of a program for maintenance or adaptation, but it is indicated (p. 88) that some local program under government or specialists would be required to maintain corn seed, true to type and adapted to local conditions, which is essentially the situation in Colombia.

In those portions which deal with crops, the cereals which might be of concern in Colombia are the sorghums, Pearl millet (Pennisetum typhoideum), Hungry Rice (Digitaria exilis) yams (Dioscorea spp.) and in this text various Colocasias, Xanthosomas, and the sweet potato (Ipomoea sp.), Cola (Cola acuminata) seed of which can be had from the Canal Zone Experiment Gardens, Summit, Canal Zone; oil palms (Elaeis guineensis) only partially introduced through Palmira, edible legumes (many) and leguminous green manure and cover crops (Stizolobium aterrimum (Bengal bean), various Mucuna spp., Calopogonium mucunoides, Dolichos lablab, Vigna unguiculata, Jerusalem pea or Phaseolus trinervis, Canavalia ensiformis, Centrosema spp.; perennials such as Indigofera spp., Tephrosia candida, etc., Cajanus Cajan and various Crotalarias.) There is an interesting brief treatise on ginger.

Much of the remainder of the book is elementary having been addressed to a specific audience and would not concern the tropical stations in Colombia.

Soil Erosion. Memorandum by the Governments of Uganda, Kenya and Tanganyika. Govt. Printer, Nairobi, Kenya Colony. 1938.

There are three reports under this cover, one from each government. The statements of the problem are perhaps no different from those given elsewhere but touch upon what appears to be the vital problem in countries where the physical characteristics of the soil are quickly altered by the destruction of humus supplies at a rate greater than that of any possible restoration, through green manure crops whether grown to be dug in, or merely as smother crops.

To quote from the Uganda memorandum, one might choose a portion of their opening section. (All underscoring is mine. B.Y.M.)

"The main predisposing cause of erosion in Uganda as elsewhere is soil deterioration or loss of structure consequent upon repeated cultivation. When land is first opened from bush, and/or forest, it is of excellent structure, the soil is granular and is capable of absorbing and retaining a good supply of water.*** Hundreds of analyses have been carried out in Uganda to find if any correlation exists between the nutrient status of the soil and its crop-producing power. No such correlation has been found. We are forced to the conclusion that deterioration is not normally due to the loss of nutrients by leaching but rather to the loss of structure by the oxidation of organic matter and by the sheer pulverization of the soil by cultivation. Before the introduction of economic crops, the native system of shifting cultivation was an adequate rotation*****."

The suggested control measures differ from the usual only in the plant materials suggested, these being particularly those for Uganda.

In the memorandum by the Government of Tanganyika (p. 9) there are somewhat similar passages to be cited.

"Some form of soil erosion, resulting from the inevitable tendency of soil material in elevated situations of weather, crumble and fall to a lower level, occurs in every part of the Territory, and is not necessarily a menace to the land. It is accelerated soil erosion, frequently associated with dessications and disintegrations, which renders the adoption of remedial measures a matter of necessity.***** Elsewhere the primary cause is soil deterioration following loss of structure by the oxidization of organic matter and pulverization of the soil by repeated cultivation, which is quoted by the Government of Uganda, etc.*****."

This memorandum also shows that "Cultivation rules covering all cultivation have now been adopted by the Native Authorities of the following districts (8 are named.) And various other areas are cited which have partial regulation.

Erosion, as observed in Colombia, is a problem of various aspects.

The details of cultural practices are all open to critical review particularly because plantings on contour are not well observed and clean cultivation is overpracticed in many areas.

The opening of new lands for cultivation from brush or forest must be accompanied by the immediate use of legume smother crops so that there will be a minimum time interval for the processes of the too rapid

oxidization of humus to get started.

The areas which are already impoverished must be gotten back into any kind of vegetation so that a planned succession of species can be introduced as soon as the humus content has been built up by the "weed" population first used has served its initial purpose.

It seems highly unlikely that any reforestation scheme will generally succeed on what are now poor herb covered lands until there have been encouraged by reducing fires and grazing and if possible employing fertilizers even if only for occasional strips.

The following are miscellaneous notes touching on various points in this report, gathered from The East African Agricultural Journal, published in Nairobi, Kenya Colony.

The data in this quarterly journal reflect the work of the Annual Reports of the Department of Agriculture. The main continuing themes, as far as plants are concerned, are coffee, sisal, and pasture and forage grasses. There is some discussion of soil erosion and plant propagation with growth-promoting substances but all else is incidental. Only two or three articles on Pyrethrum.

A Further Note on Rhodes Grass. D. C. Edwards. (Nov. 1935; pp. 233-235). Rhodes grass, although an African species, was introduced into Kenya from Australia, the seed source being Queensland, and has done extremely well. In growing it for local seed production, it was "manured especially" (but neither rate nor kind of manure is mentioned) and yielded" 50 lbs. seed to a fifth of an acre plot. It has been noted that "seed stored for a period of over two years has continued to improve in germinating capacity, and that it is advisable in every case to use seed at least one year old." Experiments using Rhodes grass in mixtures with legumes for cut hay show that Indigofera tettensis, a native species, has been the best. Further tests are planned (1935). Successful trials of Rhodes grass have not been made at altitudes over 8000 ft. and in areas where Kikuyu grass succeeds as a pasture, Rhodes grass is grown only for hay. (N.B. The first note on Rhodes Grass was a Department Leaflet published in 1934).

Raising and Planting Cinchona. F. M. Rogers. (Nov. 1935; pp. 244-245). This is an interesting article that contributes nothing to the basic facts. There are slight modifications for the sowing of seed under field conditions which are perhaps worth copying.

"The seed, which is extremely light, should be sown evenly all over the pan or box, and covered lightly with fine soil. No water should be applied after sowing, the previous soaking of the pans or boxes being quite sufficient. These should then be placed in a trench, which is made moist by watering previous to placing the seed pans inside; at Amani we have a bed dug out some two feet deep, with a concrete wall built round. The trench is then covered with corrugated iron sheets or grass roofing to keep out the rain (the latter being preferable unless grass is placed on top of the corrugated iron) until germination. This takes place in about 15 to 20 days. The covered trench not only keeps the seeds at an even temperature, but insures that no watering is needed until after germination. Should the trench show signs of becoming dry, the sides should be syringed or watered, also the spaces between the seed pans. No water should be given direct until after germination unless absolutely necessary, and then the pans should be resoaked and not watered on top. At the same time, great care should be taken that the seed pans never become dry, as once the seed pan is dried out after germination has commenced, all are lost.

"***** Damping off in the seedling stage through careless watering is the chief cause of failure."

Of Section XVII "Cover Crops and Shade Trees", the first part "Cover Crops" by A. S. Thomas outlines briefly the necessity for soil covering crops to prevent overheating and consequent soil deterioration, together with the crops used there (Uganda) whether at the Botanic Garden at Entebbe or at Kampala Plantation.

Naturally coffee is the crop in mind when the papers were prepared.

Those with favorable reporting are Cajanus cajan (Pigeon pea); Canavalia ensiformis (Sword Bean); Centrosema plumierii (sometimes too strong climging), C. pubescens (better than last but has some faults): Crotalaria spp. (most of the native species are no longer grown as they are too slow in development during the first months); Leucaena glauca, especially as coffee shade; Mucuna spp., considered highly; Phaseolus spp., P. lunatus, P. calcaratus; Tephrosia spp.

Brief notes are given on some 67 species without any singled out for praise.

From Agriculture in Uganda edited by J. D. Tothill: Oxford University Press, Lodnon. 1940.

Great Britain and Scotland

Rayner, M. C. Mycorrhizal Associations in Scots Pine.
Forestry, vol. 9: No. 2; pp. 154-155. December 1935.

This note was to correct certain data given elsewhere and contains nothing of value for our present purpose.

Reference is made to the citation that follows.

Rayner, M. C. Mycorrhiza in Relation to Forestry.
Forestry, vol. 8: No. 2: 96-125. December, 1934.

Did not read paper. Summary states among other things that experimental evidence shows that there is a direct relation between mycorrhizal development and thrifty growth of seedlings of some pines; that inoculation is possible; that pseudo-mycorrhiza must be known; that certain reactions of manures (both favorable and otherwise) must be known.

Rayner, M. C. Mycorrhizal Habit in Forestry.
Forestry, vol. 10: No. 1: pp. 1-22 (and plates) June 1936.

Important discussion related to stage and degree of decay in humus layers.

Rayner, M. C. The Mycorrhizal Habit in Pinus: a Comment.
Forestry, vol. XI: No. 2: pp. 117-121. (1937)

This is chiefly a comment on other papers which either criticized or appeared to contradict papers written by Rayner.

Guillebaud, W. H. The Afforestation of Difficult Peat and Upland-heath Soils.
Forestry, vol. XII, No. 2: pp. 80-92.

(An extract from Annual Progress Report on the Research Work of the For. Comm. for year 1937)

Very interesting comments:

Trees planted by "direct notching" etc.; on soils of this type are less successful than other methods but can give a slow return in success if drainage is good.

Prepared (dug) turf plantings were much better, dug over peat, etc. It should be noted that "all plants received the usual dose of basic slag."

Cultivation becomes more and more important as soils are more and more impoverished, etc.

Trees used were Japanese larch, Scots Pine (Pinus contorta, birch, Oregon alder (failed), Sitka spruce, Pinus montana, etc.

All work was in Scotland.

Data were given on one experiment where Pinus contorta and P. montana were mixed in stands of Norway spruce. Where the pines had grown well, there was a definite improvement in spruce.

Basic slag in all experiments.

Rayner, M. C. Mycorrhizal Habit in Relation to Forestry. III. Organic Composts and the Growth of Young Trees. Forestry, vol. XIII; No. 1: pp. 19-35. (1939) (Cont. of data published in vol. VIII (2), pp. 96-125 and vol. X (1), pp. 1-22).

The conclusions of the experiments herein described are not directly applicable to our problems, but do suggest perhaps the need for compost studies in the páramo areas and conditions.

Anderson, M. L. The Silviculture of the Larches.
Scottish Journal, vol. 54, Part 1: 22-32
(March 1940)

Main points in use of larches:

1. Larch demands light .
2. Is rapid growing so makes a good nurse for other more permanent trees.
3. Is deep rooting so does not blow over.
4. Has rapid transpiration during growing season so demands water at that time; this becomes more apparent as tree matures.

According to this author, the mineral needs, particularly nitrogen, of larch are greater than those of oak or Norway spruce (Picea excelsa) and much greater than those of Scots Pine (Pinus sylvestris), approaching those of Silver Fir (Abies Picea) or birch (Betula spp.)

"On the other hand, on dry sites over rocks with very high soluble mineral content such as limestone, apart from lack of abundant soil water, there is probably an inadequate supply of nitrogen owing to the rapid disappearance of humus matter."

In a good many places larch was used in Scotland as a nurse for Scots pine (Pinus sylvestris) and removed as soon as the latter became established.

Sutherland, M. Afforestation in New Zealand.
Forestry, vol. 10, No. 1: pp. 23-37. June 1936.

This is a valuable article particularly in that it gives the historical background of the New Zealand project. It is not particularly related to Colombia in facts.

Of the species that follow, all more or less recommended for special spots, those underlined interest me for trial in Colombia: Pinus radiata, Pseudotsuga douglasii, Corsican pine ( ), Pinus ponderosa, Pinus murrayana, Larix europea, Pseudolarix Kaempferi, Pinus strobus, Chamaecyparis lawsoniana, Pinus caribaea, P. echinata, P. taeda, P. palustris, Sequoia sempervirens, Cupressus macrocarpa, Pinus muricata, Populus serotina.

In underplantings, Chamaecyparis lawsoniana, Thuya plicata, Cryptomeria japonica, Tsuga heterophylla.

Macdonald Nursery Investigations
Forestry, vol. 9, No. 1; pp. 24-41. June 1935.

Useful data on use of sand to cover seedbeds and on short stratifications in sand to hasten germination. (The latter a Boyce Thompson routine)

United States

Baldwin, Dr. Henry Ives - "Seed Origin and Reforestation." Paper read before the New York Section, Society of American Foresters, Albany, N. Y. Feb. 1, 1935.

Presents arguments for the use of locally produced seeds in reforestation programs or at least seed from localities with similar characteristics.

Huberman, M. A. Normal Growth and Development of Southern Pine Seedlings in the Nursery. Ecology, vol. 21, No. 3: 323-334. (July 1940)

A report on nursery practices. Seed saved dry and sown out of doors in spring. These experiments were in Louisiana and the sowing dates were March and early April. Germination took place in 12-20 days. Beds covered with moistened burlap until germination starts. Root development is rapid and more apparent than top growth in first stages.

No data are given as to age of seeds used nor manner of storage before sowing, which might have some bearing on the 50% germination which seems rather indifferent.

Bramble, Wm. C. and Maurice K. Goddard. Effect of Animal Coaction and Seedbed Conditions on Regeneration of Pitch Pine in the Barrens of Central Pennsylvania. Ecology, vol. 23: No. 3, pp. 330-335 (July 1942).

There is nothing in this paper of interest to the Colombian program save to note that "on undisturbed seedbed" (i.e., seeds sown broadcast on unprepared soil) the results were the worst of all in the experiment.

Pine seed were the only seed used.

Miller, Frank J. The Influence of Mycorrhizae on the Growth of Shortleaf pine seedlings. Journal of Forestry, vol. 36, No. 5: 526-527. May 1938.

Author believes "that the mycorrhizal fungi must be present in old farm soil before 1-0* shortleaf pine can be grown satisfactorily."

Suggests "soiling crop the first year, pine transplants the second, and 1-0 shortleaf pine the third, etc."

* 1-0 means 1 year old untransplanted seedlings.

McComb, A. L. Relation between Mycorrhizae and the Development and Nutrient Absorption of Pine Seedlings in a Prairie Nursery. Journal of Forestry, vol. 36, No. 11: 1148-1154; Nov. 1938.

This article supports the text by Miller cited above.

Toumey, James W. and Clarence F. Korstian - Seeding and Planting in the Practice of Forestry. John Wiley & Sons, Inc., N.Y.C. 3d edition, 1942.

This book is prepared particularly for North American conditions but there are many portions of value for the nursery that will be established in Colombia (for tree seedlings of all classes).

The important chapters are:

Chapter XII Direct Seeding (to show waste)
XIII Forest Nursery
XIV Preparation of Nursery Beds and Seedling Culture.
XV Transplant Culture
XVII Forest planting, materials, etc.
XVIII Forest planting, methods and technique

Obviously these are not applicable in full and an annotated critique, page by passage, should be prepared.

The most important factors to be emphasized are:

1. That Colombia has no clearly defined cold period.

2. That nursery sites have to present optimum conditions, as compared to the natural conditions of ordinary plantings on the permanent sites.

Barton, Tela V. Hastening the Germination of Southern Pine Seeds. Journal of Forestry, vol. 26: 774-785. October 1928.

Typical Barton paper on storage conditions before sowing to insure germination. Seed was mixed with moist peat, placed in trays which were watched for aeration and even moisture. Various temperatures were tried and the best seems to be 5° C. for a period of two months, as this is suited to all the following species:

Pinus echinata
" *palustris*
" *caribaea*
" *taeda*

There were no data to indicate if this two-month period might be initiated at any time of year the worker desired.

Cooley, Grace E. Silvicultural Features of Larix americana. Forest Quarterly, vol. II, No. 3: 148-160 (May 1904).

Because of recollections of plantings of larch in Scotland, some effort was made to find references to the use of larches in the United States of America.

This is an interesting but unimportant paper. It stresses two factors of importance: that the young seedlings must not be overshaded and that the tree is not a swamp denizen of necessity.

A few references from Scotland are added here.

Roger, J. G. The Common Larch at High Altitudes. Scottish Forestry Journal, vol. 55, Part 2: 83-84 (October 1941)

This is a brief note to record the fact that Larix europea DC. (L. decidua Mill.) has managed to establish itself in Scotland at elevations much higher than those of the original plantations. These were at 1000-1800 ft. It is now growing (escaped) at 2819 ft. (Morrone) and 3502 (Glas Nivel). There may be others.

Argentina

Carnevale, Juán - Plantación de árboles. Sección de Propaganda e Informe, Ministerio de Agricultura, Republica Argentina (November 1927) No. 728.

Essentially for farmers and fruit planters, but a useful small publication with clear directions.

Meyer, B. S. Further Studies on Cold Resistance in Evergreens, with special Reference to the Possible Role of Bound Water.
Bot. Gaz. vol. 94, No. 2: pp. 297-321. Dec. 1932.

No bearing on our subject.

Baldwin, Henry I. Effect of After-Ripening Treatment on Germination of White Pine Seeds of Different Ages.
Bot. Gaz. vol. 96, No. : pp. 372-376. Dec. 1934.

A very indifferent short paper, which merely adds some data to those already known. Worked only with white pine, and data shows that stratification in moist peat (acidity not stated), with care to maintain aeration and moisture produced good results in old seed, the improvement being more conspicuous, perhaps, in the oldest samples, but not enough to justify the use of very old seed unless none other was available. Temperature was constant at 24° C. during germination; stratification temperature 8°-10° C. apparently based on results of Koblet (ref. cited). General average period for commercial consideration would be 60 days in stratifying chamber.

Spain

Since the problem of wood both for fuel and for construction has concerned Spain herself for some years, a brief attempt was made to look over such titles as appeared to have some bearing on the problem, remembering that there might be little of value, save in methods, since the Spanish climate does not approximate the Colombian.

The Servicio Forestal de Investigaciones y Experiencias publishes from La Moncloa, Madrid, through the Instituto Nacional de Investigaciones y Experiencias, Agrónómicas y forestales, a journal of very considerable value.

In their Vol. V, No. 10 (1932), there is a translation of A. K. Cajander's work under the Spanish title "La Teoría de los Tipos de Montes" which has no immediate application to our problem but suggests a basis for the proper study of the páramos if any extensive work is to be done on them.

Cajander's work was done in Finland and represents a very meticulous classification of soil areas and typical indigenous plant associations. Whether or not such associations are true for Colombia is a matter the writer of this report should like to investigate. The fact that there are in Finland many areas of relatively poor acid soils that do support profitable stands of forest trees: Pinus sylvestris, Betula verrucosa and B. odorata, Picea excelsa, Populus tremula, Alnus incana, A. glutinosa, even species of oaks and maples, gives some courage in considering the matter in spite of the fact that the climatic picture is utterly distinct.

In the same journal but for 1928, there is a brief article by Manuel Martin Bolaños, Ing. Agr. on eucalyptus species used in Spain, which should be of some value in Colombia where the eucalyptus are not clearly defined. Too many, in the writer's opinion, are called E. globulus and are not.

En resumen:

Eucalyptus globulus, largely used, produces good supporting timbers for mines. Apparently there is a lucrative oil-distilling business from the leaves of felled trees.

E. rostrata much hardier but wood checks badly on drying.

E. Maideni as good as E. globulus.

E. corynocalyx for heavy, rocky soils is better than E. globulus.

E. tereticornis not as good as globulus and/or Maideni, but promising; very hardy.

E. colossea, resinifera, botrioides and saligna grow as well as corynocalyx, but there are no complete data as yet: E. resinifera, however, should replace rostrata. Robusta is good at low elevations.

E. cornuta, obcordata, Lehmanni have no value as timber, but are good in dry, sandy locations.