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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.

REPORT ON

AGRICULTURAL SURVEY OF PERU

In presenting the following report, the writers have contributed separate sections, each person being responsible only for that portion to which he was assigned in the mission, Dr. F. H. Thurber, of the Bureau of Agricultural Chemistry and Engineering, reporting on the Utilization of Yuca in Peru, particularly as related to the production of starch; Dr. B. B. Robinson, of the Bureau of Plant Industry, reporting on Fiber Plants in Peru, with particular emphasis on flax; and B. Y. Morrison, of the Bureau of Plant Industry, reporting on Medicinal Plants and on general agricultural conditions.

Although originally there were some verbal suggestions that all discussions might be related to the proposed development of an experimental station at Tingo Maria, the officials in Peru requested a wider consideration, which is followed in the report.

B. Y. Morrison, in charge.

FIBER PLANTS IN PERU

Brittain B. Robinson, Agronomist
Bureau of Plant Industry, U. S. Department of Agriculture

FIBER FLAX

Fiber flax grown in Peru since 1939

Fiber flax was first grown in Peru on a commercial scale in 1939. The plantings were first made in the valleys of Pativilca and Supe. By 1941 the plantings had increased and flax was found in all valleys from Trujillo on the north to Pisco on the south. The estimated area planted to fiber flax in Peru in the year 1939 was 290 hectares or 97 fanegadas; in 1940, 1204 hectares or 402 fanegadas; and in 1941, 11984 hectares or 4000 fanegadas.

The first flax retting and scutching mill was built at Barranca and operated by the government on a charge basis. The Barranca mill was unable to take care of the increased acreage even in the Barranca valley, so by the winter of 1941 it was reported that approximately 19 new retting and scutching mills were under construction in various Peruvian valleys. All of these mills with the exception of the Barranca mill were construed with private capital. Each mill was said to represent an investment of 70,000 to 500,000 Peruvian soles, or $US10,850 to $77,500. It may be seen that the industry was started on a financial basis that might require some time for liquidation of investment unless profits were unusually high.

The large area planted to fiber flax in 1941 was sown mainly at two periods. Seedings were made in June and July, and in late September and October. With the additional areas seeded to flax up to the time this report was started (Nov.10) it was necessary to revise constantly the 1941 expected seedings from 2800 to possibly 4000 fanegadas.

This large area of flax was being harvested in 1941 from August to the end of the year. The factories under construction were believed to be sufficiently advanced to be able to ret, scutch and market all the fiber before the fall of 1942. If this is done they will be ready to process the 1942 crop which will be harvested mainly in July and represent a more normal crop year.

War and Lack of Cotton Market Caused Flax Expansion

The development of the Peruvian fiber flax culture may be the result of numerous factors. However, one main reason which may have caused the large 1941 planting was the high return which this crop paid. The price of flax fiber on the American market advanced approximately 200 per cent during 1940. This was the result of the loss of the supply normally obtained from the Baltic and Low Countries of Europe, cut off by the German occupation and control of the exports from such countries.

Another factor that undoubtedly influences some farmers was the stagnation of the Peruvian cotton market. Peruvian cotton was largely shipped

to England before the war, but English purchases after the war began were principally from the United States. The United States with its surplus cotton crop did not supply a market for much Peruvian cotton. Peruvian farmers, therefore, turned to flax which could be sold easily in the United States at profitable prices.

The success obtained in marketing the fiber produced from the 1939 crop seemed to be rather conclusive evidence that the fiber was of a quality desired, although it is possible that at least a part of the success was due the near absence of competing fiber in the market. This fact could hardly be overlooked if early Peruvian fiber of uneven grade, strength, fineness and cleanness were compared with fiber which spinning mills formerly purchased from European firms.

Duration of War and Expansion in other Countries Affect Industry in Peru

The high prices realized during 1940 and 1941 will probably not continue indefinitely. In the first place the United States market, at present the principal or only buyer, has definite requirements and these will have been filled when the fiber from the present crop is received. Further expansion of the Peruvian flax industry may result in a surplus supply unless other foreign markets become available. The market during 1940 and early 1941 was perhaps largely the result of the spinning companies being caught with no more than normal stocks on hand, and the rapid depletion of such stocks before the new expansion in Peru and elsewhere could build up the supplies.

Today the expanding production of fiber flax in the United States, the British Empire and elsewhere may take care of any deficits that may have existed up to this time, this in spite of whatever errors of inexperience may arise in the program.

In considering flax acreage expansion, therefore, Peruvian growers may well consider all factors of competition, whether immediate or at a later date since it is impossible to predict now the economic adjustments which will follow the present war.

For example, investments in new mill equipment which cannot be liquidated in the near future may result in loss if other factors of competition appear or reappear.

It may be necessary also to safeguard present investments by considering now rather than later what may happen if disturbed world markets are not able to absorb all the fiber flax produced during the crop year of 1941-42. The effect to be expected would be falling prices, due to a surplus, made even more disastrous by limited transport facilities.

Linen is really a luxury commodity even in normal times and especially so at present. It is problematical how far consumption of this commodity can be expanded in competition with other textiles which are cheaper for most uses.

Establishment of Market Grades of Peruvian Fiber Desirable

Peruvian flax fiber is a thread flax fiber with good strength. It was sought by American spinners after European supplies became unavailable. Expressed opinion indicates that its quality and value are variable. This is partly because the industry is new and experienced men are not available for the production of uniform fiber, and the grading has not always been up to proposed standards. This fault may become more serious with the operation of the new mills which are expected to start work in 1942, unless some measures are taken to standardize the product. It is believed that definite benefits would be realized by the establishment of and adherance to standard grades for the Peruvian fiber.

For the purpose of making a start, it was recommended that a flax school be held possibly at the government flax mill located at Barranca, to which each new flax mill would send one or more workmen to receive instructions not only in grading the fiber to uniform Peruvian grades, but also to receive instruction in and discuss problems at retting, scutching, tow cleaning and other problems encountered especially by new and inexperienced mill operators. It was believed that in addition to the instructional period of from two to four weeks at such a school that the training should be further supplemented by a government worker who would visit frequently each mill that wished to cooperate, for the purpose of giving further instructions and maintaining a uniform system of grading.

As this system of grading would not be entirely government controlled, it is possible that each mill selling fiber might have to use some mark to indicate the origin of the fiber in addition to the grade.

Nearly all of the Peruvian fiber sold in the past on contracted for near future delivery has been to flax spinners in the United States of America. It is believed, however, that Peru should not depend entirely upon this one market, since the production of fiber in 1942 in Peru from the flax grown in 1941 will amount to as much fiber as the United States normally consumes under peace time conditions. In view of this situation, caution should be used in substituting flax for crops of which surpluses are sometimes produced lest the farmers find themselves with an equally troublesome surplus of flax on their hands.

In order to provide additional markets for the fiber it was recommended that Peru attempt to establish immediately a market in the British Isles for some of its fiber. It is realized that the price offered in the British Isles may not be as high as that at present in the United States. However, there seems to be a good opportunity for introducing more Peruvian fiber in British mills now that little or no fiber is available from Continental Europe. The linen industry is based to some extent upon long established customs and practices, and if Peruvian fiber could create a reputation in the British Isles before the end of the war, it may be possible that in the post war period the British Isles might continue to use more Peruvian fiber.

AGRICULTURAL PRACTICES FOR BEST RESULTS

Areas of Favorable Climate: Fiber flax has been grown from Ica on the south to Chicayo on the north. At present factories or retting

and scutching mills are under construction in the Pisco valley on the south to the Trujillo valley on the north. Field observations indicate that flax from Canete to Barranca in the Department of Lima makes excellent growth. Flax grown in 1941 south of the Department of Lima in the Pisco and Chincha valleys did not make as good a growth as around Lima, which may be attributed partly to type of soil and partly to climate. The flax north of Barranca was in some cases of fair quality, but in general it did not grow as favorably as nearer Lima. Undoubtedly the climatic conditions of cloudiness that are known to exist in the Department of Lima play an important role in making this district the most favorable in the coastal area of Peru for the production of fiber flax. This condition is in conformity to other parts of the world where fiber flax grows best in cool moist climates. It is recognized that the Department of Lima is the coolest and probably has the highest atmospheric humidity of any coastal region of Peru.

As the industry has been well established in the Department of Lima, it is recommended that new areas be developed slowly and that investments be made in mills only after flax grown in new valleys experimentally has been transported to Lima, processed and proved to be of a quality that would justify the necessary investment.

In general, fiber flax has been considered a crop to be grown in the cool temperate belt of the world and not in the tropics. Possibly less than one per cent of the world's flax fiber is produced in the tropics. Some may wonder how it is possible to grow good flax at the low elevations in Peru which lie entirely in the tropics. A study of the climate of Peru will reveal that the area particularly in the Department of Lima during the winter months is cool and cloudy and the atmosphere is very humid even though the rainfall is insignificant.

SOILS AND SEEDING

There appears to be no opportunity for a wide selection of soils for fiber flax in Peru. The soils are mainly alluvial plains or deltas built up in the narrow valleys of the coastal region. In general they are fertile and produce uniform growth of plants, but there are some exceptions.

The soils are reported to be slightly alkaline in reaction. Although definite scientific proof has not been presented that alkaline soils are a detriment to fiber flax, it is generally conceded from a number of articles that have been published that the quality of the fiber in fiber flax is better when produced on soils that are slightly acid when produced on slightly alkaline soils. Further it is believed that generally speaking the fiber flax production which is carried on mainly in humid climates of Europe and elsewhere is upon soils that are slightly acid in reaction.

While from a practical point of view it may be impossible to change the soil reaction where flax is grown, it is believed that the conditions in Peru permit a study of the problem of the effect of soil alkalinity on the quality of the fiber and that future research work in Peru with fiber flax should include this problem.

In general the soils are well prepared for flax sowing and fertilizers are not used and do not appear to be necessary for the successful growth of a crop. The influence of fertilizers on the quality of fiber grown on Peruvian soils has not been determined. In the valley of the Chillon river flax seems to make a more uniform growth with a nitrogen fertilizer. Uneven growth was not observed on unfertilized soils in other valleys. While the preparation of the seed bed seems to be done under the best conditions for working the soil the seed bed is changed by its preparation for irrigation where ditches, ridges, etc. are added, and these affect the later growth of the flax. This will be discussed under irrigation. (See Plate 1.)

The soils are prepared either dry or moist. After seed bed preparation the seeding follows and if the soil is dry it is immediately irrigated, and if moist it may not be irrigated for approximately three weeks. Undoubtedly later experimental field trials will definitely show which of these two methods gives the best stand and the best yields. Observations indicate that the soil where irrigated, plowed moist and immediately planted gave good results. However, if the soil is allowed to dry two or three days after plowing and before planting it is doubtful if a uniform stand is obtained when the seed is broadcast as was the common method of planting. It is believed that for such practices it would be better to drill the seed thereby placing them in contact with moist soil which would insure more uniform germination. When seed is broadcast and covered with a harrow, roller, float, or some other implement, it is doubtful if the seeds are uniformly covered. Winds which dry the upper half inch of soil prevent the seeds from germinating well and results in an uneven stand, as the surface seeds will not germinate until after the first irrigation three weeks or more later.

IRRIGATION

Peruvian farmers in the coastal area seem familiar with the best irrigation practices for most crops. They are believed to understand the need of their soils for water as irrigation has always been the practice by the farmers. Without irrigation there could be no farming on the coast. For a new crop, and fiber flax is new to Peru, some advice may be helpful to the farmers. The scarcity of water in many valleys makes it necessary to attempt to apply the water when it will do the most good.

It has been mentioned that fiber flax is grown most extensively in northern European countries as a spring and summer crop. The seeds planted in Europe in the cool spring germinate slowly and the seedling plants grow slowly. This is believed by some to induce rich fiber development of good quality. In Peru the temperatures at the time of planting are much higher than at the time of planting in Europe. It is the writer's opinion that this is one of the principal causes which induces fiber flax in Peru to make such rapid development in the early seedling stage. While there are no charts to compare growth with age of plants to illustrate the point, it is possible in Peru to see plants a foot or more in height, one month to six weeks after planting. It is during this early stage of growth that attempts might be made to slow the growth in height and attempt to obtain better fiber development. It is believed that the time of application of irrigation water may be of some help in this connection. By using irrigation before seed bed

preparation and planting on a moist seed bed probably with a drill and not irrigating after seeding until the plants are in need of water, it is possible that the growth may be checked slightly with a resultant improvement in the fiber quality. Any improvement in the fiber due to checking the length of growth of the stems, however, must be sufficient to compensate for any value lost through any decrease in yield of fiber that might occur. Experimental work in Peru will be necessary to determine the value of this procedure.

Although it is believed that most farmers have been instructed to discontinue irrigation after flowering has started, it is known that some irrigation is done after flowering. This not only will prolong flowering and give diseases a better opportunity to attack the plant, but may result in a second growth which will be a serious detriment to the quality of the fiber. It is suggested that the farmers be further instructed to arrange their irrigation schedules so that the last irrigation will be applied just before plants start to flower or when the first flower buds appear. It is believed that even on the soils where water retention is poorest sufficient water will remain in the soil to mature the plants properly.

While the writer hesitates to make suggestions to men who are experienced in irrigation methods with their own soils, it is impossible to pass over the subject without questioning the need in some instances of such deep ditches, such waste of total area in ditch and plowed out ridges. (See Plate 1-3, 4, 5 and 6).

With the return of lower prices of fiber after the war, efforts will likely be made in Peru to harvest with machine pullers to cheapen harvesting operations and to do away with a labor problem that might at times be serious if Indians from the Sierra were not available. If pulling machines are to work satisfactorily, then the ditches must be made as shallow as possible to permit the mechanical puller to go from one irrigated bed to another without serious inconvenience. Figures (Plate 1-3, 4, 5 and 6) illustrate fields of flax in Peru where, after the flax has been sown, the farmer has plowed out deep ditches. In addition to the land occupied by the ditch which no longer produces a crop, the soil turned out of the ditch covers an additional foot of ground of the field and hence in fields of this type it is estimated that at least 15 per cent or more of the total area is occupied by the irrigation system.

Flax along the borders of irrigation ditches grows coarsely and does not mature uniformly with the rest of the field. It is desirable to reduce this factor. In the Pisco valley fiber flax was planted upon land where the seeding was done after shallow ditches and ridges had been made. The seed was planted with drills on top of the ridges and in the ditches or broadcast and rolled. Good stands were obtained by both methods of seeding and it is believed that flax from such fields would produce better quality and yields than from fields with open ditches. Some doubt was expressed regarding the difficulty of irrigating with growth in the ditches, but experimental work should prove the advantage of disadvantage of such a practice. It appears to have advantages.

In the Imperial Valley of California, where irrigation of seed flax is practiced, the ridges bordering irrigation beds are made low and rounded. Seeding is accomplished by drilling crosswise over the borders. This method might be tried experimentally in Peru.

WEEDS AND DISEASES

Weeds which are especially troublesome in many countries where fiber flax is grown are not particularly numerous in Peru, or were not in 1941 during the writer's visit. They are more frequently found in wide irrigation ditches where no flax is present to compete. (See Plate 3, Nos. 1 and 3). There were traces of dodder in some flax fields, but it was not serious and would not represent .1 of 1 percent damage to the whole crop. It should be carefully checked, however, to prevent future increase of this often troublesome pest. Pullers and all workers handling the straw in the processes of threshing should be instructed to remove all bundles in which dodder is present in order to reduce the danger of contaminating planting seed with this obnoxious weed.

Rust, Melampsora lini, may be found in traces in many fiber flax fields in Peru. During the writer's visit to fields in all the valleys where flax is grown there were only two cases where the rust was present in sufficient degree to indicate that damage would result to a greater degree than one per cent. One large field of flax in the Pisco valley was badly infected with rust and in this case it is probable that from this particular field very little line fiber of good strength would be obtained. The fiber would likely be sufficiently weakened to make only tow fiber.

The other case of bad rust infection was on a small experimental plot of only a few square rods near Barranca. It was planted with seed of Chilean origin. All the flax from this field should be discarded. While many strains of rust have been found which attack flax in different intensities, it is possible to control this disease to a large extent by planting resistant varieties and harvesting as early as possible. Flax planted as a winter crop would be less subject to serious infection than flax planted as a summer crop.

If fiber flax becomes permently established in Peru then pathological studies will have to be made in Peru to determine varieties that are resistant to the forms or strains of rust common in that area. For the present it will be best to plant seed of which the known reaction to rust has been determined in order to escape as much damage as possible.

The presence of no other disease was encountered in Peru, although pasmo had been found in Peru and is believed to have been present for some time on flax seed originally obtained from the Argentine and which had been grown for a number of years in the Sierra. No traces of pasmo were found by the writer in his visit to Peru except the collected specimens seen at La Molina.

HARVESTING

Hand harvesting by Indians from the Sierra is the common method used in Peru. It was estimated that it required 17 to 25 Indians to pull an acre of flax in one day, or approximately 43 to 63 Indians to harvest a hectare in one day. This rate of pulling appears to be rather slow according to numerous reports published in reference to hand harvesting. The rate of pay for this work was 1 sole per day, which amounts to approximately $2.75 to $3.75 per acre in United States currency for harvesting. While there are no objections to hand harvesting, it is conceivable that there may be times in the future when labor might be difficult to obtain or exchange rates would make this type of harvesting very expensive. Pulling machines if successfully used would do away with a great deal of man labor. A pulling machine was tried in Peru but was said to have been unsuccessful due to the deep irrigation ditches over which it had to travel. It is recommended that as these machines have been used with a fair degree of success in other countries, further efforts be made to introduce the mechanical flax puller into Peru for harvesting. In experimenting with the puller it will be desirable to try it in fields with low ridges and and shallow irrigation ditches.

If flax is pulled and spread on the ground to dry it is recommended that the flax be placed in parallel rows after pulling with all the heads in the same direction. This will facilitate turning the flax if that proves to be the best practice in curing, (See Plate 3-3).

It is possible that some Peruvian flax has been allowed to remain spread in the field too long after harvesting before being tied into bundles and shocked. It is not necessary to have the flax completely cured before tying in bundles. In fact, in many places where fiber flax is grown the flax is made into bundles at harvest and the straw cures in the bundles. It is believed that the hot sun on exposed straw for several days in curing is capable of reducing the quality of fiber, although there is little scientific evidence to prove this point. A particular example to illustrate this point is the old practice in the State of Kentucky, U.S.A., of shocking the hemp stalks immediately on harvesting during the hog month of July and not spreading the hemp to dew ret until late fall. It is believed that spreading the straw to ret during the summer months will lower the quality of fiber. Flax exposed to the sun in curing produced fiber slightly weaker than flax cured in the shade. This flax work was done in the State of Michigan, U.S.A. It is recommended that research in Peru determine if exposure of flax to the intense sun heat and light during certain months of the year lowers the fiber quality.

THRESHING

During the winter months threshing in Peru is slightly more difficult than in many flax growing countries. The high humidity does not lend itself to easy removal of the seed from the bolls. Roller type threshers crush the damp bolls and the crushed bolls remain adhering to the straw. For this reason the hand rippling and machine rippling machines are likely to prove the best means of removing the seed bolls and seeds. (See Plates 3-2, 4 and 4, Nos. 1 and 2).

RETTING

Tank water retting is practiced in all flax mills in Peru. (See Plate 2). In only one mill out of twenty are facilities being installed for warm water retting. As warm water retting. As warm water retting, or possibly it will be best to describe it as controlled temperature retting, usually about 80° F., is used in many countries where the industry has made the greatest technical advancement, it will be well to consider the advantages and disadvantages of such a system for Peru. Naturally it will be well for the various mills in Peru to obtain information regarding the successes and failures of the one mill using hot water or controlled retting. The term controlled retting is used for the reason that in Peru at certain seasons of the year and in certain valleys it is understood that the retting water without artificial heating is nearly 80° F. and hence the tank retting without heating the water approaches the system known as warm water retting.

Advantages of controlled warm water retting

1. Shorten period of retting during certain periods of the year. The shorter period in itself has little advantage unless it means a smaller investment in capital facilities used to greater advantage, the quicker turnover of product and less interest or carrying charges on the commodity, etc. Speed up of retting may mean idle machinery at other times unless production of raw material is increased.

2. More uniform product of fiber under many conditions. Controlled retting may make it easier to judge the proper and point of the ret as each batch to some extent is fairly similar in time of retting. Without control the retting period may be twice as long in the winter months in Peru as in the summer months. Experienced workmen would not have trouble in overcoming or taking care of this disadvantage.

3. There is a possibility of using a smaller investment in retting tanks to advantage, as it would not require so many retting tanks for each scutching machine.

Possible disadvantages of warm water retting

1. Increased financial investment would be necessary in existing facilities, many of which were not planned to best advantage for the installation of warm water retting.

2. Increased cost of retting in man labor necessary to maintain heat and possibly a more highly trained man to judge the retted "end point" as the faster the ret the more closely the ret must be watched to judge this point.

Discussion of retting for Peru

1. Conditions in Peru for retting, drying the straw and delivery of the straw to the retting mill are so different from conditions in other fiber flax growing countries that the common reasons advanced for controlled warm water retting do not seem to apply fully to Peru. The writer feels that rapid changing over to controlled warm water retting is unwarranted in Peru until the problem has been more thoroughly studied and definite advantages of such a change have been proved by the mill with the installation for this method.

2. In many countries other than Peru where fiber flax is grown, the summer retting period is short and warm retting is necessary in order to get the flax straw all retted during the summer months with as little investment in retting tanks as possible. Further in many countries where fiber flax is grown, the water used for retting is much colder than in Peru. For these reasons it is very important for European countries and Oregon, U.S.A., to use to advantage warm water retting, but this does not apply fully to Peru where fiber flax may be retted the entire year or at least ten months in many valleys.

3. In European countries and in Oregon there is a definite period of planting and harvesting. This period is only two or three weeks. The flax straw under these conditions is all ready to be retted at one time or as soon as it can be threshed. Rapid retting facilities are necessary in Europe or at least more necessary than in Peru where the less variable climate permits planting over a greater period of the year, and this distributes the harvest so that it does not all come in two or three weeks' time. This distributes the spread of the retting period or the time at which the straw is made available for retting.

4. The retting which the writer saw in operation in Peru, principally at Barranca and Canete, was well done. It is easily conceivable, however, with numerous new mills beginning operations and without experienced workmen, that some over and under retted flax may be produced.

SCUTCHING

Scutching operations were inactive during the writer's visit in Peru. (See Plate 403, 4, 5 and 6). Both the Barranca and Canete mills, which are the two that have been in operation for some time, were installing new tow equipment and new scutching machines. Other flax mills were in some cases retting flax but were not scutching. Apparently numerous difficulties were being experienced in scutching up to the expected production when trial runs were made with the new machines. Apparently this difficulty was partly due to the machine capacity having been overrated and partly due to the degree of efficiency of the laborers who were not highly skilled. Unfortunately, it caused dissatisfaction and there was little that could be done to improve the situation. If the machines are basically at fault it will be a matter of obtaining other machines. Machines of other construction would have to

be imported from England, Canada, or the United States, where a few are being made. However, the difficulties of obtaining priorities for construction and shipment would make it difficult to obtain other machines at present. Several Van Haawart machines which have been reported as giving good results in Canada and the United States have been ordered for delivery in Peru. When these machines are put into operation in Peru it will be easier to judge if the lack of productive capacity per machine and delays are the result of any particular make of machine, the conditions under which the machine is operated, the efficiency of the operators, or a combination of these factors.

Apparently the scutching machines in Peru have not been as productive as others working under favorable conditions.

Very much concern has been expressed in Peru about the high yields of tow fiber which have been obtained. It is natural that one would desire a yield entirely of line fiber which commands a higher price. Frequently one may hear that the tow yield is 50 per cent or more of the total fiber, and the writer even heard one experienced worker state that their line yield was approximately 7 per cent and the tow yield 14 per cent, both yields based upon unthreshed straw delivered at the retting mills. Such yields undoubtedly did represent the actual weights obtained, but the tow yield is misleading because it is unclean tow with wood or shives present. Normally flax plants with roots air dry cured and unthreshed as produced on a farm do not contain more than 12 to 13 per cent pure fiber. This percentage is even lower when the straw is short and the roots and seeds constitute a greater percentage of the entire weight. With very long plants such as are produced in Peru the percentage of clean scutched line and tow fiber is likely to slightly exceed 12 to 13 per cent, but with the present varieties of fiber flax which are grown commercially it is doubtful if more than 1 or 2 per cent more fiber is obtainable, and certainly not the high percentages of 7 per cent line and 14 per cent tow which clearly indicate that the fiber was not well cleaned.

Tow cleaning in Peru in the past has given a great deal of trouble as little cleaning equipment has been available. Driers have not been used in the tow cleaning process and it is believed that driers will be necessary for successful tow cleaning, especially during the winter months when the humidity is believed to be very high. (See Plate 4-4).

The future disposal of the Peruvian tow is likely to be one of the most difficult problems confronting the industry. The thorough cleaning of the tow which is likely to be much better in the near future with the installation of driers, tow shakers, and breakers, will increase the tow value. It may be possible that the low grades of tow might find a market with high grade paper manufacturers. Such a market although not very profitable, might serve as an outlet and prevent the material from being a total loss. Such material has been more and more successfully used for high grade paper in recent years with the development of methods in the United States of America of using waste seed flax straw fiber for this purpose.

HEMP, Cannabis sativa

Several tons of hemp seed were distributed in Peru in 1941 and planted in small experimental plots. (See Plate 5-4). The seed apparently was planted in September and October and none of the hemp which the writer observed in experimental plots in different departments of Peru was over six inches high. It was difficult to judge just how well the plants would grow to maturity from the small seedling plants.

Unfortunately, the stands of hemp on the experimental plots were exceptionally poor in most cases. It was known that the hemp seed had germinated well in preliminary test. The poor stands in some instances were due to the following causes: the seed was broadcast on a dry seed bed and was washed to the lower end of the plots by flood irrigation. This was evident by dense stands in small spots at the lower ends of irrigated plots and no hemp elsewhere. In other cases the flood irrigation had caused the surface to crust and bake, which may have prevented the seedlings from emerging. At the Experiment Station at Lambayeque it is believed that the seeds failed to germinate evenly from lack of sufficient moisture. The stand of plants was only a few per square meter and it is possible that all seeds germinated but before the roots could penetrate deeply for moisture the surface dried and the seedlings died. In another case it was reported that some soil worm had destroyed the stand. Hemp is not a strong plant in pushing its way to the surface of the ground when germinating. It is believed that drilled hemp seed on a newly prepared moist seed bed might give better results than were obtained in 1941. Unless good stands of hemp are obtained the light yields would be unprofitable and the quality of fiber very poor.

In the United States hemp grows best upon silty loam soils high in organic matter. It is not believed that similar conditions exist in Peru.

Hibiscus cannabinus

Mr. G. E. Nicholson, of Romero & Co., Catacaos, Peru had conducted some experiments with Hibiscus and had some data on the cost of growing and preparing this fiber. His cost figures of growing and preparing the Hibiscus fiber were only 16 cents of Peruvian money or 2.5 cents U.S.Cy. per pound. It was stated that in 1938 eight bales of the fiber of undisclosed weight had been prepared and shipped to England. After all costs of transportation were paid there were only about 8 shillings returned to the shipper for the fiber. This did not indicate that the returns were very profitable. If the fiber can actually be grown and prepared in Peru for 2.5 cents U.S. Cy per pound, then it should be possible for it to compete with jute from India.

In 1941 samples of Hibiscus fiber were shown to the writer. The first grade of fiber about 4 feet long was well cleaned and had a good appearance, but was very weak. It was no stronger than jute fiber if as strong. It had been cut at the mid-flowering period. If stronger it would be a good substitute for jute.

To the writer it appears doubtful if Hibiscus fiber can be grown and prepared profitably in Peru. It would be more profitable to grow Cannabis sativa provided it would grow and yield the same amount of fiber per unit area of land. The hemp fiber would be a better quality than the Hibiscus fiber and the cost of culture and processing would be but little if any different.

A small experimental plot of Hibiscus cannabinus was growing at the Experiment Station at Lanbayeque but it was planted in rows for the production of a seed crop. (See Plate 5-3). It is understood that the seed from this crop was to be sent to Mr. Nicholson in the Piura valley for experimentation. This Hibiscus although planted in rows had grown only 4 to 6 feet tall, which is not a good growth for the plant when planted in rows, but would be a fair height if the plant had been broadcast and the plants competed with each other for space and nourishment.

RECOMMENDATIONS

AGRICULTURAL

1. Work scutching mills on a 24 hour basis every day to get maximum production at present while high prices prevail for fiber.

2. Develop fiber flax seed production in Peru to be independent of imports.

3. Believe drilling should be better than broadcasting in seeding.

4. Believe drilling on one to two days old damp seed bed is best.

5. Irrigation ditches should be prepared before planting.

6. Irrigation ditches should be made shallower to permit mechanical puller to work eventually in fields.

7. Reduce space occupied by ditch to utilize more land of field.

8. Do not irrigate after planting until necessary.

9. Do not irrigate after first flowering.

10. In hand harvesting place flax in windrows in same direction.

11. Shock pulled flax after second day curing especially in periods of intense heat and light.

12. Move flax from shock to stacks as soon as cured.

13. Ripple type machine thresher should be most satisfactory in damp periods.

14. Remove bundles with dodder in pulling, shocking and threshing.

15. Continue to use unheated water retting until definite proof is obtained of heating water being better.

16. Build any new tanks with easier access of truck for filling and emptying straw.

17. Build tanks of type at Cañete rather than Barranca mill type.

18. Learn if other types of scutchers do better work than Soenens.

19. Use driers in cleaning tow especially in winter months.

20. Discourage the further expansion of the industry in Peru because of lack of market.

21. Instruct personnel at mill in all phases of the industry by a government school.

22. Discourage expansion of industry outside Department of Lima until experiments prove that straw grown elsewhere and processed at Barranca mill is quality desired.

MARKETING

1. Standardize the grading of fiber line and tow at all mills as similar as possible.

2. Develop fiber market outside the United States, if possible in British Isles.

3. Develop outlets for low grades of tow in high grade paper industry.

RESEARCH

1. Conduct agronomic experiments to study best practices of culture for Peru in reference to seeding, irrigation, fertilizers, time planting, harvesting and effect not only on yield in quantity but also quality.

2. Develop varieties by plant breeding methods adapted to Peru and resistant to strains of diseases prevalent in Peru.

3. Investigate the use of machine pullers for cheaper future harvesting.

4. Determine if curing of flax exposed to hot sun reduces the tensile strength and dryness of the fiber.

5. Identify dodder on flax and recommend best means of control.

6. Investigate the percentage moisture in the flax straw and flax tow in relation to time of year in Peru and the best percentages for scutching and tow cleaning.

7. Effect of soil alkalinity on fiber qualities.

Plate 1

1. This flax field together with the field shown in Plate 1-2 represents field practices that are believed to be among the best methods of culture used in Peru. In this figure the irrigation ditches are narrow and shallow and were prepared before the field was sown. Mechanical pullers would have little difficulty in crossing the ditches in this field. Contrast this figure with ones shown in Plate 1-3, 4, 5 and 6.

2. This figure shows a field with small ridges that mark the irrigation beds. The ridges made before planting do not occupy much area. Mechanical pullers would have no difficulty in operating over these low ridges. It should be possible to sow these ridges. Contrast this figure with ones shown in Plate 1-3, 4, 5 and 6.

3. A Peruvian flax field showing large area devoted to irrigation ditches. Laborers are working in this field removing large weeds.

4. Irrigating fiber flax in Peru. This method of irrigation using large deep ditches prepared after sowing is not recommended in preference to the method shown in Plate 1-1 or 2.

5. A Peruvian fiber flax field showing large area occupied by irrigation system. This method of irrigation would make it very difficult to use mechanical pullers.

6. A Peruvian fiber flax field being irrigated just after seeding. This system of irrigation ditches and planting is not recommended for best results. See Plate 1-1 and 2.

PLATE I

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Plate 2

1. A large retting tank at Barranca, Peru. Ropes used for holding the straw submerged in this tank have stretched allowing the straw to float. The men are attempting to tighten the ropes and stones have been used to help submerge the straw. A very unsatisfactory retting tank in contrast with the one shown in Plate 2-5.

2. Emptying a retting tank. Such a large tank does not permit trucks to come on each side of the tank as is possible for the tank shown in Plate 2-5. It does not permit the use to best advantage of mechanical elevators and adds to the man labor expense.

3. An empty retting tank at Barranca, Peru. Showing the ropes used to tie down the straw to prevent its floating when the tank is filled with water.

4. View of a retting tank being filled with straw previous to retting.

5. A view of a retting tank in Peru believed to be more practical than the retting tank shown in Plate 2-1 and 2 in reference to means of holding the straw submerged in the water and accessibility alongside the tank to the laborers for filling or emptying the tank. Small mechanical elevators could be used to lift the straw from the tank to trucks to empty with less labor than the ones shown in Plate 2-1 and 2.

6. Retting tanks in Peru constructed side by side. On the small platforms along one side of each tank will be constructed a narrow gauge track for a field railroad which will be used in transportation of the flax straw for filling and emptying the tanks.

PLATE 2

1

2

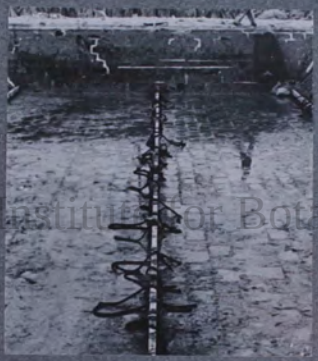

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Plate 3

1. A field of fiber flax in Peru showing the hand harvested flax curing. Notice the weeds in this field along the irrigation ditch where there was no flax growing to compete with the weeds for water, light and nourishment. Fortunately, Peru does not have many weedy flax fields, but wide irrigation ditches give the weeds a better opportunity to develop, making harvesting slightly more difficult. Contrast this figure with the one shown in Plate 3-3 where no weeds are present in shallow, narrow ditches which permitted closer planting.

2. A laborious method of deseeding fiber flax in Peru. Such a practice is only possible with cheap labor or when fiber prices are very high. Contrast this method with that shown in Plate 3-4.

3. A field of hand-harvested fiber flax in Peru. In harvesting the laborers have placed the roots of two rows together and the seed boll ends of two rows together. This prevents the flax from being turned in curing - a practice employed to some extent in Peru. It is not believed that turning is necessary in most cases.

4. A mechanical deseeder working in Peru. This rippling type of deseeder is believed to be better adapted to Peruvian conditions than the roller type, due to the high humidity that causes the roller type to smash the bolls without removing them. Note the lack of a roof which makes mill investment in Peru a small item. Seed conveyors to seed cleaning mills are yet to be installed in Peru.

5. Possibly the world's tallest flax is grown in Peru. Measuring a plant that grew 1.85 meters from the cotyledons to the tip of the panicle.

6. A Peruvian fiber flax field just starting to flower. Its excellent height insures good yields and fortunately lodging is not severe.

PLATE 3

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Plate 4

1. A view of a Peruvian flax threshing establishment. The climatic conditions existing in Peru do not necessitate building investments that are necessary in more humid climates where fiber flax is grown. The trailers used for conveying straw greatly facilitate the transportation with the investment in only one or two trucks or tractors for locomotion.

2. Deseeding fiber flax in Peru. The efficiency of the laborers is not as great as in some countries, but greater experience in handling flax may bring improvement.

3. A flax scutching mill in the Cañete valley in Peru, surrounded by retted straw drying in wigwams. Nearly all Peruvian scutching mills are of good construction. Some are built with two floors which permit scutching above and tow cleaning below, which has some advantages.

4. Tow cleaning equipment being installed in a Peruvian flax mill. A drier is to be inserted in the vacant space between the two small breakers. Tow cleaning should be better in 1942 compared with the almost non-existence of tow cleaning in 1941.

5. Scutching machinery being installed in a Peruvian flax mill. This figure represents the state of construction of many Peruvian flax mills in November, 1941 and hence the difficulty at that time of observing the type of work done on such machines.

6. Modern machinery for preparing flax is being installed in Peruvian mills. Peru flax processing methods will be as up-to-date as it is possible at the present time.

PLATE 4

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PLATE 5

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Plate 5

1. Possibly Cereus lanatus, a plant found rather abundantly in the Sierra near Huanuco, Peru and reported to be found in the north coastal region on the mountainsides. Fiber is collected by Indians from clumps of fiber that are around the inflorescence at the end of the stalks in this figure. The fiber is used commonly in Peru in filling mattresses and pillows. It is not believed to be equal to kapok in resiliency. It seems doubtful if any quantity could be exported to compete with other plant fillers.

2. Peru's first fiber crop in production and value - cotton. This figure shows the sorting of Pima cotton grown in the Piura valley in northern Peru.

3. Hibiscus cannabinus planted in an experimental plot at the Agricultural Experiment Station, Lambayeque, Peru. It is growing in rows for a seed crop and is in full bloom and approximately 1.75 meters tall. It is of doubtful value as a fiber crop for Peru because it would probably serve as a jute substitute on a foreign market and thus return only a low value.

4. Cannabis sativa is shown in the seedling stage. Nearly all the experiments with hemp, C. sativa, observed in Peru were plants at this stage of growth. The stand of plants here is not perfect, but much better than most experiments. Notice the soil crust cracking, which indicated that on this soil irrigating after sowing is not a satisfactory practice to permit hemp to emerge.

5. Carludovica palmata found growing at Tingo Maria, Peru. It is the Panama hat palm. There would appear to be possibilities of using this more profitable hat material in Peru in place of some sedges which are used to some extent at present.

6. A promising Furcraea plant growing near Huánuco, Peru. While Furcraea fiber is not valued as highly as sisal, its adaptation to this region is in favor of its utilization. Experimental processing under way may prove the value of this fiber.

THE UTILIZATION OF YUCA IN PERU

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Data given in this report were collected during the period extending from August 28 to September 12, 1941.

Yuca is known under the names "cassava" in the Dutch East Indies and "mandioca" in Brazil. Starch from cassava is shipped to the United States and sold under the name "mandioca flour." Yuca is grown in scattered areas in nearly all of the low land sections of Peru. The crop is used almost entirely for food by the people of Peru, although a small amount is used for starch production, particularly in the northern sections of the country. Statistics on the yields per hectare and on the composition of the roots are meager.

At the request of the Peruvian Government, a preliminary survey dealing with the production, yields, and probable industrial uses of yuca was begun. The survey was made under the direction of Mr. Luis Montrero Bernales, Director de Agricultura y Ganadería, Ministerio de Fomento, Mr. Pedro Recavarren Cisneros, Director de la Sección de Tierras, de Montaña y Colonización, and Mr. José Carraras G., Jefe de la Experimentación Agrícola del Norte, assisted with the surveys in the sections of the country in which their departments are located. Mr. Bernardo P. R. Morevsky, Inspector of Experimental Agriculture, made arrangements for visits to experiment stations, for laboratory aid when needed, and assisted in the collection of information concerning the production of yuca. Mr. David Dasso, Minister of Finance, is greatly interested in the possibility of obtaining additional farm crops that may be successfully grown in Peru. He discussed the situation with reference to surveys that had already been made.

Peruvian Government officials have been seeking information concerning the industrial utilization of yuca for some time. They have obtained estimates, from representatives of manufacturers of machinery in the United States, on the cost of equipment for a factory suitable for the manufacture of high grade starch from yuca and have also collected some information dealing with the technical operation of such plants.

After a number of conferences, it was decided that it would be desirable for me to visit one of the several inland valleys, and also one of the coast sections in the northern part of Peru, that might be available for the production of yuca.

VISIT TO TINGO MARIA

This is an inland valley about 650 kilometers by automobile road,

northeast of Lima (about 16 to 20 hours are required for the trip by automobile). In many places this road has been blasted out of the rock sides of narrow valleys leading to passes in the mountains. It is paved to Oroya. A two-way all-weather road is maintained from Oroya to Huánuco and a one-way all-weather road from Huánuco to Tingo María. It is expected that the road will be completed beyond Tingo María as far as Pucallpa sometime in 1943. The freight rate by truck from Lima to Tingo María is approximately $10.00 per ton.

The Peruvian Government has established a colonization center and a small experiment station at Tingo María under the direction of Dr. Swen Erickson. Colonists are being encouraged and assisted to settle and begin farming in the Tingo María valley. It is estimated that approximately 50 million acres of land are available for colonization in these inland valleys of Peru. The valleys are practically all forested at the present time. It is estimated that only approximately 10% of the timber is suitable for lumber. The wood is very soft, and it was stated by Dr. Erickson that it would not be suitable for fuel for a power plant. The country is opened up by cutting and burning the tropical vegetation. Some crop such as yuca is then planted without any preparation of the ground. After approximately three years nearly all of the tree stumps will be rotted and the ground can then be cultivated. The soil is a sandy loam type, varying from very light sandy loam to a somewhat heavy clay consistency. On the whole, the valleys are fairly level and wide areas of land could be found that would require neither drainage nor terracing.

The temperature in this valley ranges from a high of about 36 degrees to a low of about 20 degrees Centigrade. The valley is not subject to malaria or other tropical diseases. The rainfall during the past season was 3.78 meters. It may rain during every month of the year, but the so-called rainy season extends from October to mid-April with particularly heavy rainfall in January, February and March. Crops such as yuca could be harvested and processed during the six or seven months' period extending from April to October. The experiment station has conducted preliminary work on some crops that can be successfully grown in this valley and has found that such products as yuca, tobacco, cacao, bananas, papaya, pineapples, flax, and corn can be grown. Dr. Erickson has made a short report on the production and composition of yuca. A copy of his report is attached. He states that yields of about 14 to 20 tons per hectare in an approximately ten months' period of growth with a starch content of about 18% to 26% can be expected, the yield and starch content varying with the variety and the conditions under which the plants are grown. He suggests that a price of about 35 centavos an arroba (25 lbs. approximately), or approximately $4.60 to $4.75 per metric ton would be attractive to the growers. This estimate was based on prices paid for small lots of yuca purchased from colonists by the local experiment station. The experiment station used the yuca tubers for feeding livestock.

Considering the high freight rate from Tingo María to the coast, the estimated price of $4.60 would be a rather high cost for yuca to be used for industrial purposes. Starch produced from such raw material probably could not compete in price with starches produced in other countries. After a greater number of colonists have settled in the valley, it is possible that production costs will be much lower than the estimated costs reported in 1941.

Inquiries were made as to possible sources of power, should it be considered desirable to establish a yuca processing plant or other processing plants in this section. The wood was said to be unsuitable for fuel and at the present time oil must be transported from Lima. Since the freight rate is about $10.00 per ton, the use of oil would be prohibitive unless it could be obtained from one of the inland oil fields after the road to Pucallpa had been completed. It is probable that a sufficient and suitable stream could be located for the installation of a hydroelectric plant that would no doubt serve as an economical source of power. For some installations, it might also be used as a source of heat for drying. About 600 to 1000 hectares of land would be required for a small yuca products factory. Clearing could be begun at the beginning of the next dry season, plantings could be made as soon as the rains begin and at least a part of the crop would be available for use late in 1943. It seems probable that a small factory might be put into operation in 1944.

THE PRODUCTION OF YUCA IN THE COASTAL REGION OF NORTHERN PERU

A visit was made to the town of Piura to consult with experiment station representatives in northern Peru and to gain some first-hand information concerning agricultural conditions in that section of the country. Ing. Julio Favre C., Jefe de la Estación Agronómica de Piura, and Ing. Willy Hartmann, Geneticist, Estación Experimental Agrícola del Norte, Lambayeque, expressed the opinion that there was a great deal of land in northern Peru, east of Piura, Chiclayo and Trujillo, where yuca could be successfully grown. These sections have a moderate rainfall, but the land is not suitable for the growing of sugarcane or rice. They estimated that approximately twelve tons of yuca per hectare could be produced and that the cost to the grower per hectare would be about 100 soles. They believed that the growers would be well satisfied to deliver yuca to a processing plant at a price of 20 soles per ton and that the growers would make a satisfactory profit at that price. Freight rates to the coast from these sections are low and crude oil is available for fuel at a moderate cost. The conditions described would be very favorable for the establishment of a yuca products industry. Mr. Hartmann and Mr. Favre were advised to make every effort to verify their estimates and to transmit their findings to their superiors in Lima who are interested in the yuca project. It seems probable that a yuca products industry could be established in the coastal region at an earlier date than in the inland region. Probably a factory could be put into operation during the 1943 season.

It seems highly improbable that any amount of starch could be produced from yuca in Peru before the 1944 season. Expert market conditions may be greatly changed by that time. It would be desirable for Peru to try to establish some definite stable outlets for yuca products, should they decide to build up a yuca starch and yuca flour industry.

Peru uses about 280,000 tons of wheat per year. A considerable portion of this wheat is imported. In some countries flour from other sources is mixed with wheat flour for bread making. Rice flour, corn flour and yuca flour have all been used in other countries. If as much as 10% of yuca starch or yuca flour were to be added to wheat flour, a market for at least 28,000 tons of yuca starch or yuca flour per year would be created. This is

considerably more starch and flour than could be produced in Peru for a number of years.

It would be necessary to demonstrate the properties of bread made from mixed flours in order to determine the feasibility of mixing yuca products with wheat flour. For the purpose of demonstrating the type of work required a laboratory technician at La Molina Experiment Station was assisted in preparing laboratory samples of yuca starch and yuca flour. A milling concern in Lima then prepared samples of mixed flours and made baking tests with these flours and with wheat flour alone. The volume of the leaves made with mixed flours is less than those made with the wheat alone. Whether such bread would be acceptable to the Peruvian people can only be determined by conducting baking and sampling tests extending over a considerable period of time.

After further conferences with Mr. Montero, Mr. Dasso and others, it was decided that at least a year would be needed to collect data concerning the growing of yuca and to make laboratory determinations of the composition of freshly harvested tubers. For this reason, it was suggested that a technician stationed in Lima be assigned to the project for a sufficient length of time to collect the information needed for the completion of a survey.

A technician was selected by the Peruvian Government officials and was assisted in planning a program of work on the yuca project. An outline of this work and suggestions concerning probable markets, the location of factories, and the cost of producing yuca starch and yuca flour was made out and given to Mr. Luis Montero Bernales, Director de Agricultura y Ganaderia, Ministerio de Fomento. A copy of this outline follows.

Officials in Peru may wish to obtain further aid from the United States after they have collected further information on all phases of the yuca project.

INVESTIGATIONS ON YUCA

Suggested outline of work. To be modified if necessary as work progresses.

I. Production of tubers.

A. Obtain samples each month of all known varieties of Yuca tubers in Peru.

1. Note age of tubers, weight per plant, prevalence of gum or milk on cut surface, color of fleshy part of plant, fungus growth or other diseases, length of time that the tubers can be stored without visible deterioration and any other characteristics that are unusual.

2. Make the following determinations.

a. Starch, official method (perhaps a "short" method can be used at a later date).

b. Moisture

c. Crude fiber) Make these determinations on
) as many samples as available
d. Ash) time will allow.
)
e. Hydrocyanic acid)

f. Extract starch from a 500 gram sample, by method demonstrated in laboratory, note weight and save sample of starch.

3. Prepare 500 gram samples of starch and flour, by methods demonstrated in the laboratory for baking tests. (Prepare each week or as often as needed by bakery).

4. Selection of varieties suitable for Industrial utilization.

The information obtained from studies conducted under sections 1 and 2 should be used in the selection of suitable varieties. It is believed that attempts to introduce new varieties would not be advisable at the present time.

II. Probable markets for yuca products.

A. It is recommended that baking tests be continued to determine the possibilities of adding yuca starch or yuca flour to wheat flour. Extensive tests should be conducted and every effort be made to produce a suitable bread with the mixed flour because of the great domestic market that may be opened up in this way.

B. Domestic market for high grade starch, dextrin and glucose. The market should be surveyed and accurate figures on the quantities used should be obtained to determine whether this market is sufficient to support a domestic starch factory.

C. Market in other countries. Imports of yuca starch (tapioca flour) in the United States vary from year to year. An average would be something like 350 million pounds per year. Much of this starch has been coming from the Dutch East Indies. The West Indies and some South American countries are making extensive preparations to take over at least a part of this market because shipping from the East Indies has been curtailed. Assuming that free trade prevails all of the sources of supply will be in competition with each other for this market.

III. Location of factories.

A. Yuca must be processed soon after harvesting; for this reason a factory much be located within trucking distance

of a supply of tubers. For a small plant about 500 to 800 hectares of yuca per year would be required. A plentiful supply of clean water is essential although filters can be installed if necessary.

B. Freight rates, availability of power and fuel costs must also be considered.

C. Data concerning all of these factors should be collected in the sections of the country being considered for the location of a plant.

IV. Cost of producing starch and flour.

A. Under prevailing conditions starch in the yuca should cost slightly less than 1 cent per pound. The yield of starch varies and thus the value of the tubers varies. It should be possible to select a variety from which a 20% recovery of salable starch can be obtained. Under these conditions the tubers would have a value up to $4.50 per ton delivered at the factory. The manufacturing costs are dependent on a great many manufacturing factors, such as power, and labor costs, the cost of the plant, the efficiency with which it is operated and its capacity. Considering a plant with a capacity of 10 tons per day operating 150 days per year, costing not more than $100,000 and assuming a reasonable cost for power and heat, it is estimated that about 1 cent per pound of finished starch would cover all production costs in Peru. Freight and sales expenses must be added to determine cost price at the point of delivery.

B. Yuca flour is made by drying the tubers followed by grinding and screening; the percentage recovered is much greater than the percentage of pure starch recovered. Equipment and manufacturing costs are also lower. Thus yuca flour can be sold at a much lower price than yuca starch.

GENERAL DISCUSSION

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The agricultural problems of Peru, considered in broad terms, as observed personally and as presented in various conversations with Peruvian officials and agriculturists, fall into two categories:

1. Those which relate to internal consumption.
2. Those which relate to export.

This very obvious classification becomes less obvious if the conditions peculiar to the country are considered, conditions which are not purely agricultural but which certainly affect and may possible orient certain aspects of national life.

As all texts point out, the agricultural wealth of Peru comes from the highly specialized agriculture of the intensively developed valleys of the "costa", from the mines of the "sierra," with the undeveloped "montaña" often dismissed as of future potentialities although there are still memories of the "Age of Black Gold" (rubber) when it furnished considerable income. Although now diminished, there are still products collected and sold in quantity, some of which might contribute even more to the national wealth if there were more extended and suitable means of communication and transport.

If one visits typical valleys along the coast, which is easily done by utilizing the coastal highway now being integrated into the "Panamerican Highway," he finds the most intensive and careful agricultural operations, which appear to be limited first by the amount of irrigation water available and second by the amount of arable land. It seems to be the general consensus of opinion that these irrigation projects have been well executed, that they are now complete from an economic point of view and that any future irrigation schemes must be designed and carried out with a careful advance study of possible crops from which a money return would justify the investments.

It is patent that land of this character must be devoted almost exclusively to "money" crops of which only sugar and cotton need be mentioned here.

It is equally patent that a concentration of governmental attention in these areas, limited in acreage, limited in population and in possible population could, and to some extent has, led to somewhat unsympathetic agricultural studies in the areas.

At the present time these are the income-producing areas of Peru, since their harvests are much greater than those of the areas which are concerned with animal production. Any studies of land utilization for these or any other areas in Peru will have to be considered not only on cost production figures, but must be considered in terms of available labor, a definite Peruvian problem which is related on one hand to certain sociological conditions and on the other hand to questions of land ownership. Although these factors lie outside the scope of the present report, it is important that they be mentioned. There are many other minor factors that must be mentioned from time to time, none agricultural, but all impinging upon the agricultural life of the country.

The problem presented in instructions received from the State Department on August 28, 1941, as related to the work of the writer, outlined a cooperation on the possibilities of producing in Peru certain medicinal plants formerly purchased by the United States from European and other sources. This interest, communicated to our government by the officials of the Peruvian government, represents an interest on the part of landowners in west-coast valleys, who wish to diversify their cropping.

As statements covering these medicinal plants and certain culinary herbs had already been prepared by the Division of Drug and Related Plants of the Bureau of Plant Industry, copies of all were delivered to Señor Luis Montero Bernales, Director de Agricultura y Ganadería, Ministerio de Fomento, with the suggestion that the date on value of production and permanence of market be studied in comparison with the known returns from sugar and cotton in Peru. Only those plants offering any possibility of growth in Peru should be considered.*

It was pointed out that of the drug plants listed, Aconite (Aconitum napellus etc.), Belladonna (Atropa belladonna), Digitalis (Digitalis purpurea), Henbane (Hyoscyamus niger), were plants typical of north temperate humid climates; Poppy (Papaver somniferum), Stramonium (Datura stramonium) are annuals probably suited to growth in Peru under winter conditions only; and that Cinchona (Cinchona spp.) and Coca (Erythroxylon coca) were Peruvain plants, the latter widely cultivated and the former being studied in their own department of agriculture. Reference will be made to cinchona work under the discussion of the Tingo Maria station (see page 29).

The program outlined by the Peruvian officials in Washington and New York, informally, was repeated and enlarged upon by Señor Montero in Peru and served as the basis of all travel for the writer, including the visit to the Tingo Maria station. It stated that the Peruvian government wished to have some one person in the United States Department of Agriculture as widely informed as possible on the various phases of Peruvian agriculture, who might later serve as liaison officer between our governments.

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* Copies of these circulars are attached among the exhibits filed at the end of this report.

As reported in a memorandum filed at the American Embassy, Lima, Peru, and transmitted by the Hon. Jefferson Patterson, First Secretary of Embassy (No. 2302), the itinerary included trips along the coastal valleys from Piura in the north to Ica in the Ica in the south; a trip to Tingo Maria and its environs; a trip to Iquitos (originally planned in include a further trip to Pucallpa, San Ramon and return to Lima via this route, an arrangement abandoned for temporary lack of transportation facilities between Iquitos and Pucallpa); a southern trip, including Arequipa, Cuzco, Abancay, Andahuailas, Ayacucho, Huancayo, Lima. Unfortunately there was not time to visit the area missed between San Ramon and Lima, the area about Cajamarca and several other minor areas.

The agricultural problems which concern the internal phases of life in Peru are those which relate:

1. To the introduction of new plant materials.
2. To the establishment of better and more diversified practices of cropping.
3. To a wider relation of government studies to new agricultural-horticultural enterprises.

The idea of plant introduction is neither new nor unknown in Peru but its practice might be widely extended to several crop departments as indicated in later pages. These discuss specific problems as presented and in no way should serve to limit the scope of introduction activities.

The discussion of the second point must depend very largely for its significance upon the success of the experiments undertaken under the first point, examined always in the light of the land utilization program and general agricultural economy.

The third point should result from the successful conclusions that appear in the prosecution of the earlier phases.

Forage Problems

As outlined in many conferences, the forage crop problems divide themselves into green-manure problems and problems of forage and pasture. They appear in all the geographic areas and regions but in differing proportions and essentially for the same animals, sheep and cows (for both beef and milk).

COAST CONDITIONS

The problems here relate themselves to the production of feed for cattle, hogs and, to some degree, chickens; green foodstuffs that can be cut; possible some annual plants that could be used to follow rice in areas usually fallowed but stubble-grazed; and the development of grazing areas that would occupy marginal lands now practically useless because of limited water supply and occasional alkali.

The problem was presented in various places and for various reasons. In each case the speaker was asked to outline the desired optimum, regardless of whether or not it appeared reasonable or even probable. A typical case may be cited here without name: Location near Trujillo. Essentially a plant to occupy lands now idle and serve dairy cattle; at most not more than two irrigations; some alkali; some areas of relatively low fertility; all to be accomplished at minimum cost.

The situation is essentially the same in the area for Chiclayo-Lambayeque with the additional urgency that the Nestle Company has almost completed a new factory plant with a consumption approximately equal to the total present production of milk for the area. The program outlined by representatives of the company, leading to the stimulation of milk production, may possible overshadow any program possible to the government station at Lambayeque.

SIERRA CONDITIONS

All of the phases outlined in the problems for the coast reappear for the sierra and in addition there are the larger problems of permanent pastures at altitudes from 7 - 12,000 feet, a short season and a low maximum temperature. In these latter areas sheep outnumber all other animals but the writer was told that there is enough evidence to warrant the belief that suitable breeds of cattle can be produced for these localities.

There appear to be no complete or accurate studies of the native pastures, or any extensive experiments to examine the possible introduction of foreign species except in certain private establishments.

MONTANA CONDITIONS

Here the pasture problems are essentially those of all tropical areas (wet) and can be modified and improved by the wider dissemination of various tropical pasture grasses already introduced.

The major requests related themselves to those phases of forage work that require legumes to assist in fixation of nitrogen, to build up and maintain humus supplies, to assist in shade and semi-shade formation for shrub and small tree crops, and to act as smother plants in weed control.

It would appear that any cooperation that could be extended not only by the presentation of seed or planting stocks of all possible forage plants, (green manure, hay and permanent pasture) to be assembled and studied by adequate staffs under typical conditions, would be most important, but that a careful study, botanically and agronomically, of all native plants in this category might go far to determine the ultimate choices of plants for each area and purpose; particularly important in Peru because of its geographical location in relation to the equator.

General Crop Problems

The diversification and improvement of all agronomic crops is recognized and understood in Peru. The development of cotton and sugar cane present practical evidence of the complete understanding of the improvement of a specific crop and the inevitable danger that proceeds from the perfect development of a single crop of a highly specialized character. The arguments that are brought against such developments are supported inevitably on the basis of financial returns, especially from exported crops.

By careful examination of world developments, there has been more diversification within the varietal ranges of sugar cane than in cotton, since the latter has been grown more or less for specific markets now reduced or closed because of world conditions.

There are under way various tests and breeding experiments which, if carried to their ultimate conclusions, should accomplish for all the major food crops the same degree of development noted for cotton and sugar. Some of these experiments have gone far enough to suggest that Peru can and will develop varieties of all crop plants as specifically suited to her needs and conditions as other countries have done.

The experiments with wheat and rice may be cited as well under way and the programs recently initiated for intensive studies of corn and potatoes may be mentioned.

The diversification of crops relates itself not only to totals for the nation, but to diversification within the area. Any proposed new crop must be prepared to face comparison with the best yields of the present money crops. Ample evidence of this came up when flax yields were discussed and proposals for the growth of other fiber plants were considered.

Diversification of crops, for Peru, appears to mean, therefore, almost exclusively the diversification of crops for internal consumption.

As is clearly shown from the market areas that serve Lima, the vegetable crop has been diversified until it includes practically all the vegetables of the cosmopolitan market as well as the indigenous vegetables many of which are relished by the foreigner of the community.

The most interesting observation to be made along this line is the fact that there exist many old types of vegetables that may be called survivals and that merit collection and study not only by the Peruvian government but by our own government as possible bases of highly specialized breeding programs.

The field of fruits, particularly introduced fruits, would suggest an identical study and examination. The study of native fruits, as suggested by examination of markets, notes the need for careful collection and study, especially for examples of avocados (paltas) and pineapples. Citrus fruits are present in interesting variety, the types familiar in American markets being often represented by inferior varieties and the types little known here by forms and varieties worthy of our attention.

In almost no case was it possible to discover carefully maintained gardens or orchards which might be considered as varietal collections for experimental use. It is clearly recognized that such collections are expensive to maintain and that their usefulness will depend largely upon the number and vision of the personnel.

The introduction of plant materials into Peru is attended by the usual difficulties. There is but one port providing quarantine examination facilities with an office that is not kept sufficiently busy to make certain swift and adequate handling. According to various reports heard in parts of Peru distant from Lima, this may appear to be a genuine difficulty.

Except for shipments by air express from the United States which are limited in number by weight and cost, shipments of any plant materials suffer various disadvantages. Since the harvest practices in the United States often bring our seeds and plants to a merchandizable state at a date after the ideal planting dates for Peru have passed and since this date is still further postponed by the time lost in shipment, the problem in some cases becomes acute and genuine. It is further aggravated by the fact that the recipient is not always prepared or equipped to give the palliative treatments that might offset the delays.

At the present time there is unusual difficulty in shipping by boat, especially in the service from the Pacific Coast states of the United States. It should be pointed out, also, that unless plants from the eastern United States are properly packed to withstand a period of warm weather while passing through the Canal Zone area, the mortality percentages may be unusually high.

From all this it can easily be understood that all Peruvians interested in the agricultural progress of their country are concerned about the establishment within Peru of the basic materials needed in each department of agricultural life.

It may be pointed out quite properly that the idea of a service of plant introduction and dissemination is already acknowledged in the agricultural service of Peru with its most developed center at La Molina, and its projected development for Tingo Maria.

If it may appear that the developments could be on a wider basis than now exists, it should be remembered that the agricultural progress of Peru is not completely concentrated in the government service, which is sometimes overshadowed by commercial and private interests.

Although there are various schools of thought, there is always an advantage to be had in the maintenance of a governmental collection which can be managed impersonally and without the necessities of business economies. Safeguarded by the quarantine-inspection service, either as now organized or expanded as it may need be, the agricultural developments of the Peruvian government might well serve as a prime source for the enrichment of Peru. Obviously some such thought as this existed in the conception of the plans for Tingo Maria but it would appear to the present reporter that a much greater activity might well be inaugurated with at least three centers along the coast and two for the sierra, each of which could and should serve as major centers of activity in all phases of plant work, but kept for the present will within the field of applied science with a lesser activity in pure science.

Recent communications from the Ministerio de Salud Pública, Trabajo y Previsión Social, Direccion de Subsistencias, indicate that the Peruvian people are keenly aware of the fact that as a nation they have depended upon other countries for certain agricultural commodities that could be produced at least in part within their borders.

Current interest in a better dietary, brought about the discovery that commercial supplies of vegetable seeds had been purchased annually in Europe or were gathered in extremely small amounts in Peru under sub-professional conditions. A tentative suggestion was made that seeds grown in the United States did not respond well under Peruvian conditions, even those grown in California. This is a point that should be studied since it seems unlikely that seeds produced in Europe would be better adapted to the circumstances. It was also suggested by several Peruvian agriculturists that possibly the long credit terms offered by the European dealers might be the determining factor.

Special government projects are in progress to examine this specific problem and work out an advantageous solution.

It would appear to the writer that in the general sense there is an absence in Peru of commercial undertakings to provide agricultural and horticultural materials such as are produced by our seed and nursery trade. It should be recognized that there is not now in Peru a market of large proportions in this field but that if the government could train men in this particular phase, some should be able to develop considerable business for themselves and possibly some for export, not only to neighboring countries which like Peru do not produce all their required supplies, but for the United States, particularly in the field of ornamentals.

AGRICULTURE IN THE SIERRA

Although it is easy to employ such a term as this, no discussion can come into one single category.

As is already indicated in various Peruvian studies and reports, wealth from agricultural products in the "Sierra" must be wealth from animals. As this affects the plant kingdom, it relates itself primarily to forage and pasture problems already discussed. The problems of human food are equally important, are affected by the same conditions but modified by the possibility of cultures in valleys which are warmer than the pasture or range lands.

Even with the rather modern construction of highways and the greater availability of buses and trucks, there probably will not be much movement of foods within this area save staple products or small quantities of fresh products that can be carried to market.

If there is aid that can be offered for these projects, it would appear that cooperative studies of pastures and the establishment of large collections of non-indigenous forage crops might well be undertaken jointly by our governments.

Investigations in the field of cereals include not only a continuing study of new varieties but studies of cultural practices, including soils, fertilizers, temperatures, radiation, etc., all of which should lead to the eventual production of high quality races that are bred for these high-Andean conditions. Of greater interest to ourselves than to the Peruvian might be certain studies of corn (maize) as related to cold resistance, the Peruvian clones being apparently more resistant to continued cold and occasional snow and hail, as well as being suited to growth at very high altitudes.

It is the understanding of the writer that as grain these clones of corn are of excellent value, but that as varieties they furnish only a few, small ears.

It seems probable that length of day studies are more important than any other and that some survey should be made as to other areas of the world that approximate the Peruvian Andes, a study that is not likely to be very productive of anything more than the knowledge that there are similar Himalayan areas with an even less fruitful agriculture.

The problem of the potato in Peru has many approaches but it would seem that the problem of establishing and fixing the innumerable clones of Solanum andigenum, the various species indigenous to South America, and the acclimatization of the improved forms of S. tuberosum from abroad might provide a major project, leading as always to a hybrid of peculiar and specific usefulness.

The problem of transport of food into these areas, either the shorter hauls between various warmer interior valleys or the longer hauls from the coast or montana, do not concern us here as they would be circumscribed both by transport and by local buying power.

The diversification of food production in the lower valleys will be dependent upon the extension of activities in each area which in turn apparently will be charged not only with the discovery of the proper plants to grow but with persuading the population to adopt certain changes in dietary.

AGRICULTURE ON THE COAST

It would appear to the writer that there are few concrete suggestions that can be offered. The problem, as has been pointed out elsewhere, is not agricultural, it is financial, based upon return per land unit in terms of crops for export trade.

The only practical suggestion that can be made is this: The replacement, with modern improved varieties, of every crop now in Peru that has not been brought up to the cultural levels maintained for sugar cane and cotton. This is not as sweeping a generalization as might be imagined.

If it can be done, a program of gradual replacement might be undertaken for such crops as olives, which are poorly represented in Peru. Although there are various notations in Peruvian publications, no evidences

were seen toward any attempt either to replace existing orchards or to initiate new plantings.

With similar origins, more or less lost in the traditions of the pre-colonial and early colonial periods, the dates in and about Ica represent another undeveloped possibility. A survey is necessary to determine which trees may be removed, males or fruiting trees of poor quality. Replacements of imported known varieties might be carried on over a period of years until all existing trees were replaced and this area, which now provides nothing more than fresh dates in limited quantities for local consumption, would become productive. (If this area should come within the land to be served by the new irrigation projects for Ica, these proposals might have to be restudied in the light of competitive price factors.)

In a similar fashion one might wish to propose a study of all vegetables, small fruits and, within limits, tree fruits - with considerable emphasis to be laid on the citrus family, represented now in Peru by many trees of no value, more of dubious value and by a great variety of apparently local forms, some particularly good.

TINGO MARIA

The outlines for the establishment of Tingo Maria as a project in colonization were well stated in the Bulletin of the PanAmerican Union (Eng. ed.) Feb. 1939, pp. 111-112 where the text that follows appears among the "notices."

"Tingo Maria Colonization Center, Peru.

"Recognizing that the government program of highway construction in the central and eastern regions of Peru should be accompanied by the establishment of agricultural settlements, President Benavides of Peru issued Law No. 8621, of Jan. 20, 1938, providing for state expropriation of the strip of land three miles wide on either side of the highways constructed or to be constructed on the eastern slopes of the Andes, such land to be utilized for colonization purposes. A later law, No. 8687, of July 1, 1938, provided for the expropriation of strips 12.5 miles wide on either side of the highway from Huanuco to the lower Ucayali River and for colonisation on small, medium, and large tracts of land.

"Regulations for the establishment and operation of this project, known as the Tingo Maria colonization center, were issued in a Presidential decree of July 23, 1938. Colonization there is available to three types of settlers, the first two concerned chiefly with farming and the third with cattle-raising also.

"To those in the first classification, the tract to be granted is not to exceed 74 acres in size. Those entitled to acquire small lots are divided into three classes: Peruvians who have had a primary school education, those discharged from military service, laborers, and farmers deserving of state assistance; native workers at the Tingo Maria Experiment Station, and nationals, who, with some capital at their disposal, need state aid to establish themselves as farmers.

"Payments for the farms, amortized over a period of twenty years, will be made in annual installments starting at the end of the third year after settlement. The laborers employed by the Experiment Farm will pay for their lands by annual contributions of labor equivalent to one twentieth of the value of their farms.

"Medium sized lots for those included in the second classification shall not exceed 274 acres in area, and shall be available to Peruvians and naturalized foreigners who have obtained permission from the government to apply for them. On signing the contract, the applicant must make a down payment equivalent to ten per cent of the value of the property, the balance to be paid off in ten annual payments.

"The lands set aside for both agricultural and cattle raising pursuits (third classification) will also be sold on credit terms. The area of these tracts depends largely upon capital at the disposal of the petitioner and the nature of the proposed cultivation, but in no case will it exceed 7,400 acres. The initial payment will be equal to twenty per cent of the value of the farm and the balance will be paid off in ten annual installments."

While there have been some minor changes in the handling of the work with the colonists, there is no major change. The development of the buildings for the station, civic center, etc. have not been carried through to the extent indicated on the blue prints prepared for the project as a whole, no copies of which were offered us.

There are included in this report copies of three photographs presented to the writer by Sr. Pedro Recavarran, Director de la Seccion de Tierras, de Montana y Colonizacion which give a general idea of the terrain, suggest the preliminary stages of land clearance for each colonist's unit and house.

There is attached also the statement (with translation) transmitted by the writer to Dr. E. N. Bressman on September 26, 1941, on behalf of Sr. Recavarran.

During the short period spent at Tingo Maria (Sept. 19 - 23) there was relatively little rain, but this period comes before the season when rainfall is heaviest. It is perhaps enough to note that Tingo Maria, with its elevation of approximately 3000 feet is not properly inside the area of tropical forest but is definitely more than sub-tropical.

All the problems that relate to tropical agriculture are reflected in the conditions there: The selection of crops, the lack of suitable vegetables, the difficulties with forage crops, the problem of maintaining soil fertility and ample humus, etc.

Tingo Maria, in itself, represents one definite step in the attempt to move populations from the coast in which agricultural land is limited and where there are problems of over-population within the available areas.

COLONIA DE TINGO MARIA SOBRE EL RIO HUALLAGA.

TINGO MARIA - Y CARRETERA DE PENETRACION.

COLONIA DE TINGO MARIA - PREPARACION DE TIERRAS DE LABRANZA.

Under present conditions it is perhaps more isolated than it will be in the future as it is now unrelated to any major line of traffic. The major city from which one reaches the development is Huánaco, a town of some considerable importance as a center and located on a highway that returns one to Lima via Cerro de Pasco, Oroyo and the Rimac Valley. Eventually the highway to Tingo Maria will be continued to Pucallpa on the Rio Ucayali which is a more important stream than the Rio Huallaga at the point at which Tingo Maria is located.

This connection with Pucallpa may serve to defeat in part the plan to find a colony site from which might originate products that could be cheaply transported by highway back over the Andes to Lima.

The highway between Lima and Oroya is a well-built, well-designed, modern highway capable of carrying trucking as we understand it. The highway from Oroyo to Cerro de Pasco is almost as good, but from that point to Huamuco the road is less satisfactory. The profile and gradient are excellent but the actual plan of the road is often quite circuitous and tortuous. It must be remembered that all the work planned has not yet been completed and that the need for a usable road at the earliest possible date probably precluded the attainment of perfection in all details. This is particularly true of the road between Huamuco and Tingo Maria on which much work is in progress.

In this there is no suggestion of criticism of the Peruvian highway system which is extremely good and has contributed conspicuously to the unification and internal development of the country. The comments are included only to support the contention that as yet Tingo Maria is an isolated spot connected artificially with the coast and naturally with the great river systems that flow into the Amazon.

The air field, in process of construction, will assure a swift flying time to Lima, but will not contribute much to general movement of people or things. And it is possible to believe that connections with the Pucallpa, San Ramon, Iquitos systems also tend to divert the stream of progress from the west coast.

Although a brief visit was paid to the colony, no special report need be given since at best the colony could not do more than add to the future population of agricultural workers. At the present time, the colonists appear to be chiefly concerned with the development of their own holdings and in raising enough food for their own use; the usual banana, plantain, yuca, sweet potato, corn combination, a somewhat limited diet.

After the completion of the clearing of each holding, with the advice of the staff at the station, it is hoped that the colonists may be able to produce for sale various crops which have been proven by the staff of the experimental station and are either peculiar to the "montana" or may be produced there more economically.

Aside from the comfortable hostelry, the station has more than adequate building facilities which include building space for office and laboratory; for caring for cattle; for various phases of institutional work and mechanical equipment.

A very considerable amount of cleared land is in cultivation or test plots. More is needed which is in various degrees of clearing.

At the time of visit there was no equipment for nursery or horticulture work such as is ordinarily found elsewhere, nor had there been developed any extensive crop work save with tobacco.

The problem which presents itself, therefore, is not that which has been outlined in the memorandum cited, copies of which are included here:

Ministerio de Fomento
Dirección de Tierras de Montaña
y Colonización

MEMORANDUM SOBRE LAS CONDICIONES DE LA REGIÓN DE TINGO MARIA PARA EL ESTABLECIMIENTO DEL INSTITUTO INTERAMERICANO DE AGRICULTURA TROPICAL

- - -

Tingo Maria es nuestra zona de montana más desarrollada, la major dotada con elementos de toda clase y está unida a Lima por una esplendida carretera de 599 Kms, de longitud y tiene como establecimientos intermediarios a Huánuco, con un clima benigno, a sólo 164 Kms. de Tingo Maria. Como zona de colonización, la region de Tingo Maria cuenta con todos los climas y altitudes desde los 2,500 hasta los 240 mts. S. N. M. La gama de tributarios que recorre la sona comprende desde delgados filamentos de agua en las nacientes de los rios hasta el navegable Ucayali.

Por sus especiales condiciones de suelo y clima, por su accesibilidad, ya sea del lado de la costa como del Oriente, esta zona es la más adaptada para la producción e industrias de los productos tropicales, que como el jebe de altura, cube, té, harina de yuca, quina, etc., importa hoy EE. UU. de otros continentes.

Ya se han iniciado importantes campañas oficiales para el cultivo del té, caucho y tabaco y para el próximo año la del cube. Además una firma particular ha iniciado la explotación de la quina por medio de importantes plantaciones de forma Ledgeriana, procedente de las Islas Holandesas.

La benignidad de su clima, comprobado por la ausencia de malaria y otras enfermedades tropicales, ha permitido que la colonización iniciada por el Gobierno se continúe con todo éxito.

Además de su acceso por carretera, Tingo Maria estará muy pronto conectada por la red aérea, a 98 minutos de vuelo desde Lima. Hay servicio efectivo de radio y postal.

Como elementos disponibles de trabajo de experimentación contamos:-

1°) Con una Estación especial del cultivo del té, con fondos para el trabajo sujeto al siguiento presupuesto:-

Para personal técnico.....	S/ 3,600
" gastos de experimentación, cultivos, etc.....	24,000
Total al ano	S/ 27,000

(Error - see last page -BYM)

2°) La Granja Experimental de Tingo María en sí, la que cuenta, fuera de los trabajos ordinarios, en su sección administrativa con personal y presupuesto de reglamento que pueden prestar servicios sin apropiaciones especiales de dinero por este concepto. Tiene un departamento de Luz y Fuerza con un generador de 30 Kw. accionando por motor Diessel de 50 H.P. que no gravaría en nada al Instituto. Cuenta además con una Estación Metereológica de primer órden, cuyo sostenimiento de personal y conservación estaría a disposición del Instituto sin mayor gravamen.

Además la Granja experimental dispone actualmente sólo para pago de planillas en trabajos de campos, cercado, etc., de S/ 37,600 al año que en buena proporción podría ser dedicado a trabajos del Instituto. Cuenta también con personal de Topografos que podrían colaborar con el Instituto en trabajos pertinentes sin demandar fondos especiales para el caso.

Fuera de todos estos elementos económicos y de trabajo, disponibles actualmente, se encuentran los de edificaciones que en un momento dado se pueden aprovechar, pues, aún cuando por hoy una destinación determinada, no están aún dedicadas a ellas, por no estar completamente concluídos; pero podrían estarlo por dos meses más, puesto que contamos con los fondos necesarios para ello.

Las edificaciones terminadas son:

Administración de la Granja,
Establos,
Casa de Luz y Fuerza,
Correos y Telegrafos
Hotel de Turistas
Chalet para alojamientos

Se encuentran inconclusos por el momento las destinadas a:-

Estación Policial
Oficina para el Estanco del Tabaco
Hospital
Escuela Fiscal

La mayor parte de estas construcciones son de estructura de madera recubiertas de planchas especiales de fibra, revocadas con piso de cemento unas y de maderas otras.

Se acompanan dos fotografías, la una muestra con números las ubicaciones de los distintos edificios mencionados en el Centro de Colonización Oficial de Tingo María. Se incluyen también fotos de cada uno de los edificios citados.

El Supremo Gobierno ha tomado con anticipación las medidas conducentes al establecimiento de un instituto de agricultura tropical que con el nombre de Instituto Técnico del Oriente, fué creado por Ley y sólo funciona parcialmente en la actualidad, en Iquitos. Dicho Instituto podría tener como sede Tingo María, trasladando a este lugar las funciones de investigación, etc. y cuyo presupuesto actual es de S/. 32.000 ano.

Además, en el presente año contamos con una Sección nueva, dedicada exclusivamente a los trabajos del caucho, la que el año entrante abarcará las funciones del cultivo del barbasco o cubo. Actualmente dicha sección dispone de fondos necesarios para los trabajos que le corresponde con un prespupuesto de S/. 60.000 al año; pero el año entrante estará reforzado para atendar con mayor amplitud los trabajos.

Se vé pués claramente que resumiendo las partidas del presupuesto en vigencia, de los Servicios que se relacionan con el Instituto de Agricultura Tropical tenemos:

Presupuesto de la Estación del Té	S/.	27,000
" del Instituto Técnico Químico Industrial del Oriente.....	"	32,000
de la Estación del Caucho	"	60,000
	S/.	119,600

Estas cifras evidencian plenamente nuestra capacidad económica actual para atender al funcionamiento del proyectado Instituto Inter-Americano de Agricultura Tropical en Tingo María.

El E. C. Stakman, famoso fitopatólogo que visitó Tingo María el año pasado como presidente de la Comisión Américana-peruana de investigación del caucho en el Perú, podría colaborar con nosotros reforzando nuestros argumentos en favor de Tingo María, pues éste distinguido hombre de ciencia americano, quedó muy bien impresionado de las condiciones naturales del lugar y de sus valiosos recursos organizados por el Supremo Gobierno.

Estimamos pués que entre las regiones sud-americanas más aptas para el estudio y desarrollo de la agricultura tropical debe considerarse Tingo María, no sólo por sus condiciones de suelo, clima, accesibilidad y organización administrativa, sino principalmente porque se encuentra enclavada

en la zona de origen y habitat de la quina, cube y jebe peruanos, que tanto renombre alcanzaron en los mercados mundiales antes de que se iniciaran las grandes plantaciones de las Indias Orientales.-

J.F.T.-

(Seal: Ministerio de Fomento, Dirección de Tierras de Montaña y Colonizacion)

Translation:

MEMORANDUM ABOUT THE REGION OF TINGO MARIA FOR THE ESTABLISHMENT OF THE INSTITUTE OF INTER-AMERICAN TROPICAL AGRICULTURE.

Tingo Maria is our zone in the "montana" the most developed, the best supplied with qualifications of every type. It is now connected with Lima by a splendid highway of 599 kms. in length and has as well intermediate conditions (stations) at Huamuco, with a favorable (mild) climate at only 164 kms. from Tingo Maria. As a zone for colonization, the region of Tingo Maria contains all climates and altitudes from 2500 to 240 m. above sea level. The range of tributaries that traverse the region comprises all from the narrow streams from which the rivers rise to the navigable Ucayali.

On account of its special conditions of soil and climate, of its accessibility, both from the coast and the Oriente, this region is the best adapted for the production and industrialization of those tropical products such as high altitude hévea, cube, tea, yuca flour, cinchona, etc., which are imported today by the U.S.A. from other continents.

There have been started already important official companies for the cultivation of tea, rubber and tobacco and next year for cube. In addition a private concern has been started for the production (explotación) of cinchona by means of important plantations of Cinchona ledgeriana, coming from Dutch East Indies.

The healthfulness of the climate, combined with the absence of malaria and other tropical diseases, has made possible the continued complete success of the colonization initiated by the government.

In addition to the accessibility by road, Tingo Maria will be connected very soon with air service, 98 minutes from Lima. There are already effective services by radio and mail.

As elements available for work and experimentation we consider:

1) A special station for the cultivation of tea, with funds for the work, subject to the following estimate:

For technical personnel.....	S/.3,600	(Error - see
For costs of experiments, cultivation, etc.....	24,000	last page BYM)
	S/27,000	

2) The "Granja Experimental" of Tingo Maria itself, which provides, outside of the ordinary work, in its administrative section with personnel and estimates of maintenance which might be lent without special money appropriation for this scheme. There is a department of light and power with a generator of 30 kw., produced by a Diesel motor of 50 H.P. which should cost nothing to the Institute. One should also take into account the Meteorological Station of first class whose equipment of personnel and upkeep will be at the availability of the Institute without added cost.

Moreover, now the Granja Experimental prepares only for the payment of preliminary plans (sketches?) for the work on fields, fencing, etc., to the sum of 37,600 soles per year of which a good share might be contributed to the work of the Institute without asking for special funds.

Aside from all these economic factors and work, now actually available, one finds the buildings which at the proper time might be made available, because, even though for the moment they may have a determined use, they are not dedicated to such uses since they are not completely finished; but they may be so within two months more, if we may depend upon the funds for this purpose.

Finished Buildings:

Administration offices of the "Granja"
Barns
Light and Power Plant
Post and Telegraph Office
Hotel
Lodging house

Unfinished now are those buildings intended for:

Police Station
Offices of the Federal Tobacco Control
Hospital
Fiscal Office

The greater part of these buildings are made of a wooden framework covered with special blocks of fiber, some covered with cement plaster stucco and others with wood.

There are accompanying, two photographs, the one showing with numbers the location of the several buildings mentioned in the official Center of Colonization of Tingo Maria. There are included, also, copies of photographs of each building named.

The Federal Government has taken in advance the means leading up to the establishment of an Institute of Tropical Agriculture which it has

created by law with the name "Instituto Técnico del Oriente", which now functions only in part in Iquitos. This Institute might have as its center Tingo Maria, transferring to this locality the functions of investigation, etc., and its present budget of 32,000 soles per year.

In addition, this year we are taking into account a new section, assigned exclusively to work with hevea (and) which will in the next year undertake work in the cultivation of barbasco or cube. Now the said section has available from necessary funds (enough) for work which corresponds to an estimate of 60,000 soles per year; but in the next year these will be reinforced in order to increase the work.

One may see clearly, therefore, that reviewing the parts of the budget now in effect, of those services which are related to the Institute of Tropical Agriculture, we have:

Budget of Tea Station.....	S/.	27,000
" of Technical Institute of Industrial Chemistry of the "Oriente".....		32,000
" of the Rubber Station.....		60,000
	S/.	119,600 (note error BYM)

These figures show clearly our economic capacity to care for in Tingo Maria the operation of the projected Institute Inter-Americano de Agricultura Tropical.

Dr. E. C. Stakman, famous plant pathologist, who visited Tingo Maria last year as head of the "Comision Americana-peruana" for the investigation of rubber in Peru, might collaborate with us, reinforcing our arguments in favor of Tingo Maria, because this distinguished American man of science was much impressed with the natural conditions of this place and with strong efforts made in organization, by the Federal Government.

We judge (estimate) therefore, that among the South American regions most fitted for the study and development of tropical agriculture, Tingo-Maria must be considered, not only for its conditions of soil, climate, accessibility and administrative organization, but principally because one finds it embedded in the zone of origin and habitat of quinine, cube and Peruvian rubber (hevea) whose renown reached all the markets of the world before there were begun the great plantations in the East Indies.

J.F.T. (Seal)

Translator's Note - This copy was not dated. The photographs mentioned did not accompany this copy. - B. Y. Morrison

No one can fail to recognize and appreciate the spirit in which the foregoing report was prepared.

The writer does not care to present any opinions about the development of Tingo Maria as a possible site for the proposed Institute of Tropical Agricultue as compared to any other cities. He does wish to submit various opinions and suggestions.

If there is to be any aid extended to the Peruvian government leading to the development and activity at the station and producing an indirect effect upon the colony, their production and Peruvian exports, it would seem wiser to request permission of the Peruvian government to establish a more extensive and active participation than has been suggested, leading to the development as swiftly as possible of a completely equipped agricultural station which for some years should devote itself to presenting a perfect agricultural model for all to see, to the training of large numbers of young men in the practical phases of agricultural life, and to the training of a more limited number of aides in teaching and demonstration. It is the considered opinion of the writer that there is no crying need for the immediate establishment of a research center until after the more fundamental problems have been solved; above all there is the need in all parts of Peru for better trained workers who comprehend the problems and who will find satisfaction in a career that involves active participation in agricultural work.

Since the pattern for such a center already exists at La Molina, there is nothing to suggest that such a proposal would appear unreasonable nor did it so appear to various Peruvian officials with whom the whole situation was discussed informally. The hope was expressed that any North American experts who might be assigned to the mutual study could be maintained in residence for considerable periods of time.

This suggestion is one which the writer should like to urge, with the suggestion that five years residence should be considered the absolute minimum and ten years residence the preferred minimum.

It must be remembered that there are almost no North Americans who have lived and worked under tropical conditions and that this should be reason enough for the choice of men of rather special qualifications and experience, none of which need be rooted in the field of pure research science which properly occupies our own field of research, a field supported by more years of practical experience than have elapsed in these countries with their more recent considerations of agricultural production on large scale.

It may be pointed out, also, that agriculture in this area will have to prove its way, not only against the historical attitude of exploitation of natural resources, but a sincere belief that this type of agricultural development is not the proper program for the "montana" of Peru or any countries of South America. Since the arguments of this party are based on ethnic population problems, as well as questions of public health, they fall outside the proper field of this report.

In positive terms, the recommendations may be summarized as follows:

1. Tingo Maria and its environs appear to provide an ample site for the development of an excellent tropical experimental center.

2. Aid offered and cooperation requested should be on a generous basis and for long-time projects.

3. All programs should be kept on a practical plane and should be directed to a sphere of influence purely local at first but with increasing areas of influence.

4. That any North American personnel should be carefully selected and provided for long-time residence.

It will be noted that no recommendations are offered as to crops. None can be offered until the preliminary years of trial are past. Evidential data suggest that tea and cinchona, now under initial test, will succeed, but there is no evidence that the labor problems are or can be solved. In all probability the preliminary years will have to be devoted to working out a safe basis of life in the area for the transplanted population with the contemporaneous training of workers, not research scientists, all under the watchful eye of a trained medical staff large enough to relieve the present good doctor.

Comments

As might have been expected, there arose from time to time and with different officers, discussions of the organization of the Department of Agricultural of the United States as compared with the Peruvian organization.

Before going to Peru the writer read in the Boletin de la Direccion de Agricultura y Ganadería, Vol. 1, No. 1. pp. 77-92 (Sept./Oct., 1931) a general article by Mr. Jose D. Valdivieso, "Agricultural Experimentation in Peru" which is divided into four sections: Brief History of Agricultural Experimentation in Peru, The Orientation of Agricultural Experiments, Agricultural Problems, The Present State of Experimentation in Peru.

Although there have been some reorganizations, the outlines laid down in this paper and the general location of stations, sub-stations and cooperating institutions have not altered very greatly. Now, as then, the territory covered by this department does not extend into the "montana."

The most interesting feature may be the fact that many of the officers now occupy posts of very different character from those occupied at the time of this report.

The organization of the department and the presentation of the problems and projects are practically the same as now and follow the outlines which seem inevitable.

As indicated, the "montana" comes under a distincy administrative head but the general organization and procedures are not very different from the organization elsewhere in Peru.

Emphasis, however, seems to be concentrated in a limited number of areas which serve as demonstration centers as well as sources of information, discussion, propagating material, etc.

There is now, and presumably always will be, a difference of opinion as to a proper program for life in the "selva" which has already been touched upon in the discussion of Tingo Maria.

An article by Sr. Manuel Sánchez del Aguila, "La Conquista de la Selva por la Agricultura" (The Conquest of the Jungle by Agriculture) which appeared originally in Boletín de la Dirección de Agricultura y Ganadería (Vol. IX, Nos. 28-31, pp. 115-132, 1938, no month given) and was reissued later (March 1939) as a separate "for the technical section of agricultural propaganda" (extension) outlines various experiments in the clearing and bringing into cultivation of forest lands in the jungle, carried out in connection with his official work at the Experimental Farm at Satipo. The paper is clearly presented and various cost factors are presented together with a table of contrasted data to bring out the advantages in the use of machinery.

This paper shows a more than adequate understanding of the problem and the inevitable necessities involved in preparing for agriculture in the tropics, as far as this one phase is concerned.

Although inquiry was made and assurance was given that an organization chart was in process of preparation, no copy was available by December 1, 1941.

Essentially the country is divided into three portions, coast, sierra, and montaña. The montana has a separate direction but the director for the coast and sierra, which are united, has three separate inspectors for the three zones, north, central, and south. The number of stations, substations, and cooperating agencies varies in each area as does the number of staff members and the projects undertaken.

Since the writer is in no way expert in his knowledge of organization and equipment, even within his own Bureau in the Department of Agriculture, no arbitrary answers could be given to the innumerable questions asked which required any phase of critical opinion.

Certain data as presented by Peruvian officials and citizens, in discussing these phases, lead the writer to believe that none of the following points are his own but represent rather clearly the opinion of the informed Peruvian himself:

1. The annual budget for agriculture (total) is too small to operate satisfactorily in all of the branches of the organization.

As outlined the organization is quite sound. To make it function fully, it must either be more completely financed or its number of stations should be reduced, making possible better equipment and a larger staff, often needed for the best service, and an adequate scale of salaries so that a trained worker could look forward to a life in government service without need to supplement his income by private agricultural or other business.

2. There seems lacking a clearly defined understanding of the fact that agriculture must serve the life of the nation as well as the finances of the business man. The appearance of various agricultural projects in the Department of Public Health seems an unnecessary spread of agricultural attention. If carried to its logical conclusion, it would appear that the projects now outlined in Public Health will remove from agriculture some of its best fields for endeavor.

It would appear also that because of the conditions set out in item 1, the conditions touched upon in 2 are made more acute and are given additional importance because the flexibility of the budget of the Sociedad Nacional Agraria, an able organization, essentially commercial in its outlook, makes it possible for that organization oftentimes to overshadow the work of the government workers.

In "La Vida Agricola" (Vol. XIV, No. 166, pp. 743-782, Sept. 1937) there is an article by Mr. Romulo a Ferrero, "The Economic Orientation of Peruvian Agriculture", which was presented before "el Centro de Estudiantes Catolicos" July 6, 1937. This presentation, by a Peruvian to Peruvians, presents almost all the problems that have existed and still exist, and presumably will continue to exist until Peru undertakes some of the reforms indicated but not detailed in this paper. The paper is not documented.

At the same time, another paper written by a Peruvian for Peruvians might well be considered as it throws emphasis in various directions not entirely emphasized in Sr. Ferrero's paper. We refer to "The Agrarian Problem in Peru" by Dr. Cesar A. Ugarte, reissued in Lima in 1940 from the "Biblioteca de la Caja Nacional de Seguro Social."

"Some Remarks on the Agricultural Organization of the Tropical Countries of the Andes" by Dr. Manuel Lugari (Mo. Bull. Agr. Econ. & Sociology, Vol. XXXI, No. 3. pp. 89E - 101E (Mar. 1940) covers more than Peru in its discussion but presents dispassionately but rather fully the problem as the writer sees it. This same article concluded in Apr. 1940 (Vol. XXXI, No. 4, pp. 133E-146E) offers little additional data, but confirms the findings of the Peruvian authors.

3. Considerable discussion arose at various times as to whether or not the work of the government agencies should turn more toward research or toward practical phases of agricultural life, a discussion brought forward with a perfectly clear understanding of the relation between the two.

The answer seemed most apparent when one compares the very advanced equipment and procedures in the highly specialized fields of sugar and cotton and the rather prinitive conditions of general small farm agriculture.

There is no lack of information in Peru, much of it available through government agencies, some through private business (as witness the timely translation into Spanish and publication of Farmers' Bulletin 1728, Flax-fiber production, by B. B. Robinson, by the Banco Italiano). There is also no lack of communication with current publications from our own government

though this is not as general as it might be and offers some possibilities for cooperation to be discussed elsewhere. There are also a number of distinguished Peruvian workers in the scientific branches of agriculture, whose papers need no new commendations here.

The fact remains that there is a gulf between the two extremes.

If it is true that the advanced industries can and do take care of their own management and upkeep, adopting and adapting whatever improved material, machines or methods may become available, it might seem reasonable to infer that government work for a period might well be turned to those phases of national life and instruction which would raise the level of general agriculture, a program that is not as slight as it may appear.

4. The suggestion made by all persons who honored the writer by direct answers to questions, was that the government of the United States find some way to work with Peru, furnishing "money and men." No suggestions were ever made as to amounts or numbers, nor as to procedures. This point touches upon the proposals for Tingo Maria, discussed elsewhere. It impinges also upon education or training for special workers. In the opinion of many, this should take the form of graduate work for Peruvian students sent to the United States and the long-time residence and work of North American scientists in Peru, with whatever opportunities there may be for joint work on Peruvian problems in Peru.

Whether or not it would be possible to create within Peru small units in various sections of the country where American workers could remain in residence, assisted by Peruvian student aides, was not discussed.

5. The interchange of agricultural plant material seems extremely important. There is already established within the Bureau of Plant Industry a Division of Plant Exploration and Introduction which has for over thirty years served as a center for this type of exchange, acting as a clearing house from our own scientific workers and from workers resident outside the United States. A reasonable interchange has already existed with Peru but the writer brings back an extended list of materials desired, which will be filled as rapidly as possible.

Proposals

There are various projects which migh be carried out in Peru for our mutual advantage. None of these was discussed as such in Peru.

1. Botanical Survey. Taking as a basis the imposing "Flora of Peru" by Dr. J. Francis McBride of the Field Museum, Chicago, it would seem desirable to recast the material according to localities, so that basic studies could be made particularly in relation to forage and pasture studies. As far as has been discovered there are no population studies of existing pastures or native forage associations, although at present there are forage problems in almost all parts of Peru, intimately associated in most cases, either with milk production programs or meat-producing programs.

2. Medicinal Plant Survey. In addition to the botanical survey, related to it for taxonomic reasons but quite independent from it, should be a survey of the medical folk-lore and traditions of Peru; not only of the folk-lore of the native populations but of more remote populations which appear to follow systems that combine Indian and colonial lore.

It may be expected that a considerable part of these data will have no more than ethno-botanical value, but there should be a portion worthy of permanent study.

Collections of this type should be organized, as formerly, in the Division of Plant Exploration and Introduction, with harbarium material for taxonomic study, field notes, bulk material for physiological and chemical examination and analysis, and, if possible, live material for study and propagation here.

3. Horticultural Survey. There are in existence all over Peru, horticultural forms of Old World and some oriental plants, vegetables, fruit and ornamental, which should be surveyed, assembled and studied. It is most unlikely that any will be satisfactory in themselves, even some of the forms in commercial production within Peru, but since they represent "survival" values to Peru and special climatic adaptations to ourselves, they should and probably will furnish the basis of breeding experiments of particular value.

4. Special Surveys could be initiated in relation to various plants native to Peru and the adjoining countries (conchona being the most obvious example) but if these can be handled by Peru alone, no cooperation is needed. Peru is working now on native potatoes and forms of maize.

5. Translations. The writer was asked repeatedly if it would be possible to have Spanish editions of most of our Farmers' Bulletings, a few of the Miscellaneous Bulletins and a very limited number of special bulletins. The selections would be limited to those describing special crops (and their varieties) and all the bulletins describing procedures and methods. A special request was made that those departments which we call "Extension Service" and "Home Economics" be included.