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The Hunt Institute for Botanical Documentation, a research division of Carnegie Mellon University, specializes in the history of botany and all aspects of plant science and serves the international scientific community through research and documentation. To this end, the Institute acquires and maintains authoritative collections of books, plant images, manuscripts, portraits and data files, and provides publications and other modes of information service. The Institute meets the reference needs of botanists, biologists, historians, conservationists, librarians, bibliographers and the public at large, especially those concerned with any aspect of the North American flora.

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.

Guatemala City, 10 January 1940

Memorandum for Major Lamson-Scribner.

QUININE CULTIVATION IN GUATEMALA

Having recently gone over all of the experimental Cinchona (quinine) plantings in this Republic, I believe I am prepared to give you accurate information regarding the present status of this project, and an opinion as to its future.

The principal experimental plantings are at Finca Zapote (Dpto. Escuintla); Finca Helvetia (Dpto. Suchitepequez); and Finca Panamá near Patulul. Recently Merck and Company, who inaugurated and are fostering this project, have acquired Finca El Naranjo, a fine property near Chicacao, on which they have made extensive experimental plantings. These trees, however, are still too young to be of much interest.

The two major plantings are those at Zapote and Helvetia. Each of these contains several hundred trees four years of age as well as many younger ones. From the older trees it is now possible to take bark samples, which means that definite results are beginning to be known. In my opinion, the behavior of the high-yielding Ledgeriana types from Java, both at Zapote and at Helvetia, is distinctly encouraging.

The problem at the start was to determine whether or not these Ledgeriana types could be grown successfully in Central America. Many Cinchona trees already existed in Guatemala (some of them planted as far back as the eighteen seventies, I am told) but they were almost wholly of the succirubra type, which commonly does not contain sufficient quinine to be

commercially profitable.

The Ledgeriana seedlings tested by Merck and Company in cooperation with several local planters (notably Gordon P. Smith and L. Lind Pettersen) have to date made very satisfactory growth wherever planted on fairly rich soils between 3000 and 5500 feet in elevation, in locations with moist climate and free from severe winds. Ledgeriana seedlings sent to Guatemala by the U.S. Department of Agriculture - somewhat younger than Merck's original lot - are also doing very satisfactorily.

The problem in quinine cultivation, - after determining that the high-yielding types will grow successfully under local conditions, - is to select and propagate by grafting those varieties which show (1) high quinine content, (2) satisfactory thickness of bark, (3) vigorous growth, and (4) resistance to disease. Other minor factors come into play. Commercial success depends in combining all of these desiderata in as high a degree as possible.

This is now the job before us in Guatemala. In my opinion, the establishment of the first small commercial plantations should take place within the next year or two, though it will be many years before continued selection will result in the development of highly satisfactory strains. At the start we must be satisfied with somewhat lower yields than those obtained in Java.

How long will it be before this industry is on a commercial footing in Guatemala? Trees come into production about six

years from planting. If the first commercial plantings are made in 1941 and 1942, commercial production of quinine will commence about 1950. The quantity will of course be small at the start.

This industry is one which requires an unusually high degree of agricultural skill. I therefore believe it will remain, for many years at least, in the hands of a limited number of highly intelligent planters.

Wilson Popenoe

Memorandum for the American Minister

Re: CINCHONA (QUININE) CULTIVATION IN TROPICAL AMERICA

Some five years ago, when commercial cultivation of Cinchona in tropical America began to receive serious consideration at the hands of our citizens, Merck and Company of New York decided to undertake this project and to see it through to a conclusion. The first problem was to decide which region offered the best conditions for the work.

As you know, Cinchona grows naturally (wild) in the Andine region from Colombia to Bolivia, chiefly at elevations between 3000 and 6000 feet - so far as the commercial forms are concerned. At a conference held in Boston, between officials of Merck and Company and those of the United Fruit Company, in which I took part, I strongly recommended Guatemala as the best place to start the work. My reasons were chiefly (1) my belief that Guatemala has ample land of the right sort available, in the right climate, (2) it is a country traditionally friendly to us, and (3) it is close to the United States.

Not necessarily because of my recommendations, Guatemala was chosen. Merck and Company sent down Colonel Victor E. Ruehl to start the work. United Fruit turned over to him two men whom we had trained at Lancetilla Experiment Station in Honduras, Hans Franke and Jorge Benitez, to handle the propagation and care of the trees; Colonel Ruehl made arrangements with Gordon Smith and L. Lind Pettersen for the use of land; and seeds obtained from numerous sources were planted.

Cinchona trees vary greatly in quinine content, and the commercial success of the project depended upon (1) determining the suitability of soil and climate, and (2) developing through selection of seedlings highly productive strains. Competition with Java, where more than 90% of the world's quinine is now produced, was not a feature of the project: the object was to have supplies nearer home, even at a slightly higher cost. You are familiar with this angle of the problem.

In any work of this sort, progress at the start is of necessity slow. It takes ~~six~~ ^{at least seven} years from the planting of the seed, for Cinchona trees to reach a size where bark samples can be taken and quinine content determined. After that, trees which are satisfactory from this standpoint, and which also show good growth characteristics, can be propagated and planted commercially. This stage of the work is now being reached in Guatemala.

Several thousand seedlings have been grown at various places on the West Coast, chiefly at Finca Helvetia, managed by Gordon Smith; Finca Panama, managed by his son Owen Smith, and Finca El Zapote, managed by L. Lind Pettersen. Some of these have shown sufficient promise to warrant commercial propagation, which is now commencing, but which will be slow for the first few years until larger stocks can be built up.

In addition to these trees, Merck and Company obtained last year large stocks of superior seed from one of the best Cinchona-producing regions in the Andes, seeds which are considered sufficiently promising to warrant commercial planting on a large scale without preliminary testing. Trees from these seeds may not give such high returns as grafted stock

from proved mother plants, but the urgency of the work, and the long time required to develop selected strains locally, have fully justified (in my opinion) the present program. At the present time, Merck and Company have several million seedlings from this South American stock growing in their own nurseries at Finca El Naranjo (near Chicacao) and Finca Panama; while additional large quantities are being grown by the Smiths and Pettersen for their own account. These seedlings offer the best hope of building up commercial production in the immediate future.

Merck and Company, at their Finca El Naranjo, purchased last year, have at least 750 acres of what I consider to be the best Cinchona land in Guatemala. On fincas managed by Gordon Smith there are additional large areas. I consider the situation at Finca El Zapote, managed by Pettersen, somewhat more doubtful.

As you will readily understand from the above, we can expect no commercial production of importance in less than six years. If the project is pushed vigorously (as Merck and Company certainly show every intention of pushing it) increasing quantities will be available annually, and so far as I can see, there is no reason why Guatemala should not supply, in subsequent years, all the quinine needed by the United States, and more if desired. I believe there is plenty of land available in Guatemala to supply the needs of the Western Hemisphere.

This without taking into account the possibilities in other regions. In Mexico there are suitable areas, and I have recently heard rumors to the effect that the Mexican government has undertaken to encourage quinine production in those parts

of Chiapas adjacent to Guatemala (the region known as Soconusco). I believe there are limited areas in Costa Rica which would prove suitable, and in the Republic of Panama (the Volcan region in Chiriqui province). And there is, of course, the Andine region in South America, where we know Cinchona could be grown successfully because it is native there. If it was desired to extend the cultivation into this continent, I would favor Colombia and Ecuador as the two best countries, mainly because *there* I believe we could better protect our interests than we could in others. This, however, is something which the folks at Washington are obviously better prepared to evaluate.

Finally, I would like to emphasize one factor on which the success of this project depends: Cinchona cultivation is an agricultural industry requiring, in addition to very special conditions of soil and to a lesser extent, climate, a high degree of agricultural skill. It is an intensive culture, which cannot be handled profitably by such rough methods as prevail in the culture of coffee, bananas, and several other tropical crops. This means that training and experience will be required by all those who embark upon the cultivation of this crop. It cannot be placed, overnight, in the hands of large numbers of unskilled cultivators. Obviously this fact ~~will~~ retard its progress; and it will mean that there is need of skilled technicians, who can and should be supplied by the United States. Repeatedly one hears statements to the effect that the Dutch, who have made a success of this industry in Java, have brought to bear upon its development an unusual degree of agricultural skill. Granted that this is true, I am by no means willing to admit that we Americans can not, with a little time, develop as high a degree of

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skill as they have done. I think our record in the development of American agriculture bears me out.

I ask you to accept all the above on my personal responsibility, not that of the United Fruit Company by which I am employed, nor that of Merck and Company, to whom I have at the moment been loaned for three months to assist in organising the agricultural end of the Cinchona project here in Guatemala.

.....
Wilson Popenoe

Antigua, Guatemala
10 June 1940

CINCHONA INVENTORY

August 31st.1940

Summary:-ORIGINAL LEDGER SEEDLINGS:

" El Nil " Helvetia	753	
" La Guardiania " Helvetia	353	
Administrators garden Helvetia	5	
Woodland " El Nil " Helvetia	2	
Various sites - "Patzulin"	6	
Los Planes- "Mocá "	20	
Total.....		1139

ORIGINAL LEDGER GRAFTS:

" El Nil " - Helvetia "	58	
" La Guardiania " - Helvetia	29	
" Alianza " - Helvetia	119	
" La Merced " - Patzulin	39	
" Conchita " - Patzulin	749	
" Tercer Plan " Mocá	1	
Total.....		995

"COBAN LEDGERS " SEEDLINGS :

" La Guardiania " - Helvetia	592	
?? " Zacatera, " La Suiza " - Helvetia	63	
Total.....		655

" PORVENIR LEDGER " GRAFTS ??

" La Playa " - Helvetia	5	
Total.....		5

<u>GRAND TOTAL</u>	*	2794
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John G. Smith

August 31st.1940

Program for Finca Helvetia.

Flowers have been removed from all trees at El Nil, except those Ledgers which showed 8% or higher quinine content, from which only half the flowers were removed. The seed which ripens from the flowers left on the trees is to be divided 50-50 between John Smith and Experimental Plantations. The part which comes to us is to be used at Naranjo for testing sphagnum moss method of germination, and for testing seedbeds of the Stoffels pattern. Resulting seedlings are to be grown to the nursery stage, at which time they will be "rogued", i.e., all those which on the basis of our knowledge at that time do not look promising will be destroyed, and the remainder used in field plantings.

The planting at El Nil is to receive best cultural attention from now on, and Experimental Plantations agrees to pay half the costs if Gordon Smith so desires. This "best attention" involves cutting off of flowers not desired for seed; fertilizing regularly; and such extra cleaning as may be thought profitable.

The fertilizer program will be commenced as follows: First, one application of Sodium nitrate, about four ounces per tree. Then two or three weeks later, a second application of Sodium nitrate of like amount. Then, beginning three or four weeks later, regular applications of Ammophos every two months approximately, four ounces per application, the fertilizer to be dug into the soil as is now being done at Naranjo.

Regarding Guardiania, all Original Ledger trees at that place are to receive fertilizer from now on, exactly as described for El Nil. It is not necessary to give this treatment to trees other than Original Ledgers in this planting. Flowers will be removed from

these trees as has been done at El Nil.

In 1941 as many additional Ledgers will be bark-sampled as is feasible, using the general standard of taking samples only from the trees which have attained a trunk diameter of approximately two inches. It is suggested that next year's bark samples be longer and narrower than those made this year.

Plans will be made for grafting all of the propagating material available next year at Helvetia, at Naranjo, that is, Merck's 50% of grafting wood from all trees which are judged worthy of propagation. It is not expected that we shall be called upon next year to handle Smith's share of this material in our ^{own} nurseries as has been done this year, since Smith is preparing adequate supplies of succirubra stocks and is training several men to do the grafting.

September 11, 1940.

Program for Finca Panama

Experience to date indicates that

1. Soil conditions at Los Andes, while satisfactory for growing succirubra stocks, may not prove satisfactory for Calisayas and Ledgers unless we fertilize continuously.

2. We have sufficient nursery space at Naranjo for all needs which we can now foresee.

3. Supervision of nurseries at Los Andes involves an expensive loss of time, since our base is at Naranjo.

In view of the above, it is proposed to withdraw gradually from Los Andes, on the following basis:

Owen Smith will first be given his 10% of the Krukoff seedlings now in seed beds at Los Andes, as agreed in Mr. Lukens' letter of June 11, 1940. We will then remove all seedlings from the seedbeds, refill the beds with our seedlings at close spacing (to be decided later, probably not more than 3x3 inches), and take all other seedlings to Naranjo for planting in nursery. We will carry our seedlings in the seedbeds-nurseries at Los Andes until such time as we consider it desirable to move them to some other place. No further planting of seeds will be done at Los Andes.

The succirubra stocks now in nursery at Los Andes will be grafted in the summer of 1941; the grafted plants, (exclusive property of Experimental Plantations Inc.) will be grown there for one year; and we will then move them as we think desirable. No further succirubra nurseries will be established at Los Andes.

This program will enable us to terminate our nursery operations at Los Andes in the summer of 1942, at which time we propose to move Julio or any other employee who may be on the job, from Los Andes to

some other point, leaving no one at Los Andes.

As regards the permanent planting in the Merck enclosure at Los Andes, we propose to continue this for some years, until such time as we consider it no longer of value to us. In this planting are a number of Original Ledgers (360) which should be bark sampled and their value for propagation determined before we cancel the existing contract and turn the entire area back to Owen Smith. Possibly we can do this in 1941; if not, it may be necessary to wait a year or two longer. If the Ledger trees continue to die out, and nothing remains but grafted trees of which we have numerous duplicates elsewhere (and this seems quite possible) then we can move out of Panama entirely in the summer of 1942.

September 11, 1940.

Program for Finca El Zapote

When bark analyses of all samples taken in the summer of 1940 have been received, a complete list will be drawn up and transmitted to Mr. Pettersen, at which time Mr. Lukens will write him a letter to the effect that we shall desire to use our 50% of grafting material from some of these trees in the summer of 1941, and will therefore appreciate it if he will get in touch with us before doing any grafting from any bark sampled trees in 1941, so that we can get together with him and give him a list of those trees from which we desire 50% of the propagating material.

All trees bark sampled this year will be copper tagged with their Z numbers as soon as possible after the final bark analyses are in.

WE will continue to watch Ledger trees at Monterrey, especially those of the so-called "varios" group in Planting No. 1, and those in the group of Washington Ledgers; and as rapidly as these trees attain sufficient size we will bark sample those which appear promising. All which turn out well will be propagated at Naranjo.

September 11, 1940.

Memorandum re Gustavo Helmrich's trees, Finca Samac, Coban.

There are some 90 trees of the Original Java lot at this place, of which 45 were sampled in August 1940. Based upon returns from these, our policy will be as follows:

If most of the trees show quinine content comparable with the best Ledgers at Helvetia, we propose to indicate to Don Gustavo which trees are worth keeping, and which should be destroyed. He agrees to carry out our suggestions in this connection.

Seed now hanging on the trees will be of little use, since it has been cross-pollinated with nearby "Coban Ledgers". Seed from flowering in 1941 should be valuable if undesirable trees are cut out. We propose to offer him a written agreement to the effect that we will pay one dollar per gram for such seed as we may desire, beginning with the crop ripening at the end of 1941. We to have first chance at all seed produced, and to take such quantity as we may desire.

Trees not bark sampled in 1940 will be tested in 1941, so far as practicable. Those which do not look promising will be destroyed as in the case of trees not showing up satisfactorily in the 1940 bark analyses.

It is suggested we offer an agreement covering a five year period beginning in 1941.

September 11, 1940.

PUERTO RICO EXPERIMENT STATION
OF THE
OFFICE OF EXPERIMENT STATIONS
UNITED STATES DEPARTMENT OF AGRICULTURE
MAYAGUEZ, PUERTO RICO

SEPTEMBER 15, 1940

DR. JAMES T. JARDINE, CHIEF
OFFICE OF EXPERIMENT STATIONS
UNITED STATES DEPARTMENT OF AGRICULTURE

SECOND SUPPLEMENTAL REPORT OF ACTIVITIES OF THE PUERTO RICO EXPERIMENT
STATION FOR THE MONTH OF JUNE 1940

DEAR DR. JARDINE:

THE FOLLOWING IS A SECOND SUPPLEMENTAL REPORT OF THE ACTIVITIES OF YOUR PUERTO RICO STATION FOR THE MONTH OF JUNE 1940.

PLANT INTRODUCTIONS

CLAUD L. HORN REPORTS:

YEAST-FED MANGOSTEEN PLANTS HAVE MAINTAINED THEIR SUPERIORITY.

PREVIOUS REPORTS INDICATED THAT MORE DESIRABLE GROWTH OF SEEDLING TREES OF THE MANGOSTEEN, GARCINIA MANGOSTANA, WAS OBTAINED WHEN THE SUBSTRATUM IN WHICH THESE ARE GROWN WAS IRRIGATED WITH A COMPLETE NUTRIENT SOLUTION. ALSO, ADDITIONAL STIMULATION WAS OBTAINED WHEN THE IRRIGATION SOLUTION CONTAINED A WATER EXTRACT OF BREWERS' YEAST.

THE 75-PERCENT INCREASE IN LEAF AREA IN THE YEAST-EXTRACT-FED PLANTS OVER THE NON-YEAST-FED PLANTS SECURED DURING THE EARLY STAGE OF DEVELOPMENT HAS NOT BEEN MAINTAINED. HOWEVER, THE YEAST-FED PLANTS HAVE CONTINUED LARGER, ALTHOUGH THE DIFFERENCES HAVE BECOME LESS AS THE NON-YEAST-FED PLANTS HAVE PASSED THE EARLY CRITICAL GROWTH PERIOD. IT IS, THEREFORE, APPARENT THAT THE 1:1,000,000 WATER EXTRACT OF BREWERS' YEAST IS OF PRACTICAL IMPORTANCE IN CARRYING MANGOSTEEN SEEDLINGS PAST THE CRITICAL GROWTH PERIOD DURING THE FIRST MONTHS AFTER PLANTING.

COMPARABLE SEEDLINGS OF THE SAME 20-MONTH AGE WHICH HAVE GROWN CONSTANTLY IN THE SAME FERTILE LOAM SEED BED, HAVE DEVELOPED ONLY TWO AND THREE PAIRS OF SMALL LEAVES, AND MOST OF THESE HAVE DIED. SUCH IS TYPICAL OF WHAT HAS BEEN THE USUAL DEVELOPMENT OF MANGOSTEEN SEEDLINGS IN THE SOILS OF MAYAGUEZ. PLANTS IN THE TREATED LOTS ARE 12 TO 18 INCHES TALL AND HAVE BEGUN TO DEVELOP LATERAL BRANCHES.

PERMANENT FIELD PLANTING OF MANGOSTEENS HAS BEEN MADE.

THIRTY OF THE LARGEST PLANTS WERE SET OUT HEXAGONALLY 30 FEET APART IN THE BEST ALLUVIAL SOIL OF THE STATION. THIS SOIL IS WELL DRAINED AND IS OF GOOD PHYSICAL CHARACTER. THE REMAINING PLANTS WERE SHIFTED TO LARGER CONTAINERS AND WILL BE GROWN FURTHER UNDER THE BETTER-CONTROLLED CONDITIONS OF THE GREENHOUSE.

MANGOSTEEN SEED DIFFERS FROM ORDINARY DICOTYLEDONOUS SEEDS.

THE STRUCTURE OF THE MANGOSTEEN SEED IS SO DIFFERENT FROM ORDINARY DICOTYLEDONOUS SEEDS THAT IT HAS BEEN TERMED A HYPOCOTYL-TUBERCLE. THE MATURE SEED CONSISTS OF A CENTRAL STELE-LIKE BODY COPIOUSLY SURROUNDED BY A FATTY STORAGE TISSUE. THE SURROUNDING TISSUE IS EXTREMELY FATTY. ONE SAMPLE OF SEED WAS RELUCTANTLY REMOVED FROM A PLANTING FOR FAT ANALYSIS. THE TISSUE IMMEDIATELY SURROUNDING THE STELE-LIKE BODY CONTAINED 63 PERCENT OF ETHER-EXTRACTABLE SUBSTANCES, WHILE THE WHOLE SEED CONTAINED 40 PERCENT OF ETHER EXTRACTABLE SUBSTANCES. IN A MATURE MANGOSTEEN SEED NO LEAVES, STEM, OR ROOTS ARE PRESENT AS IN THE USUAL SEED; THESE DEVELOP AFTER PLANTING. FIRST, A WART-LIKE GROWTH APPEARS ON THE ROUNDED END OF THE SEED SURFACE FROM WHICH THE FIRST PRIMARY ROOT PROCEEDS TO DEVELOP (FIG. 1, B).

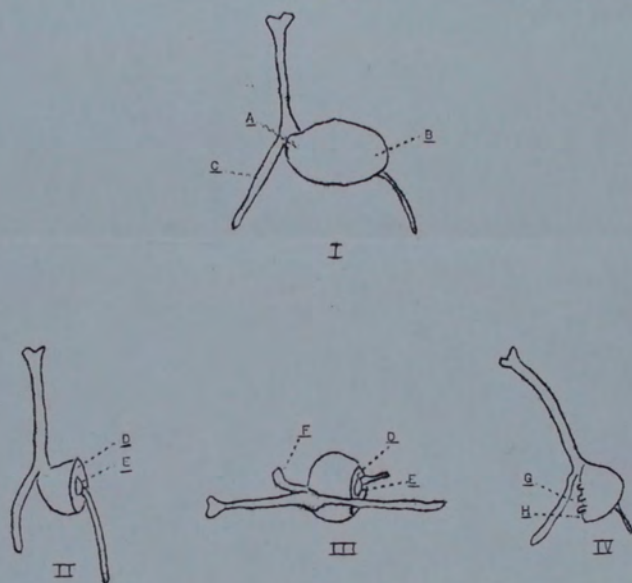


FIGURE 1. -- SEED OF *GARCINIA MANGOSTANA*. -- I. FORM OF TYPICAL GERMINATED MANGOSTEEN SEED: (A) POINTED ACROPETAL END, (B) ROUNDED BASIPETAL END, (C) SECOND PRIMARY ROOT FROM BASE OF SHOOT. II-IV. GERMINATED SECTIONS OF A TRISECTED SEED. II. ACROPETAL END: (D) BASIPETAL CUT SURFACE, (E) STELE-LIKE BODY. III. MID-SECTION: (G) BASIPETAL CUT SURFACE, (H) STELE-LIKE BODY, (I) SECONDARY SHOOT DEVELOPED FROM ONE OF THE MULTIPLE ACROPETAL PRIMORDIA. IV. BASIPETAL END: (J) ACROPETAL PRIMORDIA DEVELOPED JUST OUTSIDE THE PERIPHERY OF THE CUT SURFACE, (K) ACROPETAL CUT SURFACE.

SHORTLY AFTERWARDS, OR ALMOST SIMULTANEOUSLY, ANOTHER GROWTH POINT DEVELOPS ON THE POINTED SEED SURFACE OPPOSITE THE ROOT GROWTH POINT (FIG. 1, A). FROM THE SECOND GROWTH POINT THE SHOOT DEVELOPS. WHEN THE SHOOT DEVELOPS TO A LENGTH OF MORE OR

LESS THREE-FOURTHS OF AN INCH, THE SECOND PRIMARY ROOT (FIG. 1, c) DEVELOPS FROM THE BASE OF THE SHOOT. THE YOUNG SEEDLING THUS HAS, FOR A FEW MONTHS OF ITS EARLY LIFE, TWO PRIMARY ROOTS; RARELY ARE BOTH OF THESE PERSISTENT. THE FIRST ROOT DEVELOPING FROM THE SEED ITSELF USUALLY BECOMES NONFUNCTIONAL AND WITHERS AWAY WHEN THE SEED HAS WITHERED DUE TO THE EXHAUSTION OF THE RESERVE FOOD STORED IN THE SEED. THEN THE SMALL PLANT EXISTS ON A PERMANENT ROOT SYSTEM, NONE OF WHICH ORIGINATED DIRECTLY FROM THE SEED.

MANGOSTEEN SEED VIGOR IS GOOD.

NEARLY ALL MANGOSTEEN SEEDS GERMINATE WITHOUT DIFFICULTY WITHIN 6 TO 8 WEEKS AFTER PLANTING. THE NORMAL COLOR OF A YOUNG LEAF IS DULL RED WHICH SLOWLY TURNS TO DARK GREEN IN MATURITY. THE LEAF FORM CHANGES BETWEEN THE FIRST TO ABOUT THE FIFTH PAIR OF LEAVES FROM CORDATE FOR THE JUVENILE TO LARGE, ACUMINATE FOR THE TYPICAL ADULT FORM. LEAVES ARE PRODUCED IN CLOSE SUCCESSION UNTIL THE SEED STORAGE TISSUE IS EXHAUSTED. TO THIS POINT THE SMALL PLANT IS VIGOROUS.

AFTER GERMINATION, SEED LINGS IN MAYAGUEZ SOILS ARE INACTIVE.

AS THE SEED FOOD RESERVES ARE EXHAUSTED THE PLANT LOSES VIGOR AND OFTEN DIES SHORTLY AFTER THE STORED MATERIALS ARE EXHAUSTED. WHEN GROWN IN SOIL, THE ROOT SYSTEM OF A PLANT AT THIS STAGE OF DEVELOPMENT HAS FEW LATERAL ROOTS, AND MOST ROOTS HAVE A DEAD, CORKY OUTER COVERING AND APPARENTLY INACTIVE ROOT TIPS. THUS THE PLANT AT THIS MOST CRITICAL STAGE OF ITS DEVELOPMENT IS LEFT WITHOUT RESERVE FOOD AND WITH WHAT APPEARS TO BE A POOR ABSORPTIVE ROOT SYSTEM. PLANTS FED WITH YEAST AND NUTRIENT SOLUTION HAVE, HOWEVER, AN EXTENSIVE ACTIVE ROOT SYSTEM WITH LITTLE CORKY COVERING.

MANGOSTEEN SEED CAN FORM ANOTHER SHOOT SHOULD ORIGINAL SHOOT DIE.

WHEN THE SHOOT OF A SEEDLING DIES AS A RESULT OF TRANSPLANTING OR OTHER CAUSES, BEFORE THE FOOD RESERVES IN THE SEED ARE EXHAUSTED, THE SEED WILL OFTEN REGERMINATE A NEW SHOOT AND DEVELOP INTO A NORMAL PLANT. IN SUCH CASES SEVERAL SHOOT PRIMORDIA DEVELOP ABOUT THE BASE OF THE DEAD ORIGINAL SHOOT. OFTEN MORE THAN ONE OF THESE PRIMORDIA DEVELOP INTO SHOOTS. SUCH SHOOTS APPEAR TO BE EQUAL IN ALL RESPECTS TO THE ORIGINAL.

SOME MANGOSTEEN SEEDS ARE POLYEMBRYONIC.

FREQUENTLY TWO, RARELY THREE, AND EVEN MORE RARELY FOUR PLANTS HAVE BEEN OBSERVED TO ORIGINATE FROM A SINGLE SEED. THIS POLYEMBRYONY IS DISTINCT IN TYPE FROM THAT FREQUENTLY FOUND IN CITRUS AND MANGO. IN CITRUS AND MANGO-SEED POLYEMBRYONY THE MULTIPLE EMBRYOS HAVE ONE PAIR OF COTYLEDONS COMMON TO ALL. HOWEVER, THE MANGOSTEEN-SEED POLYEMBRYONY DIFFERS IN THAT EACH EMBRYO WITH ITS WELDED SURROUNDING FOOD STORAGE TISSUE IS A UNIT. EACH OF THESE EMBRYOS HAS A DEFINITE SEPARATION FROM ITS SNUGLY FITTED NEIGHBOR EMBRYO. TO SEPARATE THESE TIGHTLY-FITTED EMBRYOS REQUIRES FIRM MANIPULATION. DURING GERMINATION THESE EMBRYOS, WHICH ARE ENCLOSED WITHIN A FRAGILE SEED COAT COMMON TO ALL, SEPARATE NATURALLY ONE FROM THE OTHER.

INTERNAL STRUCTURE OF MANGOSTEEN SEED IS SIMILAR TO THAT OF A TUBER.

THE OUTLINE OF THE FORM OF THE MANGOSTEEN SEED IS VARIABLE, BUT IN THE FORM MOST FREQUENTLY SEEN (FIG. 1) ONE END IS ROUNDED, WHILE THE OTHER IS SOMEWHAT

POINTED. A STUDY OF THE INTERNAL STRUCTURE OF A MATURE SEED SHOWED CLOSE SIMILARITY TO THE FORM OF A TUBER IN THAT THE VASCULAR SYSTEM WAS INTERSPERSED WITH COPIOUS STORAGE TISSUE. NO "EYES" WERE, HOWEVER, PRESENT OVER THE SURFACE AS IN THE CASE OF A TYPICAL TUBER. THIS OBSERVATION OF THE TUBER-LIKE STRUCTURE TOGETHER WITH THE FACT THAT MULTIPLE SHOOTS CAN ORIGINATE FROM A WHOLE MONOEMBRYONIC SEED LED TO THE STUDY OF THE BEHAVIOR OF FRACTIONS OF MANGOSTEEN SEEDS.

PIECES FROM SUBDIVIDED MANGOSTEEN SEED CAN EACH GERMINATE ROOTS AND SHOOTS.

SOME SEEDS WERE CUT INTO TWO PARTS; OTHERS WERE CUT INTO THREE PARTS, AS SHOWN IN FIGURE 1, II-IV. WITH SEEDS OF THE TYPICAL OUTLINE (FIG. 1, I), IT IS USUALLY POSSIBLE TO PREDICT THAT THE FIRST PRIMARY ROOT WILL ORIGINATE AT THE ROUNDED END (g) WHILE THE SHOOT WILL DEVELOP FROM THE POINTED END (A). SUCH SEEDS WERE SELECTED FOR THIS STUDY AND WERE CUT TRANSVERSELY. THESE SEED PIECES WERE PLANTED IN DEAD SPHAGNUM MOSS AND WERE GIVEN THE SAME TREATMENT AS THOSE SEEDS IN THE GENERAL PLANTING.

ROUNDED-END SECTION NORMALLY YIELDS ROOT.

SHOOTS DEVELOPED FROM THE ROUNDED-END SEED FRACTIONS THAT NORMALLY GIVE RISE ONLY TO THE FIRST PRIMARY ROOT AND WERE IN ALL WAYS APPARENTLY EQUAL TO A SHOOT FROM A WHOLE SEED (FIG. 1, IV). THE FIRST PRIMARY ROOT DEVELOPED AS USUAL. THE SHOOT ORIGINATED JUST OUTSIDE THE EDGE OF THE ACROPETAL CUT SURFACE (h); NO GROWTHS WERE OBSERVED TO RISE FROM THAT ACROPETAL CUT SURFACE. SEVERAL WART-LIKE PROTUBERANCES DEVELOPED JUST OUTSIDE THE PERIPHERY OF THE ACROPETAL CUT SURFACES (g). THESE APPEARED TO BE OTHER SHOOT PRIMORDIA.

SHOOT NORMALLY ARISES FROM POINTED END.

IN A WHOLE SEED THE POINTED END (FIG. 1, A) USUALLY GIVES RISE ONLY TO THE SHOOT. IN THIS PART OF A FRACTIONED SEED (FIG. 1, II) THE SHOOT DEVELOPED IN THE NORMAL MANNER, THE FIRST PRIMARY ROOT DEVELOPING FROM NEW TISSUES FORMED AFTER THE SEED PIECE WAS PLANTED. THIS ROOT ORIGINATED FROM THE PERIPHERY OF THE STELE-LIKE VASCULAR SYSTEM (FIG. 1, II, E), WITH THE STELE-LIKE BODY SOME DISTANCE INWARD FROM THE PERIPHERY OF THE SECTIONED SEED. A FIRST PRIMARY ROOT DEVELOPED FROM A SECTIONED SEED APPEARED NOT TO DIFFER IN ANY RESPECT FROM ONE FORMED FROM AN UNSECTIONED SEED.

MIDSECTIONS OF SEED PRODUCED ROOTS FROM BASIPETAL CUT SURFACES.

IN THE CASE OF THE TRISECTIONED SEED THE MID-PORTION WAS AT THE TIME OF SECTIONING NOT PROVIDED WITH EITHER SHOOT OR ROOT PRIMORDIA. ON SUCH SEED PORTIONS, SHOOT PRIMORDIA DEVELOPED JUST OUTSIDE THE PERIPHERY OF THE ACROPETAL CUT SURFACE JUST AS THEY DEVELOPED OUTSIDE THE ACROPETAL CUT SURFACE OF THE HALVED SEED (FIG. 1, III). MORE THAN ONE OF THESE PRIMORDIA WERE OBSERVED TO DEVELOP INTO SHOOTS SIMULTANEOUSLY (f). ROOT PRIMORDIA, ON THE OTHER HAND, DEVELOPED FROM THE BASIPETAL CUT SURFACE (d) ON THE PERIPHERY OF THE STELE-LIKE BODY (e) OF THE MID-PORTION OF TRISECTIONED SEEDS, JUST AS THEY DEVELOPED FROM THE BASIPETAL CUT SURFACE OF THE HALVED SEED (FIG. 1, II, d).

GERMINATION OF SUBDIVIDED MANGOSTEEN SEEDS HAS COMMERCIAL VALUE.

IT APPEARS THAT THE PLANTING OF SECTIONED MANGOSTEEN SEED CAN BE OF IMPORTANT PRACTICAL VALUE, SINCE THE SEED SUPPLY IS NOT AMPLE FOR THE PLANNED

EXTENSION OF PLANTINGS OF THIS VALUABLE NEW FRUIT CROP. FURTHER PLANTINGS OF SECTIONED MANGOSTEEN SEED IN THE GENERAL PLANTING PROGRAM ARE UNDER WAY.

PROPAGATING MATERIALS OF 37 SPECIES OF PLANTS WERE RECEIVED DURING THE MONTH.

THROUGH EXCHANGES, GIFTS, AND THE CONTINUED CLOSE COOPERATION OF THE DIVISION OF PLANT EXPLORATION AND INTRODUCTION OF THE BUREAU OF PLANT INDUSTRY, MANY NEW PLANTS OF POTENTIAL VALUE WERE RECEIVED DURING JUNE. TABLE I LISTS THESE SPECIES BY NAME AND SOURCE AND INDICATES THE PURPOSE FOR WHICH EACH WAS OBTAINED.

TABLE I. — PLANTS INTRODUCED DURING THE MONTH OF JUNE

INTRODUCTION	SOURCE	PURPOSE
ADONIDIA MERRILLII	DIVISION OF PLANT EXPLORATION AND INTRODUCTION, BUREAU OF PLANT INDUSTRY, WASHINGTON, D. C.	ORNAMENTAL
ALSTONIA SCHOLARIS	DO.	DRUG
ARDISIA HUMILIS	DO.	ORNAMENTAL
ARRABIDAEA PACHYCALYX	CANAL ZONE EXPERIMENT GARDENS, SUMMIT, C. Z.	DO.
ASTROCARYUM STANDLEYANUM	DO.	DO.
BERRIA AMMONILLA	DIVISION OF PLANT EXPLORATION AND INTRODUCTION, BUREAU OF PLANT INDUSTRY, WASHINGTON, D. C.	TIMBER
BERRIA QUINQUELOCULARIS	DO.	DO.
BIGNONIA TWEDIANA	E. M. VERGES, 2ND, BROOKLINE, MASS.	ORNAMENTAL
BUTIA CAPITATA ODORATA	DIVISION OF PLANT EXPLORATION AND INTRODUCTION, BUREAU OF PLANT INDUSTRY, WASHINGTON, D. C.	DO.
CASUARINA GLAUCA	DO.	DO.
CINCHONA SUCCIRUBRA	DIVISION OF PLANT EXPLORATION AND INTRO- DUCTION, BUREAU OF PLANT INDUSTRY, COCONUT GROVE, FLA.	DRUG
CIPADESSA BACCIFERA	DIVISION OF PLANT EXPLORATION AND INTRODUCTION, BUREAU OF PLANT INDUSTRY, WASHINGTON, D. C.	TIMBER
CONOCARPUS ERECTA	DO.	ORNAMENTAL
CRYPTOLEPIS ELEGANS	DO.	DO.
ENTADA SUDANICA	DO.	ECONOMIC
FLACOURTIA INDICA	DO.	FRUIT
GARCINIA SPICATA	DO.	DO.
GOUANIA LUPULOIDES	DO.	ORNAMENTAL
IPOMEA CAIRICA	DO.	DO.
IXORA CHINENSIS	DO.	DO.
MARKHAMIA HILDEBRANDTII	DO.	DO.
MIMUSOPS KAUKI	DO.	FRUIT
MIMUSOPS ROXBURGHKIANA	DO.	DO.
NEYRAUDIA MADAGASCARIENSIS	DO.	FIBER
NORONHIA EMARGINATA	DO.	ORNAMENTAL
OPSIANDRA MAYA	DO.	DO.

CONTINUED ON NEXT PAGE.

TABLE 1, CONTINUED. PLANTS INTRODUCED DURING THE MONTH OF JUNE

INTRODUCTION	SOURCE	PURPOSE
PELTOPHORUM AFRICANUM	DIVISION OF PLANT EXPLORATION AND INTRODUCTION, BUREAU OF PLANT INDUSTRY, WASHINGTON, D. C.	ORNAMENTAL
PITHECOLLOBIUM BREVIFOLIUM	DO.....	Do.
PITHECOLLOBIUM CONFINE ...	DO.....	Do.
PSYCHOTRIA BACTERIOPHYLLA ..	DO.....	Do.
SENECIO KERMESINUS	DO.....	Do.
STRYCHNOS SPINOSA	DO.....	DRUG
STYLOMA PACIFICA	DO.....	ORNAMENTAL
TETRASTIGMA BICOLOR	DO.....	Do.
TRIOPTERIS JAMAICENSIS ...	DO.....	Do.
VANGUERIA INFAUSTA	DO.....	FRUIT
ZIZYPHUS MAURITIANA	DO.....	Do.

MANY PLANTS WERE DISTRIBUTED FOR TESTING IN OTHER ENVIRONMENTS.

THE MAIN OBJECTIVE OF THE WORK OF INTRODUCING NEW PLANTS INTO PUERTO RICO IS, THROUGH TESTS OF THEIR ADAPTABILITY IN THE VARIOUS ENVIRONMENTS, TO GET THEM ESTABLISHED IN AS MANY PARTS OF THE ISLAND AS POSSIBLE. DURING THE MONTH 7,146 PLANTS WERE THUS PROPAGATED AND DISTRIBUTED FROM THE STATION. TABLE 2, PAGE 206, SHOWS THE QUANTITIES AND KINDS OF PLANTS DISTRIBUTED AS WELL AS THE GENERAL LOCALITIES WHERE THEY WERE PLANTED.

DRUG AND SPICE PLANTS

WILLIAM PENNOCK REPORTS:

6,000 SMALL PLANTS OF CINCHONA CALISAYA WERE GROWN FROM SEED.

SEEDS GATHERED FROM THE MARICAO PLANTING OF CINCHONA CALISAYA MENTIONED IN THE THIRD SUPPLEMENTAL REPORT FOR JUNE 1939, AS WELL AS ADDITIONAL SEEDS PRODUCED SUBSEQUENTLY IN THIS SAME PLANTING, WERE GERMINATED AND WHEN THE PLANTS GREW TO 3 TO 6 INCHES IN HEIGHT THEY WERE TRANSPLANTED TO NURSERY ROWS.

ALTHOUGH DETERMINATIONS OF THE QUININE CONTENT OF THE BARK OF ALL THE PARENT TREES HAVE NOT YET BEEN COMPLETED, THE DETERMINATIONS MADE TO DATE INDICATE THAT THERE IS CONSIDERABLE DIFFERENCE BETWEEN INDIVIDUAL TREES IN THIS RESPECT. THEREFORE, THE SEED, WHICH WAS GATHERED FROM A TOTAL OF 28 DIFFERENT PARENT TREES, WAS KEPT IN SEPARATE LOTS. SINCE THE VIABILITY OF CINCHONA SEED HAS BEEN OBSERVED TO VARY CONSIDERABLY, DATA WERE SECURED RELATIVE TO THE VIABILITY OF SEED OF DIFFERENT AGES AT THE TIME OF SOWING.

CINCHONA SEEDS BEING EXTREMELY SMALL, SEED COUNTS WERE NOT PRACTICAL. HENCE, THE SIMPLEST UNIT OF MEASURE FOR SUCH SEED WAS USED, NAMELY THE ORDINARY TEASPOON OF HOUSEHOLD USE. TABLE 1, PAGE 207, SHOWS THE NUMBER OF TEASPOONFULS IN EACH LOT OF SEED WHICH WAS HARVESTED FROM THE DIFFERENT PARENT TREES, THE AGE OF EACH LOT OF SEED AT PLANTING TIME, AND THE CORRESPONDING NUMBER OF SEEDS WHICH GERMINATED.

TABLE 1. - SEEDLINGS GERMINATING FROM SEED OF DIFFERENT AGES FROM SPECIFIED PARENT TREES OF *CINCHONA CALISAYA* AT MARICAO, P.R.

AGE OF SEED AT PLANT- ING /1	TEASPOONFULS OF SEED PLANTED FROM PARENT TREE No. -																											TOTAL SEED PLANTED	SEEDLINGS GERMINATED PER TEA- SPOONFUL			
	11	15	17	18	19	20	24	32	38	47	49	51	54	55	60	62	63	64	67	69	70	73	75	76	106	107	108	111	TEASPOON- FULS	NUMBER		
	DAYS																															
40	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5	1	-	-	1.55	131.6	
49	-	1	-	-	-	-	0.5	-	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2	-	9.50	273.3	
104	-	-	1	-	0.05	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.05	3.4	
136	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-	3.00	50.0	
139	-	-	-	-	-	-	-	-	-	1.0	-	-	-	-	0.5	-	1.0	-	1	-	-	-	1	-	2.0	0.5	-	-	-	-	7.00	238.6
152	-	-	-	-	-	-	-	-	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.5	-	-	-	1.50	300.0	
153	-	-	-	-	-	-	-	-	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.50	400.0	
155	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.50	40.0	
157	-	-	-	-	-	-	-	-	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	280.0	
165	-	-	-	-	-	-	-	-	.5	.5	-	-	-	-	-	-	-	-	1	-	-	-	-	2	1.0	-	-	1	-	6.00	238.3	
169	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	2.00	71.0	
172	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	25.0	
186	-	-	-	-	-	-	-	-	-	.5	-	-	-	-	1.0	-	2.0	2	-	-	-	-	-	-	-	-	-	-	-	7.50	220.7	
187	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	52.0	
189	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-	-	-	5.00	37.8	
195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.00	.2	
211	-	-	-	-	-	-	-	-	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	2.0	-	-	-	6.00	9.0	
225	-	-	-	-	-	-	-	-	-	-	1.0	1	-	-	-	-	-	1	-	-	-	-	-	-	2.0	1.0	-	-	-	8.00	18.8	
248	-	-	-	-	-	-	-	-	-	1.0	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	6.00	5.3	
267	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.00	.0	
270	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	-	-	-	6.50	6.0	
287	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.0	-	-	-	-	4.00	1.3	
302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.50	4.0	
308	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	23.50	.7	
TOTAL	0.05	1	1	1	.05	3	.5	23.5	2	6.0	2.0	2	1	1	2.0	.5	7.5	11	1	1	8	1	8	21.5	5.5	.5	6	2	119.60	-		
SEED- LINGS GERMI- NATED, NUMBER	0	500	10	2	0	5	47	17	280	1,254	343	360	30	6	520	2	95	1,339	4	1	300	25	1,122	554	411	69	759	1,325	-	78.4		

/1 TIME BETWEEN HARVESTING AND PLANTING.

AS CAN BE SEEN IN TABLE 1, AN AVERAGE OF 78.4 SMALL PLANTS PER TEASPOONFUL OF SEED WAS SHOWN IN THE GERMINATION COUNTS, OR A TOTAL OF 9,380 SEEDLINGS FROM THE WHOLE LOT. OF THESE IT IS CALCULATED THAT SLIGHTLY MORE THAN 60 PERCENT, OR ROUGHLY A TOTAL OF 6,000, GREW TO SUFFICIENT SIZE FOR TRANSPLANTING TO NURSERY ROWS. THE 40 PERCENT LOSS WAS OCCASIONED EITHER BY DAMPING-OFF, WHICH OCCURRED IN PART OF ONE OF THE SEED-BEDS, OR BY INJURY CAUSED BY SOME OF THE COPPER SOLUTIONS WHICH WERE APPLIED IN AN EFFORT TO CONTROL THIS DISEASE.

CINCHONA SEED LOST VIABILITY QUICKLY.

AS MAY BE SEEN FROM TABLE 1, THERE WAS A RAPID FALLING OFF IN VIABILITY WITH INCREASING AGE OF SEED, AND BECAUSE OF THE RELATIVELY LARGE AMOUNTS OF SEED EMPLOYED, THE GENERAL TREND OF THE DATA MAY BE ACCEPTED AS VALID. IN GENERAL, SEED OLDER THAN 186 DAYS, OR APPROXIMATELY 6 MONTHS AT THE TIME OF PLANTING, GERMINATED POORLY. HENCE THE DESIRABILITY OF SOWING CINCHONA SEED AS QUICKLY AS POSSIBLE AFTER HARVEST IS INDICATED.

CINCHONA SEED GERMINATED SLOWLY.

THE SPEED WITH WHICH CINCHONA SEED GERMINATES AND THE PERIOD OVER WHICH GERMINATION EXTENDS ARE IMPORTANT FACTORS IN DETERMINING THE PROPER MANAGEMENT OF SHADE. A TEST WAS, THEREFORE, CONDUCTED TO INDICATE HOW FAST CINCHONA SEED MIGHT BE EXPECTED TO GERMINATE UNDER LOCAL CONDITIONS. FOUR LOTS OF ABOUT 1 LEVEL TEASPOONFUL OF FRESH SEED EACH, HARVESTED 49 DAYS PREVIOUSLY, WERE PLANTED IN SEPARATE PLATS 15 INCHES SQUARE. IN TABLE 2 ARE SUMMARIZED THE CUMULATIVE COUNTS OF GERMINATED SEED MADE AT VARIOUS INTERVALS FROM 21 TO 103 DAYS AFTER PLANTING.

TABLE 2. - CUMULATIVE COUNTS OF GERMINATION OF FOUR LOTS OF SEED OF CINCHONA CALISAYA 49 DAYS OLD AT TIME OF PLANTING

LOT No.	SEEDS GERMINATED IN -				
	21 DAYS	30 DAYS	56 DAYS	63 DAYS	103 DAYS ^{/1}
	<u>NUMBER</u>	<u>NUMBER</u>	<u>NUMBER</u>	<u>NUMBER</u>	<u>NUMBER</u>
1	8	70	200	230	268
2	35	180	440	450	500
3	200	440	750	766	775
4	85	265	510	525	600
TOTAL	328	955	1,900	1,971	2,143
PERCENT	15.30	44.56	88.66	91.97	100.00

^{/1} FURTHER GERMINATION WAS NOT OBSERVED TO OCCUR BEYOND THIS PERIOD.

IT WILL BE NOTICED IN TABLE 2 THAT IN THE WHOLE TEST ABOUT 15 PERCENT OF THE SEED THAT GERMINATED DID SO IN 21 DAYS OR 3 WEEKS FOLLOWING PLANTING; NO GERMINATION HAD BEEN OBSERVED DURING THE WEEK PRIOR TO THIS INSPECTION. IT WILL ALSO BE NOTICED THAT ABOUT 91 PERCENT OF THE SEED GERMINATED 63 DAYS AFTER PLANTING, OR 6 WEEKS AFTER GERMINATION WAS FIRST OBSERVED, AND THAT ONLY 8 PERCENT ADDITIONAL GERMINATED THEREAFTER. NO FURTHER GERMINATION WAS OBSERVED AFTER 103 DAYS. THE GERMINATION OF THESE SEEDS MAY THEREFORE BE SAID TO HAVE BEGUN ABOUT 3 WEEKS FROM PLANTING AND TO HAVE CONTINUED FOR A PERIOD OF 10 TO 12 WEEKS THEREAFTER.

SINCE APPROXIMATELY EQUAL AMOUNTS OF SEED WERE SOWN IN EACH PLAT, THE TOTAL NUMBER THAT GERMINATED MAY BE TAKEN AS AN INDEX OF VIABILITY. IT IS OF INTEREST TO NOTE THAT LOT 1 SHOWED THE LEAST PERCENTAGE OF GERMINATION IN THE 21-DAY PERIOD, ONLY 8 OF 268 VIABLE SEEDS, OR ABOUT 3 PERCENT, HAVING GERMINATED IN THAT TIME. IN LOTS 2, 4, AND 3, WITH TOTAL GERMINATIONS OF 500, 600, AND 775, RESPECTIVELY, THE INITIAL PERCENTAGE GERMINATION IN 21 DAYS WAS APPROXIMATELY 7, 14, AND 26, RESPECTIVELY.

GLASS-COVERED FRAMES WERE SATISFACTORY FOR GROWING CINCHONA FROM SEED.

GLASS-COVERED SEEDBEDS, WHICH WERE CONSTRUCTED FOR USE IN MARICAO IN JUNE AND JULY 1939 PROVED HIGHLY SATISFACTORY FOR GROWING CINCHONA FROM SEED. THE FRAMES WERE CONSTRUCTED PRINCIPALLY TO PROVIDE SHELTER FROM BEATING RAINS, BUT AT THE SAME TIME IT WAS POSSIBLE TO CONTROL SUCH FACTORS AS VENTILATION, HUMIDITY, DRAINAGE, AND TEMPERATURE MORE READILY THAN UNDER FIELD CONDITIONS. THE TWO SEEDBEDS CONSTRUCTED PROVIDED A TOTAL AREA OF 282 SQUARE FEET FOR SEED GERMINATION AND FOR TRANSPLANTING SEEDLINGS.

CINCHONA SEEDLINGS WERE SENSITIVE TO SLIGHT MODIFICATIONS OF LIGHT INTENSITY.

CINCHONA SEEDLINGS WERE FOUND TO BE SENSITIVE TO SLIGHT MODIFICATIONS IN LIGHT INTENSITY. GOOD RESULTS WERE OBTAINED WHEN THE SEEDS WERE GERMINATED UNDER HEAVY SHADE THAT EXCLUDED ALMOST ALL LIGHT AND WHERE, FOLLOWING GERMINATION, THE SHADE WAS THINNED OUT PROGRESSIVELY AS THE SEEDLINGS INCREASED IN SIZE. WHEN THE SEEDLINGS ATTAINED A HEIGHT OF 4 TO 6 INCHES, THE SHADE WAS REDUCED SO THAT THE LIGHT ENTERING REGISTERED ABOUT 35 FOOTCANDLES ON A WESTON PHOTOMETER WHEN FULL SUN-LIGHT REGISTERED 12,000 FOOTCANDLES.

IT WAS OBSERVED THAT CINCHONA SEEDLINGS EXPOSED TO A SLIGHT EXCESS OF LIGHT BECAME WEAK AND DEVELOPED A REDDISH COLOR, WHILE WITH MORE SEVERE OVEREXPOSURE LEAF BURNING OCCURRED. IN SLIGHTLY EXCESSIVE SHADE, GROWTH OF THE CINCHONA SEEDLINGS WAS DELAYED; IN GREATER EXCESS OF SHADE UNDESIRABLE ETIOLATION OCCURRED. SEED GERMINATED BEST IN THE DARK, AND SMALL YOUNG SEEDLINGS WERE MORE SENSITIVE TO INJURY FROM EXCESS LIGHT THAN THE LARGER AND OLDER SEEDLINGS.

APPRECIATION IS EXPRESSED TO HAROLD K. PLANK FOR HIS ASSISTANCE IN EDITING THIS REPORT.

RESPECTFULLY SUBMITTED,

Atherton Lee
ATHERTON LEE
DIRECTOR

MEMO

To Mr. Lukens
From B. A. Krukoff

Date 7/11/40

Answering {
Your Memo }

Subject

I am sending you the following extracts dealing with Cinchona:

Cinchona in Nigeria (Africa)
Cinchona in Tanganyika (Africa)
Cinchona in Java,

also an extract of Dr. Zimmermann's paper on germination of Cinchona seeds based on his work on German plantation in Cameroons, and extracts of various data on Cinchona.

It appears, by now, that English, German, French, American, and Italian literature on Cinchona is well covered by us.

For various reasons, I have made no attempt to examine the Dutch literature on the subject.

B. A. K.

BAK/JD

Enc.

cc - Dr. Popenoe
Mr. Rosengarten Jr.
Mr. Pettersen
Mr. Owen Smith
Mr. John Smith

EXTRACTS OF DATA ON CINCHONA IN NIGERIA (AFRICA).

- - - -

Kew Bulletin, Add. Series No. 9, 349 - 352, 1915.

Extensive taxonomical references are given concerning Cinchona Calisaya, C. Calisaya var. Lodgeriana, and C. succirubra.

Inasmuch as the paper deals with the useful plants of Nigeria, Africa -- an opinion is expressed concerning the possibilities of growing Cinchona upthere:

"As Nigeria opens up, it is not unlikely that some suitable localities will be found for the cultivation of Cinchona especially in the mountainous area from the Bauchi highlands eastwards to the Cameroon Boundary. C. succirubra and C. Calisaya are cultivated with success in the Island of St. Thomé, at an altitude of about 3,500 ft.; this is the nearest approach to the region indicated on the mainland where the altitude reaches 3,000 ft. and upwards, and the prime factor of deep rich soil being available there seems to be no reason why Cinchona should not be given a trial."

Krukoff's note: Bauchi is approximately at 10° 20' N.

Anonymous. The World's Cinchona Bark Industry.

(Bull. Imper. Inst., 37 (1): 18-31. 1940 also 37 (2): 183-196. 1940).

- - - - -

Dutch East India at present furnish 9/10 of the world production of bark. The production of bark in India is not sufficient for its own needs. The plantations in the province of Bengale (India) in 1936-1937 occupied 1,100 hectares, and in the province of Madras (India) 795 hectares. The Bengale plantations produced 726 tons of bark (29 tons of quinine sulphate), whereas the Madras plantations produced 155 tons of bark (8.5 tons of quinine sulphate).

In Tanganyika and in Camerouns large areas are found favorable for the culture of Cinchona, and experiments are being conducted with the propagation material obtained from Java (C. Ledgeriana and C. succirubra); experiments are being made also in Kenya, Uganda, Nyassaland, and in the Northern Rhodesia. Ceylon exported in 1938 77 tons of bark of Cinchona succirubra. Experiments are being made in Malaya, on the Island of Saint Helena, and in New Guinea.

Outside of the British Empire cultural experiments are being made in Belgian Congo. French-Indochina in 1938 produced 21 tons of bark (1.8 tons of quinine sulphate ore 8.5% in average). Cultural experiments are also being made in the French Camerouns, Madagascar, and on the Island of Reunion.

Experiments are being also conducted in Erythrea, Spain, Portuguese Colonies, U.S.S.R., Philippine Islands, Formosa, in South America, and in Guatemala.

Zimmermann, A. - Die anzucht der Chininbaume, Tropenpflanzer,
33: 373-377. 1930.

Seeds of various spp. of Cinchona are very small and delicate, and they have to be protected during the germination against the excessive humidity and the direct insolation.

The germination is effected in seedboxes filled with slightly moistened good earth which is obtained from the forest; 2 grams of seeds are sown per square meter. The frames for seedboxes are of two kinds, the first - of simple mats of cocconut fiber, the second - of metallic unfolding cylinders.

The watering of seedbeds is carried on very carefully and preferably with a pulverizer.

After the germination has taken place metallic sheets are replaced in the morning and in the evening by mats of fiber to permit young plants to have some diffused light.

In the daytime, and during rainy weather, metallic sheets are used as covers. As soon as the plants become stronger, seedbeds are left completely open during mornings and evenings.

The transplanting from the seedboxes to the nursery beds takes place when the plants attain the height of approximately 5 cm.

Plants are set in rows 10 cm. apart, and these are later weeded. (B.A. Krukoff's note: the author indicates that of the original number of transplanted plants only 1/2 of the plants are left in the nursery).

After 15 months or so after the germination, when the plants are approximately 1 meter high, they are transplanted to their permanent location.

The percentage of germination of fresh seeds is approximately 99%. If seeds are stored in glass containers they retain their germination power well. After 5 months of storage the percentage of germination is still about 95%; after 7 months -- approximately 82%; and after 14 months -- approximately 56%.

B. A. Krukoff's note: the percentages likely refer to the carefully selected fertile seeds. I have seen references in Dutch literature stating that seeds are examined one by one by Javanese girls on a glass plate, the seeds being handled by feathers. The photo of this operation was published a few months ago in one of the American Journals (Life ?), and this is in Mr. Lukens' files. If I recall correctly, the seeds are judged by the appearance, the size, and the color of the embryo.

EXTRACTS OF VARIOUS DATA ON CINCHONA.

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Weddell, H.A. - Histoire Naturelle des Quinquinas, pp. 1-109, 1849.
Paris.

An old classical taxonomic revision of the genus Cinchona, obviously of no interest in connection with our present problems in Guatemala.

Kew Bulletin No. 3, 115-117, 1931.

A record of the work of Kew Gardens in connection with the introduction of Cinchona plants to cultivation in various British Colonies (British India, Ceylon, St. Helena, Tanganyika, the Cameroons, Jamaica, Trinidad, and Dominica).

Valkenberg, S. van - Java. Geogr. Review. Oct. 1925.

The Quinine plantations, covering 16,150 hectares and producing 8,800 tons of quinine, are situated in the State of Preanger to the north of Bandung - (approx. 6° 45' S).

Chininum. Scriptioes collectae. Amsterdam, 1924.

Java plantations are furnishing approximately 90% of the total Quinine production. The production during last four years was as follows:

1921	-	513608	kilos of quinine (in bark)
1922	-	534545	" " " " "
1923	-	534624	" " " " "
1924	-	621800	" " " " "

Agriculture in Ceylon in 1921. Ceylon Dept. Agric. Rept. Director for 1921.

Among the products listed are 49,055 kil. of Quinine.

EXTRACTS OF DATA ON CINCHONA' DISEASES, AND ENEMIES,
AND ON PARASITES ON ENEMIES OF CINCHONA.

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Stevenson, John, A. - Foreign Plant Diseases, a manual of economic plant diseases which are new to, or not widely distributed, in the United States. Washington 1926.

The useful plants, such as Carica, Cinchona (!), etc. are listed in this book in alphabetical order, and for each plant a list of diseases that are known to effect them is given.

Menzel, R. - Parasites on enemies of Tea and Quinine Trees, De Thee, VI, #4, pp. 115-122, Buitenzorg, Dec. 1925.

Among the parasites on enemies of Quinine trees, is cited Anastatus sp., doubtless an indigenous one, which parasites approximately 80% of eggs of Attacus atlas L., appearing in Java and Sumatra.

Another parasite on eggs, Neotelonomus (Telenomus) abnormis Crawf., attacks also Euproctis flexuosa Sn.

Compsilura concinnata Mg. and Tricholyga sorbillans Wied. are parasitic on larvae of Metanastria hyrtaca Gr.

Kalshoven (L.C.E.) - Notes on damages caused by certain insects to Quinine tree in Java, Meded. Instit. Plantenziekten, #65, 1925. (27 pages).

Among the insects that attack Quinine-tree is mentioned Alcidodes cinchonae, (Published as now in Treubia, vol. 3, fasc. 3-4, 1923) which is indigenous to Java and Sumatra, of which the host is unknown (probably some native Rubiaceous tree), and which usually attacks Cinchona if it is planted near the virgin forest.

Keswala, K.F. - Seedling blight of Cinchona Ledgeriana caused by Phytophthora palmivora Butl. in the Dayeeling District. Indian Jour. Agr. Sc. 485-495. 1935.

In certain regions of India seedlings of Cinchona are sometimes affected by a cryptogamic disease which at first manifests

itself by the withering of catyledons and first leaves. The infection proceeds rapidly in the stem and infects bark and conductive tissues and then plants die.

The cause appears to be a form of Phytophthora palmivora Butl. Inoculations of P. parasitica, P. colocasiae, P. meadii, and of P. palmivora were made. It has been found that it is P. palmivora that is a cause of the disease. It also attacks Castor Oil plants and palms.

Blucher, von G.L.A. - Diseases and enemies of Cinchona in Dutch East Indies, Tropenpfl. 51: 231-245. 1938.

In seedbeds, seedlings pass a critical period during the rainy season, especially if they are fertilized with a poorly decomposed manure. A cryptogamic disease attributed to Moniliopsis Aderholdii may destroy the majority of young seedlings in course of their germination. A sort of cancer~~x~~ has also been observed which causes a high mortality.

On plantations the decay of roots, produced by Ganoderma pseudoferrum, Armillaria mellea, Rosellinia arcuata, has been observed frequently.

A mould (?), probably of Chytridiaceae, may develop on bark of branches and make it unsuitable for quinine extraction.

Corticium salmonicolor, provided it is well spread on the plantation, sometimes will damage seriously branches of Cinchonas.

Among the harmful insects the most dangerous is Helopeltis Antonii (Hemiptera) which is especially common on plantations located on the lower elevations.

Tetranychus sp. is commonly found on seedlings. His punctures cause the fall of leaves of seedlings.

Larvae of various Lepidoptera (Euproctus flexuosa, Attacus atlas, etc.) devour leaves of Cinchona and occasionally leaves trees completely leafless.

A borer, Phassus damer Mr., which attacks tea as well as Cinchona, makes deep galleries in branches.

Ants occasionally invade seedbeds. They may be controlled by traps, but it is preferable to prevent their entrance to seedbeds by placing on the borders of seedbeds "rolls" dipped in petroleum or in juice of Albizia.

Grasshoppers often devour young seedlings just after their germination.

AN ACCOUNT OF THE TRIP MADE TO THE ZONE OF
BARILLAS, FEBRUARY 1 to 14, 1941, IN ORDER
TO ESTABLISH A CINCHONA EXPERIMENT AT THE
HACIENDA "SANTA MARGARITA 'MAXBAL'".

February 16, 1941.



Confidential.

Guatemala City.
February 19, 1941.

Mr. R.P. Lukens,
Merck & Co., Inc.,
Rahway, New Jersey.

Dear Mr. Lukens:

The following information is not found in the Account
of the trip to the zone of Barillas:

- (1) The German Concern mentioned on Page 2 is Nottebohm.
- (2) I have reason to believe that Gantenbein Sr. would
be willing to sell Maxbal (15 caballerias) for \$ 1,500.

Very truly yours,
F. Rosengarten Jr.
F. Rosengarten Jr.

c.c. Dr. Popenoe.
F. Rosengarten Sr.

ROUTE OF TRIP TO ZONE OF BARILLAS.

SCALE
10 KMS.

FEBRUARY 1941

— = by horse

MÉXICO



-.TRIP TO ZONE OF BARILLAS.-

February 1 - 14, 1941.

FEBRUARY 1. Enrique Hoehn and I left Finca "El Naranjo", Chicacao, at 9 A.M., arriving in Huehuetenango in the late afternoon (a distance of 112.5 miles). We took with us 950 Krukoff seedlings and 50 African Ledger seedlings; in all, the plants occupied six separate boxes. 200 of the plants were packed in "pilon", i.e. with earth and moss; the remaining 800, including the African Ledgers were packed in "raíces", that is with only moss and no earth surrounding their roots. In addition we had one bottle containing approximately 75 grams of seed of KRUKOFF CALISAYA; another bottle containing approximately 75 grams of seed collected from ORIGINAL LEDGERS located at Finca Helvetia.

Our purpose was to transport the plants as quickly as possible to the finca SANTA MARGARITA MAXBAL, in the zone of Barillas, and transplant them there in the virgin forest in order to find out just how suitable this zone might be for possible future Cinchona Cultivation. At the same time, the plan was to sow the above-mentioned seed at Maxbal and observe the results of this phase of the plant's development.

The plants were to be subjected to a most arduous journey. Shortly after leaving Naranjo, upon arriving in San Antonio Suchitopéquez we had a flat tire in the broiling sun, and for several minutes the plants had to endure intense heat. The same night it was extremely cold in Huehuetenango.

Fortunately, Enrique Hoehn had a contact in the zone of Barillas in Cristian Gantenbein Jr. who had worked for him previously in the finca "Castaños", and who at this time is running the hacienda SANTA MARGARITA MAXBAL for his father, Cristian Gantenbein Sr.

The latter is a struggling labor agent in Santa Eulalia, and was quite willing to have the Cinchona experiment made on his property. He is a Swiss of about 60 who has spent over 40 years in the "Tierra Fria" of Guatemala. At one time he was quite wealthy but his ten children squandered their father's money to such an extent that Gantenbein Sr. now is almost penniless. He is, however, an upright, stolid sort of a man. He can still ride a mule all day long without feeling it. On the side, in Huehuetenango, he has an unsuccessful ice factory, and also unsuccessfully manufactures soft drinks on a small scale.

We met Gantenbein Sr. during the evening, and preparations were made for an early start on the following day.

We spent a most comfortable night in the Hotel Galvez which we felt was probably the last for some time to come. We were correct in this assumption.

FEBRUARY 2. At 7.45 A.M. we left Huehuetenango in a camioneta to negotiate the 44 Kilometers of road that is open to automobiles up to Chemal. Arriving at Chemal (altitude 10,600 ft.) at 9, we transferred as soon as possible to beasts of burden. Hoehn had a small broken-down horse, and I a smaller sorry-looking mule.

Gantenbein Sr. also had a horse, but the other member of the party had no animal and was therefore obliged to set out on foot. This latter individual, a certain don Jorge, had been sent along at the last minute by a certain well-known German-controlled company in Guatemala under the pretense of inspecting Gantenbein's books in San-

ta Eulalia; actually he had been sent as a spy, in order to discover what we were up to in the zone of Barillas.

The three of us left Chemal at 9.45 and arrived in San Juan Ixcay (altitude 7,500 ft.) at 1.30 in time for a bite to eat. The unfortunate don Jorge, however, found the going on foot a bit difficult in the Cuchu Matanes and did not arrive at San Juan Ixcay until late that night, weary and undoubtedly somewhat discouraged with his mission.

The descent from Chemal is quite steep; one passes through a series of pine forests before descending upon the valley of San Juan Ixcay where wheat, corn and pastures are to be found. The pueblo here is 100% Indian; several years ago there was a general uprising of the Indians, and the ladinos of the pueblo were massacred en masse.

Leaving San Juan Ixcay at 2.30 we passed through Soloma at about 4.30. Soloma has the distinction of being the only pueblo in the district which has a radio that works. We pushed on to Santa Eulalia, arriving in the dark at 7 P.M. At this point, Gantenbein Sr. gave us a shock when he informed us that we had no mozos for the following day. It would be necessary to speak to the Intendente and see if he could not arrange a "mandamiento", i.e. an order by which a group of mozos are obliged to perform a certain task by the Intendente, who sends along a police officer to see to it that there are no slip-ups. Otherwise we were informed that we were simply out of luck, as it was near fiesta time and it was very doubtful as to whether we could get labor voluntarily to carry our plants to Maxbal.

After a long harangue, it was arranged that 10 mozos would be obtained for the 4th. of February at 4 A.M., to carry our plants and equipment to Maxbal, work with us during four days there, and then return.

FEBRUARY 3. We were forced to spend the day at Santa Eulalia, a sad, chilly town (altitude 8,600 ft.).

The mozos carrying plants, who had left Chemal the day before at the same time we did, arrived 14 hours late, which caused us quite some worry. We were particularly anxious to keep the "African Ledgers" in good condition, for a comparison of their growth with the growth of their brethren at El Naranjo would be most significant as to the future of Barillas as a Cinchona zone.

We slept in Gantenbein's house, which formerly had been the mansion of Santa Eulalia, but which now is a shabby wreck. Our diet was naturally composed of beans, tortillas and coffee, with an occasional egg or piece of pig thrown in.

The "costumbres" in this region are very powerful. For example, in the main building of the town along with the Intendencia and Secretaria there is a room which bears the label "Jolom Canop". "Jolom Canop" is an idol of wood, but so revered by the Indians that only certain picked religious authorities or "rezadores" can enter the room bearing its name. When the Jefe Político paid a visit to Santa Eulalia last year, it was only by the most special permission that he could enter here. The Intendente, who has lived for a year and a half next to the room, has never been able to enter it.

Another strong "costumbre", of course, was to be on hand for fiestas. The fiesta of Santa Eulalia was to commence on February 9th., and consequently the mozos were not at all anxious to take on any other activity near fiesta time, as we were to find out.

FEBRUARY 4. The Intendente had promised to call the mozos together at 4 A.M., but at 9 the group was finally assembled. As we were in a strange territory, we could only be patient and not too vehement in our manner of hurrying them up lest the whole affair go

sour and we be left with nobody to carry plants.

Hoehn, who had felt ill the night before, probably from the miserable fare, was somewhat better.

In addition to the mozos and their policeman, there was a stable boy who was supposed to act as our guide. The plan was that everybody should meet at Cananá that night.

At 2 o'clock Hoehn and I arrived at San Mateo Ixtatán, after having passed through a magnificent primeval forest. The altitude here is 8,700 ft. By this time, the rest of the party was out of sight, and so, after devouring a couple of quick eggs, we managed to pick up the services of a ladino guide named don Mateo and moved on toward Cananá. Our mozos and the stable boy-guide were constantly taking short-cuts, but at this point they took an extra big short-cut and for three days and two nights we didn't see most of the plants, any of our food or my blankets.

During the afternoon we traveled through an area characterized by pines, nothing but pines. At 5.45 we arrived at the finca Cananá (estimated altitude 9,000 ft.). This property belongs to Benjamin Lopez, of San Mateo. The climate is cold and damp. At the time, we thought the area might be suitable for Cinchona, if it were not too high. At Cananá the forest growth becomes more diversified.

Fortunately the people here were very obliging to us. As shepherds, they live apart from the outside world and welcome whatever change in monotony a stranger may bring. One family of Indians, and one family of ladinos comprise the population. Luckily our new guide don Mateo was fluent in the Chuj tongue, (which is the Indian dialect in the zone of Barillas) and due to his bargaining ability, we bought two chickens from the Indians at 12 cents apiece; these we consumed with relish after they had been broiled on the rancho hearth.

At about 8 P.M. four of our mozos arrived; three with plants, and one with Hoehn's blankets. From the ladino shepherd I borrowed Mr. Benjamin Lopez's blankets which indeed were sorely needed as the temperature was close to freezing and the harsh wind whistled unchecked through the rancho boards.

FEBRUARY 5. At 7.30 A.M. we set off for Maxbal. Don Mateo had warned us that the trail was bad, and it was. We descended in the rain through a mixture of mud (at times 2 feet deep), huge roots and sharp rocks to Xoxlac (estimated altitude 3,500 ft.). Although rocky, there are portions of this region which might be suitable for Cinchona, especially the upper portion near Cananá.

In Xoxlac we had lunch for 2 cents each with a native family, and then started the ascent to Maxbal. Our animals by this time were in a state of collapse, and so we had to push them on in front of us as we trudged upwards through the mud and rain surrounded on all sides by virgin forest. We finally arrived at Maxbal (altitude 4,800 ft.) at 4.30 P.M. in a damp mist which reminds one of the climate at Cobán in the Alta Verapaz.

We were greeted at this point by Cristian Gantenbein Jr. He is a thin young fellow of 22 who lives in a dilapidated rancho filled with chickens, dogs, an adopted Indian boy and his mistress-cook. Despite the fact that his life is a hard one, and that visitors seldom come to his damp domain, he is most cheerful. Hoehn has confidence in him as a gardener, moreover, and there is no doubt about Gantenbein's willingness to work.

Refreshed by coffee, we set out to choose sites for the field-planting and nursery and seed-bed area.

SANTA MARGARITA MAXBAL is a property of some 15 caballerías of which twelve are virgin land. The soil is much more clayey than the

Naranjo soil, and in some places even gives the appearance of being muddy. The climate is definitely wet. It rains throughout the entire year, even in the supposedly dry months of March and April. Invariably a sort of dew forms during the night, so that the ground is always damp in the early morning.

Gantenbein makes a scanty living out of chickens, coffee, corn and cattle. Everything seems to grow quickly, however in Maxbal. For instance, the Chalom trees at three years of age are as large as this same type of tree on the coast (Naranjo, Castaños etc.) is at six years of age.

The rancho in which Gantenbein lives is located on a small rise in the middle of a rolling valley in which graze sheep, goats and cattle. The valley is flanked on all sides by virgin forest and is cut by several streams.

One does not have to walk far in Maxbal to encounter virgin land. Accordingly, after observing the most promising areas in the neighborhood of Gantenbein's rancho (for the sake of care and attention to the plantings which is difficult to bring about when the plantings are far away) we chose a site on a virgin slope about 10 minutes walk from the dwelling. This spot appealed to us also in that it received the benefit of the morning sun, and was rich in humus. The top soil here was between medium and strongly acid (pH 5.7-6.1 to pH 5.0-5.6). At 18 inches below the surface the soil was strongly acid (pH 5.0-5.6).

We chose for our seed-bed and nursery site a level area next to a stream, and about five minutes walk from the rancho.

At 7 P.M. the four mozos arrived who had managed to reach Cananá the night before.

After a light meal, we turned in as did the dogs, chickens, etc. The nights at Maxbal are considerably colder than those at Naranjo.

FEBRUARY 6. It was a great relief finally to arrive at Maxbal, and get started with our task. But the fact that 6 of our mozos (including the one who was carrying the "African Ledgers") had not yet arrived kept us from enjoying a peaceful state of mind all day long.

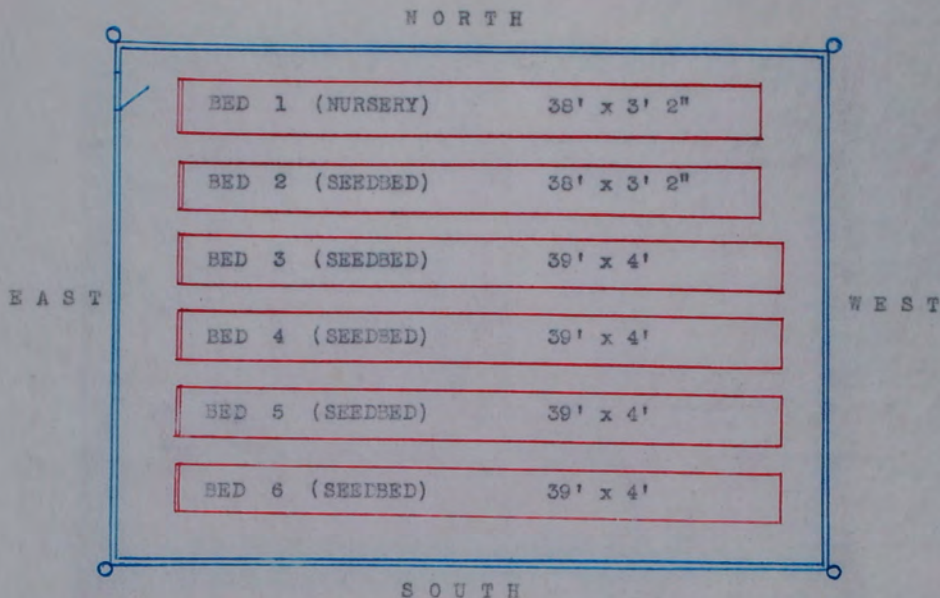
With what labor we could muster we started cleaning the 4 cuerdas (roughly one half acre) which we had decided to open up for the field planting. We also staked out the nursery and seed-bed area.

During the evening, some 26 hours after us, the rest of the mozos arrived, bearing plants, food, blankets etc., and complaining that they had lost themselves in the woods.

Immediately we unpacked the plants and placed them on the ground to recover in a sort of protected corral which we had constructed in the virgin forest for this purpose. It was dark, thus necessitating the use of a flashlight during the operation. This light attracted a lion to a spot about 30 meters distant. Fortunately he seemed bored with the proceedings and sauntered away. A familiar sound during day and night at Maxbal, which also stimulates the interest, is the melancholy shriek of a type of forest monkey known as the "Sarabate".

FEBRUARY 7. We had 16 mozos (some of them recruited from a neighbor) and made satisfactory progress knocking down the virgin forest and preparing the nursery and seed-bed area. From observing the development of the latter work, in particular, I could not help feeling that the construction of seed-beds in the future might effectively be accomplished at El Naranjo much more economically than it has been in the past. Of course, one has the advantage at Maxbal of having unlimited materials for seed-bed construction such as ferns, lumber, fiber etc. less than five minutes away.

The seed-bed and nursery area was set up as shown in the next page:



The ground in this area is not quite level, but we had to work so fast and had so few laborers that it seemed hopeless to try to fill in and level it off completely. Instead, we endeavored to make the roof of each bed as level as possible, running from east to west, in an effort to minimize the danger that might come with heavy rains. The high side of the roof of each bed, facing north, was roughly 6 ft.; the lower or southern side was approximately 4 ft. 6 inches.

It was necessary to construct a fence as hurriedly as possible to surround the above area in order to protect it from the cattle, forest animals etc.

The work accomplished in the Seed-bed and Nursery Area might be broken up as follows:

- (1) Choosing of a flat area near a stream.
- (2) Turning over of soil in this area.
- (3) Staking out proposed beds.
- (4) Building up sides of beds with logs to hold virgin soil.
- (5) Virgin soil is collected, carried to the area, sieved, and placed in the beds.

- (6) Construction of supports (for the most part made of wild "aguacate") to hold roof of palm leaves (for the most part "bosh" and "hoja de palma").
- (7) Roof is formed by the tying together of bunches of palm leaves to the supports with strips of fiber (for the most part "bejuco").
- (8) Construction of corral to protect beds.

The top soil in each bed was leveled off with a machete to present a relatively smooth upper surface before transplanting of seedlings or sowing of seeds took place. In the case of the seedbeds, a small amount of sifted river sand was mixed with the top soil.

At this point we presented to Gantenbein Jr. the following proposition, which he readily accepted. It should be fair from both sides. He will receive from Experimental Plantations Inc. \$ 10.- a month until such a time as we deem the experiment to be a success or a failure. If the experiment is a definite success, Gantenbein may well get a lucky break. If the experiment fails, of course his salary will stop. Gantenbein seems most enthusiastic about the whole thing. In this god-forsaken region it seems to me that we were most fortunate (thanks to Hoehn) to find as capable a fellow as young Gantenbein to help us with the experiment.

FEBRUARY 8. The mozos were an arrogant rebellious bunch. It must be said in their favor that as they either had to come with us to Maxbal or go to prison, they naturally would not have been inclined to be spontaneously cheerful in their co-operation. But their attitude naturally hampered the progress of the work.

We finished the actual opening-up of the field area. The program for the field area might be broken up as follows:

- (1) Cleaning of underbrush and cutting down smaller trees.
- (2) Chopping down of all large trees.
- (3) Placing stakes in the ground at fixed intervals (4 ft., 5 ft. or 6 ft.) in well defined rows to determine the location of each tree that is to be planted in the field.
- (4) The digging of a hole with machete where each stake is placed. (Smaller holes were used than we have used to date at Naranjo).

(5) The actual transplanting of the plant to the hole.

The 50 "African Ledgers" were planted in the field at 5 foot intervals; each "African Ledger" was protected by a large fern (called "chipe") bent over above the "Ledger" to serve as a temporary shield, as it were.

202 Krukoff seedlings were transplanted to the Nursery Bed.

The corral was finished which was to protect the Seed-bed and Nursery Area.

FEBRUARY 9. This was the last day the mozos were to be with us, so we really had to push things ahead.

The holing was completed by the mozos, who then retired to the Nursery Area to lean on their "azadones". Hoehn, Gantenbein and I in the meantime completed the transplanting. In all, (including the transplanting of the day before) 458 plants were planted out in the field; 538 were planted in the Nursery Bed. That is, 996 of the plants were set in the ground of the 1,000 that had been packed at "El Naranjo".

The very greatest credit must be given to Gantenbein, but especially to Hoehn, at this point. The latter accomplished far more transplanting than either Gantenbein or myself, and extended himself to the limit under the most trying conditions. There was a chilly, driving rain during the entire day which made conditions ideal for the plants transplanted, if not for the transplanters.

The field-planting site chosen at Maxbal is at an altitude of 4,900 ft. (approximately that of "Loja", El Naranjo.) This Maxbal field-planting, for the sake of simplicity, may be divided into two distinct sections. These are, looking up from the valley below, the RIGHT SIDE and the LEFT SIDE.

A summary of the Planting follows in the next page.

(A) RIGHT SIDE (PLANTING DISTANCES 4 ft. and 5 ft.)

<u>ROW.</u>	<u>KIND.</u>	<u>NO. OF PLANTS.</u>
1 (highest row)	K 45	12
2	K 45	11
2	K Indeterminate	(last) 4
3	K Indeterminate	20
4	K 13	(first) 15
5	K 13	(first) 11
6, 7, 8, and 9. (Also rest of plants in rows 4 and 5)	K 35	50
10	K 31	13
11	K 31	12
12 and 13	K 40	22
All rows below row #14	K 100	209
contain Krukoff #100, with the exception of the bottom rows of this <u>RIGHT</u> <u>SIDE</u> Planting	African Ledger	50
<u>RIGHT SIDE TOTAL</u>		<u>429</u>
which contain 50 "African Ledgers". The "Ledgers" and the "Krukoff" may be easily differentiated.		

(B) LEFT SIDE. (PLANTING DISTANCE 5 ft.)

First 3 rows (i.e. highest rows.)	K 45	16
Remaining Rows	K 40	13
<u>LEFT SIDE TOTAL</u>		<u>29</u>
<u>TOTAL PLANTS PLANTED IN FIELD AT</u>		
<u>MAXBAL</u>		<u>458</u>

Bed # 1, that is the NURSERY BED at Maxbal, contains the following plants. The plants are listed in order, running from the west end of the bed to the east end, the rows running from north to south: (the plants are planted at intervals of six inches)

<u>KIND.</u>	<u>NO. OF PLANTS.</u>
K 223	26
K 218	25
K 129	25
K 148	25

<u>KIND.</u>	<u>NO. OF PLANTS.</u>
K 108	25
K 134	25
K 249	25
K 135	25
K 148	24
K 237	51
K 142	23
K 128	49
K 129	25
K 152	25
K 133	50
K 100	90
<u>TOTAL PLANTS IN NURSERY MAXBAL</u>	<u>538</u>
<u>TOTAL PLANTS IN FIELD-PLANTING MAXBAL</u>	<u>458</u>
<u>TOTAL PLANTS MAXBAL (as of Feb. 9, '41)</u>	<u>996</u>

By good fortune, we had on hand a bottle of Bacardi, which did us no harm at all that evening, from the medical point of view.

We did our best to persuade all or any of the mozos to stay on the following day, to aid us in the completion of the Seed-Bed work. However, the entire crew abandoned us, even though a bounty of 25 cents and a slice of chivo was offered to any mozo who could remain for one more day of labor.

FEBRUARY 10. Early in the day all the mozos left for Santa Eulalia. Our only aid now was to come from two ladinos, who were working for 8 cents a day, and at the same time hiding out at Maxbal so they wouldn't have to be policemen in the pueblo of Barillas.

Our most effective plan, therefore, was to complete one seed-bed (Bed #2), and to give Gantenbein complete instructions as to how to sow seed. In Bed # 2 we sowed seed of Krukoff Calisaya at a rate of about 4 grams to the square meter.

We left the completion of beds # 3, 4, 5, and 6 to Gantenbein. He is then to finish sowing the KRUKOFF seed at the above rate, and following this, he is to sow the Ledger seed at a rate of 2 grams to

the square meter. (If sown less thickly, we felt that this fresher Ledger seed would be less vulnerable to the ravages of "damping off"). A pump, materials and instructions for the application of the BOR-DEAUX MIXTURE will be sent to Gantenbein as soon as possible in an attempt to prevent this "damping off", which, one might say, is quite likely to occur in the damp climate of Maxbal.

FEBRUARY 11. After a cheery good-bye to the cook, the adopted Indian boy and the various barnyard friends, we set off at 7 A.M. for Santa Eulalia, this time by a different route.

As we had no *mozos* to carry our food, blankets etc., we piled all these on the back of an unfortunate, unshod pony. Gantenbein himself was our guide and *arriero*, as he wished to visit his father at Santa Eulalia. (Gantenbein Jr. had not been away from Maxbal since the previous June.)

Due to the condition of the trail, it would have been impossible to return to Cananá in one day, following our former course. Our new route necessitated our climbing on foot most of the way until 2 o'clock in the afternoon through the rocky terrain of the finca Yulhuitz, up to the summit of that region which is known as Mimanhuitz (approximate altitude 8,500 ft.). Gantenbein proved himself to be a most affective and active mule-driver on this narrow treacherous trail.

From Mimanhuitz one descends through a pine-forest on a first-class trail to Chiá where one joins the main road which connects Barillas with Chemal. For the first time since leaving San Mateo we saw evidences of civilization in the village of huts, the wider road, and the immaculate wheat fields. At this junction, the village of Barillas (altitude 4,785 ft.) may be seen nestling in a large valley perhaps seven Kilometers away. As it was the zone of Barillas and the experiment rather than the pueblo of the same name in which we were inte-

rested, we continued on our way through Quetzal (altitude 7,000 ft.) to Nucá, arriving at the latter village at 6.30 P.M. Here we were fortunate to find shelter in the school-house, a large drafty rancho. Constructing a glowing fire in the middle portion of this edifice, however, we passed a refreshing night.

FEBRUARY 12. We left Nucá at 7 A.M., arriving in Santa Eulalia shortly after noon. The fiesta was coming to a riotous conclusion. Our animals by this time were exhausted, but we managed to obtain, through very good luck, fresh horses, a pack-mule and a mozo for the following day to take us through to Chemal.

FEBRUARY 13. We had arranged to get an early start at 6 A.M. It was no great surprise to us by this time, however, when our mozo failed to put in his appearance until 7.30, claiming that sleep had benumbed him.

Leaving the Gantenbeins in Santa Eulalia to their various occupations, Hoehn and I set out for Chemal over a route which was already familiar to us. The territory all the way from Quetzal to Chemal is much drier than Maxbal, much higher in altitude.

We arrived in Chemal at 4 P.M., the horses barely having been able to negotiate the last ascent from San Juan Ixcay. One must climb here about 3,000 ft. in an hour and three quarters. By chance, the telegraphic connection from Santa Eulalia to Huehuetenango had clicked, and we were greeted by the welcome sight of the camioneta which had been summoned by wire to meet us at the end of the car-road.

FEBRUARY 14. After enjoying the comfortable combination of a hot bath and a night on a soft mattress, we returned from Huehuetenango to Naranjo.

LIST OF ESTIMATED DISTANCES OF TRIP. (by horse.)

Chemal to Santa Eulalia.	February 2.	25 miles.
Santa Eulalia to Cananá.	" 4.	27 "
Cananá to Maxbal.	" 5.	30 "
Maxbal to Nucá.	" 11.	36 "
Nucá to Santa Eulalia.	" 12.	18 "
Santa Eulalia to Chemal.	" 13.	25 "
	<u>TOTAL.</u>	<u>161 miles.</u>

-.CONCLUSION.-

It is unfortunate that we did not have more time to investigate more fully the zone of Barillas; from what we saw, however, we feel that Maxbal may well be a most promising site in the zone. A large portion of this property which includes a good-sized lake was not visited by us at this time.

Another area worthy of note, we feel, lies near Cananá, although the land here may be somewhat high.

It is planned to make another expedition to Maxbal in about nine months, at which time it will be possible to get an idea as whether the Cinchona has struck or no. In the event that the zone seems most appropriate for Cinchona, a more thorough study of certain properties can be made at that time to advantage.

It is said that virgin land can be procured in the zone at present at a price of \$ 100.- the caballería.

The results of this experiment should be most interesting. In the event that the experiment is a failure, nothing is lost. If, by chance, the experiment is a pronounced success, the possibility of a more extensive future Chinchona development in the zone of Barillas should not be overlooked.

The road from Chemal to the village of Barillas (120 Kilometers) should be open to automobiles, conservatively speaking, within six years. The only really troublesome piece lies between Chemal and San Juan Ixcay. Once the road has been completed, it will be no such great problem to reach Maxbal; for instance, it would be possible to travel comfortably from El Naranjo to Quetzal in one day; the following day Maxbal could be reached with ease by mule.

F. Rosengarten Jr.

.....
F. Rosengarten Jr.

FINCA "EL NARANJO"
February 16, 1941.

ALTITUDES ABOVE SEA LEVEL

Determined with a Paulin Altimeter and a Tycoos Altimeter, checking one against the other, and checking both against the known elevation of the Railroad Station at Nahualate. Not to be considered exact, but sufficiently accurate for practical purposes, and to be used until more accurate figures become available.

NAHUALATE railroad station (railroad level)	485 feet
CHICAGAO, Plaza	1700 feet
FINCA EL NARANJO, headquarters	3800 feet

Elevations on Finca El Naranjo

Beneficio	3800 feet
Huasibamba Planting	3850 feet
Loja Planting, Lower edge	4600 feet
Upper edge	4900 feet
Chimborazo Planting, Lower edge	5900 feet
Upper edge	6050 feet
Lower Nursery	3850 feet
Upper Nursery	4100 at lower end to 4400 at upper end

Rain gauge elevations, El Naranjo

Huasibamba (El Naranjo station)	3800 feet
Loja station	4800 feet
Chimborazo station	6000 feet

②

Rainfall in inches in Finca La Soledad,
Municipality of Tumbador, Department of
San Marcos, Guatemala. Altitude 2500 ft.

	1921	1922	1923	1924	1925	1926	1927	1928
January	1.56	1.13	1.28	.70	.89	.50	.75	3.09
February	1.72	2.42	2.18	1.09	.00	.20	7.91	2.15
March	6.40	7.29	6.24	4.22	1.62	.01	1.26	4.41
April	5.85	6.24	6.71	10.75	8.80	4.09	27.36	18.48
May	28.43	26.33	28.28	19.80	13.42	18.34	17.93	24.90
June	17.24	23.67	23.21	27.25	14.86	21.56	33.11	32.47
July	21.33	7.56	6.83	16.34	17.95	22.10	17.93	19.00
August	19.31	15.68	15.41	20.33	13.86	26.00	10.29	27.25
September	23.52	22.82	23.87	37.81	22.19	32.02	36.23	26.34
October	29.87	28.67	27.38	11.85	20.62	26.28	34.41	18.30
November	8.27	9.44	.82	3.76	23.30	6.90	.92	8.80
December	1.33	2.03	.66	9.10	4.90	.61	11.42	1.67
	164.83	153.28	142.87	163.00	142.41	158.61	199.52	186.86
	1929	1930	1931	1932	1933	1934	1935	1936
January	.23	1.10	.50	1.17	4.07	4.46	5.33	.03
February	.00	10.69	.46	2.81	.75	2.94	3.58	.02
March	.00	2.05	.75	7.17	1.41	3.39	2.34	7.44
April	13.08	7.11	8.95	9.64	3.87	14.32	13.67	6.60
May	30.90	19.32	14.02	21.48	24.34	20.90	21.45	26.46
June	39.51	31.34	33.76	50.00	35.93	23.39	37.18	37.34
July	19.03	19.10	42.16	21.28	33.39	25.65	7.44	24.05
August	25.87	17.26	20.60	30.81	53.00	30.10	24.05	18.14
September	48.97	23.65	36.25	21.27	55.19	29.84	28.79	36.53
October	26.06	21.66	23.97	26.28	22.67	24.54	25.96	29.77
November	7.93	9.83	11.42	2.46	6.12	14.42	11.23	3.72
December	4.92	.76	6.72	2.49	2.96	2.44	1.58	2.92
	216.50	163.87	199.56	196.86	243.70	196.41	182.60	193.02

	1937	1938	1939	1940
January	1.68	2.98	4.91	5.13
February	3.60	3.31	2.15	.00
March	7.26	6.68	5.30	.75
April	21.11	28.23	13.48	2.82
May	15.54	29.03	15.08	12.38
June	34.82	28.22	19.18	28.13
July	31.70	32.07	21.55	15.22
August	25.03	22.50	15.20	
September	33.31	27.83	27.93	
October	38.26	32.81	15.51	
November	1.87	6.39	5.31	
December	6.82	.11	3.76	
	221.00	220.16	149.36	

NURSERY RECORD

SEED NUMBER:

KIND:

PARENT TREE: % QUININE SULFATE:

BARK THICKNESS: (MM.)

REMARKS RE. PARENT TREE:

OBSERVATIONS RE. NURSERY PERIOD:

CONFERENCIA SOBRE QUINA

Exposición de Agricultura

Sumándose a las dos conferencias que fueron ya anunciadas por la secretaría de agricultura, para desarrollarse en el curso de la feria nacional, tenemos el gusto de anunciar una tercera, sobre el árbol de quina, que tendrá lugar en el salón de la exposición agrícola, el viernes de la semana próxima a las 11.30 horas.

Esta tercera conferencia, la pronunciará el experto señor Jorge Benítez, quien será presentado por el doctor Wilson Popenoe, experto de la United Fruit Company. Este trabajo, versará sobre la multiplicación del árbol de la quina, y se invita a todos los interesados en tan importante renglón agrícola.

exposición
agrícola

LAS SIEMBRAS DE QUINA

Java ha sido, durante casi tres cuartos de siglo, la abastecedora de quinina del mundo. Desde que Mr. Ledger, allá por 1840, en audaces aventuras extrajera de los montes bolivianos las primeras semillas de la cinchona llamada más tarde en honor suyo ledgeriana, hasta que se inició la actual guerra, era aquella colonia la que rendía el mayor porcentaje del producto.

Ahora, Java ya no se considera conveniente mercado productor. Pero como el paludismo sigue batiendo su ganancia por las tierras tropicales del mundo entero, la quinina sigue y seguirá siendo necesaria, y por lo tanto habrá que cultivar en otras tierras distintas de las de las indias orientales el arbusto productor de ese alcaloide.

En América, no se trata sino de traer a su lugar de origen las plantas que un día salieron de sus bosques para ser aclimatadas y mejoradas por manos más hábiles y voluntades más energéticas, en lejanos países.

Y Guatemala está incluida entre las naciones cuyo clima y cuyo suelo pueden ser aptos para plantar árboles productores de quinina, como que existen algunas variedades en estado silvestre, y se ha probado ya el buen des-

Pasa a la 9a. página 4a. columna

ARIO NACIONAL.

Departamento de Ahorros

RENTABLES.

ON DE POLIZAS DE
DÍAS QUEDARA

pre para eventualidades.
riqueza o constituirán
en esta forma, podrán
a plazos.

CUENTA DE AHO-
ualquier suma que se

DE AHORROS.

ARIO NACIONAL

Reg. D. G. S. P. No. 540

Devuelve Vigor y Vitalidad

Garantía

protegido por la

usted está además

platos de fuerza doble

trascos de 48 tablas

Portillo Hermanos, C. O. P. No. 6

Distribuidores en Guatemala, Particu-

que se devolverá su dinero por nuestro

hasta que presente el traseco

heerly, y más joven, o de lo contrario

que usted se siente lleno de vigor y

luego. En otras palabras, Varco hará

hola satisfacción o se devuelve el

botellas bajo la garantía de dar com-

se venden aquí en todas las farmacias

tradas en los Estados Unidos, que hoy

pendiente llamado Varco ha sido tan

de del señor Roca.

luego a veces hombres del tem-

incurridas hasta el valle, están pi-

lancia de las aguas que bajan en

jocuetes, sus mesetas y la abun-

toría flora, fauna, sus enormes

agricola de las alturas que tiene

luyen la mas importante reserva

lueras que sin hipérbole consti-

da en el departamento de Zecamp.

lhoras tierras de la comarca cta-

Córdova, a descubrir las nativi-

ciudad con nuestro director, señor

res, como que ha llegado, en so-

sus atrevidos los conquistado-

mos estimarlo con el temple de

mos e inagotables energías. Debe-

de hombre de fuertes entusias-

La Juventud

lo Glandular

October 17, 1940

CINCHONA BARK ASSAY

<u>Sample No.</u>	<u>Thickness mm</u>	<u>Wt. per sq. cm. grams</u>	<u>% Quinine Sulfate</u>	<u>% Cinchoni dine Sulfate</u>
S-60	1.0 - 1.2	0.12	9.7	1.5
S-61	1.0 - 1.2	0.12	8.0	1.5
S-62	1.0 - 1.2	0.12	12.4	1.4
S-63	1.8 - 2.0	0.22	9.1	0.5
S-70	1.2 - 1.5	0.16	6.8	0.5
S-74	1.0 - 1.1	0.11	8.6	0.7
S-76	0.8 - 1.2	0.11	8.1	0.5
S-79	0.8 - 1.2	0.11	7.6	0.8
S-80	1.0 - 1.8	0.16	8.1	0.5
S-81	1.0 - 1.2	0.12	7.6	0.5
S-83	2.5 - 3.0	0.32	6.9	1.8
S-86	1.0 - 1.6	0.15	abt. 1% Q. & Cde Tart.	
S-89	1.0 - 1.2	0.12	6.7	0.5
S-90	0.9 - 1.1	0.11	7.0	0.3
S-92	1.2 - 1.4	0.15	6.7	1.1
S-98	1.0 - 1.2	0.12	9.1	2.4
S-103	2.5 - 3.0	0.32	3.6	4.0
S-106	1.5 - 2.0	0.19	2.9	1.8
S-112	1.8 - 2.2	0.23	5.3	1.4
S-114	2.5 - 2.8	0.31	2% Q. & Cde Tart.	
S-116	1.8 - 2.2	0.23	abt. 1% Q. & Cde Tart.	

10-10-40

CINCHONA BARK ASSAY

<u>Sample No.</u>	<u>Thickness</u> <u>mm</u>	<u>Wt. per</u> <u>sq. cm.</u> <u>grams</u>	<u>% Quinine</u> <u>Sulfate</u>	<u>% Cinchoni-</u> <u>dine Sulfate</u>
Colon Ledger H-2492	.8 - 1.0	.10	7.75	0.7

October 17, 1940

CINCHONA BARK ASSAY

<u>Sample No.</u>	<u>Thickness</u> <u>mm</u>	<u>Wt. per</u> <u>sq. cm.</u> <u>grams</u>	<u>% Quinine</u> <u>Sulfate</u>	<u>% Cinchoni-</u> <u>dine Sulfate</u>
H-1290	1.8 - 2.6	0.26	3.3	1.4

10-10-40

CINCHONA BARK ASSAYS

<u>Sample No.</u>	<u>Thickness mm</u>	<u>Wt. per sq. cm. grams</u>	<u>% Quinine Sulfate</u>	<u>% Cinchoni- dine Sulfate</u>
S-1	1.2 - 1.8	.17	10.3	0.7
S-2	2.0 - 2.5	.26	8.5	1.4
S-7	1.0 - 1.2	.12	10.3	0.7
S-9	1.0 - 1.2	.12	11.2	0.8
S-12	1.6 - 2.0	.20	9.5	0.5
S-13	1.5 - 2.0	.19	8.9	0.8
S-15	1.0 - 1.1	.11	7.5	0.6
S-16	1.6 - 1.8	.19	7.2	0.8
S-17	1.0 - 1.8	.16	8.0	1.9
S-18	1.5 - 1.7	.18	10.0	1.0
S-19	1.2 - 1.5	.14	10.57	1.1
S-20	1.2 - 2.0	.18	9.1	0.8
S-24	1.0 - 1.4	.14	6.2	0.4
S-25	0.8 - 1.2	.11	7.8	1.4
S-27	1.0 - 1.2	.12	6.6	3.0
S-28	1.2 - 1.8	.17	8.6	2.5
S-30	1.6 - 1.8	.19	10.3	1.0
S-34	1.0 - 1.2	.12	9.8	0.6
S-35	1.0 - 1.4	.14	7.8	0.5
S-39	1.8 - 2.0	.22	13.3	1.1
S-40	1.2 - 1.8	.17	7.8	0.5
S-42	1.0 - 1.5	.14	10.0	0.8
S-44	1.0 - 1.4	.14	8.6	1.1

Cinchona Bark Assays

- 2 -

10-10-40

<u>Sample No.</u>	<u>Thickness</u> <u>mm</u>	<u>Wt. per</u> <u>sq. cm.</u> <u>grams</u>	<u>% Quinine</u> <u>Sulfate</u>	<u>% Cinchoni-</u> <u>dine Sulfate</u>
S-45	0.8 - 1.2	.11	7.4	0.8
S-46	1.2 - 1.6	.16	6.5	0.7
S-48	0.8 - 1.2	.11	6.9	0.5
S-50	1.0 - 1.8	.16	8.2	0.6
S-54	1.0 - 1.8	.16	8.1	1.6
S-55	1.0 - 1.2	.12	10.0	1.7

4/11/41

ASSAYS OF CINCHONA BARK FROM GUATEMALA

Sample		% Quinine Sulfate USP X	Assayed 6/23/40	% Cde. Sulfate
			Q.S.	
#Z-623		2.5	2.0	3.3
"	#Z-624	1.3	1.0	3.9
"	#Z-625	3.4	2.4	4.3
"	#Z-626	3.6	2.9	4.3
"	#Z-627	3.6	2.3	5.9
"	#Z-628	6.6	3.4	5.7
"	#Z-629	8.7	4.7	4.3
"	#Z-630	7.75	2.8	3.70
"	# 631	7.35	4.7	3.5
"	# 632	3.2	2.5	4.7
"	# 646	(3.1 Quinine & Cde Sulfate)		
"	# 647	(1.7 Quinine & Cde Sulfate)		
"	# 648	2.8	2.3	1.3
"	# 649	(Abt. 1.2 Qui. & Cde Sulfate)		
"	# 651	4.4		0.5
"	# 652	(About 2.9 Qui. & Cde Sulfate)		
"	# 653	(About 2.5 Qui. & Cde Sulfate)		
"	# 654	(About 2.0 Qui. & Cde Sulfate)		
"	# A	(3.8 Qui. & Cde. Sulfate)		
"	# B	(traces of Qui. & Cde. Sulfate)		
"	# C	(2.8 Qui. & Cde. Sulfate)		

June 17, 1941

CINCHONA BARK ASSAYS

<u>Sample Number</u>	<u>Gms. per cm²</u>	<u>% Quinine Sulfate</u>	<u>% Cde. Sulfate</u>
H-845	0.15	6.4	0.4
H-852	0.16	5.7	---
H-854	0.15	9.5	0.7
H-858	0.12	9.2	0.8
H-862	0.12	5.4	0.8
H-864	0.17	8.8	1.0
H-865	0.16	6.9	0.5
H-869	0.15	6.7	0.7
H-877	0.12	6.9	0.5
H-879	0.12	9.4	0.6
H-880	0.14	13.0	1.0
H-881	0.17	5.8	0.5
H-884	0.16	6.5	0.6
H-885	0.12	5.6	0.3
H-887	0.15	4.8	0.5
H-889	0.16	7.8	0.5
H-892	0.16	10.5	0.7
H-894	0.17	9.3	1.3

June 18, 1941

CINCHONA BARK ASSAYS

<u>Sample Number</u>	<u>Gms. per cm²</u>	<u>% Quinine Sulfate</u>	<u>% Co Sulfate</u>
H-895	0.16	4.0	0.1
H-896	0.12	6.6	0.1
H-897	0.16	8.5	0.1
H-903	0.15	8.2	6
H-908	0.12	11.8	.0
H-909	0.12	11.8	--
H-911	0.12	8.9	1.03
H-914	0.12	8.6	0.5
H-925	0.16	9.5	0.4
H-926	0.15	10.3	1.04
H-928	0.13	5.4	3.0
H-929	0.16	8.5	0.7
H-930	0.07	5.3	0.5
H-931	0.15	6.3	1.6
H-932	0.16	7.0	0.4
H-934	0.16	8.1	0.6
H-937	0.12	8.1	0.7
H-941	0.14	10.9	1.0

Some Observations on Diseases of Cinchona in Guatemala.

Albert L. Müller

Three farms having Cinchona plantings, El Naranjo, Helvetia, and Patzulin, were visited on December 27, 28 and 29, 1940. In each case seed beds or seed boxes, nurseries, and permanent plantings were examined.

Seed beds

No diseases of the type known as "damping-off" were found, but it is reported that they are serious at certain other times during the year. Against these the application of Bordeaux mixture as a protective covering is advisable, and this fungicide is even more effective when care is taken to soak down the seedbed at the same time the plants are being sprayed. The use of top layers of shredded sphagnum moss, as is being attempted at El Naranjo, may help to control these diseases. The efficiency of soil disinfectants should be tested. The causes have not been determined yet.

Plants on the outer edges of seed beds showed "die back" of the tops in some cases, which may be due to over exposure to sun. In other cases plants were lying in the seedbeds due to a severe attack of thrips. The leaves of such plants browning from the margin or tip inwards. This trouble was most common at Patzulin, where it may be necessary to spray with nicotine sulphate to avoid

losses. Certain plants show narrow deformed and twisted leaves which seems to be caused by an early attack of the same kind of insects or else by red spiders.

Nurseries

In some of the nursery rows ^{of the *Succirubra* seedlings} at El Naranjo many of the plants, 1 to 2 ft. high, show cankers extending up on side, depressed, necrotic and often cracked along the margins. Not all of the diseased plants have external cankers, but they may be detected by the abnormal appearance of the tops which are foreshortened and have one or more downwardly recurved dead leaves. On cutting the stem of such plants longitudinally from buds to roots the cambium region is seen to be diseased throughout. The infection in the case of plants showing cankers also extends into the root system, many ramifications of which are dead or are spotted brown with diseased areas. All diseased plants have small root systems. It is not at all improbable that this disease has as its cause a soil inhabiting species of *Fusarium* or imperfect stage of a *Nectria*. In some parts of the world a *Phytophthora* canker disease of the crown and roots has been reported, and only by pure culture methods can it be determined what fungus produces the disease here. This disease may be distributed only the rows by contact of diseased roots with healthy roots of adjacent plants. Plants

suspected of infection should be removed and burned at once. Wounding of the crown and surface roots in weeding or cultivating by instruments which have cut through infected tissue of diseased plants is another way of spreading the disease. The original source of the disease may be the partially decomposed root system of ^{diseased} coffee or shade trees present on the site selected for the nursery rows.

Permanent Plantings

At El Naranjo one year plantings were examined, at Helvetia and Patzulin four and five year old trees were inspected in the permanent plantings, which contain several species and a number of hybrid types of *Cinchona*. Widely separated cases of "wilt" disease, not specific for any one kind of *Cinchona*, were found. In some cases the diseased trees could be discerned by a yellow aspect of the foliage which appeared flaccid or drooping, while in other cases by brown color of the dead leaves which hang for a time before falling. Several diseased trees had cankers at the base, containing the perfect and imperfect fructifications of a *Nectria* species which may be the cause. In the other cases of wilt no fructification was observed, and the disease may have as a cause species of *Rosellinia*, *Diplodia* or *Fusarium* which are known wilt producers. Diseased trees should never be allowed to remain in the plantings. The disease may ^{be spread by} root contact or by transmission by

implements, or by spore dissemination from the fungus reproductive structures forming on the cankers or on the dead tissue at the base of the tree.

In all plantings, with special reference to the Ledger types, a certain number of plants show signs of debility as evidenced by chlorotic mottling and marginal burning of the leaves. These cases are more frequent on the ridges where the soil is not so fertile and where it is drier during the season when it does not rain. Some of these plants may have been weak even in the nursery and unable to withstand adverse conditions. Fertilizing with a nitrogen compound, supplying water if possible, and protecting the soil against drying out too much are to be recommended, as well as selection of strong plants in the nursery for transplanting to the field.

Leaf spotting and the falling of spotted leaves was seen on a number of trees of the Ledger type, some of which were weak growers as described above. The spots are either tiny and reddish, or are from 1 to 2 mm. in diameter, round or irregular, brown in the center with a yellow halo, suggesting a bacterial infection. Young or old leaves show the same kind of spots which may be few or many over the entire leaf surface. Investigation should be made of all these diseases.

Antigua Guatemala, Dec. 31, 1940.

 Dr. Popense

SUMMARY OF KRUKOFF SEEDLINGS IN
SEEDBEDS AND "LOWER NURSERY"

FINCA EL NARANJO

MAY 12, 1941

KRUKOFF NUMBER	PLANTS IN LOWER NURSERY	PLANTS IN SEEDBEDS (estimated)	TOTAL (estimated)
1	10,522	825	11,347
13	599	36	635
7	52	35	87
24	747	45	792
28	2,356	125	2,481
30	104	5	109
31	734	25	759
33	168	4	172
35	5,201	450	5,651
40	2,620	200	2,820
45	772	43	815
100	176,072	356,580	532,652
101	640	400	1,040
102	897	1,282	2,179
103	1,140	448	1,588
104	1,122	245	1,367
105	191	214	405
106	197	62	259
107	1,766	1,890	3,656
108	1,264	730	1,994
109	1,752	2,383	4,135
110	151	50	201
111	464	718	1,182
112	212	40	252
113	278	145	423
114	532	790	1,322
116	11,853	916	12,769
118	147	235	382
119	699	330	1,029
121	530	1,790	2,320
122	415	530	945
Totals:	224,197	371,571	595,768

KRUKOFF NUMBER	PLANTS IN LOWER NURSERY	PLANTS IN SEEDBEDS (estimated)	TOTAL (estimated)
carried:	224,197	371,571	595,768
123	159	163	322
124	506	1,800	2,306
125	335	105	440
126	640	478	1,118
127	20	45	65
128	1,901	1,680	3,581
129	2,169	3,400	5,569
130	1,194	1,492	2,686
131	392	500	892
133	963	1,240	2,203
134	1,070	900	1,970
135	2,292	1,204	3,496
136	84	72	156
139	526	619	1,145
140	710	768	1,478
141	1,252	938	2,190
142	849	676	1,525
143	370	200	570
144	193	120	313
145	1,688	1,224	2,912
146	420	250	670
147	179	258	437
148	669	666	1,335
149	309	86	395
150	49	37	86
151	1,464	1,167	2,631
152	279	418	697
200	75,513	38,474	113,987
201	153	130	283
202	212	80	292
203	45	32	77
204	307	120	427
205	152	140	292
Totals:	321,261	431,053	752,314

KRUKOFF NUMBER	PLANTS IN LOWER NURSERY	PLANTS IN SEEDBEDS (estimated)	TOTAL (estimated)
carried:	321,261	431,053	752,314
206	60	72	132
207	870	679	1,549
208	238	140	378
209	357	92	449
210	372	335	707
211	169	90	259
212	390	140	530
213	105	145	250
215	990	363	1,353
216	880	855	1,735
217	1,120	480	1,600
218	1,497	855	2,352
219	415	330	745
220	696	588	1,284
221	420	264	684
222	1,034	1,023	2,057
223	2,736	3,240	5,976
224	279	140	419
225		26	26
226	683	220	903
227	1,000	1,970	2,970
228		18	18
229	185	65	250
230	334	140	474
231		44	44
232	34	9	43
233	795	717	1,512
234	227	359	586
235	1,035	950	1,985
236	233	260	493
237	925	629	1,554
238	495	396	891
239	130	150	280
Totals:	339,965	446,842	786,807

KRUKOFF NUMBER	PLANTS IN LOWER NURSERY	PLANTS IN SEEDBEDS (estimated)	TOTAL (estimated)
Carried:	339,965	446,842	786,807
240	780	285	1,065
241	730	300	1,030
242	3,060	1,308	4,368
243	250	385	635
244	612	401	1,013
245	1,178	856	2,034
246	640	250	890
247	238	442	680
249	755	658	1,413
250	150	260	410
252	963	633	1,596
254	394	115	509
255	900	620	1,520
301	61	55	116
302	87	65	152
303		7	7
501	1,032	159	1,191
502	2,854	1,197	4,051
503	708	409	1,117
504	415	1,198	1,613
506		31	31
507	1,096	995	2,091
509	820	1,351	2,171
510	2,319	1,188	3,507
511	135	120	255
512	362	359	721
514	80	185	265
515	276	19	295
516	381	125	506
Totals:	361,241	460,818	822,059

KRUKOFF NUMBER	PLANTS IN LOWER NURSERY	PLANTS IN SEEDBEDS (estimated)	TOTAL (estimated)
Carried:	361,241	460,818	822,059
5		3	3
6		1	1
8	21		21
9		5	5
10	16		16
11	50	6	56
12	18		18
15	33		33
19	3		3
20	89		89
21	10		10
25	78		78
26	50	2	52
29	25		25
32	32		32
34	37		37
36			
37		2	2
38	31		31
39		80	80
41		2	2
42		67	67
43		40	40
44	27		27
47		2	2
48	16		16
49	18		18
50	41		41
51	23		23
52		2	2
53	47		47
54	22		22
55	21		21
56	33		33
57	31		31
58	54		54
411	69		69
325	29		29
TOTALS:	362,165	461,030	823,195

SUMMARY

Krukoff seedlings in "Lower Nursery" ----- 362,165
 Krukoff seedlings in Seedbeds (estimated) ----- 461,030

Total (estimated) Krukoff seedlings,
 at Finca "El Naranjo", May 12, 1941 823,195

Finca "El Naranjo"
 May 12, 1941

J. Raengarten
 F. Raengarten Jr.

Dr. Poplave.

TRANSPLANTING TO NURSERY AREAS.

This work is being handled most capably by Benitez. We have to date transplanted 362,000 Krukoff seedlings to the "Lower Nursery".

Off and on during this rainy season, the exact times to be determined by his judgment, Benitez will transplant about 150,000 Krukoff seedlings to the "Esterlina Nursery", at 6" by 6"; for the most part, these seedlings will come from the groups already transplanted in the "Lower Nursery" at 3" by 3".

In addition, approximately 100,000 of the largest Krukoff seedlings in the Seedbeds will be transplanted to the "Lower Nursery", at 3" by 3" during June and July.

The work of preparing the "Upper Nursery" will be continued. The terracing should be completed here by the middle of July, by which time the pump and pipe lines should also be installed.

The main transplanting to the "Upper Nursery" will probably take place in November. A vast and as yet unpredictable number of Krukoff seedlings will be moved here from the seedbeds at 3" by 3"; from the "Lower Nursery" and "Esterlina Nursery" at 6" by 6".

Benitez is doing a magnificent job with this phase of the Cinchona work, as his results testify.

The nursery beds themselves will be supported by chalom logs and "izote" in the steeper portions of this area to prevent the washing away of the soil. When the chalom supports rot away in 2 years or so, the "izote" should then be large and abundant enough to serve this purpose.

The roofing of these nursery beds will be composed as follows (for the most part): barbed wire running lengthwise along both sides of the beds will support "billil" stakes placed at intervals perpendicular to the barbed wire. "manaca" or "chipe" leaves will then be placed on the "billil", depending on the available supply of these materials. In case the supply of "billil" is limited, barbed wire can be placed crosswise on the beds as a substitute. Bamboo can also be used as a substitute for the barbed wire running lengthwise on the beds. The shade will be increased or decreased from time to time according to Benitez's judgment.

OPENING UP OF FIELD AREAS.

60 mozos are now carrying on with this work under the energetic supervision of Enrique Hoehn. Our aim is to knock down all the largest trees in 250 acres of the land between 5,300 and 7,300 ft. (leaving untouched certain choice areas for the future.)

Then when the dry season comes in December, the underbrush will be cleared, as many smaller trees will be cut down as seems advisable, and the staking of the proposed holes carried out.

Hoehn feels at this time that it might be best to leave no shade at 7000 ft., and gradually increase the shade as the altitude decreases to 4000 ft., but even here leave only a small amount of shade.

By March 1942, 250 acres should be opened up; the labor used for this work will be gradually decreased during the rainy season, and then increased again in November. The heavy rains in September and October will undoubtedly slow up this work considerably.

These 250 acres should then be ready to receive from 500,000 to 550,000 plants, for the most part Krukoff seedlings, during the rainy season of 1942.

Finca El Naranjo,
May 14, 1941.

FR Jr.
F. R. Jr.

Minutes of Cinchona Conference held in Finca "El Naranjo" on
Wednesday, April 16th. 1941

1. The meeting opened at 1.15 p.m. with Mr. F. Rosengarten in the Chair, the following being present: Messrs. W. Pennock, L. L. Pettersen, F. W. Owen Smith, A. E. Bianchi, P. O. Davies and E. H. Lewonski.
2. The minutes of the previous meeting were read and approved.
3. Mr. Rosengarten read extracts from a letter sent to him by Mr. Bianchi in which the growth of certain plants was mentioned and suggested that some method be devised for measuring such growth to enable comparisons to be made. The erection of a stick alongside the plant on its transference to the field was not considered satisfactory as a risk is run of the stick being disturbed by the labour in the course of cleaning and other works. It was decided that the safest method would be to measure the height of the plant with a yardstick and that a start be made with the measuring when the Krukoff plants and last season's grafts are planted to the field this season.
4. Mr. Bianchi enquired whether there is any recommended treatment for wounds caused by the removal of suckers but it was accepted that from previous experience no danger need be anticipated, particularly if the suckers are rubbed off by hand while still small.
5. Mr. Rosengarten then read a letter received from Mr. Davies advising of the damage caused in Patzulín by an application of Bird Guano. He said that letters like those received from Messrs. Davies and Bianchi are just the type which should be exchanged as they impart useful information and provide material for discussion.
6. Mr. Rosengarten called to the attention of those present the importance of making seed gardens and stated that in El Naranjo and Panamá a start is to be made with what little high content material is available. As it is not yet known what the minimum distance should be between a seed garden and the nearest cinchona planting to avoid cross-pollination, the seed-garden should at least be made as far away as possible.
7. With regard to the suggestion made at the previous meeting that the grafting boys be given a practice session, grafting will begin at Panamá in the week beginning the 21st. inst. As Mr. Smith had offered that the next meeting take place at Panamá those interested can take their boys and these could stay over under supervision of Benítez. At the same time they can learn something of the preparation of grafting material, after-care of the grafts etc. It was decided after discussion that Mr. Rosengarten find out what Benítez considers to be the cardinal points to be observed in grafting and that these points be drawn up in writing for the benefit of learners. At this point Mr. Pettersen said that his experience in El Zapote is that grafts made close to the ground show big losses compared to those made higher, due to a rot forming at the union. In view of this he is grafting at Zapote at a height of nine inches from the ground. Answering a question from Mr. Owen Smith he said that in Zapote the successful grafts average about 50% over the year with 90% of takes in some cases.

Minutes of Cinchona Conference of April 16th. 1941

Following on this discussion of grafting it would seem that the best time for this work is the wet season though it might be extended into the early part of the dry season by watering. The reason for this is that in the wet season the stock shows vigorous growth while the humidity in the atmosphere does not permit the scion to dry out before the union is effected.

8. Mr. Rosengarten said that some Coban seed is in course of drying out for separation and cleaning and that he expects to be able to distribute it in about two weeks to those who are interested.

9. Mr. Pennock said that at the last meeting he had expected to have some data on manures prepared for the present conference but he had found that the results were not yet sufficiently apparent.

10. Mr. Smith said that he has been experiencing trouble at Panamá with "Gallina Ciega", both in his own seed beds and in those of Experimental Plantations, Inc., Mr. Pennock said that he is getting a preparation but he thinks it might be rather expensive and suggested that the better course might be to reduce the amount of vegetable matter in the soil replacing it with inorganic manures. Mr. Bianchi said that in Mocá his method is to trap the June Bugs, of which the Gallina Ciega is the larva.

11. It was agreed that the next meeting be held at Finca Panamá on Tuesday, June 17th. at 9 a.m. Mr. Rosengarten said that he would not be present and relegated the Chair to Mr. Owen Smith for that meeting.

12. Mr. Smith proposed a Vote of Thanks to Experimental Plantations Inc. for the hospitality extended by them, this being passed unanimously.

13. The meeting was brought to a close at 2.40 p.m.

Minutes of Cinchona Conference held in Finca "Moca"
on Tuesday, February 25th. 1941.

The session was opened at 8.30 a.m., the following being present: Messrs. W. Pennock, F. Rosengarten, L.L. Petterson, P.O. Davies, A.E. Bianchi, F.W.O. Smith, G.P. Smith and E.H. Lewonski.

1. Mr. G.P. Smith in opening the session said that the idea behind the meetings is to exchange information on everything connected with the planting and cultivation of cinchona, thus allowing all to profit from the experience of each. No questions of policy would be touched on, these being of course entirely the business of each concern represented and of no interest to the remainder.

2. After discussion it was decided that meetings be held in rotation on the various properties where cinchona is being cultivated, the place and date of one meeting to be arranged at that preceding it. Minutes should be kept of what occurs at every meeting in a legally authorized book and in both English and Spanish. Copies of the minutes are to be sent to all those attending the conferences and to those others who are also interested.

3. Mr. Smith proposed that Mr. Rosengarten should be Chairman at succeeding meetings and Mr. Lewonski Secretary, this being passed unanimously.

4. Passing to specific discussion of matters connected with planting of cinchona and difficulties encountered, Mr. Davies addressed a number of questions to Mr. Pennock, the following being the important points worthy of recording:

With regard to transplanting of seedlings between seedbed stage and planting out to field, Mr. Pennock stated that the policy so far planned and carried out as far as circumstance permits, is to transplant two to three times, firstly at two inch centres, later to six inch centres and from here directly to the field. In dry weather, he agreed that transplanting should not be attempted till the seedling is from three to four inches high. At the same time it was agreed that smaller plants are inferior to the larger ones in a seedbed, probably not in heredity but rather owing to poorness of seed, poor rooting or other reason. In Naranjo planting of seedlings is carried out with a dib or stick, all roots being left intact, though in the case of *Succirubra* the main root may apparently be cut without danger of damage resulting.

The discussion having turned to questions of manure, Mr. Pennock said that in El Naranjo experiment is being largely confined to inorganic or chemical manures. He knows no reason why stable manure should not be satisfactory though this has the same drawback as coffee pulp and similar manures which contain large amounts of fungi which may be expected to cause trouble. Again, cinchona being similar to coffee, it is possible that diseases of coffee might be transmitted to the cinchona, these manures forming the carrier. Bone meal, guano and dried blood were all suggested as possibilities for manuring, the first being procurable from Max Augustynski and the second from Messrs. Toepke & Co., both of Guatemala. Mr. Pennock said that by the time of the next meeting he hopes to have some definite data on manures to impart.

Minutes of Cinchona Conference. 25/2/41

Mr. Owen Smith stated that he had made a rough trial with flowers of sulphur, after having read that this has been used to combat damping-off in seedbeds. His experiment was quite inconclusive though he is satisfied that damping-off was less pronounced in that part on which flowers of sulphur was applied. It was agreed that his should be tried further, application being made after germination of seed. With reference to damping-off, Mr. Pennock maintained that the ideal to work for is to avoid this disease, thus saving trouble in its combat and after-effects in the development of the plants and trees. He also said that in El Naranjo planting of seed is still being carried out at an approximate density of two grammes per square yard, taking into consideration that seed is not selected and part of that sown does not germinate. With regard to the selection of seed he said that he prefers not to select as bulk is advantageous in procuring an even distribution of seed over the area to be planted. In connection with the same question of seedbeds, Mr. Bianchi stated that he intends to sun leafmould and humus on the coffee patios with the intention of thus killing fungi which abound in this vegetable matter. Mr. Pennock agreed that this would be a most useful step to take while pointing out that the spore of fungi would not be destroyed by such sunning. Mr. Pennock said, with reference to the picking of seed, that there is a definite amount of latitude with regard to the ripeness of seed and that it can be collected at any time within a period of about two to three weeks before the pod dries and opens on the tree. If the thumbnail does not easily penetrate the capsule it may be taken that the seed is mature. Mr. Rosengarten offered to write to Dr. Krukovskiy and ask him for a memorandum on his methods of collection in South America. Turning to matters of grafting, it was stated that Benitez does not recommend that flowering wood be used for scions as, in his opinion, the percentage of takes is lower. Returning to the question of manuring, it was here agreed that green manuring is not as successful in practice as in theory and that the results to be achieved do not repay the trouble.

5. During the general discussion on points of interest it was decided that it is important to select suitable *Succirubra* trees from which to procure grafting stock, the important point being disease-resisting qualities and, if possible, good quinine content as the roots provide perhaps as much as one third of the bark. It was also agreed that an eye should be kept open by all interested parties with a view to training suitable human material for grafting and other of the more important works.

6. At a later meeting a decision should be taken about calling together all the boys for grafting practice, as was done in Panamá and El Naranjo last year. They can thus learn a lot from watching one another at work and see the technique to be employed.

7a. A vote of thanks to Mr. Pennock for his helpful attitude and the information he imparted was proposed and passed unanimously.

7b. A vote of thanks to Mr. Gordon Smith for his energy in getting the meeting started, and for his intelligent manner of handling it.

Minutes of Cinchona Conference. 25/2/41

8. It was arranged that the next meeting should be held in El Naranjo on Wednesday, April 16th. next at 9.30 a.m. and
9. There being no other matters to discuss, the present meeting closed at 11.15 a.m.

Signatures follow:

Dr. Pojarnae

5/13/41

CINCHONA BARK ASSAYS

<u>Sample No.</u>	<u>Gms. per sq. cm.</u>	<u>% Qui. Sulfate</u>	<u>% Cde. Sulfate</u>
H-24	0.14	7.2	0.8
H-75	0.15	5.6	0.8
H-84	0.125	3.9	0.3
H-135	0.08	8.6	1.0
H-152	0.16	(2.4% Qui. & Cde. Sulfate)	
H-162	0.17	6.3	0.9
H-165	0.15	4.5	1.2
H-167	0.16	8.6	0.8
H-180	0.15	(2.3% Qui. & Cde. Sulfate)	
H-184	0.115	7.0	0.5
H-191	0.13	6.8	0.3
H-193	0.115	7.2	1.6
H-195	0.115	7.7	1.2
H-260	0.13	3.2	0.2
H-314	0.16	3.9	0.5
H-316	0.115	4.6	0.5
H-339	0.14	5.4	1.3
H-359	0.13	(3.0% Qui. & Cde. Sulfate)	

Cinchona Bark Assays

<u>Sample No.</u>	<u>Gms. per sq. cm.</u>	<u>% Qui. Sulfate</u>	<u>% Cde. Sulfate</u>
H-369	0.13	5.2	0.3
H-370	0.14	6.8	0.9
H-373	0.15	5.1	0.7
H-410	0.14	2.0	2.0
H-411	0.16	5.4	0.7
H-414	0.16	6.0	0.7
H-431	0.15	(2.6% Qui. & Cde. Sulfate)	
H-433	0.15	8.1	1.2
H-453	0.16	5.0	0.3
H-458	0.16	10.4	0.5
H-459	0.16	4.1	0.6
H-463	1.0	4.3	1.1
H-464	0.14	6.4	1.0
H-465	0.14	10.6	0.5
H-479	0.15	(2.9% Qui. & Cde. Sulfate)	
H-480	0.17	4.1	1.4
H-482	0.13	(4.5% Qui. & Cde. Sulfate)	
H-486	.06	(3% Qui. & Cde. Sulfate)	

LAND AT NARANJO.

From the adjoining sketch, it will be seen that in May, 1941, we estimate we have a total of 8 caballerías at Naranjo which we can use for planting Cinchona in the field:

Between 6,300 and 7,300 ft., 2 1/2 cabs. or 277.5 acres.
 Between 5,300 and 6,300 ft., 2 cabs. or 222 acres.
 Between 3,800 and 5,300 ft., 3 1/2 cabs. or 388.5 acres.

Total 8 cabs. or 888.0 acres

If we calculate conservatively at 2,200 trees per acre planted at 4' by 4', (instead of the 2,600 trees which should theoretically fit into an acre at 4' by 4'), allowing for the interference of big trees that will fall, broken portions of the land, etc., we then find we have space at Naranjo for the following:

610,500 trees between 6,300 and 7,300 ft. (277.5 acres.)
 488,400 trees between 5,300 and 6,300 ft. (222 acres.)
 854,700 trees between 3,800 and 5,300 ft. (388.5 acres.)

i. e. There should be enough land at Naranjo for 1,953,600 trees planted out in the field at 4' by 4'.

Note: Of course the estimate of 8 caballerías may not be exact; Enrique Hoehn has spent several days recently, however, measuring the areas mentioned above, so we really do have some idea of the amount of land we have at Naranjo, even if a rough one. (Moreover, even if we are 33 % too high in our estimate, we would still have space at Naranjo for 1,302,400 trees planted out at 4' by 4'.)

As noted in the accompanying data, we have in the Seed-beds and Nurseries at Naranjo, as of May 12, 1941, an estimated:

823,195 Krukoff Seedlings
 39,939 Other plants (apart from Succirubra stock)

Total. 863,134

Adding to this total the 20,000 odd plants still belonging to us at the Finca Panamá, and the 6,260 trees already in the field at Naranjo, we then have an estimated total of approximately 890,000 plants in our possession, whereas Naranjo should be able to take care of 1,953,600 trees planted out at 4' by 4'.

We can hardly hope to make as many as 100,000 grafts per year before 1943 at the earliest, with the limited amount of high-yielding material which we have at our disposal at present, so this type of plant should not cause us concern for several years, as far as needing more land is concerned.

However, if we have enough success with the seedlings grown from seed of the high-yielding "Original Ledgers" at the Finca Samac, Cobán, and Finca Helvetia, we may consequently find ourselves short of land; but one might safely say that, in any event, we should have enough land at Naranjo to satisfy our needs for at least two more years.

Finca El Naranjo,
May 14, 1941.

F. Rosengarten Jr.

D. P. Jones
22 de mayo de 1941.

Las 2 1/2 caballerías que van a abrirse para 1942 se encuentran en las siguientes alturas:

1 1/2 caballerías entre 5,300 y 6,300 pies.

1 caballería en el cafetal entre 4,500 y 5,300 pies.

Between Narango & Lunel.
List of fincas

Finca "Colima", Zunilito

4 1/2 caballerías, 4500 ft. altitude, Banco Central, quite level and has sufficient water, has 1 caballería virgin forest; the entire finca is sown with cenga Chalum.

Finca "Las Elviras", San Francisco Zapotitlán

5 caballerías with virgin forest, 4500 ft. altitude, Banco Central, Ismael Fernandez.

Finca "La Esperanza", Zunilito

1 caballería with virgin forest, 5500 ft. altitude, Enrique Hoffens owes to the Banco Central.

Finca "Los Angeles", Zunilito *

10 caballerías with virgin forest, 5000 ft. altitude, Enrique Hoffens owes to Cia. Holandesa.

Finca "San Enrique", San Francisco Zapotitlán

3 caballerías without virgin forest, 4500 ft. altitude, Agapito Alvarez very much in debt to Hércilio Varma.

Finca "Blanca Flor", San Francisco Zapotitlán

1 1/2 to 2 caballerías, 4000 ft. altitude, Mandujano owes very much; With virgin land.

Finca "Quenené"

5 caballerías, 5500 ft. altitude, owner Banco Central, former owner Calderón; With virgin land.

Finca "Oquendo", Samayac *

5 caballerías, 5000 ft. altitude, Antonio Ramirez, not in debt. With virgin land.

Finca "Las Margaritas", San Francisco Zapotitlán

5 caballerías, 3000 ft. altitude, Bonifacio Hnos., does not owe;
with virgin land.

Finca "La Conchita", San Francisco Zapotitlán

6 caballerías, 3000 ft. altitude, Silvestre Ricci, Banco Central;
with virgin land; entire finca sown with coffee and Bananas.

Finca "Venecia", San Francisco Zapotitlán

12 caballerías, 3000 ft. altitude, Banco Central;
with virgin Forest

Juan Nicomedes Punc *

12 caballerías only virgin land, 6500 ft. altitude,
above finca Horizonte; owner lives in Santa Clara.

* most promising.

May 22, 1941
Thanks to E. Huchin.

(In case we need more land sometime,
one or more of these might be of interest. When you
return to Guatemala let's have a look at the
most likely.) JHjr.

Dr. Pyper

LEDGER SEEDLINGS IN SEEDBEDS AND NURSERIES AT EL NARANJO

(as of September 15, 1941)

<u>Seed Number</u>	<u>% Q. S. Mother tree (latest results)</u>	<u>Location</u>	<u>Estimated Total</u>
H-1293	10.7	Seedbed # 20	1,974
H-1133	13.3	Seedbed # 20	2,115
H-1229	12.6	Seedbed # 20	2,115
H-1210	11.1	Seedbed # 20	10,575
Malay States Ledger Type	---	Seedbed # 20	1,946
H-1293	10.7	Lower Nursery, Seedbed D	2,240
H-1133	13.3	Lower Nursery, Seedbed D	5,075
H-1229	12.6	Lower Nursery, Seedbed D	2,420
H-1210	11.1	Lower Nursery, Seedbed D	14,960
H-1210	11.1	Esterlina Seedbed A-1	890
H-1213	12.3	Esterlina Seedbed A-1	31,860
H-1213	12.3	Esterlina Seedbed A-2	6,700
H-1216	9.9	Esterlina Seedbed A-2	10,000
H-1171	9.8	Esterlina Seedbed A-2	3,960
H-1256	9.7	Esterlina Seedbed A-2	7,400
H-1278	9.6	Esterlina Seedbed A-2	7,140
H-1278	9.6	Esterlina Seedbed A-3	9,100
H-1223	9.6	Esterlina Seedbed A-3	2,170
H-1257	8.3	Esterlina Seedbed A-3	17,220
H-891	9.5	Esterlina Seedbed A-3	6,300
H-1270	9.2	Esterlina Seedbed A-3	990
S-39	13.3	Esterlina Seedbed A-4	27,760
S-62	12.4	Esterlina Seedbed A-5	24,300
			<u>199,200</u>

<u>Seed Number</u>	<u>% U.S.</u> <u>Mother tree</u>	<u>Location</u>	<u>Estimated Total</u>
		(carried)	199,200
S-18	10.0	Esterlina Seedbed A-5	800
S-7	10.3	Esterlina Seedbed A-5	7,280
S-7	10.3	Esterlina Seedbed A-6	19,600
S-19	10.57	Esterlina Seedbed A-6	3,885
S-1	10.3	Esterlina Seedbed A-7	500
S-34	9.8	Esterlina Seedbed A-7	3,920
S-20	9.1	Esterlina Seedbed A-8	2,370
S-30	10.3	Esterlina Seedbed A-8	15,000
S-39	13.3	Esterlina Seedbed A-9	4,920
S-9	11.2	Esterlina Seedbed A-9	1,000
Malay States Ledger Type	---	Lower Nursery I-9	88
Malay States Ledger Type	---	Lower Nursery I-10	1,620
Estimated Total Ledger seedlings at Naranjo, as of Sept.15, 1941			260,183

Finca "El Naranjo"
September 20, 1941

F. Rosengarten Jr.

A. Hartleben

Dr. Popenoe.

Seed Costa Rica.

STATUS OF KRUKOFF SEEDLINGS

(as of September 22, 1941.)

INCLUDING PLANS FOR FUTURE NURSERY AND FIELD
OPERATIONS.

c. c. Mr. Perkins.
Mr. Lukens.
Dr. Popenoe.✓
Dr. Krukoff.
Mr. Pennock.
Mr. Benitez.
Mr. Hoehn.
Naranjo files.

<u>Krukoff No.</u>	<u>% Q. S. Mother tree</u>	<u>Plants in Lower Nursery</u>	<u>Plants in Esterlina Nursery</u>	<u>Plants in Pump Nursery</u>	<u>Plants in Seedbeds</u>	<u>TOAL (estimated)</u>
K-1		2,897	5,645			8,542
K-4	3.7				2	2
K-5	3.1				3	3
K-6	3.7				1	1
K-7	6.6	56			27	83
K-8	3.5	17				17
K-9	3.0				6	6
K-10	3.8	16				16
K-11	3.2	41			6	47
K-12	3.5	18				18
K-13	6.7	88	167		27	282
K-15	2.9	222				222
K-18	3.4				1	1
K-19	4.4				3	3
K-20	2.5	74			1	75
K-21	5.4	8				8
K-24	5.2	340	119		27	486
K-25	3.0	68				68
K-26		47			2	49
K-28	6.6	714	1,121		110	1,945
K-29	3.8	24			1	25
K-30	5.9	16			5	21
K-31	6.3	80	207		23	310
K-33	5.9	20			4	24
K-34	3.1	18				18
K-35	5.0	1,896	1,528	820	240	4,484
K-36	4.1	36				36
TOTALS:		6,696	8,767	820	489	16,792

<u>Krukoff No.</u>	<u>% Q. S. Mother tree</u>	<u>Plants in Lower Nursery</u>	<u>Plants in Esterlina Nursery</u>	<u>Plants in Pump Nursery</u>	<u>Plants in Seedbeds</u>	<u>TOTAL (estimated)</u>
(carried)		6,696	8,787	820	469	16,792
K-37	4.7				2	2
K-38	2.8	31				31
K-39	4.6				65	65
K-40	5.3	1,370	614		175	2,159
K-41	3.8				2	2
K-42	4.7				42	42
K-43	4.5	14			65	79
K-44	3.9	29				29
K-45	5.2	280	69		35	384
K-46	3.2				1	1
K-47	3.2				2	2
K-48	2.1	53			2	55
K-49	3.0	15			1	16
K-50	3.3	32				32
K-51	3.0	20				20
K-52	2.8				2	2
K-53	4.0	45				45
K-54	2.3	18				18
K-55	4.0	20				20
K-56	3.8	28				28
K-57	3.3	27				27
K-58		44				44
K-100		108,411	57,912		299,954	466,277
K-101	8.0	299	523		292	1,114
K-102	9.5	613	779		494	1,876
K-103	9.9	685	358		350	1,393
K-104	5.2	497	603		165	1,265

TOTAL: 118,227 69,845 820 302,128 491,820

<u>Krukoff No.</u>	<u>% Q. S. Mother trees</u> (carried)	<u>Plants in Lower Nursery</u> 119,227	<u>Plants in Esterlina Nursery</u> 69,645	<u>Plants in Pump Nursery</u> 820	<u>Plants in Seedbeds</u> 302,128	<u>TOTAL (estimated)</u> 491,820
K-105	3.3	175			135	310
K-106	9.5	70	14	81	44	209
K-107	8.1	1,153	14	520	1,260	2,947
K-108	7.2	694	873		610	2,177
K-109	8.6	2,134	2,030			4,164
K-110	6.0	87	9	56	40	192
K-111	9.2	188	8	848	490	1,534
K-112	7.5	77	14	117	35	243
K-113	5.7	113	9	195	70	387
K-114	3.8	448			834	1,282
K-116	11.0	3,255	7,078		1,090	11,423
K-118	4.5	85	2		205	292
K-119	6.1	384	18	251	275	928
K-121	3.1	336		359	1,297	1,992
K-122	4.0	205	8		340	553
K-123	7.9	112	10		130	252
K-124	4.9	873	6	1,147	1,364	3,390
K-125	5.5	259	11		73	343
K-126	5.6	344	363		260	967
K-127	3.7	20			50	70
K-128	5.2	1,860	1,439		220	3,519
K-129	4.1	830	2,232		2,256	5,318
K-130	3.2	772		793	1,579	3,144
K-131	4.8	286	9		775	1,070
K-133	5.3	546	133	955	1,140	2,774
K-134	4.4	389	11	570	926	1,896
K-135	3.1	1,077		1,162	1,656	4,095

TOTALS: 135,992 63,936 7,874 319,482 547,291

Krukoff No.	% Q. S. Mother tree (carried)	Plants in Lower Nursery	Plants in Esterlina Nursery	Plants in Pump Nursery	Plants in Seedbeds	TOTAL (estimated)
		135,999	85,938	7,374	319,482	547,291
K-136	7.9	32	7		45	84
K-139	5.4	224	12	402	524	1,162
K-140	7.4	632	11		418	1,061
K-141	6.0	1,512	404		160	2,076
K-142	4.2	397	11	600	440	1,448
K-143	5.3	265	8		85	358
K-144	7.5	68	8	157	55	288
K-145	4.2	1,901	763		130	2,794
K-146	4.3	206	272		164	642
K-147	4.6	68	29	103	194	394
K-148	7.2	493		631	370	1,494
K-149	9.2	103	4	157	52	316
K-150	6.8	40	7		37	84
K-151	8.8	681	827		821	2,329
K-152	7.4	193	17	338	195	743
K-200		39,924	14,499		30,961	85,284
K-201	8.3	109	16		75	200
K-202	9.0	156	13		65	234
K-203	7.8	26	11		27	64
K-204	8.5		20		103	123
K-205	9.9	48	20	172	85	325
K-206	3.9	48			70	118
K-207	8.0	570	15	1,107	356	2,048
K-208	6.6	118	14	240	65	437
K-209	6.4	174	18	312	39	543
K-210	7.2	151	14	350	100	615
K-211	7.1	131	15		65	211

207418- 184,268 100,971 12,443 355,083 652,766

<u>Krukoff No.</u>	<u>% Q. S. Mother tree (carried)</u>	<u>Plants in Lower Nursery</u>	<u>Plants in Esterlina Nursery</u>	<u>Plants in Pump Nursery</u>	<u>Plants in Seedbeds</u>	<u>TOTAL (estimated)</u>
		184,269	100,971	12,443	355,083	652,766
K-212	6.1	166	11	585	83	845
K-213	9.7	74	6		85	165
K-215	5.2	552	460		230	1,262
K-216	5.0	630	230		728	1,638
K-217	5.9	447	903		490	1,840
K-218	6.5	728	10	1,056	490	2,284
K-219	Q.+C. 4.7	316			390	706
K-220	8.0	561	8		455	1,024
K-221	7.0	248	236		170	694
K-222	8.2	625	404		792	1,821
K-223	4.5	926	7	940	2,504	4,377
K-224	6.4	104	11	191	62	368
K-225	5.6		7		23	30
K-226	10.0	270	13	184	120	587
K-227	9.1	354	7	1,455	965	2,781
K-228	5.7		5		16	21
K-229	6.8	92	11	111	28	242
K-230	7.75	274	8		110	392
K-231	6.8		11		37	48
K-232	3.9	12			13	25
K-233	7.0	259	19	840	402	1,520
K-234	4.7	179	7		255	441
K-235	6.8	489	11	644	639	1,783
K-236	5.6	230	12	148	220	610
K-237	6.7	515	8	773	475	1,771
K-238	7.2	314	9	349	380	1,052
TOTALS:		192,634	103,485	19,719	365,245	681,083

<u>Krukoff No.</u>	<u>% Q. S.</u> <u>Mother tree</u>	<u>Plants in</u> <u>Lower</u> <u>Nursery</u>	<u>Plants in</u> <u>Esterlina</u> <u>Nursery</u>	<u>Plants in</u> <u>Pump</u> <u>Nursery</u>	<u>Plants in</u> <u>Seedbeds</u>	<u>TOTAL</u> <u>(estimated)</u>
(carried)		192,634	103,485	19,719	365,245	681,083
K-239	4.1	75	9		143	227
K-240	6.9	186	13	249	150	598
K-241	7.8	584	11		330	925
K-242	5.3	1,023	9	1,457	869	3,358
K-243	4.6	96	6	283	455	840
K-244	6.0	303	11	377	200	891
K-245	5.2	755	6		548	1,309
K-246	5.4	226	5	263	140	634
K-247	3.4	97		148	295	540
K-249	5.3	374	12		250	636
K-250	3.7	86	9		205	300
K-252	5.3	305	5	915	570	1,795
K-254	3.4	159	9	263	55	486
K-255	5.2	476	9	621	554	1,660
K-301	6.6	46	10		45	101
K-302	5.8	38	11	81	31	161
K-303	5.7				8	8
K-325		23				23
K-411		23				23
K-501	7.2	460	11	448	85	1,004
K-502	5.0	1,984	1,030		120	3,134
K-503	5.1	401	554		242	1,197
K-504	4.1	264	6		1,064	1,334
K-506	7.3		7		23	30
K-507	5.1	557	11	1,005	661	2,234
K-509	4.0	333	8		890	1,231
TOTALS:		201,503	105,247	25,329	373,178	705,762

<u>Krukoff No.</u>	<u>% Q. S.</u> <u>Mother tree</u>	<u>Plants in</u> <u>Lower</u> <u>Nursery</u>	<u>Plants in</u> <u>Esterlina</u> <u>Nursery</u>	<u>Plants in</u> <u>Pump</u> <u>Nursery</u>	<u>Plants in</u> <u>Seedbeds</u>	<u>TOTAL</u> <u>(estimated)</u>
(carried)		201,508	105,247	25,329	373,178	705,762
K-510	5.6	2,034	783		67	2,884
K-511		92		106	45	243
K-512	3.2	320			285	605
K-514	4.9	96	12		195	303
K-515	6.4	416	14		15	445
K-516	3.7	324	10		100	434
TOTALS:		204,790	106,066	25,935	373,885	710,676

Finca "El Naranjo"
September 22, 1941

F. Rosengarten Jr.

A. Hartleben

To supplement the accompanying data, it will be observed that at this time we have on hand the following Krukoff seedlings at Naranjo. (Apart from the 6,438 planted out in the field during 1941).

In Seedbeds (estimated) -----	373,885
In Lower Nursery at 3" x 3" -----	150,346
In Lower Nursery at 6" x 6" -----	54,444
In Esterlina Nursery at 6" x 6" -----	106,066
In Pump Nursery at 6" x 6" -----	25,935

TOTAL (estimated):	710,676

It is proposed to treat these seedlings in the following fashion:

(A) October 6, 1941. The 10,775 Krukoff seedlings in Seedbed 20 will be moved to the Pump Nursery at 6" x 6", to make room for Original Ledger seedlings which will be brought to this bed and transplanted at 1 1/2" by 1 1/2", after the soil in this bed has been changed.

(B) October 15 - November 15, 1941. During this period, the plants that are at 3" by 3" in the Lower Nursery will be "entre-sacado"; that means that of the 150,346 plants at 3" by 3", 112,760 will be removed leaving the remainder, or 37,586 at 6" by 6". Then 8,000 of these 112,760 will be planted at 6" by 6" in another part of the Lower Nursery (Section K). This leaves 104,760 still to be transplanted; of these 104,760, 28,000 will be planted in the Lower Nursery Section K at 3" by 3"; the remaining 76,760 will be moved to the Pump Nursery at 6" by 6".

(C) From November 15 to December 15, 5,000 plants will be taken from the seedbeds and planted at 6" by 6" in the Esterlina Nursery, bringing the total for that Nursery up to 111,000 Krukoff seedlings at 6" by 6".

Thus on December 1, 1941, our Nursery Set-up should be as follows:

In Esterlina Nursery at 6" by 6" -----	111,066
In Lower Nursery at 6" by 6" -----	100,030
In Pump Nursery at 6" by 6" -----	113,470

1.e. TOTAL at 6" x 6",	324,566
Dec. 1, 1941	

In addition, we should have 28,000 Krukoff seedlings at 3" by 3" in the Lower Nursery, and 358,110 Krukoff seedlings in the Seedbeds on that date.

(D) From December 1 to January 15, an estimated 50,000 Krukoff seedlings in the Seedbeds of 3" in height and over will be transplanted to the Pump Nursery at 6" by 6". Another 28,000 will be moved to the Lower Nursery Sections A and L at 6" by 6".

(E) During January, February and March, an additional 70,000 Krukoff seedlings will be moved from the seedbeds to the Pump Nursery. Let us assume 40,000 will be planted at 6" by 6"; 30,000 at 3" by 3". In addition, 20,000 more seedlings will be moved to Section K of Lower Nursery at 3" by 3".

(F) In May the 28,000 at 3" by 3" in Section K of the Lower Nursery (which will have been there since October) will be "entre-sacado"; leaving 7,000 plants in the Lower Nursery at 6" by 6"; the remaining 21,000 plants will be moved to the Pump Nursery at 6" by 6".

On May 10, 1942, therefore, our Seedbed and Nursery set-up should be as follows: (not allowing for losses).

In Esterlina Nursery at 6" by 6" -----	111,066
In Lower Nursery at 6" by 6" -----	135,030
In Lower Nursery at 3" by 3" -----	20,000
In Pump Nursery at 6" by 6" -----	224,470
In Pump Nursery at 3" by 3" -----	30,000
In Seedbeds -----	190,110

TOTAL: 710,676

To be on the safe side, however, we should at this point allow for a 5% loss of all Nursery material, and a 10% loss of all Seedbed material. Thus on May 10, our actual set-up, including probable losses, should be as follows:

In Esterlina Nursery at 6" by 6" -----	105,513
In Lower Nursery at 6" by 6" -----	128,278
In Lower Nursery at 3" by 3" -----	19,000
In Pump Nursery at 6" by 6" -----	213,246
In Pump Nursery at 3" by 3" -----	28,500
In Seedbeds -----	171,099
	665,636

Of this total, the following, according to Don Jorge Benitez should be ready to be planted out in the field in May, June 1942:

From Esterlina Nursery (at 6" by 6")	105,513
From Lower Nursery (at 6" by 6")	101,678
From Pump Nursery (at 6" by 6")	62,000 *

TOTAL KRUKOFF SEEDLINGS READY TO BE PLANTED OUT IN FIELD MAY, JUNE 1942. 269,191

* This 62,000 made up from the plants in Section B of Pump Nursery which were already there in September 1941 at 6" by 6", plus remainder from the largest of 76,760 moved to Pump Nursery, October 15, November 15, 1941.

After the planting p to the field areas in May, June 1942 is completed, we should have the following Krukoff material remaining in the Seedbeds and Nurseries:

In Lower Nursery at 6" by 6" -----	26,600
In Lower Nursery at 3" by 3" -----	19,000
In Pump Nursery at 6" by 6" -----	151,246
In Pump Nursery at 3" by 3" -----	28,500
In Seedbeds -----	171,099
TOTAL:	396,445

From among the 151,246 in the Pump Nursery at 6" by 6" and the 26,600 in the Lower Nursery at 6" by 6", it is expected that an additional 70,000 will be large enough in September 1942 to be planted out in the field at that time.

To recapitulate, we should have the following Krukoff plants available to be planted out in the field at the following dates:

May-June 1942	269,191
September 1942	<u>70,000</u>
	<u>339,191</u>

At Finca Panamá we have in addition approximately 20,000 Krukoff seedlings in nursery stage; it might be best to bring to Naranjo for planting in the field in June-September 1942 the Krukoff seedlings in this group from the highest yielding mother trees (i.e. over 5% Q.S.). The remainder could then be given to co-operators to try out zones of interest etc.

The total Krukoff seedlings brought to Naranjo from Panamá in June-September 1942 will be so small, however, that it would seem more prudent not to add these plants to the 339,191 we expect will be ready for field planting at Naranjo in June-September 1942, but rather consider these plants as additional insurance against inevitable losses in the total of 339,191.

In addition to these 339,191 Krukoff seedlings, we will have approximately 5,000 other plants to be planted in the field in 1942 (including grafts from "Loja" and "Los Andes", Malay States Ledger seedlings etc.).

Thus we may count on approximately 344,000 plants as being available to be planted out in the field at Naranjo in 1942.

Land is already being prepared to receive this total.
1 1/2 caballerías of virgin forest between 5,300 and 6,300 ft. have been opened up, according to the plan formulated in January 1941.
1 caballería of cafetal between 3,800 and 5,300 ft. is being prepared.

In the 1 1/2 caballerías of virgin land, if we plant at 5 foot centers, we find that theoretically there should be space for 1,742 trees per acre. Discounting 25%, however, for terrain that is incapable of being used because of lying in barrancos, holes lost on account of fallen trees etc., we find we can count on 1,306 trees per acre in this region. In 186 acres in the caballería and one half, we have space, therefore, for 216,706 trees at 5 foot centers.

In the caballería of cafetal, we can count on 1,655 trees per acre at 5' by 5', or space for a total of 183,705 trees.

THEREFORE: in 1 1/2 caballerías of virgin land at 5' by 5'	216,706 trees
in 1 caballería of cafetal at 5' by 5'	183,705 trees

So in area opened up for 1942, we have space for	400,501 trees
	at 5 foot centers.

However, as noted previously (bottom of page 10) we calculate we will have only 344,000 plants ready to be planted in the field in 1942. Consequently, space for 56,000 plants will be held in reserve (probably in the cafetal) as a margin of safety for 1942's planting; of course, this unused space can always be used to advantage for 1943's plantings.

* The loss of 25% of total holes that theoretically should be used in an acre of virgin land at Naranjo may be explained as follows: when the terrain was measured, parts of barrancos were included that will not be used for planting. So while the actual loss of holes in each acre that is used will be probably only 10%, the total loss in the 1 1/2 caballerías has the effect of being 25% per acre. (to the best of our knowledge).

Regarding our nursery space: we have available at the following nursery areas in Naranjo the following space available for seedlings; losses of space on account of drains, posts, etc. already have been deducted from the totals:

Lower Nursery (not including Section J)	35,130 sq.ft.
Lower Nursery Section J (Succirubra)	3,333 sq.ft.
Grafting Nursery (for Succirubra)	17,560 sq.ft.
Esterlina Nursery	27,750 sq.ft.
Pump Nursery	138,114 sq.ft.

TOTAL:	221,687 sq.ft.

The Pump Nursery is divided into 9 separate sections, A to I inclusive.

Section A, (area 37,436 sq.ft.) will be set aside for Succirubra stock to be planted at 10" by 10". 53,900 Succirubra can be planted here. This section is especially suitable for a grafting plot, as it is the dampest portion of the Pump Nursery.

Section I, according to Don Jorge Benitez, is the choicest portion of the Pump Nursery. Containing 37,324 square feet, it will be reserved for Ledger seedlings and the most valuable Krukoff classes. There is space in this section for 149,296 plants at 6" by 6". In all probability, 75,000 Krukoff seedlings will be planted here at 6" by 6"; the remainder of this section will then be reserved for Ledger seedlings at 3" by 3" and 6" by 6".

The remaining sections B - H inclusive, excluding a portion of B that already contains 25,935 Krukoffs, have a total usable area of 63,384 sq. ft. and will be devoted exclusively to Krukoff seedlings during the next twelve months.

The Pump Nursery, therefore, has the capacity for the following plant material:

Section A	53,900	Succirubra at 10" by 10"
Sections B-H inclusive	279,351	Krukoffs at 6" by 6"
Section I	75,000	Krukoffs at 6" by 6"
Section I	74,296	Ledgers at 6" by 6"

Of course, if the planting distance of any of the above types is decreased, the total plant capacity of the nursery increases. (This would refer to Krukoffs and Ledgers, some of which might be planted first at 3" by 3" and later "entresacado" to 6" by 6", depending on their future growth. Also to Succirubras which might first to be planted at 5" by 5" and later "entresacado" to 10" by 10".

Succirubra

We have at present in Naranjo space for the following Succirubra to be used for grafting purposes and planted at 10" x 10".

Graft Nursery (between Lower Nursery and Esterlina Nursery)	25,000
Lower Nursery Section J	4,800
Pump Nursery A	53,900
TOTAL:	83,700

83,700 Succirubra plants should be more than adequate for the grafting material which will be available to us during the next 18 months.

At the end of twelve months, we plan tentatively to devote the Esterlina Nursery, which should then be completely empty (all the Krukoffs there now at 6" by 6" having been planted out in the field), to Succirubra Stock for Grafting Purposes. An additional 39,960 Succirubra can be planted here at 10" by 10".

Our grafting from now on will be discontinued as far as the "Loja" Nursery is concerned, until further notice.

It will be centralized in the damp "Graft Nursery", Pump Nursery Section A, and Lower Nursery J.

The "Loja" Nursery suffers from the major disadvantage of having no available water for irrigating purposes.

Ledger Seedlings

At the end of 12 months, we plan tentatively to devote the Lower Nursery, which by that time should have at least 25,250 sq.ft. available for other plants (101,000 plus of the Krukoffs which were at 6" by 6" having been moved to the field) to Ledger Seedlings. Before the Ledger Seedlings are planted in this Nursery, new soil will be placed in it.

We also will have available for sowing activities with Ledger seeds during 1942, the odd seedbeds. (New soil having been placed here also).

Thus after October 1942, we should have space for:

101,000 Ledger seedlings at 6" by 6" in Lower Nursery.

74,296 Ledger seedlings at 6" by 6" in Pump Nursery.

175,296

I. e., in October 1942 we should have space for 175,296 Ledger seedlings in the Nurseries at 6" by 6" not counting available seedbed space.

In the latest count of Ledger seedlings made at Naranjo in September, we have an estimated 230,183 seedlings from the choicest available Samac and Helvetia seed. The seedlings are from two to six months of age, from date of sowing. Undoubtedly this total will decrease substantially by October 1942.

There should also be space available in October 1942 for a total of 354,000 Krukoffs in the Pump Nursery. It is highly improbable that we will have over 225,000 Krukoffs at the most on hand at that time. Consequently, space we did not need for Krukoffs in the Pump Nursery could be devoted to additional Saccirubra Nursery space for Grafting Purposes.

From the above, it seems clear that we have at present in Naranjo sufficient prepared Seedbed and Nursery space to satisfy our needs until at least the end of 1943, in view of the present material available to us.

Field Areas.

In 1942, the choicest portions of the field areas available for planting will be reserved for the Krukoff seedlings from the highest yielding mother trees.

We calculate at present, that after the 2 1/2 caballerías originally planned for 1942's field planting have been used, we will have available for future field plantings at Naranjo:

Between 3,800 and 5,300 ft. (coffee land)	260 acres
Between 5,300 and 6,300 ft. (virgin land)	90 acres
Between 6,300 and 7,300 ft. (virgin land)	140 acres

TOTAL:	490 acres

Besides these 490 acres, we will have for 1943 and the following years the part of the cafetal that will not be used in 1942's plantings; i.e. about 34 acres, or space for 56,000 trees at 5' by 5'; or 86,000 trees at 4' by 4'.

Thus in these 490 acres, if we plant at 4' by 4': in the cafetal (260 acres) we could count on 2,500 trees per acre or 650,000 trees; in the virgin land, (230 acres), we could count on 2,200 trees per acre or 506,000 trees; i.e. a total in 490 acres at 4 foot centers of 1,156,000 trees.

Or if we plant at 5' by 5' in these 490 acres: in the cafetal (260 acres), we could count on 1,655 trees per acre or 430,300 trees; in the virgin land (230 acres) we could count on 1,306 trees per acre or 300,380 trees; i.e. a total in the 490 acres at 5 foot centers of 730,680 trees.

So if we plant at 4' by 4', we should have space at El Naranjo for 1,241,000 trees in 1943 and the future; if we plant at 5' by 5' we should have space at El Naranjo for 736,680 trees in 1943 and the future.

For field plantings in 1943, with our present material we could not possibly have as many as 730,000 trees to go out in the field including Krukoffs, Lodgers and grafts. It is unlikely we will reach this total even including 1944's field plantings.

In conclusion, therefore, we can safely state that we have sufficient land at Naranjo to satisfy our Seedbed, Nursery and Field Planting needs, until at least 1944, and in all probability until January 1, 1945.

Fincas "El Naranjo"
September 22, 1941

F. R. Jr.

F. R. Jr.

Dr. Popenoe

NOTES TO ADD TO REPORT ENTITLED "Status of Krukoff Seedlings",
(as of September 22, 1941).

Of "very promising" Krukoff seedlings from mother trees
over 5% Q. S. (& including K-200), we find the following:

In Lower Nursery	81,147
In Esterlina Nursery	39,092
In Pump Nursery	19,724
In Seedbeds (estimated)	54,267

(estimated) ... Total: 194,230

Of this total of 194,230, we already have planted at
6" by 6" at Naranjo, 85,102 "very promising" Krukoffs, in the
following fashion:

In Lower Nursery at 6" by 6"	26,286
In Esterlina Nursery at 6" by 6"	39,092
In Pump Nursery at 6" by 6"	19,724

Total "very promising" Krukoffs
already at 6" by 6". 85,102

Thus in Lower Nursery we still have 54,861 "very promising"
Krukoffs at 3" by 3". These will be "entresacado" from October 15
to November 15, leaving 13,715 at 6" by 6" in the Lower Nursery;
the remainder, or 41,146 will then be moved to the choice Section I
of the Pump Nursery at 6" by 6".

From Dec. 1, 1941, to January 15, 1942, as many as possible
of the estimated 54,267 "very promising" Krukoffs in the Seedbeds
will also be moved to Section I of the Pump Nursery at 6" by 6".

Finca "El Naranjo"
October 13, 1941.

F. R. Jr.

Grafting Totals of Grafts made in 1941

(According to latest count)

At Merck Area, Los Andes, Panamá; April, May, 1941.
(Original Ledger cuttings and other material).

<u>Grafter</u>	<u>Attempts</u>	<u>Dead</u>	<u>Living</u>	<u>% of Success</u>
Benitez	711	432	279	39
Castañeda	1,345	944	401	30
R. Cuellar	847	528	319	38
Fernandez	1,021	773	248	24

At Merck Area, Los Andes, Panamá, July, 1941.
(Original Ledger cuttings and other material)

R. Cuellar	522	208	314	60
Castañeda	523	126	397	76
Fernandez	517	146	371	72
Medina	398	157	241	61
Castañeda	585	318	267	46
R. Cuellar	360	198	162	45
Benitez	232	104	128	55
Fernandez	545	328	217	40

At "Loja", Naranjo, May 1941.
(High-yielding material from Finca Samac, Cobán).

Benitez	922	241	681	74
Fernandez	488	174	314	62

At "Loja", Naranjo, May, June and July, 1941.
(High-yielding material from Helvetia, Loja & Zapote).

Fernandez	1,292	844	448	35
Benitez	1,627	630	997	61
Castañeda	161	71	90	56
Benitez **	305	52	253	83
R. Cuellar	19	11	8	42

** Note: among Benitez's grafts in this particular group, we find;
H-1239 (17.8%) 46 4 42 91
H-1196 (16.1%) 10 1 9 90

Grafting averages of Individuals.

<u>Grafter</u>	<u>Attempts</u>	<u>Dead</u>	<u>Living</u>	<u>% of Success</u>
Benitez	3,797	1,459	2,338	62
Medina	398	157	241	61
R. Cuellar	1,748	945	803	46
Castañeda	2,614	1,459	1,155	44
Fernandez	3,863	2,265	1,598	41

Grafting averages of Locations.

"Los Andes", Panamá	7,606	4,262	3,344	44
"Loja", Naranjo	4,814	2,023	2,791	58

Total average of grafts thus far in 1941.

12,420	6,285	6,135	49
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Finca "El Naranjo"
September 30, 1941.

F. R. Gr.
F. R. Gr.

c.c. Mr. Lukens,
Dr. Popenoe, ✓
Mr. F.W. Owen Smith,
Mr. Pennock,
Mr. Benitez,
Naranjo files.

NOTES ON

ERYTHRINA.
FICUS.
PAPAYA.
RYANIA.
OITICICA.
STRYCHNOS TOXIFERA.

c. c. Mr. Perkins.
Mr. Lukens.
Dr. Popenoe.
Dr. Krukeff.
Naranjo files.

October 29, 1941.

ERYTHRINA.

A good survey has been made. We know we want *E. Berteroana*. Commercial shipment may contain 1% of alkaloid in which we are interested. Variation .3 to 2%. We don't yet know why.

Erythrina Program.

- (1) Make analyses to get selections.
- (2) Make experimental plantings at various altitudes with cuttings from selected trees.

With regard to (1); R. P. L. to ask Folkers for (A) analyses of samples already tested, and (B) How many samples can Folkers handle in 1942, as we can easily supply him in March, April with 30 from Naranjo, 5 from Antigua, 5 from El Salto, and 5 from Yepocapa. If necessary more.

R. P. L. will get assays from Folkers in November and let F. R. Jr. know which are best trees. W.B. Davies' and Owen Smith's records as to locations of these trees. Once F. R. Jr. is advised, he will take Benitez to best trees, get cuttings and bring them to Naranjo to be placed in Nursery. These could then be placed in field at 24 ft. by 24 ft. in rainy season. Benitez feels better to place Erythrina cuttings in nursery during dry season, (November to March); during rainy season they can go directly to field.

Samples will be taken in March, April according to request of Folkers. Samples will average 100-200 grams. Carefully tagged. Beans spread in room for week and then sent in linen bags with labels. Bean should have black speck.

Later, Erythrina cuttings can be planted out at 24 ft. by 24 ft. at different elevations. 5000 ft. at Loja, El Naranjo. 3,800 ft., Naranjo proper. 2400 ft., Rynia property, if it is purchased. 910 ft., Manuel Herrera.

We can count on 10 to 25 cuttings from each mother tree.

Cuttings from known Smith mother trees will go to nursery at Naranjo in December or January, and then to field in rainy season.

Cuttings from best mother trees sampled in March, April 1942 can be placed in field in September, October 1942.

An important question with regard to Erythrina. How does yield per tree per year vary at different elevations?

B. A. K. to devise Individual Tree Record for Erythrina.

FIGUS AND PAPAYA.

A meeting was held at El Salto on October 27, 1941, between Messrs. Lukens, Krukoff, Bellamy and Rosengarten.

Messrs. Lukens, Krukoff and Rosengarten had agreed before hand that El Salto, having an excellent start on ficus (glabrata), this location would be best suited for the continuation of the experimental work.

El Salto enjoys the following advantages:

1. Convenience to Guatemala City.
2. Good roads.
3. Willing cooperation.
4. 200 trees about 25-30 ft. tall. Very husky. Healthy. Soil well adapted. Favorable elevation. Can irrigate. Trees 4-5 years old.
5. Power and manufacturing facilities.
6. Water power suggested (Pelton wheel).
7. Additional wild ficus glabrata available at El Salto.

Bellamy willing to put 40-50 acres in ficus. Has approval of his company. Areas to be selected can be irrigated. Bellamy is also willing to make experimental plantings of Papaya.

R. P. L. to consult research on yields and work out steps for pilot plant.

Bellamy to supply land for experimentation.

Merck to supply:

1. All necessary equipment and installations.
2. Pay for all labor.
3. Return any building to its original state.
4. Equipment to remain property of Merck & Co.

Bellamy to take ficus cuttings from best of present trees and propagate; merely a few cuttings to see how easily ficus can be propagated by cuttings. Bellamy will also start cropping experiment to determine annual yield of leaves per tree. Note also damage to tree. He may possibly take all leaves from one tree and weigh. (Weight guessed at 300 lbs.).

R. P. L. to approach Stevenson for 25 Radula cuttings for Bellamy to propagate.

If we estimate at 25 foot centers, 70 trees per acre; then in 50 acres, we get 3,500 trees. If each tree yields 300 lbs. of leaves per year, then under above conditions we could get 1,050,000 lbs. of leaves per year.

Bellamy to start seed garden for wild papaya now at El Salto.

Rosengarten to approach Dr. Popence to get papaya seeds from Jamaica. Failing this, Bellamy has contact there. Dr. Krukoff will also supply seeds of certain types of papaya.

If above program is acceptable, Bellamy to be advised and will start at once. R. P. L. to work out informal contract. For pilot plant operation, ficus glabrata and common papaya. But propagate experimentally ficus radula and other papaya from B.A.K. and W. Popence.

Important Ficus question. Do we need to irrigate?

RYANIA.

For background see B. A. Krukoff's letter of Oct. 1, 1941. Although Rynia is a small tree confined to the lowest storey of the forest in Trinidad, after considering the situation of the Guatemalan soils, W. Popenoe declared that he did not know of any tropical lowland plant which would not thrive on the Pacific coast of Guatemala, between 1500 and 2500 ft., in the region above Chicacao and Mazatenango. Accordingly, although at first the Puerto Barrios and Motagua regions of Guatemala had been considered for Rynia, the opinion seemed to change in favor of the Pacific coast, especially in view of the question of supervision which would be quite a problem with our present set-up if the Rynia experiment were carried on in Quirigua, whereas on the Pacific coast it would be relatively easy.

There is a property for sale at an elevation of 2400 ft., between Castaños and Chicacao. It is only 15 minutes by car from Naranjo. It lies about 800 yards off the main road between Naranjo and Chicacao, directly below Castaños. It contains 17 to 18 acres. About one half of the property is very flat, and could easily be adapted for seedbeds and nurseries on a relatively large scale. The sloping portion of the property is cafetal. There are some bananas on flat portion. These materials would greatly facilitate construction of seedbeds and nurseries. The cafetal has the additional advantage of having large shade trees already growing in it. The question of shade is of utmost importance in our development of Rynia. The soil is similar to that of Naranjo. There is a good public road leading into property from main Naranjo-Chicacao road. There is no shortage of water, as there are two sources, (1) Toma or ditch which carries water from Castaños. Water from this toma could easily be taken to flat area of property, which is only slightly above it. (2) A river flows about 100 ft. below level portion of property.

On this property there is a fairly good house, with a lamina roof. Also 2 ranchos. A mozo who formerly worked for Hoehn and who is most reliable lives next to property; his services could be obtained very cheaply. In addition, in case property is obtained, Julio Fernandez might be brought over from Panamá to live in house.

Property could be obtained in about two months for from \$1,600 to \$1,700 from man named Fernandez, who lives in Chicacao.

Chief advantages of property:

(1) Dr. Popenoe states he does not know of any tropical lowland plant which would not thrive here. Incidentally rainfall is considerably higher at 2400 ft. than at 1000 ft. on Pacific coast of Guatemala.

(2) Convenient supervision from Naranjo by Benitez.

(3) Shade test possible here at once.

(4) Reasonable price.

(5) Property has sufficient land for seedbed and nursery work, and also for field trial.

(6) Same type of soil as Naranjo.

(7) Adequate water supply.

(8) House already built on property.

(9) Experiments with Erythrina, Cinchona, Strychnos toxifera etc. could also be carried out here. For example, if Cinchona did well here, it would mean all land between this property and Naranjo might be worth considering in several years when we expand Cinchona field planting operations.

B. A. Krukoff will send a trial shipment of seeds from Trinidad if possible, in November 1941. Failing this, he will send down 20 small *Ryania* plants from New York in December, so Benitez can familiarize himself with *Ryania* before large scale operations with this plant commence.

If *Ryania* property near Naranjo is purchased, presumably seedbed and nursery operations will be concentrated in said property. Small experiments, presumably with seedlings, could also be carried out near Quirigua with Fruit Co., also in Lancetilla with Stanwood.

If *Ryania* property is obtained, we will expect large shipment of *Ryania* seeds in Guatemala about (?) March or April 1942.

Oiticica. (*Licania Rigida*) 5 plants.

These plants will be brought to Naranjo in first week of November, 1941. Benitez will pass them to larger pots. Then in 6 weeks, 2 months these will be taken to Velásquez, altitude 910 ft., and given to Manuel Herrera. By oral agreement, or an exchange of letters it will be arranged that later on we will have right to 1/2 seeds and cuttings of these trees.

Licania Rigida is a competitor of tung oil. Recently introduced to New York market and favorably received. Far eastern planters are interested in this. It comes from dry belt in Brazil. Piahy, Maranhao. Below 500 ft.

Very large tree with well developed crown.

Fruits give oil, reputed superior to tung oil.

A hardy plant. Should not be watered too heavily.

Strychnos toxifera. 13 plants.

These plants will be brought to Naranjo in first week of November, 1941. Benitez will pass them to larger pots, and keep them at Naranjo until we obtain *Ryania* property.

Strychnos toxifera is a very rare plant. From interior of British Guiana. Not even found in Georgetown Botanical Garden. Thrives on *Ryania* elevation. Woody vine. Very large. At first erect shrub. Bark of vine is used. Contains active principle of best type of curare.

These plants require much more water than the *Oiticica*.

GINCHONA NOTES.

c. c. Mr. Perkins.
Mr. Lukens.
Dr. Popenoe. ✓
Dr. Krukoff.
Naranjo files.

October 29, 1941.

Following a general survey of fincas El Zapote, Helvetia, Patzulín, Panamá and Naranjo, Messrs. Lukens, Popenoe, Krukoff and Rosengarten gathered on October 23, 1941 at Naranjo. A summary of the most outstanding points decided on in this meeting, including several matters that had been discussed earlier in the week, follows:

To simplify the Cinchona program, let us divide it into two headings: (A) Research, and (B) General Program apart from Research.

(A) Research.

1. Root-stock problem.
2. Grafting problem.
3. Fertilizing problem.
4. Can hybrids be propagated successfully by cuttings?
5. Cover Crop problem.
6. Seed-garden problem.
7. Bark-sampling problem.
8. Miscellaneous experiments.

A-1. Root-stock problem. It was agreed that at this time we have the following likely sources of root-stock material for grafting purposes: (Qualities desired in root-stock being (A) Vigor, and (B) Average Quinine content of 3-4%).

1. Succirubra already growing in Guatemala.
2. Hybrids already growing in Guatemala.
3. Wild Cinchona from Costa Rica.
4. Succirubra from Ecuador.
5. Succirubra from Belgian Congo.
6. (Krukoff Calisaya).

Succirubra already growing in Guatemala: 30 to 40 of these will be bark-sampled by Mr. Rosengarten. Trees to be sampled will be chosen on basis of (1) Vigor, and (2) Being apparently pure Succirubra types. Samples will be taken from trees in various portions of Guatemala. Seed will be collected from these same trees.

Hybrids already growing in Guatemala: A few grams of seed of Original Key Tree at El Zapote will be sown (kindness of Mr. L.L. Pettersen). Also a few grams of seed of H-2492 will be sown.

Wild Cinchona from Costa Rica: In middle December, 1941, Mr. Rosengarten will make a trip to Costa Rica to (1) Take bark samples of representative trees of this variety, (2) Collect seed from trees bark-sampled, (3) Collect, if possible, a few botanical specimens of these trees.

Succirubra from Ecuador: Dr. Popenoe will arrange with contacts in Ecuador that seed be sent to Guatemala.

Succirubra from Belgian Congo: Dr. Krukoff will arrange with contacts in Belgian Congo that seed be sent to Guatemala.

(Krukoff Calisaya): The employment of this material as root-stock for grafting purposes will depend, of course, on the vigor seedlings show in future.

(A-2). Grafting Problem. It was noted that success in grafting depends on, in general: (1) Inherent ability of scion, (2) Skill in grafting, (3) Extent of losses subsequent to grafting. Certain clones apparently lend themselves to grafting more readily than others. Ultimately, we shall undoubtedly have to concentrate our grafting on this type of material.

Dr. Popenoe kindly agreed to return to Naranjo in November or December and go over the problem of technique with Benitez in field. Especial attention will be given to the grafting method commonly used in Java, which is different from the method used by Benitez at present. Benitez's method is used in general in grafting of Cinchona in Guatemala today.

Hope was expressed that extent of losses subsequent to grafting would be reduced by placing grafting nurseries in more favorable locations.

A-3. Fertilizing Problem. It was agreed that pure Ledger type grafts at Naranjo and Merck Area, Los Andes, would be fertilized on May 1, June 15, August 1, September 15 and November 1, 1942. Also Ledger seedlings at these two locations which show hope of survival. The reason for the application of this fertilizer will be to increase supply of high-grade grafting material. We have the following fertilizers on hand at present in Naranjo: *

Sodium Nitrate	600 lbs.
Amn. Sulfate	2000 lbs.
Pot. Sulfate	1600 lbs.
Conc. Super Phosphate	1000 lbs.

To make 100 lbs. mixed fertilizer containing

N	K ₂ O	P ₂ O ₅
10%	5%	5%

mix Sodium Nitrate 30 lbs.; Amn. Sulfate, 25 lbs.; Pot. Sulfate, 10 lbs.; Conc. Super Phosphate 14 lbs.; Sand 21 lbs.

When Sodium Nitrate gives out, use this formula: Amn. Sulfate 50 lbs.; Pot. Sulfate, 10 lbs.; Conc. Super Phosphate, 14 lbs.; Sand, 26 lbs. (Kindness of R. P. L.).

It is clearly understood that this fertilizer program is of secondary importance to the main planting program, and should in no instance conflict with it.

* In addition to the above we have 900 lbs. Amn. Phosphate and 1250 lbs. Guano.

A-4. Can hybrids be propagated successfully by cuttings?
A straw house, Lancetilla style, will be constructed at Naranjo. A propagating box will be placed in it. Benitez will then experiment along this line. R. P. L. to send plant hormones and plant hormone literature from Rahway to Naranjo.

A-5. Cover crop problem: Dr. Popenoe to obtain from Lancetilla, Pueraria phascoloides, and Bolichos hosei. From Costa Rica, Centrosema pubescens.

A-6. Seed-garden Problem: During April 1942, one small seed-garden will be established with grafts of '38, placed in the field at Naranjo in 1939. These older grafts will be used in order to obtain seeds as soon as possible. Location will be chosen in region as far removed as possible from other Cinchona trees. Possibly an isolated portions of Moca, or Pacayal or some other carefully selected spot.

Seed-Garden A. April 1942.

H-1239 1 graft. Male. 17.8% Q.S. Wt. per sq. Cm. Gr., 0.14
H-1174 3 grafts, Female 10.7% Q.S. " " " " " " , 0.20

In addition, 2 other small seed-gardens will be established in April 1942, with grafts of 1940, planted out in 1941. These seed-gardens will also be place in isolated locations to be chosen with care by P. R. Jr.

Seed-Garden B. April 1942.

H-1229. 1 graft. Male. 13.2% Q.S. Wt. per sq. Cm. Gr., 0.17
H-1153 3 grafts. Female. 13.1% Q.S. " " " " " " , 0.17

Seed-Garden C. April 1942.

H-971 1 graft. Male. 11.3% Q.S. Wt. per sq. Cm. Gr., 0.16
H-1283 3 grafts. Female. 10.7% Q.S. " " " " " " , 0.14

These grafts are chosen as they should flower at the same time. In case of enlarging program at later date, material in each instance will be doubled. In 1942, however, our comparative shortage of material limits us to the above arrangement.

A-7. Bark-sampling Problem: First of all, an idea advanced by Mr. Pennock will be tested: i. e. that the quinine content of the root bark of a graft is increased when a high-yielding Ledgeriana scion is grafted onto Succirubra root stock. This idea is naturally of the utmost interest to us, for if it proves to be correct, we would then choose root-stock for grafting purposes solely on the basis of vigor, and not on quinine content. To check this theory, bark samples will be taken from (1) stem, and (2) roots, of two or three comparatively large grafts at El Nil, Helvetia. Careful notice will then be taken of the quinine content of the roots of these grafts, in comparison to stem bark of C. Ledgeriana scion.

Secondly, an effort will be made to determine how our present typical bark samples of stem of a given tree, compare to total average yield of said tree. This will be accomplished by first taking typical bark sample of a given tree; then uprooting tree and dividing total

bark obtained into 3 headings: (A) Root bark, (B) Stem bark, and (C) Branch bark. The weight of the bark of the roots, stem and branches will then be ascertained. Also, % Quinine Sulfate of each. Then it will be possible to make comparison between typical sample we take in Guatemala, and total average Q. S. yield of bark in same tree.

At present, due to limited material, we hope to study 2 seedling trees at El Mil (kindness of Mr. Davies), of let us say, 5 or 6% Q.S. Eventually when we have more adult trees we will follow same program more extensively.

The same program will be carried out on 2 hybrids at El Zapote (kindness of Mr. Pettersen), and 2 vigorous Succirubras of about 7 years of age.

A-8. Miscellaneous Experiments: It is planned to carry out altitude experiments with grafts in 1942 in the same manner as altitude experiments were carried out with Krukoff seedlings in 1941. The locations employed will be as follows:

Velasquez	910 ft.
Panamá	2000 ft.
Helvetia	3000 ft.
Huasibambita (Naranjo)	4000 ft.
Loja	" 5000 ft.
Chimborazo	" 6000 ft.
Aconcagua	" 7000 ft.
Mont Blanc	" 8000 ft.

Two classes of grafts will be used:

Z-A-G (7.2% Q. S.) (Wt. per Sq. Cm. Grams, 0.14)
H-1283-G (10.7% Q.S.) (Wt. per Sq. Cm. Grams, 0.14)

5 grafts pf Z-A-G, and 5 of H-1283-G will then be planted at each of the above locations. All grafts will be grafts made in 1941. In 4 to 5 years we should then be in a position to make some interesting comparisons with above material.

Finca "El Naranjo"
October 29, 1941.

F. R. Jr.

(B) General Program apart from Research.

1. Krukoff Nursery Program to be pushed according to F. R. Jr.'s report of September 22, 1941.
2. General Field Program same as F. R. Jr.'s report of September 22, 1941. The planting distance employed in 1942 will be 5 ft. by 5 ft. in both Krukoffs and grafts. In the case of grafts, it is felt more material will be able to be obtained from grafts in future if they are planted at 5 by 5, than if they were planted at 4 by 4, as far as 1942's field planting program is concerned. An effort will be made to obtain 150,000 stems of izote during the next few months. This izote will then be planted every 5 rows in the steepest portions of field plantings at Naranjo; i. e. places where erosion would be most likely to occur. This izote will then be a source of cuttings for future izote plantings at Naranjo.
3. Minimum size of Krukoff seedlings to be transplanted to field in 1942 will be 14".
4. Ledger Seedlings. For 1942 and until further notice, we will carry 100,000 Ledger seedlings up to Nursery position at 3" by 3" and 6" by 6". (Choosing healthiest, most vigorous, and purest types from seedbeds, and discarding weaklings and hybrids.). A few hybrids will be carried along for experimental observation.
5. During 1942, no charge will be made to co-operators for Krukoff seedlings with which to try out zones, etc.
6. Grafting Program for 1942 to be submitted by F. R. Jr.
7. Inventory to be prepared by F. R. Jr. in January 1942.
8. Budget to be prepared by F. R. Jr. in January 1942.
9. Julio Fernandez to go to Cobán end of January 1942 to collect seeds at Samac, according to careful instructions on seed-collection given to F. R. Jr., by B. A. Krukoff.
10. Further employment of photography for historical purposes.
11. Continue sowing enough Succirubra seeds every month to obtain 10,000 plants for grafting purposes.
12. Further experiments to be carried out at Cobán with W. E. Dieseldorff, George Koester, and Hempsteads, during 1942.
13. Bark-sampling campaign in March, April 1942 to be carried out at Helvetia and Zapote, with particular effort to get samples from mother trees at these two fincas, which have not yet been analyzed, and of which we have representative grafts at Naranjo.
14. Contacts will be maintained as suggested by Dr. Popenoe in September 1940.
15. Small experiments also to be made with Herreras in Zona Reina, and MacKinney in Tumbador during 1942.

Dr Popenoe

MANARANJO FIELD PLANTINGS

1941

ACONCAGUA

<u>Row No.</u>	<u>Class</u>	<u>No. of plants</u>	
1	P.I.118797	105	planted out May 1941.
2	K-13	95	planted out June 1941.
3	K-13	93	" " " "
4	K-13	96	" " " "
5	K-40	77	" " " "
6	K-40	78	" " " "
7	K-40	80	" " " "
8	K-40	43	" " " "
9	K-40	88	" " " "
10	K-40	70	" " " "
10	K-45	29	" " " "
11	K-45	98	" " " "
12	K-45	94	" " " "
13	K-45	92	" " " "
14	K-45	93	" " " "
15	K-45	6	" " " "
15	K-30	54	" " " "
15	K-33	29	" " " "
16	K-33	78	" " " "
17	K-7	16	" " " "
17	P.I.133017	24	planted out August 1941
17	K-35	49	" " " "
18	K-35	88	" " " "
19	K-35	88	" " " "
20	K-35	92	" " " "
21	K-13	30	" " " "
21	K-35	62	" " " "
22	K-35	24	" " " "
Total:		----- 1,871	

CHIMBORAZITO

<u>Row No.</u>	<u>Class</u>	<u>No. of plants</u>				
1	K-116	101	planted out August 1941.			
2	K-116	101	"	"	"	"
3	K-116	102	"	"	"	"
4	K-116	96	"	"	"	"
5	K-116	88	"	"	"	"
6	K-116	89	"	"	"	"
7	K-116	86	"	"	"	"
8	K-116	37	"	"	"	"
8	K-24	59	"	"	"	"
9	K-24	91	"	"	"	"
10	K-24	67	"	"	"	"
10	K-31	23	"	"	"	"
11	K-31	77	"	"	"	"
12	K-31	93	"	"	"	"
13	K-31	90	"	"	"	"
14	K-33	23	"	"	"	"
14	K-30	30	"	"	"	"
14	K-31	49	"	"	"	"
15	K-31	104	"	"	"	"
16	K-1	100	"	"	"	"
17	K-1	100	"	"	"	"
18	K-1	100	"	"	"	"
19	K-1	89	"	"	"	"
20	K-1	99	"	"	"	"
21	K-1	87	"	"	"	"
22	K-1	15	"	"	"	"
Total:		2,011				

LOJITA

Grafts

<u>Row No.</u>	<u>Class</u>	<u>No. of plants</u>	<u>planted out:</u>	<u>Row No.</u>	<u>Class</u>	<u>No. plants</u>	<u>out:</u>	<u>pltd.</u>
1	H-1068 G	4	July 1941	6	K-35	42	Aug. '41	
1	H-1105 G	3	" "	7	K-35	42	" "	
1	H-1155 G	17	" "	8	K-35	44	" "	
1	H-1103 G	16	" "	9	K-35	45	" "	
2	H-1103 G	3	" "	10	K-35	42	" "	
2	H-779 G	15	" "	11	K-35	39	" "	
2	H-938 G	21	" "	12	K-35	35	" "	
2	H-1076 G	4	" "	13	K-35	15	" "	
3	H-1076 G	2	" "	14	K-35	60	" "	
3	H-1077 G	2	" "	15	K-35	61	" "	
3	H-1190 G	11	" "	16	K-35	63	" "	
3	H-1051 G	8	" "	17	K-35	63	" "	
3	H-1176 G	9	" "	18	K-35	50	" "	
3	H-1198 G	12	" "	19	K-35	43	" "	
4	H-1198 G	25	" "	20	K-35	40	" "	
4	H-1152 G	19	" "	21	K-35	37	" "	
5	H-1152 G	5	" "	22	K-35	30	" "	
5	H-1244 G	6	" "	22	K-1	2	" "	
5	H-1168 G	3	" "	23	K-1	32	" "	
5	H-1207 G	1	" "	24	K-1	31	" "	
5	H-991 G	2	" "	25	K-1	52	" "	
5	H-891 G	7	" "	26	K-1	53	" "	
5	H-957 G	2	" "	27	K-1	51	" "	
5	H-1278 G	1	" "	28	K-1	52	" "	
5	H-1147 G	2	" "	29	K-1	52	" "	
5	H-1008 G	1	" "	30	K-1	52	" "	
5	H-1280 G	1	" "	31	K-1	52	" "	
5	Z-211 G	1	" "	32	K-1	52	" "	
5	H-1223 G	1	" "	33	K-1	53	" "	
	Total:	204		34	K-1	45	" "	
				35	K-1	45	" "	
				36	K-1	45	" "	
				37	K-1	44	" "	
				38	K-1	44	" "	
				39	K-1	44	" "	
				40	K-1	44	" "	
				41	K-1	44	" "	
				42	K-1	51	" "	
				43	K-1	51	" "	
				44	K-1	51	" "	
				45	K-1	51	" "	
				46	K-1	50	" "	
				47	K-1	51	" "	
				48	K-1	48	" "	
				49	K-1	8	" "	
				Total:		2,204		

HUASIBAMBITA

<u>Row No.</u>	<u>Class</u>	<u>No. of plants</u>	planted out August 1941			
1	K-1	5	"	"	"	"
2	K-1	17	"	"	"	"
3	K-1	24	"	"	"	"
4	K-1	33	"	"	"	"
5	K-1	34	"	"	"	"
6	K-1	34	"	"	"	"
7	K-1	33	"	"	"	"
8	K-1	34	"	"	"	"
9	K-1	36	"	"	"	"
10	K-1	36	"	"	"	"
11	K-1	15	"	"	"	"

Total:		301				

SEEDGARDEN # 2

<u>Row. No.</u>	<u>Class</u>	<u>No. of plants</u>						
1	H-1229 G	11	Planted out May & July 1941					
1	H-1213 G	1	"	"	"	"	"	"
1	H-1283 G	1	"	"	"	"	"	"
2	H-1283 G	4	"	"	"	"	"	"
2	H-1133 G	4	"	"	"	"	"	"
2	H-1153 G	5	"	"	"	"	"	"
3	H-1153 G	12	"	"	"	"	"	"
4	H-1153 G	2	"	"	"	"	"	"
4	H-971 G	3	"	"	"	"	"	"
4	H-866 G	1	"	"	"	"	"	"
4	H-1208 G	1	"	"	"	"	"	"
4	H-878 G	2	"	"	"	"	"	"
4	H-1229 G	2	"	"	"	"	"	"
4	H-1213 G	1	"	"	"	"	"	"
5	H-1213 G	8	"	"	"	"	"	"
Total:		58						

SUMMARY:

Acondagua	1,871 plants
Chimborazito	2,011 "
Lojita	2,204 "
Huasibambita	301 "
Seedgarden 2	58 "

Total planted out in field in 1941.	6,445

Antigua, Guatemala, 19 Novbr 1941

Mr. R.P. Lukens,
Merck and Co.,
Rahway, New Jersey.

Dear Mr. Lukens:

Since you left I have given some thought to the matters we discussed, particularly as set forth in Mr. Rosengarten's memo of 29 October entitled "Cinchona Notes" and I have paid another visit to Finca El Naranjo. I offer the following comments for what they may be worth to you:

In the first place, I desire to say that I think Dr. Krukoff's visit was extremely useful, and his suggestions and criticisms of the utmost value. I believe it would further our progress appreciably, and assist in keeping the work properly oriented, if he could spend a week in this region annually. His familiarity with Cinchona in the wild, and his wide knowledge of the literature, are unique. Further than this, I feel that his outlook is practical and sound.

Commenting now on the eight points included in the Rosengarten memo referred to above:

1. Root-stock problem. I have written to friends in Ecuador, asking them to get us seed of wild succirubras from that country. These seeds may be some time in arriving but I believe we shall get some eventually. I am giving Fritz letters of introduction to several friends in Costa Rica, including the Minister of Agriculture, and I feel sure there will be no difficulty in rounding up any material available down there. The people in Costa Rica have more to gain by getting seeds from you than by keeping you from getting any seeds available down there and they know it. I am particularly recommending that Fritz tie up with Luis Cruz, Director of Agriculture, who is

an energetic chap and can grease the wheels effectively. I have the feeling that the most likely source of interesting root-stocks is Ecuador, and I shall stay behind this until we bring together seeds from various regions in that country.

2. Grafting problem. It seems to me that our recent trip shed quite a little light on this. I have been going over the literature we have here in grafting technique in Java and elsewhere and do not believe the method used by Benitez differs materially. At the same time, I agree that we should carry out further experiments and I will give Benitez all the assistance I can in effecting these. I hope to visit Naranjo again about Christmas, and at that time would like to do some personal experimentation along this line, although the season will not be too good as it will be dry. We should be doing a little grafting every month, however, to see just what the seasonal effects may be. As far as I can see, Mr Pennock did not contribute anything to our knowledge of this subject and our progress of the last year is mainly this: We have seen at Helvetia that some of the Ledgers graft very successfully, even when the work is not done by experienced people, while others give much lower percentages of "takes". Condition of root-stocks, seasons, and experienced technique all come into play. Given varieties which graft readily, I am still of the opinion that we can do as good a job as they do in Java, when we have the root-stocks in prime condition and the season is favorable.

3. Fertilizer problems. We have not made the progress on this which we should have made during the present year, for which no member of the present staff is to blame. In any case, it takes time to get results from fertilizer experiments. I strongly recommend that we push forward with this work as rapidly as possible. I am

wondering if Mr Hoehn could not profitably take charge of certain experiments of this kind in the field? We could lay out some plots for him, prescribe the treatments, and leave him to carry out the applications and keep the records. I believe Hoehn is fully capable of this sort of thing and I suspect he would be glad to handle.

4. Can hybrids be propagated successfully by cuttings? This obviously falls in the bailiwick of Benitez, and I believe he can do a good job of it. I do not feel that we should place too much stress on the use of hormones and the like. Try them, but remember that in general they do not affect the fundamental results: they hurry things up a bit, but I doubt that we can expect them to make all the difference between success and failure. I would base the program primarily upon the work done at Bell, Maryland. This work will be particularly important with regard to hybrids such as H-2492 and several of the Zapote trees.

5. Cover crop problem. About three weeks ago I brought a batch of rooted cuttings of Pueraria phaseoloides from Lancetilla and Fritz took them down to Naranjo, where Benitez planted them; but they went into the ground just before a period of heavy rain and all of them have failed. I will try again as I believe this the most promising of all cover crops for Naranjo. I will try to get seed of Cenbrosama pubescens from Costa Rica. I believe we should follow up this line of work as we are likely to hit upon a good leguminous plant to keep down weeds in future field plantings.

6. Seed garden problem. The program outlined in the Rosengarten memorandum strikes me as excellent and I am strongly in favor of carrying it out.

7. Bark-sampling problem. If the quinine content of *succirubra* roots is increased by having a *Ledgeriana* top grafted on them I

feel pretty sure the folks in Java would have found it out by now. Maybe they have done so, and have not told us about it. Primarily because of this possibility I am in favor of investigating the matter. And I think it highly desirable to carry out the other investigation, i.e., determination of the ratio between standard bark sample as now taken by us here and total quinine content of all commercial bark produced by any given tree.

8. Miscellaneous experiments. Determination of the effect of altitude upon quinine content is basic information and I am strongly in favor of carrying out the experimental plantings suggested.

FINALLY, I would like to say that I feel the present situation at Naranjo wholly satisfactory and adequate to meet present requirements and I believe 1942 should see steady and satisfactory progress. And I would like to reiterate your statement that at present the only thing which experience has shown to be satisfactory for commercial plantings is grafted Ledger of varieties which combine (1) reasonably high quinine content with (2) ability to prepropagate readily by grafting. Pending further results with Ledger seedlings, hybrids, and Krukoff seedlings I feel we should place much emphasis on propagation of all Ledgers growing locally which have shown 10% quinine sulfate or above, weeding out as occasion demands those which do not give a reasonable percentage of "takes" - say 75% - when grafted under favorable conditions of root-stocks, season, and operator.

Yours sincerely,

Wilson Popence

cc Mr Frederic Rosengarten Jr.

Antigua, 20 Nov 1941

Mr Rosengarten:

Consideration of the grafting problem, it seems to me, must taken into account the following factors and possible a few others with which we are not yet familiar:

1. Other things being equal, some varieties or clones will give a much higher percentage of "takes" or successes than other varieties. We may find that this ranges from as low as 30 or 40% with varieties which are hard to graft, to 90% with those which are easy to graft. This is in line with horticultural experience with many other tree crops.

2. To obtain a high percentage of successes in grafting, cion wood must be as nearly ideal as possible. This means that the wood must be of the proper stage of ripeness; it must not be flowering wood; and it must be of the right diameter. I doubt that we are qualified, as yet, to choose ideal wood; but we know something about it and will know more with time. In much of the grafting work done to date, operators have used wood which they knew was not satisfactory, solely because we were anxious to propagate the clones just as rapidly as possible. Percentage of success have therefore been, in certain cases, lower than necessary.

3. Stock plants must be in prime condition; that is, they must be of the right stem-diameter, and in vigorous growth. If on unsuitable soil they can never be in prime condition; and if taken when too young or too old maximum success can not be attained. This also has been a factor in the past, when we have not always had an abundance of stock plants with which to work.

4. Weather conditions. With all nursery work there is a

seasonal factor. In the case of fruit trees which have been propagated for many years so that ample experience has been gained in any given region, grafting is usually limited to a certain season of the year. It has been found that higher percentages of success are possible if this is done. We do not yet know much about this in connection with *Cinchona*. Benitez believes, on the basis of his experience to date, that June-July is about the best time. When we have had further experience we will know more definitely how important is this factor, and can be guided accordingly.

5. Skill of operator. This is a factor with any kind of propagation. It is in part natural aptitude, and in part experience. It must be taken into account when evaluating results.

6. Losses subsequent to successful union of cion and stock. We have had more trouble from this angle than I would have expected, and I cannot explain it. Benitez says that many plants, after the cion has united with the stock and commenced to grow, suddenly collapse and die. This deserves investigation. I believe we can materially reduce losses of this sort. They may be due in part to wrong kind of cion wood; in part to unsatisfactory condition of the stock-plant; or to something we do not understand as yet. This is a point I would watch carefully.

Wilson Popenoe

cc Mr R P Lukens

Finca El Naranjo,
June 26, 1942.

Sr. Don Luis Cruz B.,
Director del Departamento de Agricultura,
San José de Costa Rica.

Dear Don Luis:

Enclosed please find the results of the samples of bark of the *Cinchona pubescens* I took in Costa Rica in December. Nos. 1 - 16 incl. were from the San Ramón region, and nos. 17 - 75 incl. were from the Zapote-Buena Vista region beyond Zarcero.

I am very sorry to have taken so long in advising you of these analyses, but war-time conditions were mostly responsible for the delay.

I have been authorized by the Export Control Branch of the Board of Economic Warfare of the United States to pass this information along to you; at the same time, I have been asked to request you not to disclose this information except as absolutely necessary in your operations.

Apparently the *C. pubescens* of Costa Rica, as indicated by these analyses is too low yielding to be of commercial value in itself. It is still possible this *C. pubescens* might be useful as a patrón in grafting *C. ledgeriana*, but this remains to be seen.

At least the presence of the wild *C. pubescens* in Costa Rica indicates that Costa Rica might have appropriate land for cultivating other higher yielding varieties of *Cinchona*.

We still hope to make a *Cinchona* experiment at Cuesta del Macho, but apparently the owner of the property there has no desire to sell. Antonio Bonilla in the meantime is studying the cultivo here at Finca El Naranjo, and is getting along very well.

Do drop me a line sometime and tell me how you are.

With kindest regards,

Sincerely yours,

F. Rosegarten Jr.
F. Rosegarten Jr.

c.c. Dr. Poppenoe

26 de Junio de 1942.

Dr Juvenal Valerio, R.,
Director del Museo Nacional
San José de Costa Rica.

Estimado amigo:

Adjunto sírvase encontrar los resultados de las 75 muestras de cáscara de la *C. pubescens* de Costa Rica que corté en Diciembre de 1941.

Números 1-16 incl. son de la región de San Ramón; #s 17-75 incl. son de la región Zapote - Cuesta del Macho - Buena Vista.

Tenga la bondad de perdonar la demora respecto de la llegada de estos analyses a Costa Rica. Siempre hay demoras así en tiempos de guerra.

El "Export Control Branch of the Board of Economic Warfare" de los Estados Unidos me ha autorizado a entregarle a Ud. esta información: al mismo tiempo, háganos el favor de considerarla como confidencial, es decir avisársela solamente a estas personas que podrían usarla para el bien de Costa Rica. Me refiero a su sugestión muy astuta que la gente en San Ramón, por ejemplo, se de cuenta del hecho de que no vale la pena cultivar la *C. pubescens* en aquellos terrenos, por el rendimiento bajísimo de la cáscara de esta variedad de Cinchona. Estaría agradecido si podría avisarle a don Antonio Ohrlich que las Cinchonas en San Ramón se encuentran en esta categoría, como se nota de los analyses.

Sin embargo, todavía es posible que la *C. pubescens* de Costa Rica podría usarse como patrón para la *C. ledgeriana*: o, como hemos discutido, que Costa Rica se prestaría al cultivo de las más finas clases de Cinchona.

Se van mermando nuestras posibilidades de conseguir el terreno que se llama "Cuesta del Macho". Parece que el dueño no quiere vender. Le aseguro, al mismo tiempo, que todavía tenemos interés en un ensayo en Costa Rica.

El aprendiz Antonio Bonilla está estudiando el cultivo de la Cinchona aquí en Guatemala, y hasta ahora se ha portado muy bien.

Favor de avisarme si Ud. quiere más semilla de *C. Succirubra* o *C. Ledgeriana*. Siempre estamos a sus órdenes. También sírvase saludar a don Otón Jiménez.

Hasta la vista, y que le vaya muy bien. Como siempre, me repito de Ud. su amigo afectísimo y atto. s.s.

F.R.
F. Rosengarten Jr.

Finca El Naranjo,
June 26, 1942.

Sr. Don Alfredo Volio,
Ministro de Fomento,
San José de Costa Rica.

Dear Mr. Volio:

Enclosed please find the results of the 75 bark samples of Cinchona pubescens I took in Costa Rica in December 1941.

I do hope you will excuse the delay in passing these results along to you, a delay which was caused by war-time conditions.

I have been authorized by the Export Control Branch of the Board of Economic Warfare of the United States to pass this information along to you; at the same time, I have been asked to request you not to disclose this information except as absolutely necessary in your operations.

Apparently the C. pubescens of Costa Rica, as indicated by these analyses is too low yielding to be of commercial value in itself. It is still possible this C. pubescens might be useful as a patrón in grafting C. ledgeriana, but this remains to be seen.

At least the presence of the wild C. pubescens in Costa Rica indicates that Costa Rica might have appropriate land for cultivating other higher yielding varieties of Cinchona.

With kindest regards,

Sincerely yours,

FRJr
F. Rosengarten Jr.

cc. Dr. Popenoe ✓

D. Popenoe

Para don Julio Fernandez.

Respecto del viaje á Cobán, el 7 de julio de 1942, para traer vástagos de la Pinca Samac.

- 1.) Camioneta Chicacao-Guatemala, 7 de julio
- 2.) Camioneta Guatemala-Cobán, 8 de julio
- 3.) 9 de julio y 10 de julio en Cobán
- 4.) 11 de julio camioneta Cobán-Guatemala
- 5.) 12 de julio camioneta Guatemala-Chicacao
- 6.) 13 de julio, los vástagos deben de injertarse en Naranjo.

Sírvase estudiar la copia de la carta a don Gustavo.
Se nota que Q.100.00 deben de entregarse a don Gustavo. Favor de pedirle el comprobante para llevar á Naranjo.

El arreglo es que él recibe 10 centavos por cada vástago.
Estos Q.100.00 representan entonces mil vástagos.

Al regresar á Naranjo, cuando se injertan los vástagos, se puede contar el número exacto de vástagos, para poder pagarle al Sr. Helmrich después exactamente lo que se le debe (aparte de los Q.100.00).

El viaje de regreso debe de efectuarse en lo menos tiempo posible para el bien de los vástagos.

Hay que tratar de cortar un promedio de cincuenta vástagos de cada árbol en la lista. De los árboles sobresalientes (*) hay que cortar, si es posible, entre 50 y 100 vástagos.

Hay que usar etiquetas con estos vástagos. Favor de tener mucho cuidado con estas etiquetas.

Para don Julio Fernandez

He aquí la lista de los árboles de los cuales vástagos deben de cortarse en Samac:

<u>No.del árbol</u>	<u>% Q. S.</u>	<u>No.del árbol</u>	<u>% Q. S.</u>
S-1 *	10.3	S-49	8.9
S-2 *	8.5	S-50	8.2
S-6	8.2	S-52 *	11.2
S-7 *	10.3	S-54	8.1
S-9 *	11.2	S-55 *	10.0
S-12 *	9.5	S-57	9.7
S-13	8.9	S-60	9.7
S-17	8.0	S-61	8.0
S-18 *	10.0	S-62 *	12.4
S-19 *	10.57	S-63 *	9.1
S-20	9.1	S-71	9.1
S-23	8.0	S-74	8.6
S-26 *	11.4	S-76	8.1
S-28	8.6	S-78	9.2
S-29 *	11.0	S-80	8.1
S-30 *	10.3	S-83 *	6.9
S-34	9.8	S-88	9.5
S-38 *	11.4	S-98	9.1
S-39 *	13.3	S-100 *	10.8
S-42 *	10.0	S-101 *	10.1
S-44	8.6	S-102 *	10.7

Total 42 árboles; 21 sobresalientes.

* significa árboles sobresalientes, de los cuales hay que cortar, si es posible, entre 50 y 100 vástagos.

Finca "El Naranjo",
4 de Julio de 1942.

FRJ
F. Rosengarten Jr.

c.c. don Jorge Benítez

COPY

Finca El Naranjo,
July 4, 1942.

Mr. L. L. Pettersen,
Finca El Zapote, Escuintla.

Dear Pete:

I have talked over with Jorge Benitez the question of moving the 500 grafts of the "Rey" tree.

He feels that if we handle the plants with care, we should experience practically no loss in transplanting to Naranjo 500 "Rey" grafts of 1941, which have recently been planted in the field in Monte Rey.

Accordingly, provided this meets with your approval, Benitez will come over to Monte Rey, Zapote, in a truck on Friday, July 17, 1942, to move these 500 "Rey" grafts of '41.

We sincerely appreciate your offer re. these "Rey" grafts.

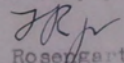
As I informed you the other day, Alejandro Hartleben will be leaving Naranjo on July 12, 1942. Also we have 15 kilos of Succirubra seed on hand here at El Naranjo, waiting for you. If you like, Benitez could bring this seed over to Zapote with him on July 17, if this date suits you.

Don't forget we look forward to seeing a lot of you at Naranjo after July 12. Likewise, you know your new Administrator is welcome here at any time, to spend a few days with Benitez and Hoehn, if you see fit.

Will you please let me know at El Naranjo, at your earliest convenience, if July 17 is O. K. for Benitez's visit, and if you would like him to bring over the Succirubra seed at that time. I would appreciate it if you would send a copy of your reply to me at Apartado Postal 284, Guatemala.

Best regards,

Sincerely yours,


F. Rosegarten Jr.

4 de Julio de 1942.

Sr. Don Gustavo Helmrich
Finca Samac, Cobán A. V.

Estimado don Gustavo:

Em primer lugar, me es grato saludar a Ud. y a su estimada Sra. esposa.

Don Julio Fernandez, el portador de esta carta, ha llegado a Samac con el objeto de cortar los vástagos de la Cinchona ledgeriana, según nuestro arreglo.

Para facilitar el pago de estos vástagos, estamos pagándole por ahora cien (100.00) Quetzales, que Don Julio tiene para Ud. Sirvase firmar el comprobante debidamente.

Se entiende que estos cien (100.00) Quetzales solo representan el pago de mil vástagos. Es probable que Don Julio cortará más de mil vástagos. Nuestro propósito pues es lo siguiente: Cuando don Julio regresa á Finca El Naranjo, contaremos los vástagos al injertarlos, pagándole entonces la diferencia exacta por los vástagos arriba de mil (1000). Por ejemplo si averiguamos aquí que hemos cortado 1,678 vástagos de Samac, le mandaremos Q.67.80 (es decir por 678 vástagos @ 10 centavos, la diferencia arriba de mil) por corréo, certificado, en efectivo etc.

Siento mucho no haber podido venir para saludarles personalmente.

Deseándoles mucha buena fortuna en el futuro, me quedo de Ud.,

atto. y S. S.

F. Rosengarten Jr.

c.c. Dr. Popenoe.

13 de Julio de 1942.

A QUIEN INTERESE:

Por medio de la presente hacemos constar que el portador de la presente, don ALEJANDRO HARTLEBEN trabajó en la Finca "El Naranjo", Chicacao Such. desde el 1º de Marzo de 1940 hasta el 13 de Julio de 1942, como tenedor de Libros.

Aparte de su trabajo como tenedor de libros el señor Hartleben ayudó en los asuntos relacionados con la Administración de la Finca. También por su conocimiento del inglés, prestó servicios valiosos con los records que tenemos en dicho idioma.

Los suscritos manifiestan que durante todo ese tiempo que el señor Hartleben trabajó en nuestra Compañía, pudieron observar muy buena conducta é intachable honradez, así como capacidad para el desempeño de su cometido.

Como una constancia para el interesado extendemos la presente de la cual puede hacer el uso que le convenga.

.....
por EXPERIMENTAL PLANTATIONS, INC.
Frederic Rosengarten, Jr. Gerente.

13th. July 1942.

TO WHOM IT MAY CONCERN:

By means of this letter, I certify that the bearer, Mr. Alejandro Hartleben, has worked with this Company at Finca "El Naranjo", Chicacao Such. as bookkeeper, from March 1940 to the present and during that time has consistently worked diligently and faithfully. He has always demonstrated absolute honesty, thoroughness and accuracy in his work, as well as an intelligent approach to it.

.....
For EXPERIMENTAL PLANTATIONS, INC.
Frederic Rosengarten Jr., Manager.

Krukoff seedlings to be transplanted from "Los Andes", Panamá to the field at Naranjo in June, 1942.

Note: We should also have 11,926 Krukoffs from "Los Andes" (K # 100, and other classes under 5%) to distribute to cooperators. Allowing for 10% loss, we will probably actually have 7,342 Krukoffs to move to Naranjo; and 10,735 to distribute to co-operators in June 1942.

F. R. Jr.

July 14, 1942

Dear Dr. Popenc:

Welcome to Guatemala!

I am leaving tomorrow for El Naranjo where I plan to be until Sunday when I will go to Panamá, Mosá, & return to Naranjo on Monday afternoon. Tuesday July 21 we have a "Cinchona Meeting" at Naranjo. I do hope you and Mrs. Popenc will be able to come over to Naranjo during the next few days. Please wire me at Naranjo anytime before July 22 as to your plans and when you might come to Naranjo.

A Dr. Birdsall of the Dept. of Agriculture, who is going to Paris on the Cinchona, will be coming to see Naranjo Thursday and Friday of this week.

Dr. Kruboff was supposed to arrive here yesterday - but because his Guatemala visa was delayed, couldn't leave as planned. Goodness knows when he will be coming now.

In the enclosed notes there is a report I wish you would study and give me your frank opinion about entitled "Succumbra Cultivation in Guatemala". (I think we should take action on this at once.) (over)

I do hope to see you soon,
With kindest regards to you both

Sincerely

Fritz

[Frederic R. Koenig, Jr.]

Apartado Postal 284,
Guatemala.

July 25, 1942.

Dear Dr. Popenoe:

Dr. Krukoff is now in Guatemala with me.

On July 29 or 30 we plan to fly to San Jose, Costa Rica to return by plane to Guatemala on August 6. We feel it is time we got something definite started in Costa Rica re. a property. So we plan to study the Turialba region, as you suggested, as well as Cuesta del Macho and get at least three possible properties lined up. It would be wonderful if you could meet us in San Jose about the first of August. Then we could really get this matter arranged. Apparently the Cuesta del Macho has fallen through completely, although there may be other possible farms obtainable in that region. We will do our best.

In case you can't come to Costa Rica (but we hope you can), might we stop off and see you at Tegucigalpa say the night of the sixth? Or is there still hope of seeing you in Guatemala on the sixth?

At Naranjo everything seems to be going along smoothly. The two main problems now we feel to be (1) Getting another property of 12 to 20 caballerias to plant 2,000,000 Succirubra at 5' by 5' (see my report entitled "Succirubra Cultivation in Guatemala"). (2) Getting a property of our own in Costa Rica. You could be of tremendous help in both of these.

Dr. Krukoff and I are both convinced it is absolutely necessary to carry through the Succirubra Program at 5' by 5'. This is no fly by night speculative proposition, but a sound agricultural proposition, the success of which has already been proven on the west coast of Guatemala between 2000 and 6000 ft.

Please cable us of your plans and suggestions. Between July 30 and August 5 you can reach us care of Gran Hotel, San Jose, Costa Rica. Before and after those dates care of Jose Gibson, 10 Calle Oriente # 7, Guatemala.

Dr. Krukoff joins me in kindest regards to you and Mrs. Popenoe,

Sincerely,

Intz.

P. S. I acknowledge receipt of yours of July 22. Sorry I won't be able to accompany you to Naranjo on the 30 or 31. As stated above, Dr. Krukoff and I both feel our real problem is not Naranjo but expansion; we have thought of both Castanos and Filadelfia for the Succirubra Program at 5' by 5'. But both of these look like tough nuts to crack. Can you think of other fincas of 12 to 20 cabs. on the Guatemala west coast near Naranjo that might be valuable prospects. Your help on this would certainly be appreciated.

⊗ like Succirubra at 10" x 10", which is certainly a
very good one for Botanical Documentation, 2 yr harvest etc

Antigua, Guatemala, 2 August 1942

Mr R P Lukens,
Merck and Co.,
Rahway, N.J.

Dear Mr. Lukens:

On my arrival here last Wednesday I was met by Dr Krukoff and Mr Rosengarten, who took me to the latter's apartment, where we discussed at some length the program for extensive cultivation of *Succirubra* in Guatemala as set forth in Mr Rosengarten's memorandum of 12 July.

It is obvious that Mr Rosengarten has given a great deal of thought to this project and worked up the data carefully. I can add nothing to what he has said in his memorandum; but I wish to say that I believe the project is worth your careful consideration. You know more than we do regarding the future of totaquina. If, on the one hand, you have sufficient confidence in the commercial future of this product; or on the other, you feel that the future of quinine sulfate is such that you will have to work low-grade barks on a large scale - then in either case Mr. Rosengarten's project looks good; and so far as the agricultural end is concerned, you have seen enough of the situation here in Guatemala to feel as Messrs Krukoff, Rosengarten and myself do, i.e., the cultivation of *Succirubra* on a wide range of soils is feasible and offers very few risks;

On page 4 of his memo, Mr Rosengarten recommends that this project, if undertaken, should in no manner interfere with continued work on establishment of good Ledger clones and experimentation with Calisaya and Ledger seedlings. I feel he is absolutely right about this.

Yours sincerely,

Wilson Popenoe

cc Mr Frederic Rosengarten Jr.

EXPERIMENTAL PLANTATIONS INC.

FINCA EL NARANJO

CHICACAO, SUCH.

OFICINA GUATEMALA
10 CALLE ORIENTE, N° 7

July 25, 1942.

Mr. R. P. Lukens,
Merck & Co., Inc.,
Rahway, N. J.

Dear Mr. Lukens:

As usual Dr. Krukoff's visit here has been most helpful and stimulating.

I am sorry the Colombian project has apparently fallen through, but this very difficulty accentuates (1) The importance of the Development of 2,000,000 Succirubra at 5' by 5' as previously suggested on a property which we ourselves should buy as soon as possible, near El Naranjo in Guatemala. (2) The necessity of carrying through our plans in Costa Rica.

Enclosed please find latest information re. Maxbel.

Incidentally Dr. Krukoff and I agree 100% on the following: (a) that we urgently desire to push ahead the 5' by 5' program of 2,000,000 Succirubra on a property of our own. (b) that we are against the 10" by 10" Succirubra Program on a large scale because it is highly experimental and speculative.

Under separate cover by Air Mail I am sending you a detailed estimate of costs involved in program (a). Also included is estimate of profit that may reasonably be expected. In the hope of getting action on this program (a) from the board of directors during Mr. Perkins' absence, I am sending copies of the estimate and report to F. Rosengarten Sr. and J. G. Rosengarten Jr.

Very truly yours,

F. Rosengarten Jr.

*P.S. Both Dr. Krukoff and Mr. Gibson
have been of great help to me in the
estimate being sent under separate cover.*

EXPLANATORY NOTES RE MAXBAL, JULY 1942.

Inventory of Cinchona Material

<u>Seedbeds:</u>	350.000	Ledgeriana Seedlings	
	200.000	Succirubra seedlings	
		TOTAL SEEDBEDS	550.000

<u>Nurseries:</u>	8.000	Ledgeriana seedlings	
	4.000	Krukoff seedlings	
		TOTAL NURSERIES	12.000

<u>Field:</u>	2.641	Ledgeriana seedlings	
	2.698	Krukoff seedlings	
		TOTAL FIELD	5.339

<u>MAXBAL</u>	Approximate Grand Total	567.339
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On July 22, Dr. Krukoff, Mr. Hoehn and myself had a conference about Maxbal. From the adjoining translation of Mr. Hoehn's report of his recent trip to Maxbal, plus the above inventory, plus the following explanatory notes, you can get the up to date picture of Maxbal:

(1) Ledgeriana seedlings. Apparently the Ledger seedlings are continuing to thrive at Maxbal. Dr. Krukoff and I agree that we should devote Maxbal principally to Ledgeriana at this time and push Ledgeriana ahead as much as possible there.

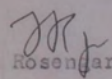
(2) Succirubra seedlings. The low content of Quinine per unit of bulk makes Succirubra cultivation at Maxbal less attractive than Ledgeriana, due to the inevitable long freight hauls. However, we plan to handle our supply of Succirubra seedlings at Maxbal in the following manner:

(a) Succirubra at 10" by 10". 1 acre or 50,000 Succirubra seedlings will be planted at 10" by 10" for experimental purposes, partly in November '42, partly in July '43. If it is then later decided to carry out a large scale 10" by 10" Succirubra Program, we will have a line on Maxbal similar to that of experiments carried out on west coast of Guatemala in like fashion.

(b) Succirubra at 5' by 5'. Our present plans are to carry 75,000 of these to field position at 5' by 5'; partly in November '42; partly in July '43.

(3) Maxbal, showing more promise than ever, will be purchased outright by us within the next six weeks or so.

Finca El Naranjo
July 23, 1942.


F. Rosen Garten Jr.

Translation of
Report on Maxbal, July 22, 1942

Field Plantings: Observing the Ledgers and Krukoffs that were planted in the field in February 1942, I noted a great change. All the plants are healthy, free from disease and have shown most encouraging growth. The largest Krukoff now is 75 inches tall, and has a diameter of 1-3/4". The smallest Krukoff in this group is 48" tall, and the rest of the plants are from 48 to 75 inches in height, and from 1/2 to 1-3/4 inches in diameter. The Ledgers also have grown a lot, and are completely healthy. The largest Ledger (African Ledger) is 54" tall, with a diameter of 1-1/4". The rest of the plants are from 33 to 44 inches in height. More satisfactory growth and development could not be desired.

(As the Krukoffs and Ledgers had many branches, I cut a few off and made an experiment with "cuttings" in a nursery bed. I used tender branches and shoots for this experiment and at the end of my 3 weeks in Maxbal, these showed promise. It might be possible to propagate at Maxbal with cuttings, planting them directly in field position, but this remains to be proven.)

Nurseries of May, 1941. The nurseries are in excellent condition on the whole. I planted to the field at this time from these nurseries 2,641 Ledgers and 1,975 Krukoffs at 5' by 5'. I could not plant more to the field in my limited stay at Maxbal, but have left instructions for the planting of 10,000 more Ledgers to the field in July, November 1942. I gave detailed instructions to the employee at Maxbal in staking etc., i.e. essentials of field planting work. The plants planted in the field at this time were from 16" to 44" in height, averaging about 25" in height.

Very few plants have died in the nurseries, probably less than 1%. Also there are very few stragglers in the seedbeds that have not exhibited the customary vigorous growth of Maxbal. Some cattle broke into the nursery corral and crushed some 1,800 plants, according to the employee. I did not prune the leaves of any of these plants, which I believe is an advantageous action.

Seedbeds of April 1942. These 7 seedbeds are doing very well. Seeds from High yielding Ledgers at Naranjo and Samac have germinated well, are healthy and already at 3 months from date of sowing there are some plants 6" tall. 3,875 of these I transplanted to Nursery position, in beds disoccupied by plants going to the field. This I did as an experiment, to see if such small plants thrive in a transplanting during the heavy July rains, as if they do, it would considerably facilitate the timing of transplanting work at Maxbal.

The seedbeds at Aguacate have not made out as well as the seedbeds at Maxbal. While the cattle have done damage to the seedbeds at Maxbal, Aguacate, being one hour by foot from Maxbal, may have suffered from lack of attention.

The best period of growth, without doubt, in both Seedbeds and Nurseries is from July to January.

New Seedbeds July 1942. I sowed 78 sq. meters with Samac Ledger seed, and 205 sq. meters with Succirubra seed from Finca Paris.

As the growth of seedlings in the seedbeds

is so rapid in Maxbal, in no instance is it advisable to leave seedlings in seedbeds for more than one year at the most. From July to December seems to be the best time to plant to the field. From January to July is the driest period of the year, although there are well distributed mists and showers. The level of the lake at Maxbal rises as much as 3 meters between July and December. At this point, tejamanil seems to be the best material to use as covering for the seedbeds at Maxbal.

Work Schedule left with employee July 1942.

1. Sow average of 200 grams of Ledger seed every month.
2. Plant 10,000 more Krukoff & Ledger seedlings to field during July-December 1942.
3. Make Nursery for 100,000 Ledgers.
4. From now until January plant Ledgers from seedbeds directly to field 12" in height and over.
5. Transplant from seedbeds to Nursery acc. to instructions.
6. Open up virgin land; 2 caballerías in Maxbal and 1 caballería in Aguacate (part of Maxbal), prepare land and stake, to have at least 200,000 stakes ready for July 1943.
7. Prepare land for Succirubra planting at 10" by 10" acc. to instructions to be sent.
8. Finish rustic dwelling house and construct 4 cheap galeras for mozas.

Trip to Barillas Village. Having heard that Don Marcos Recinos had "Quina" at the finca "Soledad", I visited that finca to investigate. From Maxbal to Barillas, 9 hours by horse; from Barillas to "Soledad", 2 hours by horse. This proved to be not Cinchona but "Quino de la montaña" which bears no resemblance to Cinchona. However, as the bark of this tree is used by the Indians to cure malaria, I took a bark sample and some leaves back with me to El Naranjo, which are now being dried.

Properties near Maxbal worthy of note

Yulhuitz. 14 Caballerías. Property directly west of Maxbal. Finca's boundaries planned; owner has title and escritura etc. This finca has a large flat area on it; also 3 rivers. Terrain very similar to Maxbal. Almost entirely virgin land. Owner Hermanos Cordillo, San Mateo Ixt.

Finca Via Laura. 15 caballerías. Owner Rafael Molino, Barillas. Next to Maxbal and Yulhuitz.

Finca Santa Elena. 15 caballerías. Owner Señorita Elena Herrera, Huehuetenango. Next to Maxbal and Via Laura. Adjoining lake at Maxbal. A large river passes through this finca and there are large flat areas suitable for large scale nursery work. This same Señorita has a larger block of 25 to 35 caballerías adjoining Santa Elena. This land could be bought along with Santa Elena at about 90 cents per acre. Promising.

E. Hoehn

Observations made at the Northeastern Forest Experiment Station, Williamstown, Mass., on July 13 and 14, 1942, by Dr. John R. Shuman. (Dr. Ernst J. Schreiner, U.S.D.A., Silviculturist, conducted the writer on this tour of inspection.)

Purpose of trip: Forest tree breeding is conducted at a limited number of locations in the United States. This station was visited to obtain suggestions for techniques and procedures useful in breeding *Cinchona*.

NOTES ON BREEDING

GENERA AND PROBLEMS

Breeding is being conducted in Tulip Poplar, Oak, Birch, Poplar, Pine, Maple, Elm, etc. Depending on the species, new types are desired which will be able to meet specific difficulties due to disease, rate of growth, wood structure, hardiness, paper pulp quality, etc.

BREEDING PROGRAM

(Prior to initiating extensive breeding, it was necessary to study flowering behavior, functioning and receptivity.)

The parental old trees were identified with aluminum tags which proved to be unsatisfactory because they became broken and were lost. Maps showing the locations of the trees by angle and distance are preferred.

Generally speaking, crosses are being made between two species of the same genus, followed by subsequent selection of the superior individuals in the hybrid (F_1) progeny. Outstanding hybrid individuals are multiplied by cuttings for testing, and are also to be used for further breeding. Crosses are planned between F_1 's of different parentage and of the same parentage. In some instances this latter mating has been accomplished.

POLLEN COLLECTING AND STORAGE

The developing floral buds are covered with glassine parchment (Patapar), or viscose (Visking) bags and fastened to the tree with the copper wire strung to a red or blue tag. (Visking is made in tubular form, and is wired fast to the flowering branch with a cotton batting plug and similarly closed at the free end.) Pollen is obtained from branches of desirable trees with a tree pruner. These branches are placed in pint fruit jars partially filled with water, and stood on a $1\frac{1}{2}$ ' square of glassine paper. The pollen is collected from the paper, put in glass vials about $\frac{1}{2}$ " x 2" and placed in laboratory dessicators of 25-50% humidity. The humidity is controlled with concentrations of

H₂SO₄ which are checked periodically with a hydrometer. The wells of these dessicators used in the field are filled with glass wool to prevent spilling of the sulfuric acid solutions. Pollen is stored at 4° Centigrade.

Pollen viability is observed by means of a binocular on samples of pollen sewn on $\frac{1}{2}$ " disks of agar medium mounted on the inner surface of the lid of a petri dish containing the same medium. This arrangement insures better control of the humidity serving to prevent condensation on or dessication of the small agar disks.

POLLINATIONS

Pollen is sprayed on the inflorescences with medicine droppers which are drawn to a fine tubular point. The point is pushed through the paper bag covering the flowers or inserted in the outer end of the viscose tube. If a hole was made, it is closed with adhesive; otherwise, the cotton plug is replaced. The data of pollination are recorded by means of a "day book" numbering system. For example, "day book" number 1/7/13 means the first pollination on the 13th of July. This 1/7/13 is written on the white or yellow tag (color indicates sib, species cross, etc.), and fastened to the pollinated flowering branch. The blue or red tag, which formerly marked the inflorescence, is then removed. The data of pollination as to parentage, number of flowers, etc., are temporarily recorded on a 3" x 5" sheet of a pocket note book while at the tree. Subsequently, this information is entered on a page of a permanent 8 $\frac{1}{2}$ " x 11" loose leaf book under 1/7/13. The pages for each year are bound separately.

Leaves on the reproductive shoot die when under Kraft or glassine bags. Since the inflorescences are near the tip-most leaves of a branch, this dying caused difficulty. This was solved with the use of viscose or parchment bags. Following pollinations on dense trees, the main branches bearing the flowers are further marked with white tags having a muslin red streamer 1" x 6" long.

About two weeks after all the inflorescences of a tree have passed their receptive stages, all the coverings are removed and the paper tags are replaced with copper ones on which the original "day book" number is written with a medium hard pencil. At this time a record is made as to whether the fruit are developing. If the pollination was a failure, both the bag and tag are removed.

HARVESTING

Therefore, throughout most of the summer the inflorescences are exposed to the elements, marked only with the individual copper tag, and perhaps located with the streamer tag on the fertile branch. About four to six weeks before the fruit and seed are ripe, the inflorescences are covered with dark green or brown muslin bags which

are tied on with a strip of cloth or string. (This procedure is employed to prevent seed and fruit losses caused by normal dispersal in some species, and to the attacks of insects and rodents.) When the seed or fruit are collected, each lot is given an arbitrary consecutive seed lot number. The lot is planted immediately or stored after stratification in peat moss and sand. Although more than one lot may have exactly the same parentage, they are kept separate in order to observe errors of natural or accidental pollinations.

SEEDLING CULTURE

GERMINATION

Seed are germinated in a greenhouse using about 6" pots which have the seed lot number marked on 6" stakes. The soil is mixed with sand or finely divided gravel and covered with a thin layer of peat moss to prevent losses due to damping off and unknown reasons.

SEEDLINGS

Individual seedlings are transferred to 2" pots each with their own stake bearing the seed lot number. When sufficiently well established, these plants in their pots are taken outside and sunk in beds containing a layer of small gravel. Depending on the species, the plants at the end of the first season are removed from the pots and stored in a cold cellar for the winter.

The second year they are planted in the nursery with uniform spacings of 4" to 6" squares and the entire progeny marked with the seed lot number on a copper tag. Each plant of a progeny can be identified by its number, and its position in the uniformly spaced nursery planting. If a plant should be lost through death or accident, its absence would be noted by the greater space between adjacent plants or stakes.

When the plants in the nursery have grown sufficiently, they are reset in progeny rows. The plants are placed two feet apart with three feet between rows. These individual plants can be likewise identified by their seed lot numbers and their position within the row. Cuttings from selected plants at this stage have supplied the material for field trials.

FIELD TRIALS

EXPERIMENTAL DESIGN:

Two types were observed. One was a split plot type, and the second, a lattice square. The first was used to determine the effect of pre-planting preparations of the land and involved 2 clones of pine. The second was testing 29 clones of poplar under varying fertilizer treatments. Individual clones were identified with

Maps showing their positions in the replications. Each replication was marked at its lower left corner with a copper tag stapled to a 2" x 2" x 2' stake. The data are being evaluated by means of analysis of variance techniques.

OBSERVATIONS ON OTHER RESEARCH

COLCHICINE TREATMENTS:

Different colchicine concentrations in lanolin or water were applied for varying lengths of time to the active growing tips of poplar hybrids. Injections of aqueous solutions of colchicine were also made by means of small glass tubes with one end drawn to a fine point. The treatment generally producing growth retardation without killing, was applied to the tips of the stems bent into small vials held in position with slender stakes. Concentrations around 1% colchicine were most successful. No polyploid plants or shoots have been isolated to date although it was believed that "islands" of such tissue existed in the treated shoots but that the parental tissue surrounded it.

ROOTING OF CUTTINGS:

A. B. Snow, M.S., U.S.D.A., Assistant Plant Physiologist, conducted the research on vegetative propagation. Due to his no longer being associated with the station because of curtailment of the program, little information was obtained. Concerning his experimental work, however, cold frames covered with thin muslin screens were in evidence. A few pine seedlings had rooted in good sized lots of cuttings. A range of treatments with or without growth substances had been employed.

SUPPLEMENTARY NOTES

EQUIPMENT:

The most satisfactory pruning pole for removing branches to obtain the pollen was: Telephone tree pruner No. 1, Seymour Smith & Sons, Oakville, Conn.; John H. Graham, 105 Duane St., New York City, is the company's representative. Ca. \$15.75.

Snap Cut Pruners No. 119, same source as above, were recommended. Ca. \$2.50.

Ladders were of three types: One made by joining 6' sections, fitted together with large turnbuckles having hooks at each end (Ca. \$30/6 sections); the second was the inverted v type generally used to change billing on theatre marquees; and the third, a 3 legged 8' step ladder. All of these were manufactured by the Flint Ladder Co., New Haven, Conn. (30' seemed to be the maximum working height,

and at this distance it was necessary to guy the ladder with rope attached to pipe driven in the ground with a sledge.) Throughout the discussion of ladders, it was apparent that this was one of the big effort and time consuming problems. The setting up and moving of ladders taxed the program and workers. For general ease of operation the type of ladder mounted on the $1\frac{1}{2}$ ton telephone truck was considered most satisfactory. The desire was expressed to purchase same. Attention should be paid in planting the breeding stock so that it could all be reached by truck or car.

Linemas's safety belt - Western Hdw. & Tool Co., 9th & Mission Street, San Francisco. (Any telephone or light Co.)

Pencils - Dixon's Eldorado 2 H, and their Phano for Glazed Surfaces 71.

Copper tags - Anaconda C R annealed Copper (hot roll) 100 linear feet 12" wide x .005". (Size used 1" x 2")

Copper wire - #26(B & S gauge) soft bare (.0159 Diam) 10 lb. spool will wire 3-4000 tags - year's supply. Ca. \$0.57/lb.

Increment borers - Dietzgen - Ca. \$20.00

Topographic Abney - Dietzgen - Ca. \$20.00

Tapes for circumference in $1/10$ ths of inches or feet
The Artizan Lukin Rule Co., Saginaw, Mich.

Paper tags - Dennison F.W. Seemed to be the best because of its brass eyelet. (Some of the colored types were eyeletted by the station workers. All were strung there with #26 copper wire.)

Viscose bags- Visking Bags - The Visking Corporation, 6733 W. 65th St., Chicago, Illinois or 10 E. 43rd Street, New York City

Samples were obtained of glassine, paper tags, vials, Visking bags, copper-paper-and wooden tags, as well as a series of the principal record sheets.

EXPERIMENTAL PLANTATIONS INC.
FINCA EL NARANJO
CHICACAO, SUCH.

OFISINA GUATEMALA
10 CALLE ORIENTE, N° 7

30 de Julio de 1942.

Dr. Wilson Popenoe,
La Antigua Guatemala.

Señor Popenoe:

De acuerdo con apreciables instrucciones de nuestro Mr.
Rosengarten, Jr., adjunto a la presente lo siguiente:

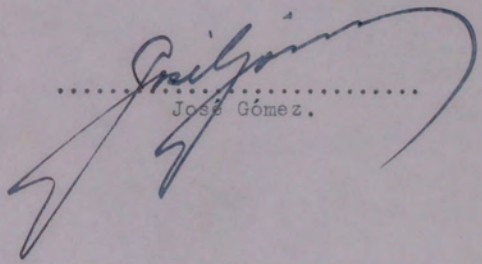
"SUMMARY OF ESTIMATED EXPENSES OF
SUCCIRUBRA CULTIVATION IN GUATEMALA" and

"CONCLUSION"

Soy de Usted,

Muy atto. y S. S.,

.....
José Gómez.



EXPERIMENTAL PLANTATIONS INC.

FINCA EL NARANJO

CHICACAO, SUCH.

OFICINA GUATEMALA
10 CALLE ORIENTE, N° 7

CONCLUSION.

Let us calculate on an average of ten lbs. of dried bark per ten year old Succirubra.

Let us allow for an average yield per tree of 2 % Quinine Sulfate; 8% total Cinchona alkaloids.

Let us assume such bark would be worth 10¢ per lb., either for Quinine Sulfate or total alkaloids.

Then each 10 yr. old Succirubra would yield 10 lbs. of dried bark @ 10¢ per lb. That is, each ten year old tree worth \$ 1.00.

Calculating that 1,700,000 trees are to be harvested, (i.e. allowing for 15% loss in field) @ \$ 1.00 per tree, bark from this project should be worth \$ 1,700,000.

From the adjoining estimate of expenses, we estimate we will have spent on this project "Succirubra Cultivation in Guatemala", \$ 643,000 by 1954.

Therefore the estimated financial return may be computed as follows:

Estimated receipts from bark harvest	\$ 1,700,000
Less estimated expenses (incl. interest)	<u>643,000</u>
TOTAL ESTIMATED PROFIT ON THIS PROGRAM BEFORE EXPORT TAXES ETC!	\$ 1,057,000

The profit from this project may reasonably be expected to more than cover all expenses we have incurred to date in Guatemala. That is to say this program recommends itself as a sound investment for Merck & Co., quite apart from the quinine emergency.

As Guatemala Manager of Experimental Plantations Inc., I strongly urge this program be authorized by Merck & Co. and undertaken at once. To avoid red tape, delay etc. and because of the soundness of the investment, it would seem advisable for Merck & Co. to undertake this program on their own, without any help from the U. S. Government, and with no strings attached. As noted in the report "Succirubra Cultivation in Guatemala", timing in this program is all important, and delays caused by lack of decision in New York, Washington etc. might jeopardize the success of the Cinchona program in Guatemala, and so actually stand in the way of our contribution to the war effort.

Respectfully submitted,

F. Rosentraten Jr.

SUCCINBRA CULTIVATION IN GUATEMALA

555555

SUMMARY OF ESTIMATED EXPENDITURE.

	TOTAL \$.	YEAR 1. \$.	YEAR 2. \$.	YEAR 3. \$.	YEAR 4. \$.	YEAR 5. \$.	YEAR 6. \$.	YEAR 7. \$.	YEAR 8. \$.	YEAR 9. \$.	YEAR 10. \$.	YEAR 11. \$.	YEAR 12. \$.
CAPITAL OUTLAY	75,000.-	75,000											
SEED BEDS & NURSERIES	17,700.-	2,400	4,788	7,800	2,625								
FIELD EXPENSE	107,100.-		17,300	18,940	26,360	7,600	5,000	5,000	5,000	5,000	5,000	5,000	5,000
OVERHEAD	70,200.-	6,600	6,600	6,600	6,600	6,600	6,600	6,600	6,600	6,600	6,600	6,600	6,600
HARVESTING	190,000.-										66,250	60,478	60,478
	460,000.-	84,000	26,668	33,240	37,565	14,200	11,600	11,600	11,600	11,600	79,550	72,478	72,478
MARGIN FOR UNFORESEEN EXPENSE	55,000.-	12,000	9,000	5,000	5,000	2,000	2,000	2,000	2,000	2,000	5,000	5,000	5,000
	534,000.-	96,000	37,668	38,240	42,565	16,200	13,600	13,600	13,600	13,600	87,550	80,478	80,478
INTEREST 3%, p.a.	106,000.-	3,000	4,000	5,000	7,000	7,500	8,000	8,500	9,000	10,000	13,000	16,000	18,000
	642,000.-	99,000	41,668	43,240	49,565	23,700	21,600	22,100	22,600	23,600	100,550	96,478	96,478
-DETAILS OF ABOVE SUMMARY.-													
CAPITAL OUTLAY:													
Initial Cost of Property	75,000.-	75,000											
SEED BEDS & NURSERIES:													
Construction of Seed Beds 150 Beds 45 sq m. each over three years	2,000.-	400	600	1,000									
Care of Seed Beds	3,700.-	740	1,110	1,850									
Construction of 625,000 sq. ft. of Nursery space to receive 2,500,000 Succinbra plants at 6 in. x 6 in.	2,750.-	550	825	1,375									
Transplanting from Seed Beds to Nurseries	1,550.-	250	375	625									
Care of Nurseries	2,750.-	550	825	1,375									
Uprooting Seedlings in Nursery & transfer to field	8,550.-	-	1,050	1,575	2,625								
TOTAL SEED BED & NURSERY EXPENSE	17,700.-	2,400	4,788	7,800	2,625								
FIELD EXPENSE:													
Preliminary Cleaning of Field Areas	2,400.-		480	720	1,200								
Opening up (cutting down trees, etc.)	9,600.-		1,920	2,880	4,800								
Further preparation of field areas prior to staking	9,600.-		1,920	2,880	4,800								
Staking 2 million positions 5" x 5" including 'holing'	9,600.-		1,920	2,880	4,800								
Planting 2 million Succinbra plants in field	3,600.-		720	1,080	1,800								
Cleaning after planting	7,200.-		1,440	2,160	3,600								
Pruning	1,200.-		-	240	360	600							
Replanting Costs	5,000.-		-	1,000	2,000	2,000							
General Cleaning subsequent to planting	56,900.-		8,900	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
TOTAL FIELD EXPENSE TO HARVEST STAGE	107,100.-		17,300	18,940	26,360	7,600	5,000	5,000	5,000	5,000	5,000	5,000	5,000

		TOTAL \$.	YEAR 1. \$.	YEAR 2. \$.	YEAR 3. \$.	YEAR 4. \$.	YEAR 5. \$.	YEAR 6. \$.	YEAR 7. \$.	YEAR 8. \$.	YEAR 9. \$.	YEAR 10. \$.	YEAR 11. \$.	YEAR 12. \$.
<u>OVERHEAD EXPENSE:</u>														
Salaries:														
Administrator	1,800.-													
Mayordomo (2)	1,000.00													
Book-keeper, Storekeeper Etc.	750.-													
Taxes:														
3 %/oo Property Tax	300.-													
"Sanidad"	25.-													
Transportation	500.-													
Livestock & Maintenance	175.-													
Repairs House & Buildings	500.-													
Travel	750.-													
Office Costs - incl. Postages, Cables, Tel. & Stationery	350.-													
Sundries	450.-													
	6,800.-	79,200.-	6,800	6,800	6,800	6,800	6,800	6,800	6,800	6,800	6,800	6,800	6,800	6,800
<u>HARVESTING BARK:</u>														
Implements & Tools	6,000.-											2,000	2,000	2,000
Drying & Pulverizing Machinery	10,000.-											10,000		
Sacks 1,700,000 @ 10¢ each sack for 100 lbs.	17,000.-											17,000		
Operation of Machinery	4,000.-											1,600	1,600	1,600
Labour (allowing for 15% loss in field 1,700,000 trees will be harvested; calculation based on 2/5 of a days wage of 20¢ per tree for stripping bark from one tree carrying to patio, drying & packing in bags)	156,000.-											34,000	51,000	51,000
Cartage to extraction plant near R.R. Guatemala West Coast	17,000.-											4,250	6,375	6,375
	190,000.-											68,250	60,675	60,675

Antigua, Guatemala, 2 August 1942

Mr R P Lukens,
Merck and Co.,
Rahway, N.J.

Dear Mr. Lukens:

On my arrival here last Wednesday I was met by Dr Krukoff and Mr Rosengarten, who took me to the latter's apartment, where we discussed at some length the program for extensive cultivation of *Succirubra* in Guatemala as set forth in Mr Rosengarten's memorandum of 12 July.

It is obvious that Mr Rosengarten has given a great deal of thought to this project and worked up the data carefully. I can add nothing to what he has said in his memorandum; but I wish to say that I believe the project is worth your careful consideration. You know more than we do regarding the future of totaquina. If, on the one hand, you have sufficient confidence in the commercial future of this product; or on the other, you feel that the future of quinine sulfate is such that you will have to work low-grade barks on a large scale - then in either case Mr. Rosengarten's project looks good; and so far as the agricultural end is concerned, you have seen enough of the situation here in Guatemala to feel as Messrs Krukoff, Rosengarten and myself do, i.e., the cultivation of *Succirubra* on a wide range of soils is feasible and offers very few risks,

On page 4 of his memo, Mr Rosengarten recommends that this project, if undertaken, should in no manner interfere with continued work on establishment of good Ledger clones and experimentation with Calisaya and Ledger seedlings. I feel he is absolutely right about this.

Yours sincerely,

Wilson Popenoe

cc Mr Frederic Rosengarten Jr.

Dr. Popenoe

Observations on commercial grafting and layering in fruit trees at
the New York Agricultural Experiment Station, Geneva, N. Y.,
August 6, 1942.

by Dr. John R. Shuman

Dr. H. B. Tukey, Chief in research and professor of pomology, Cornell, 1927-, is in charge of production and evaluation of the present and new introductions of horticultural fruit trees including the pear, quince, cherry, peach, etc. The station is maintained for the purpose of giving assistance to the commercial fruit growers of New York State.

After presenting the problems of obtaining improved strains of Cinchona and the methods of plant propagation now in use, we went to the field plots.

CLONAL ROOTSTOCKS

The mother plantation or stool block for propagation of clonal rootstock was visited first. "The apple rootstock nursery is probably the largest in the United States." It is a comparatively recent advance in this country but has been used for sometime in Europe. Certain rootstocks can be multiplied on a commercial scale by layering.

The technique involves setting out of year old plants in rows in the rootstock nursery. After becoming established during the first growing season the shoots are cut off an inch below the crown. Adventitious shoots appear during the second growing season and the rows are weeded and cultivated several times. The soil is worked gently and gradually towards the stool of plants without actually covering or smothering them and results in a mound of earth extending throughout the length of the nursery rows. A shovel full

of finely divided soil is sifted on the center of those closely clumped shoots once during the growing season to separate the shoots and provide more opportunity for developing good root systems.

After the leaves have fallen the mounds of earth are carefully removed with a pick ax and the rootstock plants are separated from each other. These are planted in rows (lining-out stock) for budding the succeeding summer when the buds on the scions are mature. The rootstock nursery is well fertilized, both with commercial fertilizer and manure. The rootstock nursery soil is also supplied with peat moss. The latter aids in developing roots, which result appears to be due to the increase in the amount of oxygen present in the soil.

The rootstock nursery remains intact and will furnish an annual crop of young stock plants for many years, (20-40). With the developing of a larger root system in the rootstock stem plants there is an increase in the number of rootstock plants per year. After each crop of stock plants is harvested, the crown of the stem rootstock plant is covered for winter protection. This is removed in the spring by disc harrowing and the nursery bed is leveled.

New sources of rootstocks adapted to increase by layering are more likely to be developed from those seedlings whose central axes appear burred or knotty. After one has been found which readily produces adventitious shoots and roots, it should be tested for its value as a stock. Emphasis was placed first on locating a plant which will respond to layering and then to determining its commercial value.

Clonal rootstocks have the advantage over stocks originating from seed in being uniformly constant for whatever desirable characters the original stem plant may have, such as resistance to disease and drought, rate and vigor of growth, a wide range of adaptability, as well as effect on the scion. One is then working with an entity whose performance is known and predictable.

GRAFTING

Dr. Tukey kindly demonstrated and discussed various types of grafts including the bud, cleft, notch and sprig. Considerable attention was paid to the fact that the common grafting practice in Cinchona is by sprig rather than by bud. He was much interested in learning the reasons for the use of the former in view of the potentially greater number of grafts per stem parent by buds. The cleft, notch and bud grafts were reviewed with respect to their usefulness in hastening flowering of breeding material. A sample was obtained of the rubber strips used for bud grafting. These are made by the Goodyear Rubber Company; the tape that is used for the other grafts is supplied by Johnson and Johnson.

FIELD TRIALS

Experimental designs of test plots of fruit trees under trial were discussed and various types of arrangements were inspected in the field. Randomized designs had been found unsatisfactory because the commercial producers remained unconvinced of a given entry's superiority unless they could be visually compared in adjacent plots.

The preferred design for the test of large numbers of entries consisted of 2 plants of each stock-scion (stion) combination in

3 or 4 replications systematically arranged. They were planted in rows and columns in which any row would have the same stock throughout and vary only in scion, and vice versa for the columns. As the plants matured they were thinned to one tree per entry. No selection was made when the 2nd plant was removed--an entire row or column being eliminated at that time.

The refined trial for previously tested combinations of stock and scion consisted of 10 trees planted in rows with 3 or 4 replications. The trials were likewise set out twice as close as in the mature orchard and thinned by removing entire rows. (Thus, 20 trees of each entry were originally planted.)

During the latter part of the afternoon Dr. Tukey discussed his fundamental studies of fruit, seed and embryo structure; and his culture techniques of the latter when excised from seed that would not otherwise germinate.

The following were secured for the El Naranjo Library:-

Photos:

Stool block as a source of clonal rootstock
Uncovering and cutting rootstock plants in stool block
Uncovered rootstock shoots showing root development
Field crews budding rootstock
Close up of operation
Close up of newly budded plants
Uniformity of 2 year old grafted apples and cherries

Articles:

H. B. Tukey and Karl D. Brase, The propagation of multiflora rootstocks for roses by soft wood cuttings, N.Y. Agr. Sta. Bul. 598, 1931.

_____ and _____ Influence of the cion and of an intermediate stem-piece upon the character and development of roots of young apple trees, N.Y. Agr. Exp. Sta. Tech. Bul. 218, 1933.

_____ and _____ Random notes on fruit tree rootstocks and plant propagation, N.Y. Agr. Exp. Sta. Bul. 649, 1934.

_____ Plant propagation, N.Y. Agr. Exp. Sta. Circ. 138, 1934.

_____ Stock and cion terminology, Amer. Soc. Hort. Sci. 35: 378-382, 1938.

_____ and _____ Size relationships of trees of five varieties of apples on several clonal rootstocks, Amer. Soc. Hort. Sci. 37: 299-304, 1939.

_____ Selection, care and planting of nursery grown fruit trees, N.Y. Agr. Exp. Sta. Circ. 188, 1940.

_____ and _____ The performance of mailing apple rootstocks in the nursery as regards stand of lining-out stock and production of nursery trees, Amer. Soc. Hort. Sci. 39: 247-252, 1941.