

# Cinchona Cultivation in Guatemala— *A Brief Historical Review up to 1943*

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## Cinchona Cultivation in Guatemala— *A Brief Historical Review up to 1943*

*The first American planting of cinchona was in 1860 in Guatemala and Jamaica. Subsequent investments in Guatemala by private and governmental agencies, negligible until stimulated by the recent war, have culminated today in plantations aggregating only about 1,000 acres with 1 3/4 million trees.*

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### Introduction

At first glance it seems remarkable that two hundred years should have elapsed between the discovery of cinchona (about 1630) and its adoption as a cultivated plant. But this is not so strange when we pause to recall that cinchona, in its more valuable forms, is not an easy tree to cultivate, and that there were ample supplies of wild bark to meet demands in Europe and America.

It was not until the British and Dutch undertook the development of the Asiatic tropics that the necessity for bringing cinchona into cultivation became apparent. Throughout the Indies malaria was a scourge affecting millions of people. Serious-minded investigators who visited the cinchona forests of the Andes returned to Europe stating that the supply of wild bark was dwindling, the trees in danger of complete extermination.

In 1813 Dr. Ainslie bemoaned the fact that India did not grow her own cinchona bark, a sentiment reiterated by Dr. Royce in 1835; and in Java the botanists Fritze, Miquel and others urged the introduction of the tree into that island.

The Dutch were the first to take ac-

tion, but the British were not far behind. The year that Hasskarl left for the Andes (1852), efforts were made to get the British government to send out an expedition. These did not bear fruit until 1859 when Clements R. Markham was instructed to organise an exploration of all important cinchona-producing regions and bring to India planting material—seeds and young trees—of as many promising forms as possible. Thus began one of the most dramatic and important series of events in the entire history of plant introduction. The work was successful; but it remained for Charles Ledger, an Englishman living in Upper Perú (now Bolivia), to lay the foundations of the modern cinchona industry in the Far East by obtaining seeds of a superior strain from the region of Coroico in 1865.

### Cinchona in Jamaica

Markham did not limit his program to India; he included Jamaica. So far as we have been able to ascertain, this was the beginning of cinchona cultivation in the American tropics. In his classic work, "Peruvian Bark" (London, 1880), Markham states that the first seeds were sent to Jamaica in 1860 and planted on the Blue Mountains near



Bath. About 1868 a further supply of seeds was sent to that island from Ceylon. The later history—and ultimate failure—of cinchona planting in Jamaica need not be recounted here.

### First Attempts in Guatemala

Though Markham sent seeds to Mexico, where they were planted near Córdoba in 1872, nothing came of the effort; and we can turn our attention to Guatemala, the only tropical American country where serious attempts were made to grow cinchona in these early days.

Emili Pilli, who brought together in 1942 much documentary material regarding the history of cinchona culture in this Republic, states that Julio Rossignon was the first to plant the tree here. The date is given as 1860, the location near Cobán. Rossignon is known also for having been the first to send seeds of teosinte (*Euchlaena*) to Europe. Pilli states that Rossignon's cinchona trees received little attention and finally disappeared.

The first serious attempt to grow cinchona commercially in Guatemala seems to have been that of the Sarg family, of which we have reliable details in the memoirs of Franz Sarg, "Deutschum in der Alta Verapaz", 1938.

Our chief interest in those early plantings is to trace the origin of the seeds employed, since it is from these seeds that many of the trees growing in the Republic have descended. Sarg states definitely that the stock used by his family was obtained from Ceylon through the good offices of Prince Nikolaus of Nassau, and that the year was 1878.

In this same year the Minister of Agriculture, Manuel Herrera, addressed a lengthy memorandum to President Justo Rufino Barrios, pointing out the advantages of cinchona cultivation and urging that the government take steps

to foster the introduction and establishment of cinchona trees. In 1878 President Barrios issued a decree sponsoring the project, and offered prizes to those who would make plantings. Under the terms of this decree, the Sarg brothers received in 1882 the sum of \$1,500 for their planting of 2,200 trees, which at that time were two years or more of age. Pilli states that the Alcalde of Cobán, who had these trees examined, reported that they were of two species, *Calisaya* and *succirubra*.

In connection with the taxonomy of *Cinchona*, not only in the early days but right down to the present time, the greatest caution must be exercised. Early studies suggested, and more recent investigations have amply demonstrated, that cinchonas in the wild are subject to such extreme variation—and there are so many hybrids—that specific names may mean very little.

The next step of importance seems to have been taken by the government of Guatemala which in 1883 contracted the services of W. J. Forsyth, an Englishman who had worked with cinchona in the Asiatic tropics. Under the terms of his contract, Mr. Forsyth went to Ceylon and brought back seeds with which nurseries were established in a number of places. Since the succirubras which were obtained by Richard Spruce on the slopes of Chimborazo in Ecuador were at that time being cultivated extensively in Ceylon and India, it is reasonable to believe that much of the Forsyth stock was of that strain, an assumption borne out by the appearance and the alkaloid-pattern of many trees now in Guatemala which originated in, or have descended from, the Forsyth introductions.

Pilli presents some interesting figures, as of 1884, regarding the location and extent of the Forsyth plantings. These data are of value to us in connection with the history of the material with



which we are working today. Of particular importance is the planting at Finca El Porvenir, made under the direction of President Justo Rufino Barrios, who was the owner of the property and who rightfully may be called the father of cinchona cultivation in Guatemala. This honor, however, should perhaps be shared with others—notably the Sarg brothers of Coban, and Don Manuel Herrera, Minister of Agriculture.

After the death of Barrios the Reformer, cinchona culture entered a period of decline due to several factors, some of which can with difficulty be evaluated at this late day. Colombia was shipping large quantities of wild bark, much of it better in quality than that being grown in Guatemala; Java was coming into production with its fine Ledgeriana barks; prices were falling in world markets; and coffee was King.

### The Beginnings of a New Era

Throughout the 1890's and the first three decades of the 1900's, cinchona cultivation in Guatemala was in the doldrums. Many of the trees which had been planted for shade in coffee fincas were destroyed. Experimental shipments of bark which were occasionally made to the United States and Europe usually resulted in loss—or at best no satisfactory profit—to the growers. The preponderance of succirubra blood in practically all of the Guatemalan trees rendered impossible any competition with Ledgeriana barks from Java.

During the first World War a serious situation developed with regard to supplies of quinine needed by the Allies. In subsequent years it was realized that an effort must be made to achieve independence of the Far East with regard to this important product.

The genesis of this effort is set forth by Frederic Rosengarten, Jr., in his

"History of the Cinchona Project of Merck and Co. Inc., and Experimental Plantations Inc., 1934-1943", from which I quote the following paragraph:

"In early 1932 Merck and Co. Inc. considered the advisability of developing Cinchona in the Western Hemisphere, at the suggestion of, and in co-operation with, the State Department of the United States. It was deemed expedient to build up supplies of cinchona bark in the Americas in order to become independent of the Dutch Quinine Monopoly. It was logical that Merck and Co. Inc. should have been keenly interested in bringing cinchona cultivation back to the Americas, in view of the fact that this Company, through its predecessors, had maintained an unbroken interest in the extraction of quinine from cinchona barks since 1822, when Farr and Kunzi commenced the operation of a quinine factory in Philadelphia, two years subsequent to the isolation and identification of quinine as a crystalline compound by the French chemists Pelletier and Caven-  
toux".

After a brief and unsuccessful attempt to establish cinchona in the southern United States, Guatemala was chosen as the base for experimental work. Some of the arguments in favor of this country were the following: (a) it is nearer the United States than the cinchona regions of the Andes; (b) its government was favorably disposed toward projects of this sort; (c) experience of the previous century gave grounds for believing soil and climate were suitable; and (d) there were present in Guatemala considerable numbers of intelligent, progressive coffee planters, prepared to cooperate in the work with energy and determination.

Col. Victor E. Ruehl was delegated by Merck and Co. Inc. to undertake the organization and development of the project. He came to Guatemala in the



spring of 1934 with a supply of Ledgeriana seed which had been purchased in Java. His first act was to establish close contact with the Director of Agriculture, Don Mariano Pacheco H., a man peculiarly fitted to assist because of his keen interest in new crops and his unusual ability as a plantsman.

Col. Ruehl travelled widely over the Republic, seeking out what appeared to be favorable sites for experimental plantings. He was warmly received by the finqueros (coffee planters), and shortly entered into arrangements with the late Gordon Smith of Finca Mocá near Guatalón; L. Lind Pettersen of Finca Zapote, Escuintla; Pedro G. Coñío of Finca Retana, Antigua; and Gustavo Helmrich of Finca Samac, Cobán.

At that time, Guatemalan agriculturists had no experience with Ledgerianas—except at Finca El Porvenir where Dr. Goebel had planted a few trees. Everyone had to start from scratch. Col. Ruehl's first need was for nurserymen to propagate and grow the Java stock. He obtained from the United Fruit Company two young men trained at Lancetilla Experiment Station in Honduras: Jorge Benítez, an Ecuadorian; and Hans Franke, a German. These men were put in charge of nursery work, cooperating with the finqueros mentioned, who furnished all facilities.

Seedbeds were established at Retana, in Antigua; at Finca El Zapote; at Finca Mocá; and at Finca Samac near Cobán. In addition, some of the Java seed was left at Washington to be propagated in the greenhouses of the United States Department of Agriculture, and some was given to Don Mariano Pacheco. A small quantity was sent to Lancetilla Experiment Station in Honduras but failed to grow at that low elevation.

The seedbeds at Retana were a failure. We have since learned that Ledger-

iana is not suited to that location—perhaps in part because of climate, in part because the soil is not sufficiently acid. The first plantings made at Zapote also failed because the seeds were killed, it is believed, by formalin treatment aimed to prevent the development of disease. A stand was obtained at Mocá, but it was soon observed that the plants were not doing well, and the stock was removed, in the main, to Finca Helvetia, also under the direction of Gordon Smith. Gustavo Helmrich at Coban, working alone, grew some plants and established what was, until destroyed by floods in October, 1940, one of the best plantations in Guatemala. Fortunately, before these trees were lost, many of them were propagated by grafting as well as by seed.

Don Mariano Pacheco grew a fine stock of plants which were later distributed to various places. B. Y. Morrison of the U. S. Department of Agriculture sent to Guatemala not only many plants grown from the Ruehl seed, but many others grown from seed obtained from the Philippines; from Amani, Africa; and elsewhere. Seeds from old trees near Cobán, at Helvetia, and other places in Guatemala were also planted in various nurseries.

### The Kinds of Material

Before proceeding further it becomes necessary to discuss briefly the kinds of cinchonas with which we are dealing. The subject is almost hopeless if we adhere to a purely botanical classification. Ever since Weddell's time (the 1840's), the botany of the genus *Cinchona* has baffled every student. The best-known kind of cinchona, Ledgeriana, is itself so variable, and has been subject to so much crossing with other forms, that it is hard to say just what constitutes a Ledgeriana tree and what does not. Sir Frank Stockdale, in his report on cinchona culture in Java (1938), writes:



"Survivors of the original planting are still to be seen on the estate and it is clear that the seed was heterozygous as in the population raised from it many variations in habit of growth, leaf and bark characteristics are to be noticed". And elsewhere it has been stated that among these original trees, grown from Mr. Ledger's Bolivian seed, there is a range in quinine sulfate content from 3% to 13%.

And again, the wild form of *C. pubescens* or *succirubra* in Costa Rica contains practically no quinine; while the wild form from the slopes of Chimborazo in Ecuador (from which it is probable that most of the *succirubras* in cultivation have been derived) sometimes contains as much as 5%. It is therefore obvious that the agriculturist must devote little attention to the botanical classification of the material with which he works and much to its characteristics of growth and its economic value. This is made even more obligatory by the fact that much of the material in cultivation is undoubtedly the result of hybridization, often between a known pistillate and an unknown staminate parent.

At the same time, we must take notice of the botanical classification of our cinchonas because there are characteristic differences in what may be termed the alkaloid pattern of these wild forms. Thus, the *Calisayas* normally show a preponderance of quinine over the other principal alkaloids—cinchonine, cinchonidine and quinidine; while the *succirubras* do not have this preponderance; and the *micranthas* typically show almost no quinine at all.

Early efforts to split the genus into many species which do not always come true from seed proved hopeless from the standpoint of the practical agriculturist, as they have proved to be from that of the sound botanist. The tendency now is to recognize only a few

well-defined species and admit that within each of them there are many forms of varying economic value.

In the early days of cinchona exploitation in the Andes the wild forms acquired common or trade names, and it may be well for us to follow these in part. Sir Clements Markham listed the principal wild sources of commercial bark as follows:

*C. Calisaya* (Bolivia and Peru) Yellow Bark or *Calisaya*.

*C. succirubra* (now called *C. pubescens*) Ecuador, etc. Red Bark.

*C. micrantha* (Ecuador and Peru) Gray Bark.

*C. officinalis* (Colombia and Ecuador) Crown Bark.

*C. Pitayensis* (Colombia and Ecuador) Colombian or Pitayo Bark.

Of the above species, one of the most recent students of the genus, Paul C. Standley of Chicago, recognizes only *C. officinalis*, *C. pubescens*, *C. micrantha* and *C. pitayensis*, including the *Calisayas* or Yellow Barks in *C. officinalis*. Certain other botanists, however, do not agree in this. The divergence of opinion is of little importance, compared with the discrepancy between some of the earlier classifications, which made 30 to 40 species of the above, and the present simplified outlook.

### The Work in Guatemala Continues

The Ledgerianas planted in Guatemala in 1934 from Java seed showed many variations from the start; nevertheless there could be recognized a narrow-leaved form which was considered to be the type and which in general showed the highest content of quinine. At Finca El Zapote these narrow-leaved forms (which had come from the Washington stock, shipped down after the original seed failed to germinate in Guatemala) promptly began to die out, while the broader-leaved forms survived in small numbers and have given rise to



a group of plants, considered to be hybrids, which are of strong growth and good quinine content, though not so high as some of the narrow-leaved *Ledgerianas*. L. Lind Pettersen took up with energy the study and propagation of these forms, and they are generally considered, at the present writing, to be some of the most promising in all Guatemala for commercial cultivation.

At Finca Mocá a few *Ledgerianas* which were planted in the field have done fairly well; but most of the stock which, as has been mentioned, was removed to Helvetia has done much better; and Helvetia at present has the largest planting in Guatemala of the narrow-leaved *Ledgeriana* forms. From Helvetia plantings were made at Finca Patzulín where also the narrow-leaved forms have done well. It is to be noted that the soils at these two places in general show a more acid reaction than those of the lands farther to the eastward on the Pacific side of Guatemala.

At Finca Panamá, Guatálón, both Owen Smith and Merck and Co., Inc. planted many *Ledgeriana* seedlings. Here as at Zapote the results with the narrow-leaved types have not been satisfactory, while the broad-leaved forms have done well. Only a few trees survived out of some 3,000 "Philippine Ledgers" sent down from Washington, and these were all broad-leaved forms locally considered to be hybrids.

In 1939 Merck and Co., Inc., feeling encouraged by the general progress of the project which had been able to survive in spite of a difficult financial situation among local finqueros incident to the low price of coffee in the 1930's, considered the time had arrived to expand their own activities and purchased Finca El Naranjo, above Chicacao, in the department of Suchitepéquez. The headquarters of Hans Franke and Jorge Benítez were moved to this property (they had previously been living on

fincas of the cooperators, Benítez at Zapote and Franke at Helvetia); and F. C. Armstrong, an Englishman with plantation experience in the Far East, was employed as general supervisor of the work. This arrangement was terminated in May, 1940, when Wilson Popenoe was loaned by the United Fruit Co. for six months to assist in developing the project.

Earlier in 1940 B. A. Krukoff, a botanist with extensive tropical experience, had visited Guatemala on behalf of Merck and Co., Inc., and with him had come Frederic Rosengarten, Jr., who remained at Naranjo to assist in carrying out the development of extensive seedbeds at this and other places.

The year 1940 was an important one for the new industry in Guatemala. Not only were large quantities of Calisaya seed from South America planted at Naranjo, at Zapote, at Finca Panamá, at Helvetia and at Patzulín, but efforts were made to organize the experimental work along many important lines. Thus, for example, a uniform system of numbering individual trees for identification was adopted by the collaborating experimenters, after much study and effort on the part of Owen Smith, in particular. The "Individual Tree Record", prepared by Popenoe and Krukoff, was adopted, thus making possible for the first time the preservation of data in an organized form. And bark sampling, now feasible because the Ledgers grown from the Java seed had attained in some instances sufficient size to yield worthwhile specimens, was undertaken on a large scale. Particular credit should be given Mr. Rosengarten for his tireless efforts in securing and preparing bark samples from all areas, samples which were sent to Merck and Co., Inc., at Rahway, New Jersey, for analysis.

In August of this same year William Pennock, who had worked with cin-



chona at the U. S. Department of Agriculture's Experiment Station in Puerto Rico, was employed by Merck and Co., Inc., to undertake horticultural investigations at Naranjo. John Smith, son of Gordon P. Smith, who had returned from the Imperial College of Tropical Agriculture, Trinidad, B. W. I., took charge of cinchona experiments for the interests represented by his father, but left toward the end of the year to volunteer for military service with the Royal Canadian Air Force. His work was ably continued by Percy Davies and Harold Lewonski of Finca Helvetia.

In spite of the progress made during this year—progress along many sound lines—the young industry suffered the hardest blow yet experienced, in the death of Gordon P. Smith of Finca Mocá. Ever since the planting of the Java seeds in 1934, Gordon Smith had led and inspired the local work, and had refused to be discouraged by failures and by the difficulties through which the coffee industry had been passing. For his dogged persistence, his enthusiastic support and his willingness to cooperate at all times and in all ways, the cinchona project in Guatemala owes much to this able agriculturist whose memory will live.

At the end of 1940 Wilson Popenoe turned over the administration of the Merck interests, operated locally as Experimental Plantations, Inc., to Frederic Rosengarten, Jr., who carried forward the activities with vigor and enthusiasm. George W. Perkins, Executive Vice President of Merck and Co., Inc., and his colleague, R. P. Lukens, Director of Manufacturing (who managed the cinchona project from the Rahway end), continued to make occasional visits to Guatemala, as they had done from the start, guiding and encouraging the local cooperators. Both these gentlemen have done much to forward the work, not to mention the heavy

investment of funds which they have approved with no certainty regarding the ultimate outcome.

Toward the end of 1940 Hans Franke left Naranjo, and in 1941 William Pennock left. Franke was replaced by Enrique Hoehn, a Swiss citizen with 20 years experience on coffee plantations in Guatemala, and more than usual ability as a horticulturist. Much time was devoted, on all the cooperating properties, to the care and transplanting of the Calisaya seedlings from South America, and to investigation of pressing problems. Of particular importance was grafting. It was during this year that widespread use of this method of propagation came into play, and numerous workers were trained in the necessary techniques. L. Lind Pettersen deserves great credit for taking a leading part in this; Owen Smith at Panamá, aided by Vidal Cabrera, also pushed ahead as did Finca Helvetia, the work being based largely on the pioneering in this field which had been done by Jorge Benítez.

### Some of the Problems

Obviously all of this progress was not attained without encountering obstacles, nor without making mistakes. At the start there was the problem of seedbeds. Experience was lacking, and literature on the subject was not too abundant, nor were the practices therein described necessarily the best for Guatemala. The fungous disease known as "damping off" gave trouble the first year or two, but experience showed that it could be controlled through proper adjustment of ventilation and watering.

Attempts to grow cuttings did not turn out satisfactorily, probably due to inexperience—at least with *succirubras*—since it is now known that this method of propagation is extensively used in several other regions. Budding was tried and not considered very satisfac-



tory until results obtained at Finca El Zapote, mainly with the strong-growing hybrids, were so successful as to encourage others.

With the arrival of Ralph Pinkus at Naranjo in 1942, increased attention was given to problems of propagation at that place. Mr. Pinkus has had excellent success with the side-graft, as opposed to the veneer-graft originally used.

Data from the various centers of experimentation continued to accumulate. There was need of someone to compare growth rates, bark yields, quinine contents and disease resistance of the many clones then growing under different environmental conditions. Dr. John R. Shuman was brought from the United States to do this, and his arrival was timely, as several people who had been involved in the first experiments were gone, records were incomplete in many instances, and the burning question was, Which clones should be planted on a commercial scale?

Growth measurements were taken by thousands, laboratory analyses of bark were brought together for correlation with tree behaviour, and a detailed statistical study (in which Dr. Shuman was aided by Amado Pelén C.) was made of all this information.

It may be said that this work terminated a definite period in the develop-

ment of cinchona culture in Guatemala; for just at this time the entrance of the United States into World War II threw the cinchona alkaloids into a position of great and immediate strategic importance. Programs aiming to obtain large supplies of cinchona bark in the shortest possible time were placed on foot, not only in Guatemala but also in several South American countries. The history of these projects forms a separate chapter in the romantic tale of cinchona which it is not the purpose of this brief paper to discuss, but which has already been told in part by those who participated.

#### Editor's Note

Dr. Popenoe's article induced the editor to ask him for some figures concerning the extent of cinchona cultivation at present in the New World. To this inquiry Dr. Popenoe replied under date of June 24, 1948:

"Merck & Co. have 600 acres at Finca El Naranjo [Guatemala]; most of the trees are at least four or five years old. They have another planting near the Mexican border, but I do not know just how large it is. There are good-sized commercial plantings of four or five private growers, and, in addition, the U. S. Government has planted a great many trees on a silvicultural basis at Finca El Porvenir [Guatemala]. I would think it safe to say that there are approximately 1,000 acres in cultivation."

Since these trees have been planted with a spacing of 4×4 or 5×5 feet, there must be about 1½ million trees under cultivation.



