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

NOTES ON THE ARCHITECTURE OF THE SPANISH COLONIAL PERIOD IN GUATEMALA

Wilson Popenoe

"The earlier structures in Mexico, erected in the first generation succeeding the Conquest" writes the well-known authority Sylvester Baxter, "had little architectural character. Utility was the sole consideration. The early ecclestiastical edifices were built under the supervision of the Franciscan friars, who were the pioneers of the Church in New Spain. These churches in various parts of the country have a rudely massive character, with a look of austere severity, frowningly sombre. They are commonly distinguished by battlements that suggest defensive functions, and are of an easily recognizable type that might be termed 'early Franciscan'. A noteworthy survival of this work is the old Franciscan church at Cuernavaca."

Guatemala was colonized from Mexico, and it therefore seems logical to assume that the first structures built in this region by the Spaniards would follow architectural style of contemporaneous work in Mexico. But so far as I am aware no buildings now exist in Guatemala, which in their present form can with certainty be attributed to the XVI century.

Nevertheless, Professor Verle S. Annis, (to whom I shall refer in detail further on) considers that we have, in the Ermita or small church which stands on the Cerro del Carmen in Guatemala City, a building which in its general outlines is characteristic of the early Franciscan style. Is it the only one now to be seen in Guatemala? I do not know; but I am inclined to suspect that it is. Certainly it is to be reckoned among the oldest buildings in the republic: Jesus Fernandez, writing in 1894, states categorically that it was built, in its present form, as early as 1620. The decoration on both

sides of the main doorway, Professor Annis thinks, may have been added in later times; and we know that the building was seriously damaged by the earthquake of 1917; but the restoration done after that disaster followed very closely the original lines.

Quoting again from Baxter's classic work, "Spanish Colonial Architecture in Mexico", I believe the following remarks apply to Guatemala as well as to the country he was discussing: "The influence of the full Renaissance was dominant in Spain when the great cathedrals of Mexico and Pueble were begun, in the latter half of the XVI century .... In the remaining part of the XVI, and throughout the XVII, both religious and civil architecture were dominated by the Baroque, with its capricious proportions, its accidental profiles, its heavy and corpulent members, its ragged fronts, its abundant, irregular and crude mouldings,- but picturesque withal, and in Spanish hands, of extraordinary character."

During the eighteenth century ecclesiastical architecture in Mexico was largely characterised by what Baxter terms a peculiarly Spanish outcome of the Baroque,- The Churrigueresque, in which the decorative tendencies of the Free Renaissance" went to the uttermost extreme of architectural unrestraint." In this style "the column and the anta are transformed into pillars and pilasters replete with decoration, all panels are decorated, lines are infinitesimally broken, and the sculpture becomes an integral portion of the structure, serving as decorative members."

Churrigueresque architecture, in well-developed form, seems never to have been used in Guatemala; perhaps in part because this country did not have the wealth possessed by Mexico, hence simpler, more modest buildings were the rule; perhaps in part because it did not come into vogue sufficiently early for its influence to be felt in Guatemala at the time most of its great ecclesiastical

structures were being built.

Baroque, according to Professor Annis, is the dominant note in Guatemalan ecclesiastical architecture. I have already quoted Baxter's characterization of this style: another definition which has seemed to me illuminating,- and which I culled from the newspaper report of an architect's speech in Boston a few years ago, is as follows:

"Baroque is a style which is a combination of straight lines and curves, its beauty lying in the relationship of the two. Its inception was a reaction from the severity of the classic styles and was concomitant with the rise of the Italian renaissance. It spread throughout Europe and served for an uncommonly long span until it fianlly degenerated into the rococo."

Summarizing, we are principally concerned - in studying Spanish colonial architecture in Guatemala - with the Renaissance and its sequences; first the Baroque, and ultimately its degenerate expressions known as rococo. To this we must add what some Mexican writers term an architectural style but which Professor Annis prefers to consider a form of decoration, the plateresque. This is so-called because it resembles, in technique, the decorative work done by silversmiths of the early period.

The principal - infact, the only - purpose of these notes is to place on record the comments of Professor Annis regarding major architectural features of the principal structures of the Colonial period in Antigua, Guatemala. So far as I am aware, nothing of this nature has been published. Professor Annis, I believe, is the first person to undertake a detailed study of Spanish colonial architecture in Guatemala. During the spring and summer of 1938 he spent five months in this country - his second visit - and brought together a vast amount of information, as well as photographs and measured drawings, from which it is to be hoped he will shortly prepare an authoritative technical publication.

Until this appears - and perhaps even then, for the visitor not professionally interested - the following comments by Professor Annis should be helpful.

Antigua, Guatemala

Palace of the Captains General. Completed in 1764, only nine years before the destruction of the city. Badly damaged by the earthquake: the facade was later restored. "Renaissance, not as good workmanship as the Ayuntamiento."

Palace of the Muy Noble Ayuntamiento. I believe this to be of fairly late construction, not 1540, as indicated by a tablet on the front wall. "Renaissance; heavily proportioned. No other styles involved.

The Cathedral. The facade seen at the present day has been built since 1773; it was not part of the original cathedral which was destroyed in that year. "Renaissance, with much Plateresque ornamentation."

The University of San Carlos. Now occupied by the Museo Colonial. Architecturally almost unique in Antigua; "Moorish inspiration throughout, yet not definitely Moorish in details."

Church of San Agustin. The facade is a good example of Baroque.

Jesuit Church and Monastery (La Compania), now occupied by the market. "Facade of the church is mainly Baroque, but of a reserved sort. Elaborate use of fresco has made it very interesting. The decoration is in good taste; and the church has the distinction of being the only one in Antigua to have been characterised by exterior frescoes."

Church of La Merced. One of the last to have been constructed in the old capital before the earthquake of 1773. Said to have been completed in 1760. "Merced belongs to the decadent period of design. Probably intended to be Renaissance with Plateresque decoration; it is, in fact, basically Renaissance

with Plateresque decoration badly done."

Church and Monastery of San Francisco. The facade is "good, straightforward Baroque in all its features. The portada (gateway) to the west likewise. The small chapel used at present, known as the Capilla de la Tercera Orden, together with its portada or gateway to the north - probably built after the earthquake of 1773 - are entirely without character." Professor Annis considers the facade of San Francisco one of the best examples of pure Baroque to be seen today in Antigua.

Church and Monastery of Belen. The facade of the latter is "commonplace; the cloister has Renaissance feeling. The Bethlehemites always built plainly, simply, severely." The facade of the church which stands at one side of the old monastery is post 1773, and in bad taste.

Escuela de Cristo. Facade of the church "cannot be classified; Renaissance pilasters on second storey. If it were in Mexico it would suggest Early Franciscan, because of its massiveness and severity," but its construction took place at too late a date for it to have been influenced by that type: according to history it was built about 1720.

Calvario, at the end of the Alameda of that name. The Companario or bell tower, which Professor Annis considers one of the best bits of Baroque in Antigua. stands at the entrance; behind it is the little church, which is "Renaissance: the two small structures on either side may have been added at a later date, and are a mixture of Renaissance a nd Baroque."

Santa Cruz. A small church standing in a coffee plantation, across the Rio Pensativo from the ruins of Belen. Professor Annis thinks this/the architectural gem of Antigua; it should not be missed by one interested in this subject. "Baroque with Plateresque decoration. Fine proportions, clean cut of its style, workmanship excellent."

Church of San Juan de Dios (next to Hospital). "Free Renaissance with over-elaborate decoration. Proportions and lines not good. The shrine on the East side of the church, southward from the main entrance, is good Baroque."

Los Remedios, a small church standing in a coffee plantation on the Alameda del Calvario. "Renaissance; pure, simple, unadorned."

San Cristobal el Bajo, some distance outside of town, "is straight forward Renaissance, and not bad."

San Jose el Viejo, built, according to Juarros, in 1687. "Somewhat Baroque, tending toward Rococo. Bad architecture."

San Gaspar, some distance from town, toward San Juan del Obispo. "Renaissance, rather decadent, with touches of Baroque. Plateresque decoration. For a small outlying church, rather nice."

Church of Capuchinas. Facade is "pure Renaissance; - straight, cold Renaissance, well-proportioned."

Church of Carmen. "Almost pure Renaissance, with Plateresque ornamentation. Lower columns Doric, upper columns Ionic. This facade is the most consistently Renaissance - Plateresque of all structures in Antigua."

Santa Clara. church and convent. "Facade and side entrance of church Rococo, cloister pure Renaissance. The facade is perhaps the nearest approach to Churrigueresque to be found in Antigua, but not good enough to merit that classification."

Church of Santa Teresa. Facade of church is "Free Renaissance, and quite good; one or two Moorish features."

Santa Rosa de Lima. Facade of this small church is one of the architectural gems of Antigua. "Baroque - good Baroque on the whole - with tendencies toward the Rococo."

Candelaria, lower church, "very Moorish. Plateresque decoration, also of Moorish character. Door forms and niches Moorish, but the upper portion of the building almost Renaissance. A hybrid."

Dolores del Cerro (upper Candelaria), facade is "rather poor Renaissance; simple."

Jocotenango, some distance out of town on the road toward Chimaltenango, is Baroque.

Guatemala City

Iglesia del Carmen, on the Cerro del Carmen, has already been mentioned in detail.

Church of La Merced, one of the finest in the City, "more purely Renaissance than anything else in town; the dome is pure Renaissance."

The Cathedral, built about 1800, represents the "early classic revival, Good Renaissance; consistently classic." The towers were destroyed by the earthquake of 1917, and have been rebuilt, not quite as they were before.

THE MANGO: A STUDY IN SYSTEMATIC POMOLOGY

Wilson Popenoe
United Fruit Company

That branch of horticultural science known as systematic pomology - the classification and description of fruit varieties - has received scant attention in tropical America. The citrus fruits, involving several species and many varieties, have come to us in the main from subtropical regions, well classified and described by students who have devoted long years to the subject. The avocado, because of the commercial importance it has recently attained in the United States, has also been placed upon a fairly satisfactory basis.

But with the great majority of tropical fruits the situation is different. Since few of them have been propagated vegetatively to any great extent, horticultural varieties have not been recognized nor established; and lacking horticultural varieties, there has been no need for classification and description.

This situation is changing - not as rapidly as some of us had hoped, but it is changing nevertheless; and the time will come when many tropical fruits are propagated vegetatively for the commercial production of high-grade fruit, which to be acceptable to an exacting public must be uniform in character and marketed under recognized varietal names.

The mango, though known in tropical America mainly through the abundance of inferior seedling forms, is one of the truly great fruits of the world. In the Asiatic tropics, especially in

India, it has been propagated vegetatively for centuries and many fine varieties are the result. These are in many instances imperfectly known pomologically. Their nomenclature is confused, and their classification has received attention only at the hands of a few scattered workers. This fruit, therefore, seems eminently suited for a study of the possibilities of systematic pomology in the tropics, and it is proposed here to review the situation, not so much with a view to increasing the available information regarding mango varieties and their classification as to stimulating further interest in the general subject.

Nomenclature.

The basis of pomological science is sound and accurate nomenclature. As long as confusion exists regarding varietal names, as long as there is bewildering synonymy, as long as the same name is applied to two or more different varieties, there can be no classification nor description.

A pomological variety has been defined as "a group of plants propagated vegetatively from one original plant producing fruit of a distinctive appearance, texture, flavour or aroma, by which characteristics it may be distinguished from fruit of other trees of the same species." Once it meets these requirements, a variety should be given an appropriate name by which it can be distinguished from others of its kind.

Many years ago, the rules governing nomenclature of fruit varieties were codified by the American Pomological Society and generally accepted by horticulturists in the North. These rules have stood the test of time, and have been found useful in developing a more appropriate and convenient nomenclature. There

seems to be no reason why they should not be followed in the tropics. Succinctly stated, they are these: In choosing names for new varieties, distinctiveness, simplicity, ease of spelling and pronunciation, and indication of origin or parentage are all points to be kept in mind. Varietal names should consist of a single word, and the use of a number either singly or attached to a word, is to be tolerated only as a temporary expedient. The use of such terms as "seedling" and "hybrid" is not considered admissible, neither is the use of a possessive noun.

The mango varieties propagated vegetatively and cultivated in the West Indies at the present time are fortunately not so numerous as to present any serious problem from the standpoint of nomenclature. We have, for example, Julie, and Haden, and Pairi, all simple names conforming in every respect to the Code (though there is some confusion with regard to the correct spelling of Pairi); but the situation in the Asiatic tropics seems quite different. Such names as "Fernandino No. 2", "Phillip's", and "Banchore of Dhairey" are to be found in the literature.

Obviously, it is no easy matter to alter a name which has been in use during a long period of time. The lesson we must learn is to avoid in the future the mistakes of the past, and keep the subject as free as possible of the complications which result from the use of compound names, numbers, and words difficult of spelling or pronunciation. Indian literature on the mango has been particularly characterised by illogical orthography and many variations. For example, one and the same variety is listed as Pairi, Pirie, Peary, Pyrie and Paheri. And again, the variety Khirsapati occurs as Kheershapottee while Kilimuku is spelled

Killeemookoo. Most of these difficulties are due to the translitëration of native names into English. In such cases, satisfactory solution is attained by having the names written in native character by an educated native, then translitbrating them on the system adopted by the International Congress of Orientalists at Geneva in 1894; which is, that consannnts are given their value as in English, vowels as in Italian.

Classification.

The object of classification is, or should be, to bring together all, those varieties which have several characteristics in common; in other words, those which presumably are related by descent from a common ancestor. As opposed to this Natural System, as it is termed, is the arbitrary or artificial classification often employed in cases where information is still wanting on which to base a natural classification. In the early days of avocado culture, for example, it was no uncommon thing to see varieties classified in such groups as these: (1) Pear-shaped, green-fruited varieties; (2) Pear-shaped, purple-fruited varieties; (3) Round, green fruited varieties; and so on. Such a classification has little value when compared with the one in use at present, namely, the grouping of avocados in three races, the West Indian, the Guatemalan, and the Mexican, each of which has several important characteristics common to all its members, and distinct from those of the other races.

Races, it should be stated, are such broad general divisions that individuals breed true when grown from seed, so far as the racial characteristics are concerned. While the mangos of the world have not yet been thoroughly studied from this standpoint,

investigation of the seedlings growing in certain parts of tropical America has led to the belief that numerous well-defined races do exist. The origin of these races is lost in antiquity. Some of the evident differences may in fact be the result of derivation from more than one species of Mangifera. Particularly do the mangos known in Cuba as Filipinos, and those of the Cambodiana class in Florida (a group introduced from Indo-China some forty years ago) appear so distinct from others that botanical rather than horticultural characters seem involved.

The problem of defining the seedling races is broader and probably more important than that of classifying the horticultural forms propagated vegetatively. Work on the latter subject can if necessary be confined to the varieties present in any given region. It has in fact been attempted in India, in Florida, and probably a few other places. When engaged on mango investigations for the United States Department of Agriculture many years ago, the present writer attempted a classification of the principal varieties then growing in Florida (cf. "The Natural Groups of Mangos Cultivated in Florida", Proc. Am. Pomological Soc., 1917) based wholly on what appeared to be natural relationships. This was later used in his "Manual of Tropical and Subtropical Fruits" (Macmillan and Co., 1920) and seems to have proved satisfactory, though admittedly it is by no means perfect. In forming this classification of natural groups (Mulgoba, Alphonse, Sandersha and Cambodiana), growth characters, leaf characters, the inflorescence, and the fruit were all taken into account; and though differences in some cases were so slight that they were not evident to the casual observer, familiarity with a large number of varieties in the field resulted in a final conviction on the part of the writer

that the relationships were real. A similar study of the mangos of the West Indies is suggested.

Description

If nomenclature is the basis, accurate and complete description is the essence, of systematic pomology. In general, it seems fair to state that the tropics still lag far behind the temperate zone in regardto the quality and uniformity of descriptive work used in defining pomological varieties. Next to vegetative propagation itself, it is sincerely believed that there is nothing which will do more to advance the cause of fruit growing in the tropics than detailed attention to this subject.

For this reason, and with no pretense of having developed a a descriptive technique for the mango which admits of no improvement, the writer takes the liberty of reproducing from the Proceedings of the American Pomological Society, 1913, the following outline of the procedure to be followed in making a technical description of a mango variety. Such a description, be it remarked, greatly facilitates the identification of fruit specimens and the placing of a variety in its appropriate natural group.

In describing a variety, the General Form of the fruit should be stated first. It may be reniform, subreniform, oval, oblong, elliptical, spherical, etc. Often it is asymmetrical. Frequently a combination of two or more terms is needed; indeed, some mangos are of such peculiar form as almost to defy accurate description. In cross section the fruit is usually round, oval, or elliptical.

Size. As the mango is so little-known pomologically, eac h

individual usually has his own ideas as to what constitutes a small, medium, or large fruit, hence the use of such terms is not always satisfactory. They should in any event be supplemented by the dimensions and weight. The dimensions necessary are length, breadth, and thickness. Breadth is taken dorso-ventrally, it being an easy matter to determine the ventral surface of the fruit by the location of the "nak" or stigmatic area, which is always to the ventral side of the apex. Care must be exercised to get each measurement in one plane only.

The stem must be described with regard to its insertion - square or oblique. One should also mention its length, and whether it is stout or slender.

The base is commonly rounded, flattened, or tapering. The "shoulders" form an important character, and are distinguished as ventral and dorsal. They should be described as to prominence. Often one is entirely wanting, sometimes both. Rarely are they equal in prominence.

The depression around the insertion of the stem forms the cavity. It is sometimes wanting, the base of the fruit being extended where it joins the stem. The cavity should be described as to form, depth, breadth, and markings. The form may be obtuse, acute, or acuminate, and wile usually regular, the cavity is sometimes furrowed or plaited more or less deeply. The depth may be shallow, medium deep, or deep; breadth from narrow to broad; the markings, if any, are in the nature of russeting or distinctive coloring.

The apex is commonly obtuse, rounded, or acute; sometimes more or less prominently hooked or "beaked". The stigmatic point is situated close to the apex on the ventral side of the fruit and

is known as the "nak", a Hindustani term probably first used by Maries. It may consist in a slight prominence or a slight depression; its height or depth should be stated, together with its distance from the longitudinal apex of the fruit.

The surface should be described as to smoothness, and next as to color. By color is meant the ground color of the skin, aside from the color of the dots or blush sometimes present on the cheek, which should be described separately. The dots, most of which are usually subcutaneous, should be described as to size, color, form and abundance. The color and thickness of the bloom should also be stated.

The skin should be mentioned as regards thickness, texture, and adhesion to the flesh.

The flesh should be described as to color, texture, aroma, and juiciness. One should also mention whether it is scant or abundant. The amount of fiber present should be stated, as well as its coarseness or fineness. In some varieties the fibers are confined to the ventral edge of the seed and do not extend any great distance into the flesh.

The flesh is a point often difficult of description. Nevertheless, a fairly accurate idea may usually be given by the use of such terms ad acid, subacid, sweet, aromatic, spicy, mild, rich, melting, and the like.

Quality. A careful attempt should be made to estimate the general quality of the fruit, which is usually described by the use of such terms as poor, good, or excellent.

The form and size of the seed should be carefully described,

and the weight, as well as longitudinal, transverse, and lateral dimensions given. Further, in the light of the recent important discoveries regarding the embryony of the mango, it should be stated whether the seed is monoembryonic or polyembryonic.

The season is usually described as early, midseason, or late; but it is well to add the exact period during which, in each particular region, the fruit can be picked; also its keeping and shipping qualities.

There are usually a few remarks regarding the fruit which will suggest themselves, and which have not been provided for in the general description. These should be noted down, following which the characteristics of growth and productiveness should be fully described. Under this head will be included any peculiarities of growth or foliage, resistance to cold or disease, and those most important of points, precocity and regularity of bearing, as well as the average size of the crop.

The importance of accurate illustrations to accompany the description of each variety cannot be overestimated. If photographic apparatus is not available, careful drawings will suffice. One drawing should show the general outline of the fruit, another a longitudinal section with the seed in place, and a third the seed alone, viewed longitudinally.

While the above outline applies solely to the mango, the sequence in which characters are treated, and the general method of treatment, are those which are used generally in pomological description. Eliminating one or two of the characters (e.g., the beak, which is a feature unique with the mango) and substituting others - but not altering the sequence - some such form as this

should be used in describing fruit varieties generally.

In the temperate zone, interest in systematic pomology seems slightly to have waned during the past quarter of a century. The excellent examples of pomological description - many of them prepared by that master of the subject, William A. Taylor - which appeared annually in the Yearbook of the United States Department of Agriculture during a period of many years, have been discontinued. So far as the north is concerned, perhaps the need for such work is not so great now as it was in earlier days. But it is the writer's firm conviction that the tropics, where fruit growing is only now commencing to emerge from the dooryard stage (excepting of course with regard to such crops as citrus and bananas), can gain much from detailed study, along the lines suggested above, of the pomological materials so abundantly at hand.

QUININE PRODUCTION IN THE AMERICAS

By Wilson Popenoe

In the Year of our Lord 1633, the good Padre Pedro Calancha wrote, "In the country of Loja there is a tree which they call fever-tree, the bark of which, ground to powder and administered in the form of a potion, cures fevers; there have been marvelous cases of this in Lima."

The romantic history of quinine has received much attention at the hands of chroniclers ancient and modern. About the middle of the last century, the English savant Sir Clements Markham, who played a prominent part in the establishment of Cinchona cultivation in the eastern tropics, placed on record an account which until recent years has been generally accepted as the best. According to this authority, an Indian of Loja (Ecuador) revealed the virtues of Cinchona bark to the Corregidor of that town, who in 1638 sent a small quantity to the court physician at Lima, by means of which the wife of the Viceroy was restored to health after suffering from repeated severe attacks of malaria.

In more resent years, interested students have delved into the dusty archives of Spain and Peru for further details on this fascinating subject. In 1938 the well-known Peruvian physician, Carlos Enrique Paz Soldán, published a little work entitled "Las Tercianas del Conde de Chinchón," which not only alters the tale materially, but is in itself a literary gem. Based upon this work, the story can be told as follows:

Don Luis Geronimo de Cabrera y Bobadilla, Fourth Count of Chinchon, arrived in Lima on the 14th January 1629 to take up the

important post of Viceroy. He was accompanied by his second wife, doña Francisca Enriquez de Rivera - his first wife, doña Ana de Osorio, having died in Spain some time during the year 1625. This item is of importance since tradition has held that doña Ana de Osorio was the one who was cured of intermittent fevers, thus bringing quinine to the attention of the medical world.

The recent discovery in Peru of a contemporary document, the "Diario de Lima" written by a priest named José Antonio Suardo, which is quoted at length by Paz Soldán, proves conclusively that the new Viceroy, shortly after his arrival, was attacked by tertian fever which during several subsequent years repeatedly incapacitated him for work. Following the best medical practice of the times the court physician, Dr. Juan de Vega, applied the accepted treatments: the Viceroy was bled, he was purged; he was purged and he was bled, but the attacks of fever continued to recur and at one time the patient was so low that he prepared himself for death.

Through these years, the Diario de Lima of Padre Suardo makes no mention of any illness suffered by the Lady Francisca, consort of the Viceroy. Then in 1638 don Luis Gerónimo was suddenly restored to health. On the 18th December 1639 he transferred the authority of his high office to his successor, don Pedro de Toledo y Leiva, and prepared to leave for Spain.

The voyage in those days was a long one, via Panama and Cartagena de Indias (now Cartagena, Colombia). On reaching this last-named port doña Francisca was suddenly stricken with a fatal illness, and don Luis Gerónimo continued to Spain accompanied only by his young

son. On reaching home he retired to his hereditary estate and died at the ripe age (for those days) of sixty-eight.

Attempting to harmonize the known facts, as brought to light mainly through the Diario de Lima, with the legendary tale of the discovery of the therapeutic value of Cinchona bark, Paz Soldán argues, with irrefutable logic, that the Corregidor of Loja, who had learned the secret from the Indians, sent the precious bark to Lima to cure the Viceroy, not his consort; and that the latter, in fact, administered the drug, the court physician clinging to the tenets of his profession, which did not include the use of unknown remedies of the Indians.

For it must be assumed that the Indians did know the value of quina-quina - as the bark was called by them - though there have been stories to the contrary. La Condamine, Jussieu, and Ruiz, early scientific travelers who visited the native home of the trees, all were of the opinion that the Indians gave the secret to the Spaniards; and when one reflects upon the extensive plant knowledge possessed by the more advanced native races of America, such as the Aztec, the Maya, and the Quichua (of which the Incas were the ruling clan) he is not inclined to doubt that this was the case.

The subsequent history of the use of cascarilla (as the bark was called by the Spaniards) includes the names of Dr. Juan de Vega, the court physician of the Count of Chinchón - who, though he may have doubted the efficacy of the drug when first brought to his attention in Lima (although in fairness it must be said the evidence is incomplete on this point), was later convinced; and especially that of the Compañía de Jesus - the Jesuits - who were active in making the drug known throughout Europe. The tale is marked by one unfortunate,

though minor, incident: when the great Linnaeus came to include the genus in his published works, which formed the foundations of modern botany, he spelled the name Cinchona instead of Chinchona, an error which Sir Clements Markham later attempted unsuccessfully to rectify.

For two centuries the sole source of this valuable drug was the forests of the Andes, from Colombia to Bolivia, where the Cinchona trees grow wild; then, because of increasing scarcity of the bark and increasing appreciation of its immense medical value, the Dutch and British Governments began to take an interest in establishing Cinchona plantations in their Asiatic colonies. In 1852, plants grown from seeds collected in Bolivia by the botanist Weddell were sent to Java; in 1854 these were followed by others grown from seeds collected by Hasskarl. Then in 1859 the British Government made extensive plans for establishing Cinchona cultivation in British India, plans which were entrusted for execution to Sir Clements Markham.

The story of the search for the best Cinchona trees in the Andes, carried out by the naturalist Richard Spruce and others, forms another romantic chapter in the history of quinine. Ultimate success was achieved when Charles Ledger, an Englishman who had resided in Peru and Bolivia for twenty years, obtained seeds of a superior strain which were sent to Europe in 1865 and were found in Java to produce trees of much higher quinine content than any which had previously been grown. From these seeds have come the trees which form the basis of the extensive plantations - more than forty-five thousand acres - which to-day supply most of the world's quinine. Markham, a devoted admirer of the native races of America (as are all intelligent persons who have come in intimate contact with them) has immortalized the name

of Manuel Mamani, a Bolivian Indian who risked his life - and finally sacrificed it - to obtain the seeds which Ledger sent to Europe. Ledger's memory is kept green through the use of his name for the trees which were grown from his seeds - a Dutch botanist subsequently bestowed upon this variety the botanical appelation Cinchona Ledgereana.

Though Java now grows more than enough Cinchona bark to supply the world's needs, recent unsettled political conditions have made it seem desirable to encourage production in the Western Hemisphere. The United States Government has therefore fostered experimental work looking toward development of plantations in those Latin American countries where conditions are favorable. Here it must be pointed out that Cinchona - at least the varieties of high quinine content - are extremely exacting in their requirements of climate and soil. They come from regions in the Andes where the mountain sides are covered with a thick layer of humus - the accumulated leaf-fall of centuries - and where clouds piling up from the lowlands keep the atmosphere moist a large part of the time. Successful establishment of commercial plantations depends upon (1) utilizing areas which have proper climatic and soil conditions, and (2) growing types which are of relatively high quinine content.

Most of the world's quinine is produced by the calisaya type of tree, native to southern Peru and Bolivia. Ledgereana or the Ledger race is a form of calisaya, which latter is considered by some modern authorities to be a good species - the Cinchona calisaya of Weddell - while others view it as a geographical form of C. officinalis. Quite different in character is the species Cinchona succirubra; it rarely yields more than 2 or 3% of quinine sulfate, while trees of the Ledger race commonly average 7% or higher. The succirubra species is mainly

used to-day as a stock-plant on which to graft the less robust Ledgereana, though it is cultivated to a limited extent for the production of what are known as pharmaceutical barks used in the form of "quills" for pharmaceutical purposes and for the medication of wines.

There are, and have been for some years, small commercial plantations of calisayas in the mountains of Bolivia. Plantings of succirubra were made many years ago and still exist (usually in a more or less abandoned state) in Ecuador, Colombia, Guatemala, and perhaps a few other countries. Recent efforts have been aimed at the development of plantations limited mainly to higher-yielding types such as Ledger. Guatemala has been the scene of the greatest activity along these lines, though experiments have also been started in Brazil, Venezuela, Colombia, Costa Rica, Mexico, and elsewhere.

"The problem for the Cinchona grower," writes Sir Arthur Stockdale, "is to find those conditions which promote the greatest degree of bark growth of reasonable quinine content in the shortest period of time." This statement sums up the objectives admirably. Those concerned with Cinchona culture in most of the countries mentioned above are having to start from scratch; for, with the exception of a few vague memories of earlier experiments conducted in Guatemala in the 1880's, and published information from Java, they knew nothing when they commenced work a few years ago.

Plantings were started in Guatemala at various elevations, from 2000 to 6000 feet, and on widely differing soils. Much difficulty was experienced at the start in propagating the high-yielding Ledger types. They are delicate trees which, if on their own roots, require

rich virgin soils, not too sandy in character, but at the same time not heavy. And experience in Java has shown that they are only fully successful within a certain altitudinal range - approximately 3500 to 5500 feet in that Island.

Seeds are planted in carefully prepared beds surfaced with forest loam, and protected from the sun and rain by means of sheet-iron roofing. To indicate the delicate character of the seeds, it is only necessary to state that it takes some 2500 of them to weigh one gram.

While the seeds are germinating, which takes from three to four weeks, they must be kept uniformly moist but not wet. If allowed to dry out after they have once swollen, they die. Then there is the problem of protection from the damping-off fungus while the seedlings are small. This requires a very careful adjustment of the light relation. As the plants grow larger, they must be given more light lest they become too "leggy;" but if exposed to direct rays of the sun for even a few hours, they may be killed.

From the seed beds they are transplanted, when three or four inches high, to nursery beds - again with partial protection from the sun's rays - and after six months or so, again transplanted at wider spacings. It may require as much as two years to bring the young trees to the size suitable for transplanting to permanent places in the field.

Because Ledgers are so delicate, it is the practice in Java to graft them upon roots of the more rugged succirubra species - unless the land on which they are to be grown is unusually rich and of just the right soil texture. Grafting also furnishes an opportunity for standardizing the production, for grafted trees are naturally uniform in quinine content (comparatively speaking), while seedlings are not.

The selection of high-yielding mother trees for this purpose is another phase of the problem. At first glance it appears simple enough: one would think it necessary only to choose those trees which have the highest quinine content, a thing which can easily be determined by laboratory tests. But this is not the whole story. A tree which contains, let us say, 14% of quinine sulfate may be such a slow grower, and have such a thin bark, that it is more profitable to cultivate a tree which is a rapid grower with thick bark, but which only shows 10% of quinine sulfate upon analysis of a bark sample. Other factors also come into play, such as disease resistance, facility with which the variety can be grafted, and the like.

Whether grafted or seedlings, the trees must have been in the field several years before any bark can be harvested. The process of "thinning out" is then practiced annually, the trees having been planted close together at the start to permit of this. Since there are as yet no commercial plantings in Guatemala sufficiently old to permit of commercial harvesting, we will again quote Sir Arthur Stockdale, who has recently described the technique used in Java: "Three years after planting, the first thinning begins - all plants which have made inferior growth are taken out and their bark used. This thinning is continued annually for a few years and then at longer intervals. Under ideal conditions of soil and climate, bark growth continues to be active up to ten years and then slows down. Under these circumstances a ten-year rotation is practiced but the Government plantation at Tjinjeroean works on a twenty-year rotation as bark increase continues for that period..... An average yield of 7 tons of bark per acre is obtained from a cut-out area, but of course there are the yields of bark which have been obtained

from the earlier thinnings. These may produce an additional 3 to 4 tons of bark per acre."

Bark is removed by beating all parts of the tree - trunk, larger roots, and branches - with wooden mallets and then stripping it by hand. Its preparation for the market is simple: it is dried, then ground to a coarse powder, in which form it is received by the manufacturing plants which chemically extract the quinine sulfate and the minor alkaloids such as cinchonidine, quinidine, and cinchonine.

At the invitation of Dean Ryerson, I had the honor of attending, last spring, a meeting of the Advisory Committee on Inter-American Cooperation in Agricultural Education. I came in a humble frame of mind, because I am not an educator, and because I have for many years been largely cut of touch with the progress of agricultural education in the United States.

Dean Ryerson seemed to think these might be the very reasons why I should come. For the past fifteen years I have lived in Latin America, and have travelled rather widely, particularly in the countries bordering on the Caribbean. I have been in contact - in rather intimate contact, I believe I can say - with many young Latin Americans working in the field of agriculture. I have discussed with them at length their problems and their ambitions.

Therefore, I tried to present, at the meeting in reference, the needs of these young men as I understand them; and I tried further to throw some light upon the broader problem of what we North Americans can do to aid effectively in the agricultural development of the tropical regions to the South. Since I am unable to attend the present meeting in person, it has been suggested that I attempt to set forth in written form the gist of my remarks at last spring's meeting. This I take great pleasure in doing, always with the understanding that mine are the views of one not qualified to discuss intelligently the more academic aspects of the subject.

The field is a large one, and our capacity for giving assistance is of necessity limited by many factors. I shall therefore restrict myself to asking two questions, and attempting to answer them on the basis of my tropical experience. First, In what way can we most effectively assist Latin American

youths in obtaining sound technical education in agriculture? And second, In what way can we most promptly, efficiently, and economically assist in the general improvement of agricultural practices in the tropical countries? I wish to make it clear that I am considering only those areas which lie within the tropics.

Taking up the first question, I have visited many of the secondary agricultural schools in tropical America and have known intimately some of their graduates. In the opinion of many of us who live and work in the tropics, these schools are in general subject to the criticism that they place too much stress upon the academic side; that their training is too theoretical; that their graduates are not well prepared for practical work. If this is true, I believe it is due in large part to the fact that these schools are frequently handicapped by the lack of well-trained, experienced teachers. It is not uncommon, in the smaller countries, for a youth to be named as a professor immediately upon graduating. He is fully responsible for teaching a subject regarding which he has had only the training he received during his undergraduate course. This situation has come about wholly because of the lack of teachers with better training.

Or again, having graduated from a school in which many of his teachers were men with very limited preparation, a young man may/be - and it can truthfully be said in many instances, is - given a post in his country's Department of Agriculture where he has either to deal with difficult problems of a practical nature - as in the case of extension workers - or pursue technical investigations for which he is not adequately prepared.

Do not think for a moment that teachers of the kind I have mentioned are

unaware of their lack of adequate training for the job, nor that graduates who are thrown into work for which they are not ready do not long for advanced training. To their everlasting credit be it said that I have met few if any who did not wish fervently for an opportunity to gain further training. But where are they going to get it?

This is the question which we can and should help them answer.

Perhaps I have overlooked some major feature of the problem, but it seems to me there are two ways in which we might assist. One is to send them teachers of the right sort; the other is to bring their students to our agricultural institutions for training. And I doubt that we can achieve much along the first line. It is difficult to find Americans willing to devote themselves to teaching in the smaller agricultural schools of the tropics; and when they do come, they must spend several years learning the language and the country's agriculture before they are ready to serve efficiently. During twenty-five years familiarity with tropical countries of Latin America, I have met a dozen or more American teachers. Those who have remained more or less permanently I believe I can count on the fingers of one hand. I shall not attempt to analyze the reasons for their failing to stay: there are too many factors involved.

Let us turn to the other angle, for here I believe, lies real hope. Not only real hope, but such hope that I am tempted to become enthusiastic regarding the possibilities. To show you that I am not theorizing, that my views are based upon experience, I shall take the case of Colombia. Here is a country which has been making great strides toward scientific agriculture. There is an agricultural college at Medellin, affiliated with the National University. They have turned out, to date, something like one hundred and fifty graduates

with the degree of Ingeniero Agronomo, - agricultural engineer - though they are not engineers in our understanding of that word. I have met and worked with at least twenty five or thirty of these young men during the past five years. Almost without exception they have said to me, "We have no means of getting specialized training. It can only be obtained abroad, and we do not have the money to go abroad."

Some of these boys are fine material. I say it sincerely. Given good training in their specialities, they will do work which will redound to the credit of their country and will advance the science of tropical agriculture.

What then, is needed? Scholarships, scholarships, and more scholarships in our American agricultural colleges. And these must be scholarships ofaa sort which will, in some cases, permit the man to come without meeting difficult academic requirements. In other words, training and not a degree is the objective. Naturally, there are men who will want to work for degrees, but these are already cared for to a considerable extent; much better, at least, than the men who want to come for specialized training without the idea of taking a degree. I say this because I have been trying for several years to find places in the United States for some of these men whose previous work in their own countries showed that they had the ability and zeal to do something worth while.

I would like, in short, to see more scholarships of the nature of the one established this year at the Florida State College of Agriculture by David Burpee of Philadelphia. Realizing the almost complete lack of trained horticulturists in Central America, Mr. Burpee is trying out a plan where-

by one young man is brought to Gainesville each year to study horticulture. Florida has shown its broad-mindedness and its sincere interest in Pan Americanism by waiving the usual fees for non-resident students, and by giving these lads an opportunity to choose the courses which will help them most. The matter of a degree is not in the picture. The immediate problem is to develop better horticultural technique in Central America. We have to be realistic about it. We have to understand that we will turn away some promising lads if we insist that all students meet the requirements for admission and work for a degree. There is not yet sufficient coordination between the educational systems of the North and the tropics, and there is not sufficient money to prepare all of these tropical lads so that they can meet our standards. Many of you may not agree, but it is my feeling that we should waive some of the usual requirements, and when we have a promising candidate, help him to get at least a little training along the right lines.

I am not arguing, mark you, that our schools should not receive students from Latin America in the usual way and carry them through to a doctorate wherever possible. That is all to the good. I am trying to point out that there are many young men of great potential usefulness to their countries who cannot come to our schools on that basis, for one reason or another. For both these groups I urge upon you the pressing need of more scholarships. This, it seems to me, is where our opportunity lies.

Now we come to our second question: In what way can we most promptly, efficiently, and economically aid in the general development of agricultural practices in the tropical countries of Latin America? This problem, you may say, does not fall within the scope of agricultural education. But I am

going to make a plea for more and better extension work, and this, I believe is sufficiently close to your field so that I hope it may appeal to you. The agricultural colleges can and should help by supplying some of the men for the work which is to be done.

Perhaps I can best present the matter by quoting the resolution adopted at the last meeting of the Advisory Committee on Inter American Cooperation in Agricultural Education. This resolution stated that it was agreed:

"To emphasize the need for promoting extension services in the other American republics through the instrumentality of at least ten agricultural advisers who would work closely with the United States diplomatic missions in the countries which request them, but whose actual operations would be undertaken on behalf of and under direction of the National Ministry of Agriculture. It is believed absolutely essential that the men chosen for these posts should go out into the country and work with the people rather than remain in the capital cities exclusively."

I can add little to this excellent recommendation except a few items out of my own experience by way of explanation. The situation, frankly stated, is this: There exists in numerous tropical regions a regrettable but remediable lack of men trained in the technique of growing tropical crops, not to mention such items as plant-breeding and the like. It has been proposed above that we cooperate by assisting the Latin Americans to train their own young men for these jobs: but in the meantime, there is a splendid opportunity to provide real and immediate aid, which to be fully effective, I must add, should be furnished without great expense to the countries accepting it. Several times during the past ten years the United Fruit Company has loaned me

informally to Latin American governments to assist in establishing new crop plants. In each case I have worked directly with the Ministry of Agriculture, but our diplomatic representative has been kept closely informed of progress and his advice has been sought before undertaking any project.

Let me cite a concrete example - again from my own experience, not because it is unique, for there have been others doing this same sort of thing, but because I am naturally more familiar with the details. Last year when I was in Colombia, we offered to assist the Colombian Minister of Agriculture on any projects which were of current interest and on which we were qualified to help. He suggested three: olives, Cinchona, and rubber - two of which, it may be remarked in passing, are on our National Defense program.

Through the good offices of Dean Ryerson of California, we obtained cuttings of a large number of olive varieties from that State, and in collaboration with the Colombian Director of Agriculture chose a site for a nursery and a man to care for it.

Then we obtained Cinchona (quinine) seeds from Guatemala, chose a suitable site for a nursery, and planted seed-beds. The United Fruit Company then defrayed the expense of sending a young Colombian to Guatemala to learn the technique of growing Cinchona trees.

Thirdly, we traveled rather widely over Colombia with the Director of Agriculture, assisting him in selecting suitable sites for rubber nurseries.

These are small matters, but they represent only what could be done in two or three months' time. At least two of our Ambassadors in Caribbean countries have told me that they would be strongly in favor of such a program as that outlined in the recommendation of the Advisory Committee quoted above.

From my own experience, I feel confident that a man with general training in tropical horticulture and agriculture, working over a period of several years in any one of a dozen countries, could render immense and practical service, at a cost which altogether would not be great. As I have said in commencing the discussion of this point, I know of no other way in which we could render such direct and economical aid, and I believe it is a move which would meet with great favor in several countries. I strongly recommend it to your serious consideration.

Wilson Popenoe

La Lima, Honduras
November 1, 1941.

THE AVOCADO: A HORTICULTURAL PROBLEM

Wilson Popenoe
United Fruit Company

About the turn of the century - in 1901, to be exact - George B. Cellon of Miami, Florida, began to offer budded trees of named avocado varieties to the horticultural public. Thus one more tropical fruit came out of the jungle stage of its existence. Since then, named varieties have multiplied - chiefly in Florida and California - until they number several hundred. A cooperative association of California growers, organized for the dual purpose of studying the cultural problems of the young industry and of marketing the fruit, looks back on twenty-five years of successful work. California now markets seven to eight million pounds of avocados each year.

Yet the avocado remains a dooryard tree throughout the Caribbean region. Sporadic efforts to place it on a higher plane have generally failed. No one factor is responsible for this. Distance from good markets has played its part. Unfavorable soil conditions have in many instances been fatal. Insufficient attention to the selection of varieties has retarded progress in several countries. And there have been other obstacles.

The time seems ripe for us to stand back and survey the situation in the light of what has been learned regarding avocados since those days, forty years ago, when Cellon singled out two dooryard trees near Miami, called them Trapp and Pollock, propagated them by budding, and placed them on the market with what impressed many persons as extravagant claims regarding the commercial possibilities of avocado culture - claims which subsequent experience has fully justified.

EARLY HISTORY

We have no proof that the Very Magnificent Lord Don Cristobal Colon saw the avocado in the course of his voyages of discovery. It was not then grown in the West Indies, where most of the Great Admiral's time was spent. But Martin Fernandez de Enciso, whom Sir Clements Markham characterised as a "cartographer, a good observer with the gift of lucid description" saw it on the mainland near Santa Marta, Colombia, as he coasted along those shores with one of the first Spanish expeditions; and he described it in his "Suma de Geografia" which was published at Sevilla in 1519. Thus was the avocado made known to Europeans - and we might add, in a dignity befitting its merits, for Enciso's "Suma de Geografia", one of the first published accounts of the New World, has become a classic of classics.

Subsequent travelers and historians - Oviedo, Cieza de Leon, Cervantes Salazar, Acosta, and others - noted the presence of this fruit from Mexico to Peru, and in some instances described it in detail, always in flattering terms. Oviedo, for example, wrote in 1526, "On the mainland are certain trees called pear trees, but they are not like those of Spain, though held in no less esteem; rather is their fruit of such a nature that they have many advantages over our pears."

From the tales of the early voyagers, we are able to picture fairly clearly the distribution of the avocado in tropical America at the time of the Conquest. As has already been mentioned, it definitely was not present in the West Indies. It was abundantly grown in Mexico, extending almost to the Rio Grande on the north. It was a popular fruit among the Maya tribes of Guatemala, and was cultivated by the Indians of Nicaragua. Cieza de Leon noted its presence in the western valleys of Colombia. Not long after the Conquest the Inca,

Garcilaso de la Vega told how it had been carried from the province of Palta (in what is now Ecuador) to the warm valleys near Cuzco by Tupac Yupanqui, sometime between 1450 and 1475.

It is fair to assume, therefore, that the avocado was known throughout the territory between northern Mexico and central Peru; but there is no evidence that it was known in the eastern part of South America. On the other hand, it seems highly probable that it was not known east of the Venezuelan Andes.

ORIGIN OF THE CULTIVATED AVOCADOS

With this understanding of the distribution of the avocado at the time of the Conquest, it is in order for us to ask, "Whence came these cultivated or semi-cultivated trees which were seen by the first voyagers? Were they derived from a wild form, still to be found somewhere between Mexico and Ecuador? If so, where does it grow and what is it like?"

This problem is complex, for we are concerned, not with a single group of avocados, obviously of common origin; we are concerned with three groups, which may or may not have had a common origin. These three groups, which were recognized and characterised as early as 1653 by Fray Bernabe Cobo, in his "Historia del Nuevo Mundo", are today known horticulturally as the West Indian, Guatemalan, and Mexican races. Any investigation of their origin which we may attempt to carry out, brings us up against the more technical problem of their botanical classification and relationships.

BOTANY OF THE AVOCADOS

Is more than one species of Persea involved in the origin of the cultivated avocados of today? It is my personal opinion that this question must be answered in the negative. Let us review the situation briefly:

Gaertner, in 1807, described Persea gratissima, the avocado. In recent years it has been shown that Miller had previously described it (1768) under the name Persea americana; and on grounds of priority this is the name now accepted by most American botanists.

In 1831 Chamisso and Schlechtendahl described P. drymifolia, thus raising to specific rank the Mexican race of avocados. This has not been generally accepted; more recent and exhaustive study, especially that of Sidney F. Blake of the United States Department of Agriculture, reduces this race to the status of a botanical variety of P. americana. Personally I am not even willing to grant it that distinction; in my opinion the Mexican avocados constitute a geographical form of P. americana - but I am not a taxonomist and have no right to be heard.

At the time Blake made his "Preliminary Revision of the North American and West Indian Avocados" (Journ. Wash. Acad. Sci., Vol. 10, No.1), he discovered that the horticultural variety Trapp - then the principal one cultivated in Florida - differed from all others of which he had material for study, in that the floral parts were almost glabrous. Since this constituted a botanical distinction, Blake made a new species, calling it P. leiogyna. Later, he had opportunity to see specimens, not of Trapp, which exhibited this same characteristic; and in recent discussions he has expressed to me the conviction that leigoyna is not a good species.

This, then, brings us to the conclusion that all known avocados are referable to P. americana, from which the Mexican race can be distinguished as a botanical variety, drymifolia, if one chooses. Though again I must say that extensive observation in the field convinces me that there are insufficient

grounds for separating the Mexican race, botanically, from the others.

We are not here concerned with Persea schiedeana Nees, which some authors have considered a botanical variety of P. americana, but which in the light of more recent study is obviously entitled to the specific rank given it in 1836. This avocado-like fruit is the chinini of southern Mexico, the coyo and chucte of Guatemala, the yas of Costa Rica.

Our problem therefore boils down to this: Where is Persea americana found in an indigenous condition, and what is the wild tree like?

During my travels of the past twenty five years, I have seen wild avocados of three distinct types in tropical America. It is my belief that at least two of these represent the wild forms of two of the horticultural races, the Mexican and the Guatemalan. Regarding the prototype of the third race - the West Indian - I am not so clear.

In southern Mexico, particularly on the slopes of the volcano Orizaba, there occurs abundantly a wild avocado which bears small, thin-skinned fruits, purple or green in color. The foliage and bark of the tree are characterized by a strong anise-like scent. This geographical form of P. americana, which I have called the wild avocado of Orizaba (cf. Yearbook of the California Avocado Association, 1935) can without any stretch of the imagination be considered the wild prototype of the Mexican avocado, the P. americana drymifolia of Chamisso and Schlechtendahl. It differs from the cultivated forms only in the size of its fruit.

On the summit of the Chichoy mountains in central Guatemala, not far from the town of Tecpan, there grows another wild avocado, so much like the cultivated forms of the Guatemalan race as to leave small room for doubt that it is in fact the prototype of this horticultural group. This geographical form - which I have called the wild avocado of Tecpan - grows at higher elevations than

any other avocado known to me. It occurs in the forest, surrounded by pines, oaks, and the stately Cupressus benthami. Its foliage, which is devoid of anise-like odor, resembles that of cultivated varieties of the Guatemalan race, while its fruit differs in no respect except its smaller size, and the relatively small amount of flesh. The "shell" is so hard and woody that it cannot be cut easily with a knife.

This leaves only the West Indian race to be accounted for. I have already explained that this does not come from the West Indies. I have seen no wild form which can with confidence be claimed as its prototype. In the lowlands of the Atlantic side of Honduras, and again in the vicinity of San Jose de Costa Rica, I have seen a wild avocado - which I have called the wild avocado of San Isidro - which may be the prototype of this race, though if this is the case, it argues a long period of cultivation; for the differences which exist between this wild form and the cultivated West Indians are considerable, though perhaps not unsurmountable. The wild avocado of San Isidro has the anise-like odor which characterizes the Mexican avocado, and which never occurs in the cultivated West Indians. And it has the thick "shell" of the Guatemalan race - thicker and more woody than is common in cultivated forms of the West Indian. Its presence in an indigenous condition on the Atlantic side of Central America; its identity with the West Indian race in botanical characteristics; and the probability that avocados have been cultivated in this region for a thousand years or more,- these, and our failure to discover any other wild avocado which has closer ties with the cultivated West Indian race - lead me to believe that this may have been the prototype of the West Indian avocados of today.

THE DEVELOPMENT OF COMMERCIAL VARIETIES

I have tried to sketch the background - so far as we know it - of the present-day commercial varieties cultivated in California, Florida, and a

few other regions. Now as to the origin of the varieties themselves:

They are - without exception I believe - chance seedlings, chosen for a sexual propagation because of their desirable commercial characteristics. Some of them are "pure-blooded" representatives of the West Indian race, some are Guatemalan, and some Mexican. Some have characteristics which lead us to believe that they are natural crosses between two of these races. This group is perhaps the most interesting of all, and the most promising. The major purpose of this paper, in fact, is to point out the possibilities of some of these crosses for the West Indies.

As stated above, no varieties on the market today are the result of crosses made by man. We, therefore, do not know the parentage of those varieties which we consider crosses, except on one side. We do not in all cases know even this. Take Fuerte, for example - the variety which today makes up more than 75% of the total acreage planted to avocados in California. Because its growth is unusually vigorous; because its foliage has the anise-like odor which is characteristic of the Mexican race, while its fruit is thicker skinned and more suggestive of the Guatemalan - for these and a few other reasons we have always assumed Fuerte to be a Mexican-Guatemalan cross. But we know neither its seed-parent nor its pollen-parent. It was discovered in a garden in Atlixco, Mexico, already a full grown tree with no recorded history. The presence of numerous trees of the Mexican race in that neighborhood, as well as numerous trees of the Guatemalan race, made our hypothesis tenable. Further evidence was later acquired through the behavior of Fuerte seedlings.

Aside from Fuerte, California cultivates, in the main, varieties of the Guatemalan race and varieties of the Mexican race. In Florida, the situation is different.

Trapp and Pollock, the first two varieties placed on the market in

that State, are typical West Indians, presumably to be traced back to Cuba since most of the West Indian seedlings found in Florida originally came from that source. In the years immediately following the introduction of Trapp and Pollock, several other West Indian varieties were placed upon the market. Then, through the presence of a few trees of Guatemalan origin in the Plant Introduction Garden maintained by the United States Department of Agriculture at Miami, West Indian x Guatemalan crosses began to appear upon the scene.

We assumed, at least, that they were crosses. The fruit was thicker skinned than was commonly true of the West Indians, and it matured considerably later. This latter characteristic immediately stamped the crosses as of great promise; for the chief commercial characteristic lacking in the West Indian varieties previously cultivated was a ripening season which would take them out of competition with Cuban seedlings. The latter ripen from July to September, though an occasional variety, such as Trapp, will hold part of its crop into October or even November. But the West Indian x Guatemalan crosses ripen much later, enabling the grower to place fruit in northern markets during the winter months when high prices are realized. Pure-blooded Guatemalan varieties, many of which have proved highly successful in California, do not thrive so well in Florida. Out of twenty-three selections which I made in Guatemala during the years 1916-1917, and which were distributed for trial in Florida by the U. S. Department of Agriculture, I do not believe a single one has achieved any commercial importance, though Itzamna has given a good account of itself in several places.

In addition to the West Indian x Guatemalan crosses, which are assuming greater and greater commercial importance in Florida, there is one variety which, to me, has always possessed peculiar interest. This is Gottfried, believed to be a West Indian x Mexican cross, the only one which has ever come to

my attention. Gottfried ripens early, wherein it resembles the Mexican. Its fruit, though considerably larger than that of any pure-blooded Mexican which I have seen, has the same thin skin, the same nutty flavor. The tree has leaves which look like those of the Mexican race, and they have the characteristic anise-like odor.

So much for the make-up of those avocado varieties which are commercially planted today in California and Florida - the two chief centers of avocado culture. Many of these varieties have, during the past twenty five years, been planted experimentally in various parts of the American tropics. What can we learn from their behavior? What are the lines along which our future efforts should be directed?

CALIFORNIA AND FLORIDA VARIETIES IN THE TROPICS

Before going into this matter, let us consider for a moment the situation around the Caribbean with regard to native seedlings. These are all of the West Indian race. Some regions possess fine specimens of this race, others poor; Jamaica, for example, has many good avocados while Puerto Rico very few.

Cuba has many excellent seedlings, particularly on the limestone soils of the western portion of the Island. The situation is much the same in Jamaica, and in parts of Haiti. Puerto Rico, as I have just said is characterised by few trees of poor character; and it is my opinion that this same situation holds in a general way for the Lesser Antilles. Occasional exceptions occur, no doubt, but so far as my observation extends, the native seedlings of the lower islands do not compare, on the whole, with those which grow on the limestone soils of Cuba and Jamaica.

Upon the Spanish Main there are excellent avocados to be seen in the neighborhood of Santa Marta, Colombia. The coastal region of Venezuela, on the other hand, has few choice ones and no great abundance of mediocre ones. Westward from Santa Marta, there is no coastal region famous for its fine avocados until one reaches Yucatan. This is not saying that avocados of fair quality are not to be found here and there.

With the development of commercial avocado culture in California and Florida, horticulturists around the Caribbean awakened to the possibility of extending the short ripening season of their native West Indian seedlings through planting Guatemalans and Guatemalan-West Indian crosses. Puerto Rico was one of the first regions to go in for these new sorts. During my later years in the Department of Agriculture at Washington - somewhere around 1920 - we made numerous experimental shipments of budded trees to Puerto Rico. But when I visited that Island recently, I learned that little has come of the effort. In fact, there seem to be very few areas in Puerto Rico where avocados of any sort are happy. The region of Yauco, on the southern side of the Island, is one notable exception. I blame the trouble on heavy soils, which in turn mean lack of good drainage and aeration in most instances. If there is one thing the avocado simply will not tolerate, it is wet feet.

Cuba had its fling, and at approximately the same time as Puerto Rico. Cuba is an avocado island, and at one time there seemed to be a strong probability that one or two of the Guatemalans, and several of the Guatemalan x West Indian crosses, would attain commercial importance there. But something happened. I don't know just exactly what it was. Perhaps a mixture of politics and bad drainage, with emphasis on the latter.

In more recent years, some of these same varieties have been planted

in Jamaica, in Haiti, in Trinidad, in Colombia, and elsewhere around the Caribbean. It is too early, in most cases, to talk of results. But I can speak with confidence regarding what has been done in one fairly representative region - the north coast of Honduras. Here, at Lancetilla Experiment Station, we introduced in 1925 and subsequent years, an extensive collection of varieties including Guatemalans, West Indians, Guatemalan x West Indian crosses, one Guatemalan x Mexican cross (Fuerte), and the one known West Indian x Mexican cross, Gottfried.

As far as I can judge, climatic conditions on the north coast of Honduras are not unlike those of the wetter parts of the West Indies. We are at sea level, and we have a dry season of one or two months duration at Lancetilla proper; one of three or four months at our substation Quebrada Seca, some forty miles up the Ulua valley from the coast. Annual rainfall at Quebrada Seca is in the neighborhood of 60-80 inches; at Lancetilla it varies from 125 to 175 inches.

Pure-blooded varieties of the Guatemalan race have been a complete failure here. This is not saying that the trees have not, in several cases, made good growth; nor is it saying that they have not borne fruit. But I am convinced that it is a mistake to grow Guatemalans at sea level in the tropics. This is a highland race, and when taken down to the coast, the fruit almost invariably loses its flavor and quality. We have grown such varieties as Nimlioh, Panchoy, Queen, and Linda: all mature their fruits very late in the season, ripening from November to January in the main, but all are disappointing and all show a tendency to produce small crops. They are not satisfactory.

Pure-blooded varieties of the Mexican race serve no purpose here, unless one might argue that their superior flavor is a desideratum. Their value lies chiefly in their resistance to frost. But we have tried them, mainly out

of curiosity, and they have not done well. Like the Guatemalans, they belong in the highlands.

Fuerte, the leading commercial variety of California, is presumably a Guatemalan x Mexican cross. In the light of what has just been said regarding the behavior of these two races at sea level in the tropics, how could one do otherwise than predict a gloomy future for Fuerte in such a place as Lancetilla? We have grown it for fifteen years; the trees vegetate well, they blossom freely, but they produce few fruits and these of poor quality. Even the southern part of Florida is too tropical for Fuerte. This is distinctly a subtropical avocado. When grown in the tropics, it must be at high elevations. It might prove very useful in the Andes.

And now we come to the brighter side of the picture: the West Indian x Guatemalan crosses. This is, in my opinion, the group which will in time place avocado culture in the West Indies upon a new and sounder footing. Even with the varieties available today, much can be done; and new varieties can and will be produced in large numbers.

THE FUTURE

Collinson, Winslowson, Collinred, and Lula have all done well in Honduras, and they have done well at several other places in tropical America. Perhaps they are not ideal varieties: from the commercial standpoint, I am willing to concede that they are not. But they show what can be expected of this cross. It offers, in my judgment, the one real hope of producing in the Caribbean region avocados of good commercial quality at that season of the year when avocados are most desired - the winter months.

Viewing the matter from another standpoint, here is an opportunity to lengthen the period during which avocados are available in the West Indies

for local consumption. This is a matter of greater potential value than appears at first glance. For the avocado as a source of human food is not yet fully appreciated in the Islands. We hear much talk these days of over-population. How are people to be fed? If they are to be largely dependent upon what they can produce - as most certainly is desirable - then we need crops which (1) will give maximum yields of food from a given area, (2) which are available during as many months of the year as possible, and (3) which people will eat, and like.

When we horticulturists can offer avocados during six or eight months of the year, when we can supply varieties which contain 12 or 14% of oil (this is by no means asking too much), we shall be making a real contribution toward the solution of one of the grave problems confronting some of the Islands. The one serious obstacle, which I see, is the admitted failure of the avocado to thrive on certain soils, or in certain areas. Whether this is a matter of drainage, whether it is due to root diseases of which we still know little, or whether it is due to something about which we know nothing at all, it is a real and serious obstacle to wider and more successful cultivation of the avocado. So far as I have been able to observe, there is no trouble where avocados are grown on sloping lands derived from soft limestone. There is no trouble where they are grown on sandy loams and clay loams, if these are well drained and not subject to flooding. But put the avocado on stiff, impermeable clays; put it on the best sandy loams and flood it for even a few days - in other words, cut off the oxygen supply to its roots, - and if my experience is any guide, you will soon see the younger branches beginning to die back and the end is in sight.

To avoid further disappointment, let us put our avocados on the right kind of land; and let us then devote serious attention to the development of new varieties of the West Indian x Guatemalan group, varieties which will give us fruit of excellent quality and extend the present avocado season in the West Indies by three or for months at least.

Wilson Popenoe: Plant Resources of Guatemala.

In considering the plant resources of their country, Guatemalans commonly think of the latter as divided naturally into five zones, as follows:

1. The central highlands, a broad area extending from the Mexican frontier to the borders of Salvador and Honduras, mountainous in character with intervening plateaux and small valleys lying at elevations of 2000 to 8000 feet. Here is concentrated most of the country's population, and here was centered Indian agriculture in pre-Columbian times. Many parts of the region have excellent volcanic soils, sandy loams to clays, and moderate rainfall (about 35 to 50 ins. annually) distributed in well-defined wet and dry seasons of approximately equal length. The rains usually commence in April-May and terminate in November-December. The higher mountainsides are often covered with ~~handsome~~ stately forests of pine and oak. The agricultural lands, still largely in the hands of the Indians (except toward the Salvador-Honduras side, known as the Oriente) are cultivated mainly in corn, beans, and other subsistence crops. Above 6000 feet, approximately, tender plants such as bananas are injured by frost. Citrus fruits and avocados are grown up to 7500 feet.

2. The Pacific region, scene of most of the country's large-scale agriculture with exception of the banana industry in the Motagua valley on the north. Commencing on the higher slopes of the volcanic chain which parallels the seacoast, this zone extends down to the latter, including the fertile coastal plain about 30

except those of the area near the Mex border

miles in width. The soils are mainly volcanic sandy loams to light clays, deep and of excellent agricultural quality; rainfall is heavy in the upper part of ~~the area~~ this zone (sometimes as much as 150 to 200 ins., with only two or three dry months), low toward the littoral, where it may be only 25 or 30 ins., all of which falls between May and November. Coffee is the main crop between 2000 and 5000 feet. In the vicinity of Mazatenango, between 1000 and 2500 feet, Soconusco cacao was formerly cultivated ~~extensively but has~~ for export. Production declined in modern times. for many years but is now again on the increase. At low levels on the coastal plain bananas and sugar cane are extensively grown, often with irrigation; while cattle-raising is important, and subsistence crops such as corn and beans are planted in the wet season.

1 +

3. The Alta Verapaz, a somewhat isolated mountainous region in the north, characterised by limestone soils devoted in part to coffee cultivation, in part to Indian (subsistence) agriculture. There are no high elevations in comparison with those of the central plateau; the cultivated areas lie mainly between 2000 and 5000 feet, and have a well-distributed rainfall of 80 to 100 inches per annum.

4. The Motagua valley, running from the central highlands in a northeasterly direction to the Atlantic. In its central portion the valley floor is some ~~750 to 800~~ varies from 250-500 ft feet above sea level; the soils with exception of narrow vegas or flood-plains along the river and its tributaries are mainly sandy or gravelly clays, which combined with low rainfall give the region a semi-arid appearance. Toward the lower end of the valley, from Gualán to the sea, and in the adjacent Polochic-Izabal valley to the north, the natural vegetation is tropical rain-forest (precipitation 80 to 120 ins. annually) and the alluvial lands are cultivated in bananas, with smaller areas in corn, rice, and other subsistence crops.

2 +

5. The immense plain of Peten in the north, occupying about one-third of the total area of the republic. This is a low, rolling almost unpopulated region of limestone formation, yielding chicle for export and hardwoods and (obtained from wild trees of the genus Achras), for export and limited quantities of corn and other subsistence crops for local use. Elevations commonly range from 500 to 700 feet above sea level; there is a well-marked dry season.

At the time of the Spanish conquest (1523-1524) those parts of Guatemala which were the most fertile and possessed the most salubrious climates were farmed by numerous Indian tribes related to the Maya of Yucatan and (in a few instances) to the Aztec of Mexico. They grew corn, beans and squashes; chile peppers (Capsicums) and guisquiles (Chayota edulis); while in their door-yards, according to the climate in which they were situated, grew cacao trees; pacaya palms (Chamaedorea) with edible inflorescences; avocados, jocotes (Spondias purpurea), zapotes (Calocarpum mammosum), various species of Annona, and other fruitbearing trees.

During the last half of the XVI century, cacao was exploited by the Spaniards as an export crop. By 1600, however, its importance was declining, and indigo was coming to the fore. Wheat, barley, and other European crops had been introduced for subsistence use, and were cultivated with more or less success in the highlands. Sugar cane had also been brought from Europe, as had the citrus fruits, plantains, and several vegetables. Grapes and olives had been planted, but it seems doubtful that their cultivation was very successful, for the latter has disappeared entirely, while the former do not succeed well today.

Coffee, most important of modern export crops, was introduced about the middle of the XVIII century, but did not become

extensively grown until much later. In the meantime indigo had been replaced in large part by cochineal, which in turn became unprofitable due to the use of analine dyes. Toward 1875 coffee cultivation began to increase rapidly, while shortly after 1900 the banana industry began to develop in the lower Motagua valley and around Lake Izabal, later to be extended to the Pacific coast. These two crops, coffee (about one million cwt.) and bananas (6-10 million bunches) now account for about 90% of Guatemalan exports. Mining is of little importance; cattle are reared to supply the local demand for beef; and sheep are grazed on the highlands (mainly at 6000 to 11,000 ft.) to supply part of the local demand for wool.

Agriculturally, Guatemala is one of the most self-sufficient countries of the American tropics. Though its economic prosperity may be affected by fluctuations in the coffee market, its subsistence needs are met locally to a remarkable degree. Corn and beans are the basic foodstuffs, particularly among the Indians (who constitute some 80% of the total population); there is sufficient wheat produced in the highlands (6000 to 8000 ft.) to meet part of the demand for wheat flour and more could easily be grown. Sugar cane is grown widely up to elevations of 5000 feet; production is adequate to meet national demands for panela (crude brown sugar), white sugar, and aguardiente or rum. Some cotton is grown, but not enough for present local requirements. Rice production is increasing, ~~but is still supplemented by imports~~. The country is rich in tropical fruits, such as oranges, mangos, avocados, and pineapples; while in the highlands at 6000 to 8000 feet there is a small but increasing production of such temperate-zone fruits as apples, peaches, pears, plums and strawberries.

There are many good timbers available for local use, and a small export trade in several. In the central and northwestern highlands at elevations of 8000 to 11,000 feet grows the native cypress (Cupressus Benthami), much used for construction purposes; also several species of Pinus and the native fir or pinabete, Abies religiosa. On the lowlands of both coasts are Honduras or broad-leaved mahogany, Swietenia macrophylla, Spanish cedar (Cedrela mexicana), guayacán or lignum vitae (Guaiacum spp.), palo blanco or primavera (Tabebuia Donnell-Smithii) all used locally and exported whenever the demand warrants; in addition to several trees used locally for construction purposes and cabinet work. Wild rubber trees of the genus Castilla occur in several parts of the country and have been tapped at times for exportation; their latex is used locally for making rain-capes.

The government of Guatemala maintains a Department of Agriculture headquartered at Guatemala City, where it concerns itself with introduction of new crops; advice to planters on cultural problems and disease control; and similar matters. There are no agricultural experiment stations, but a well-equipped chemical laboratory is located in Guatemala City where soil analyses are made and agricultural products are examined. There is a small botanical garden in the edge of Guatemala City.

Forestry has received but scant attention up to the present. There is need for work in reforestation, forest pathology, and above all for erosion control in deforested areas. There is also need of more pathological work on the control of coffee diseases (which fortunately are not yet serious in many areas), and for studies looking toward improvement of coffee cultivation through

vegetative propagation of selected strains, better pruning, rational use of fertilizers, and erosion control in coffee plantations.

Current activities of promise, on the part of governmental agencies and private planters, include the following:

Establishment of Hevea or Pará rubber cultivation in the republic. In this the government of Guatemala is cooperating with that of the U.S., which sent in 1940 a survey party to locate suitable lands for this purpose, and which is distributing budded plants of high-yielding clones. There are believed to be large areas suitable for this crop, both on the Atlantic and Pacific sides of the country.

Commercial development of Cinchona (quinine) cultivation. Attention was devoted to this subject as far back as 1880, but little was accomplished, due most probably to lack of the right type of planting material. Extensive experiments are now under way in the coffee zone of the Pacific side at elevations of 3000 to 6000 feet; and in the Alta Verapaz at 4000 to 5000 feet. The U.S.Department of Agriculture has cooperated in this work through supplying seeds and plants from many parts of the Eastern tropics; the Guatemalan Department of Agriculture is also cooperating.

Improvement of sugar cane cultivation through introduction of superior varieties. One of these, POJ 2878, is now replacing varieties formerly grown in many areas, with an increase of almost 100% in yields.

Cultivation of kapok fiber (Ceiba sp.), a tree native to ~~this~~ Guatemala country; and of henequen, which has been planted in the Alta Verapaz, where its product is used for cordage, mats, etc. sold locally. It seems probable that national needs for coffee and other bags will shortly be met by henequen or other fibers grown within the country

Experiments looking toward the productionof tung and other industrial oils. Tung (Aleurites montana, not the species grown in Florida, which latter is A. Fordii) is growing successfully in the Alta Verapaz at 4200 ft. and at places on the Pacific side, but it is not yet clear that yields are going to be satisfactory.

Cultivation of Citronella (Andropogon nardus) and lemon grass A. citratus) for oils which are already being exported on a commercial scale from the region of Escuintla on the Pacific side.

Tests of rotenone-yielding plants such as Derris elliptica, and further exploitation of medicinal plants such as sarsaparilla.

From the above it will be noted that there is at present great interest in crop diversification, though Guatemala has never been so dependant on one or two crops as have many other tropical countries. While these activities are not of recent inception - for example, tea has been grown commercially in the Alta Verapaz for many years, also cardamoms - interest today is keener than it has ever been in the past.

and to a small extent vanilla

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SOME INTERESTING FRUITS FROM TROPICAL ASIA

Wilson Popenoe
United Fruit Company

When Dr. Wolfe invited me to present this brief paper before the Krome Memorial Institute, I grasped the opportunity with particular pleasure, primarily because it gives me a chance to pay tribute to the memory of William J. Krome. It was my good fortune to see him frequently, back in the early days when he was developing an orchard at Homestead. I felt the impulse of his dynamic enthusiasm, and I believe I appreciated what he was doing for south Florida and for subtropical horticulture. In short, my admiration for him and for his work knew no bounds.

Yet many results might have been lost had not Mrs. Krome carried on so ably and so devotedly with the work. I need not mention this, for most of you are more familiar with the facts than am I. But I cannot miss this opportunity of expressing the gratitude to her which all of us feel so deeply.

I have thought that you might be interested in hearing something of the work we have done, these past fifteen years, with Asiatic fruit trees at our little experiment station in Honduras. These results may not have much bearing upon your own horticultural problems; yet there are perhaps a few respects in which our experience may be useful to you.

In discussing fruits of the Asiatic tropics, one more or less automatically begins with the mangosteen. Ever since Doctor Fairchild began telling us about mangosteens back in the early nineteen hundreds, I suspect the cherished but secret ambition of every horticulturist in southern Florida has been to grow this fruit. Many have tried it. I

played with it myself when I was working with Edward Simmonds at the Plant Introduction Garden in Miami about 1915, but the discouragements were so numerous and so definite that I decided we were too far North; and I moved to Honduras, where, in a lovely little valley three miles from the beach at Tela, we started planting mangosteens in 1925. To give due credit, I should mention that R. H. Goodell had already planted two or three which he had obtained from Dr. Fairchild at Washington, and they were prospering.

We obtained seed from Jamaica and from Indo-China, and finally contracted for the entire crop produced by an old tree on Lake Izabal in nearby Guatemala. We had no trouble in starting the seedlings, and a year or two later we began planting them out in the field. We kept at it until we had about seven hundred, which together constitute, I feel sure, the largest mangosteen orchard in the Western Hemisphere. Today most of them are in bearing - it took them about eight years to reach that stage - and I can offer any of you who will honor us with a visit during August, all the mangosteens you care to eat.

People often ask me, "Is the mangosteen really as good as Doctor Fairchild says it is?" I shall answer this by repeating the invitation: Come and see for yourselves. One of its virtues lies in the fact that they do not fill you up; you can eat mangosteens by the dozen, thus prolonging the enjoyment beyond that which you can achieve with any other tropical fruit of my acquaintance.

Given a warm climate and reasonably good soil, the mangosteen is not hard to grow. But it is a tree which recognizes no half measures.

Either it thrives, or it does not grow at all, and when they are young, they are susceptible to sunburn, so that we customarily give them some shade during the first few years. Once they reach four or five feet in height they go right ahead, asking no favors.

After the mangosteen, perhaps the Asiatic fruit which enjoys the greatest reputation is the durian. When Doctor Fairchild was on one of his visits to Java - I believe it was at the time he was exploring in the South Seas with Allison Armour in the yacht Utowana - he sent us some durian seeds by mail, and they readhed us in good condition. From these we now have seven or eight fine trees, nearly fifty feet tall, and as beautiful as any trees you could wish to see. They bear well, but we have not yet noted any unbridled enthusiasm for the fruit among our tropical colleagues. Writers on Asia admit that durians are an acquired habit. Avocados are too, but I think the habit much easier to acquire. When we had our first crop of durians, I gave several specimens to one of our research men. He tried to eat one, gave it up, and then decided it would be a good joke to hang it under the bed of one of the boys who occupied a room near him in the bachelor quarters. This chap passed a most uncomfortable night, but in the morning discovered what was the matter. He said he thought it was a dead rat until he examined the strange prickly fruit and realised that it originated in the vegetable kingdom.

Doctor Fairchild will chide me for speaking in this disparaging manner about durians. My answer is the same as the one I have just given regarding mangosteens: come and see for yourselves. We are not expanding our duran orchard.

Having thus disposed of the two great mysteries in the field of Asiatic pomology, I want to mention a fruit which I feel has great possibilities, not only for the American tropics but for subtropical regions such as south Florida. In fact, I think this fruit - the lychee - will generally prove more satisfactory in south Florida than in Honduras. We are finding that the lychee does not fruit abundantly in very wet climates.

It is notorious that many tropical fruits are not really first-class, when compared with such highly improved northern products as the apple, the peach and the pear. But the lychee, in my opinion and in that of a good million people who live in China, will stand comparison with the best of our northern fruits. Nor is it one of those fruits which is excellent when prepared in the form of jam or preserves. The lychee is good as a fresh fruit, and it is good canned.

In Honduras we have an extensive collection of lychee varieties. Many years ago the Department of Agriculture sent us from Washington the parent trees of several Chinese varieties which Dr. Fairchild had introduced and which had been growing in Washington greenhouses until they were about to go through the roof. We have grown these trees and we have propagated them; but in general we have to get our fruit from other areas, for our climate is too wet and our soils too rich for the trees to fruit well. By removing rings of bark from the branches we can induce flowering and fruiting, but one cannot keep this up indefinitely.

Most of you know better than I do that the lychee succeeds in south Florida. All I can add is this: it deserves to be much more widely grown than has been true up to now.

Speaking of the lychee reminds me to mention two other fruits of the same family, the rambutan and the pulasan, botanically known as Nephelium lappaceum and Nephelium mutabile. Unlike the lychee, these two have proved highly successful in our wet climate. They fruit at an early age and they fruit most abundantly. Of the two, I think I prefer the rambutan, which is almost as good as the lychee. I rather doubt, however, that either will be found to thrive in subtropical climates. A test will determine this.

Another well-known fruit of the Malayan region is the langsat or lanzon, Lansium domesticum. We have grown some thirty or forty trees of this species at Lancetilla Experiment Station - as we call our little trial garden in Honduras - and they have been rather disappointing. They have not fruited freely, and the specimens which we have harvested have been disappointing in flavor. I have eaten the lanzon in the Philippines, and my memories of it are pleasant though rather vague. I don't know what is the matter with the ones we have grown in Honduras.

From all this you will gather that some of the famous Asiatic fruits have been disappointing in tropical America - at least so far as we are concerned - while others have proved even more dissatisfactory than we had dared hope. This last situation applies particularly to the Java mangos. For years I had read of the fine mango varieties of Java - of Golek, and Arumanis, and Madoe and others. It had always seemed to me that they must be better adapted to wet climates than some of the Indian varieties like Pairi and Amini and Mulgoba.

One of our colleagues in the United Fruit Company, Dr. Otto A. Reinking, was travelling in the Asiatic Tropics at the time I went to live in Honduras,

and we arranged to have him bring back to us, in Wardian cases, a fine collection of Asiatic fruits. There were grafted durians, and a sweet variety of Averrhoa carambola (which has done very well with us) and best of all, a fairly complete collection of grafted mangos.

From the pictures we had seen in the literature, these Java mangos looked as though they belonged to the Cambodian group. When they came into bearing, we found that this is indeed the case so far, at least, as concerns those which to date have borne fruit with us. Golek appears to be a valuable acquisition. It is a larger mango than Cambodiana, but of that general character. And it is almost the only good mango which will fruit freely in our wet climate.

In the British West Indies, Julie is today the favorite grafted mango, so far as new plantings are concerned. It is not much on looks, but it fruits regularly and fairly abundantly, which is not true of most of the finer Indian varieties. In some of the Spanish speaking countries, Haden has become a popular favorite. Golek, we believe, is a promising candidate for high rank among the favorites, and we are doing all we can to propagate it and disseminate it. Incidentally, I would like to see all of these Java mangos tested thoroughly in Florida. I do not believe it has yet been done, but I may be mistaken. When one gets to Florida as rarely as I have done these past fifteen years, he cannot keep in touch with all developments.

In passing, I would like to mention that we have fruited at Lancetilla one or two of the other species of Mangifera, including the stinkfrucht of the Dutch East Indies, whose name is not hard to translate even by those unfamiliar with the Dutch language, provided you have tried to eat the fruit. We have fruited the mabolo, Diospyros discolor, which is quite suggestive of the

white sapote in character; and Artocarpus odoratissima, a rare relative of the breadfruit; and Sandoricum koetjape and one or two species of Canarium. And finally, to leave a good taste in your mouths, I must mention a really rare and unusual tree, Bouea macrophylla, a relative of the mango, which came to us from the garden of the King of Siam. This is a beautiful small tree, resembling the mango in foliage, with fruits of golden yellow color the size of hen's eggs.

Some of you may ask, "What's the use of having all those things down in Honduras where no one can get at them to see whether or not this man is telling the truth about them?" It is my personal opinion that you really don't want durians much closer to you than Honduras; and as for the rest, we have a source of seeds and other propagating material down there and are trying as rapidly as we can, to disseminate the best things all over the Caribbean region, and this includes south Florida.

VARIETIES OF TEMPERATE ZONE FRUITS FOR TROPICAL AMERICA

Wilson Popenoe and Jorge M. Benitez

This paper is intended to bring up to date our observations on the behavior of temperate zone fruits in the Central American highlands. The paper we presented at the Antigua meeting in 1962 was necessarily preliminary in nature, as this one is also, for we have yet much to learn. We would like to mention, however, that the symposium on temperate zone fruits in tropical America which was a feature of the 1962 meeting, gave a decided impetus to work in this field, which has already been reflected in increased attention to the study of varieties and their adaptation to local conditions in numerous countries; to the search for varieties of local origin; and to the introduction of promising sorts for trial.

It is hoped to continue the work of identifying varieties of which the names have been lost; of introducing new and promising varieties for trial; and of studying climatic and soil adaptations as well as cultural problems. The senior author of the present paper resides in Guatemala but maintains contact with workers in California, Florida and other regions. The junior author has recently transferred his activities from the Instituto Agropecuario Nacional of Guatemala to Alimentos Kern de Guatemala, S.A., a firm which plans to develop commercial plantings of temperate zone fruits in the Guatemalan highlands; and we are happy to announce that Robert P. Armour, Assistant Director of Escuela Agricola Panamericana has again come into the picture. Mr. Armour, a horticulturist of long experience in Central America, will supervise the experimental planting on Uyuca mountain in Honduras, which was established by the Escuela some twelve years ago,

and which was considered by George Darrow to be the best collection in Central America of temperate zone fruits with lowchilling requirements; and he will also devote as much time as possible to these fruits in surrounding countries.

Our object is to ask, Where do we stand today, and Where do we go from here? We hope that other workers in this field will come forward at this meeting with their own observations, even though some of them may show that in certain instances we ourselves are off on the wrong tack, as sailors would say. We will commence with a discussion of what is recognized as the most important fruit of all,

THE APPLE

Perhaps we should consider this under three headings, (1) the behavior of important commercial varieties from the major apple-producing regions of the world; (2) interesting or little-known apples which are found here and there in tropical America and which show promise, and (3) the crabapples and their hybrids, which may become of commercial importance because in some instances they promise to succeed at lower elevations in the tropics than the commercial apples of the North.

Winter Banana still holds its place as the leading commercial apple in Guatemala, and Milton Lau (who worked in Peru for some years) and Chet Hemstreet (who is working there at present) says it is grown successfully on the coastal region south of Lima. When that great authority on temperate zone fruits with low chilling requirements, Professor W. H. Chandler of California, was with us in Honduras in 1949, he left this note with us: "Winter Banana is the best southern California apple of delayed-foliation resistance, and the most vigorous

grower of all the apples. Commonly used as a grafting stock in Watsonville, being grown to secondary laterals in orchard form, then grafted to the desired variety. Fair quality, good for dessert and for cooking. Clear yellow with reddish cheek. September." In the Central American highlands the reddish cheek is often deep red, which makes this apple attractive -.and right here it is to be noted that to be popular in Central America it is important that an apple should have plenty of red color. The catalogs of North American nurserymen place much emphasis on strains of important commercial apples which are mutants with deeper red color than the type.

Red Delicious looks very promising in Guatemala. We have no reports on its behavior elsewhere in tropical America. It may need somewhat more chilling than Winter Banana. But its outstanding importance in the United States as a dessert apple makes us feel that it should receive plenty of attention down here.

The apple which has been termed Juarez in Guatemala, because it has become known through its presence in the small orchard of señor Juarez in Chichicastenango (6800 feet) we believe we have identified as Ben Davis. It agrees fully with the pomological descriptions of that variety. In Guatemala, where consumers have not become as critical of quality as they are in the United States, this apple has made a very favorable impression. It is productive, it is of good size, it is highly colored but not uniformly so, and it has shown excellent keeping qualities. The fact that it is now obsolete as an important commercial apple in the United States of course makes us wonder if we should encourage extensive planting.

Gravenstein has done so well in the Quezaltenango region of Guatemala that we hate to give it up, though Robert Ticho, in his

excellent report to which we made numerous references in our last paper, discards it. It ripens early, it is of excellent dessert quality here as elsewhere, and it does not seem to have a high chilling requirement. Perhaps the defects which caused Ticho to eliminate it from his recommended list may not be factors everywhere.

Blenheim Orange, a variety highly esteemed in England, and known in Colombia and Ecuador as Emilia and Pennsylvania, in both of which countries it is, or has been, a leading commercial apple (we are not up to date, perhaps, on this point) attracted the attention of George M. Darrow when he made his 1952 tour of Latin America. In fact, it was through his interest that the variety was correctly identified by the Royal Horticultural Society in London. We do not know just what to think of it, but for the present we would be more inclined to stick to Winter Banana and Red Delicious. Right here we should mention that Yellow Delicious, an important apple in the United States, has not yet been tested extensively in tropical America, but in the cool climate of Quezaltenango, Guatemala, it shows a considerable amount of red color.

Now as to the second group, interesting or little-known apples, some of which are of recent introduction, we would like to mention Anoka, which seems to have a low chilling requirement and has produced fruit at less than two years of age on the property of Arturo Falla (6900 feet) near Antigua, Guatemala. Wealthy also looks promising for the lower elevations; it is growing rather well in Antigua, Guatemala, at 5000 feet. We introduced it from Bountiful Ridge Nurseries because we thought its baccata blood might mean a low chilling requirement. And finally, we would mention the Key West apple, one of those pomological anomalies. The original tree was growing at Key West,

Florida, where it acquired something of a reputation because apples have no right to grow at sea level right up against the tropic. But it has done so well at the Subtropical Experiment Station, Homestead, Florida (forty miles south of Miami) that we secured two trees through the good offices of John Popenoe, Horticulturist, and at less than two years of age we shared with Francisco de Sola the first fruit, produced at Antigua, Guatemala, 5100 feet. It was a bright red apple, of fair size, and good quality. The origin of this variety is unknown, except that the parent tree was grown at Key West, but it definitely seems worthy of further trial.

On the slopes of the Volcan de Santa Ana, in the Republic of El Salvador, Francisco de Sola has come upon an apple tree which at an elevation of 5200 feet has produced for years good crops of fruit of acceptable size and quality. He is propagating it. Many such things doubtless exist in tropical America and as time goes on will be brought to light.

Our observations in Guatemala of the past three seasons have served to emphasize the importance, in fact the necessity, of using aphis-resistant rootstocks, for we have seen numerous old orchards which have literally been destroyed by the ravages of woolly aphis. For this reason we are recommending the Malling-Merton stocks, and we are not too much interested in the dwarfing varieties as we are in the others, because apple trees in the tropical American highlands seem not to attain such large size as they do in northern countries.

One of the objects of our work has been to find apples of acceptable dessert (as well as cooking) quality which will grow at lower elevations than the commercial apples of the North, for in Central America there are not many large areas suitable for apple

culture which lie above 6500 feet - about the lower limit for the commercial apples. George Darrow first called our attention to the possibilities of the crabapples and especially their hybrids, when he came to Central America in 1952 - as was mentioned in our previous paper. Since then we have had opportunity to observe further the behavior of the Spanish cider crab, as Dr. Darrow called it, in the town of Guinope, Honduras, where the elevation is 4200 feet. Even under poor cultural conditions, this crabapple produces nonastringent fruits up to two inches in diameter, yellow with red cheeks, fairly good for eating out of hand but generally used when cooked. We believe we have seen this same variety at Jinotega, in Nicaragua. Unless and until we get something better, it seems worthy of propagation.

During the past two years we have introduced, through the generous cooperation of Bountiful Ridge Nurseries, Princess Anne, Maryland, the following varieties, all of which have been planted at Quezaltenango; near Antigua, Guatemala (Finca San Sebastian, where they are being grown by an experienced horticulturist, Arturo Falla; and on Francisco de Sola's Finca "Los Andes", near Santa Ana, in El Salvador: Whitney, Chestnut, Young America, Rescue, Martha, and USDA 1225. In addition we obtained Lady apple. We do not know the background of this variety. It is a small fruit, said to be of European origin (many years ago) and delicious.

THE PEAR

We will divide this topic into two headings, the Occidental or European pears, varieties of Pyrus communis, and the Oriental or Japanese pears, varieties of Pyrus serotina though more properly we

should say, as regards those we are growing, hybrids between the Japanese and the European varieties. We are not greatly interested in varieties of pure serotina blood.

As for the European pears, which are what we would really like to grow, we have made substantial progress in identifying those which are cultivated in Guatemala, largely through having seen the trees in the Chema Barrios place at Quezaltenango, where several of the very best varieties seem to have been introduced more than 50 years ago. Where they came from we do not know, but several have been propagated on a limited scale and are grown elsewhere in the region. There also are some European pears at Molina Helvetia near Tecpan, and of course, those which are grown in considerable abundance in the vicinity of San Bartolomé, between Guatemala City and Antigua. We have mentioned this region in some detail in our previous paper. It seems worth while to put the following notes on record:

Pound. The most important pear in Guatemala today is probably the variety known locally as Larga, which from descriptions and illustrations in the literature we believe - but cannot guarantee - is a very old European variety, which has many names, but which Hedrick describes ("Pears of New York") under the name Pound. This fruit would not be quite so poor if picked at the proper time and properly ripened, which is rarely the case. But we have to agree with Robert Ticho, who writes "the taste is watery, there are many stone cells, which may turn brown when the pear is ripe. The variety suffers from a brown core breakdown before the fruit softens and becomes mealy". Probably its local popularity is due to its large size more than anything else.

The other important variety in Guatemala - which really means the

San Bartolomé region - is the one known as Redonda, this and Larga being good examples of local pomological nomenclature. This variety conforms very well to Hedrick's pomological description of Lincoln, and agrees with his excellent color plate. Lincoln, when picked at the proper time and properly ripened, is a good pear, though in the opinion of numerous authorities, not to be compared with such excellent pears as Beurré Bosc. But both this and Pound seem well adapted to the climate and soil of San Bartolomé, elevation about 6500 feet, while we do not know so much about the adaptability of several others which are better.

Beurré Bosc. This is our present choice as a delicious pear (and we are not alone in this). It has been grown for many years in the Quezaltenango region of Guatemala on a small scale. Professor Chandler told us it is probably more resistant to delayed foliation (i.e., has a lower chilling requirement) than Bartlett and Winter Nelis and Seckel (we cannot find that either of the two last-named has been successful anywhere in Guatemala; maybe we have overlooked them somewhere).

Beurré d'Anjou we believe we have identified in the Quezaltenango region and at Molina Helvetia, near Tecpan, Guatemala. And recently in the vicinity of Patzicia, Guatemala, and in the market of Antigua, we feel pretty sure we have tied down Doyenné de Comice. With these three pears one could not ask for much more, though of course we would like Bartlett (the great canning pear of California), which we feel sure we have found at Totonicapan but it has not done well in some other places, perhaps because as Professor Chandler says, it has a relatively high chilling requirement.

All in all, we feel very hopeful about the fine European pears,

if they are grown at the proper altitudes in tropical America. In the Guatemalan highlands, this seems to be from 6500 feet, or a little more, to 8000 feet. We could only guess at the best altitudes for them in northern South America, and of course on coastal Peru we must always take into account that remarkable Humboldt current climate.

Ticho makes an interesting point: "Pears are remarkably adaptable to humid and foggy areas". This is important, because so many of the highland areas in tropical America <u>are</u> humid and foggy, more likely to be suitable for pears than for apples. There is another matter which is of interest: fire blight. At the Antigua meeting, one of the visiting plant pathologists, I believe it was Professor Owen of Georgia, said he had seen fire blight at San Bartolomé, and more recently Eugenio Schieber of the Guatemalan Ministerio de Agricultura told us it is common in the Quezaltenango area. But we ourselves have not seen old pear trees which had been killed by it. Not being plant pathologists, we have not looked for minor damage. We brought this subject to the attention of John Popenoe when we took him through the Guatemalan highlands last summer, and he told us he did not think we need to worry too much about this disease, because it is mainly serious where pear trees bloom during moist weather. The disease commonly enters through the flowers and can not do this if the flowers appear during very dry weather. Later he sent us Cornell Extension Bulletin 966, from which we extract the following lines: "In recent studies in pear orchards (this is in New York state) strong evidence indicates that the blight problem is less on well drained sites than under wet soil conditions. In fact, in none of the orchards studied on well-drained soil sites was the disease of consequence.....High temperatures and high humidity combined favor the initiation of infection, particu-

larly in the blossoms.....In a study of severity of infection over a period of thirtyseven years it was found that the more severe infections were in years when the temperatures during the blossoming period were high and accompanied by at least traces of rainfall than when temperatures were low and there was no rain." This last point is important, since pear trees blossom in the Guatemalan highlands during the dry season, and because of the high altitudes temperatures are never high.

As for the Oriental or Japanese pears, and more properly their hybrids with P. communis, Pineapple, which is of some importance in the San Bartolomé region of Guatemala, is not a fine pear. Kieffer is a strong, healthy grower and very productive. It is a good pear for canning and may have value for the making of pear juice or "nectar", a product which is beginning to attain real importance in tropical America. But as dessert pears of this group, our experience in Guatemala and Honduras leads us to recommend the following two:

Baldwin. The tree is a strong grower in the small orchard of Escuela Agricola Panamericana on Uyuca mountain, at an elevation of 5900 feet. The fruit is of good large size, yellow in color, the flesh not "gritty", very juicy and of true pear flavor.

Hood. Of about the same quality as Baldwin. At Molina Helvetia, near Tecpan, Guatemala, the tree has proved to be strong, productive, and the fruit, while not so large as Baldwin, and not quite so attractive, is a good keeper and very satisfactory from every standpoint.

It is of course understood by all of you that these Japanese hybrids are successfully grown in tropical America at considerably lower elevations than the European pears. They can go down to 5000

feet - in some cases even lower - and they are more resistant to fire blight than the European pears, if that ever becomes a serious problem in tropical America. We will not mention pollination at this time. As Professor Hedrick says in his book "Systematic Pomology", Self-fertility and self-sterility vary greatly in accordance with climate. This is something that will have to be worked out for individual varieties in individual locations. Of course, until we know more, it would be wise to provide for cross pollination in the case of most varieties. Hedrick writes in his "Pears of New York", that Beurré Bosc is relatively self-fertile.

THE PLUM

In our previous paper, we pointed out what most horticulturists know, that apples in general have the highest chilling requirement of the temperate zone fruits, pears come next, followed by plums, and then peaches. As regards the plums, we have to emphasize that we are talking about the Japanese varieties and their hybrids. We have had sufficient experience with these to make a few tentative recommendations which are as follows:

Santa Rosa is the leader (in terms of popularity) in Guatemala, Reina Claudia in Ecuador - but this is not the Reine Claude of Europe, apparently, but a salicina or triflora (Japanese) variety which has been given the name Reina Claudia in Ecuador because it was thought to resemble in appearance a Reine Claude of Europe and the Reine Claudes are famous plums. Satsuma has proved, in Central America, to grow and fruit successfully at lower elevations than many of the others (as low as 5000 feet or even slightly lower) and it is very productive. The fruits do not have the dessert quality of Santa Rosa, but they are

good shippers and in general very acceptable. Mariposa is another fine variety, as also Kelsey (one of the finest as a dessert plum), and there are several others. In fact, most of the Japanese plums are good; it is largely a matter of what variety will do best in a given location and prove most profitable when placed on the market. We should not overlook, however, the matter of ripening season. There is a rather small dark red plum in the Guatemalan highlands (mainly near Tecpan) which is known locally as Española. This comes into the market by April first, some weeks before any other variety appears. It has been thought that this may be Methley, but we doubt it, and have introduced trees of Methley for comparison. Methley, in any case, may prove a valuable acquisition, as may also be true of a relatively new plum, Ozark Premier.

We will not discuss the problem of pollination at this time, because, first of all, we do not know enough about it. It may be something like the matter of pear pollination, mentioned above. Perhaps we do not need to follow all the recommendations which hold good in California; perhaps we can alter them in certain tropical American climates.

But there is one point which we wish to bring up for your consideration at this time. This is the declining productivity of Santa Rosa plum trees (and probably others) after they reach ten or twelve years of age. This has been called to our attention by several growers in Guatemala, and Ticho makes quite a point of it. Trying to get some information, we wrote to Knowles Ryerson in California, who passed our letter on to Claron O. Hesse, Pomologist of the University of California at Davis, from whose reply we quote as follows:

"It is quite apparent that deciduous fruit trees behave very

differently in the high altitudes of the tropics than they do in temperate zone climates. When the trees are young and growing vigorously they respond much better under conditions of insufficient winter chilling, and the trouble you observe may simply be due to a slowing down of growth and a need for greater chilling under such conditions. Have you ever tried cutting the trees heavily to stimulate vigorous new growth?"

We have not, and we are going to try it. It is well known that our temperate zone fruit trees in Central America are rarely pruned at all, after they have been properly formed at the start - and even this "poda de formación" is not always practiced.

Professor Hesse goes on to mention other factors which might possibly come into play, such as mineral deficiencies and a virus disease termed in California "rusty blotch" but since he thinks heavy pruning of old trees to produce new and vigorous wood the most promising and simplest line of attack we will try this first. We would suggest that fertilizers might well go along with it.

THE PEACH

Regarding this fruit we can add little to what we said in our 1962 paper, except to mention that of the "melting flesh" varieties, Jewel from Florida has seemed to us the best of those which have been grown in Guatemala, though some of the newer ones which have been sent out by Armstrong Nurseries in California may well prove superior. Several of these have come into bearing at Labor Ovalle, the experimental collection of fruit varieties which was established several years ago by the government of Guatemala near Quezaltenango (7800 feet). They look very promising. These varieties, along with Jewel, have low chilling requirements, which is not true of such

northern varieties as Elberta. All of these latter have up to now been complete failures in Guatemala.

As for the melocotones, or large, firm-fleshed clings - what we like to call "canning clings" - selections are being made from seedling trees in Guatemala which we know have low chilling requirements, and which produce fruit comparable to the canning clings of California, unless it may be that they are not quite so good in flavor. We believe they will prove satisfactory, and we feel sure they will grow successfully in the tropics in many regions where the California clings may fail completely. Since the processing of temperate zone fruits in tropical America is just over the horizon - in fact already with us in the form of jams, jellies, fruit juices and nectars - the development of good canning peaches is certain to come in for serious attention.

A FEW OTHER FRUITS

Grapes constitute one of our most difficult problems. The Cauca valley of Colombia - and adjacent regions - have long been the leaders. Isabella (a labrusca hybrid, widely grown in tropical America) and several vinifera varieties are grown there, but we are reliably informed that most of the "wine" made is based on oranges and blackberries. Fine table grapes, which are expensive to produce, bring such high prices in the market that it is scarcely feasible to use them for wine production. It is estimated, however, that the wine industry does consume about 10% of the total grape production of the Valley.

In Central America we have been devoting ourselves mainly to the introduction and testing of American grapes. Arturo Falla at Finca

San Sebastián, near Antigua, has been particularly active in this work. It does not yet seem certain that it is going to be economically feasible to produce grapes on an extensive commercial scale in Guatemala. Of the varieties now under trial, Golden Muscat, Caco, Catawba, Niagara, and one or two others look promising. As far as growth and production are concerned, Isabella still seems to be the most satisfactory in the majority of regions where grapes have been planted.

As for Strawberries, production in many countries is increasing gradually and there is not much change in the situation as regards varieties. Missionary holds its own pretty well. Florida 90 is gaining ground in some places. Klondike and Blakemore have proved very satisfactory in many regions but we do not believe their cultivation is being extended. The recently-introduced Lassen is a fine berry; we are not yet convinced that it is better, in flavor, than Missionary or Florida 90, but we have not seen much of it.

The most interesting and important development in the field of small fruit culture is the planting of Rubus glaucus, the mora or Andes Berry, of which Francisco de Sola produced and sold one thousand quintales last year from his Finca Los Andes, on the slopes of the Volcan Santa Ana in El Salvador. Part of this really impressive production was sold as fresh fruit for table use, part processed in the form of jellies, and part used as the base of a fruit nectar similar to pear nectar and peach nectar. As far as we know, there has as yet been no work done on the selection of varieties of this fruit, though we grew several from seed sent by George Darrow from South America in 1952. One of these proved superior in flavor but did not have good shipping quality.

Raspberries are not making much progress, though we are hopeful that the varieties Indian Summer and September, introduced about two years ago, may not require as much chilling as the standard varieties of red raspberry, hence be suitable for lower elevations. They look promising at 4800 feet at Finca San Sebastian in Guatemala.

IN CONCLUSION

It is encouraging to note the increased interest in the cultivation of temperate zone fruits in tropical America, which has been evidenced during the past few years in more than half a dozen countries. Progress has been made in the selection of the best varieties already grown in the various tropical regions, and in the importation of new ones which look promising. The time has come when we must devote more attention to such problems as rootstocks, pruning, and other cultural practices, including control of diseases and pests. We have been, perhaps, a bit slow in spreading out into this field. But it seems safe to say that the day is not far distant when we shall no longer need to import such fruits as have been mentioned in this paper from far-distant regions, but will be growing them closer to home.