

THE AVOCADOS OF MEXICO: A PRELIMINARY REPORT

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Plate I.

Photo by Wilson Popenoe

A Good Specimen of the West Indian Race

Grown at Tapachula, Chiapas. Fruit weighs nearly two pounds.

The outstanding importance of Mexico as a field for the study of avocados and avocado culture is evident at a glance. The great extent of its territory, the immense range in elevation and consequent differences in temperature, the widely diverse soils found in

various parts of the republic,—these and other factors combine to produce an almost endless series of environmental conditions. Added to this the fact that avocados are not only cultivated in abundance, but are found also in the wild state, and nothing further is needed to convince the student of avocado culture that here are opportunities for investigation and research such as are offered by no other country in the world.

In the development of the avocado industry in California the greatest factor up to date has been Mexico. Glance over a list of the varieties which have been tested in California, and you will find that the majority of them are of Mexican origin. It is natural, therefore, that the horticulturists of California should be deeply interested in Mexican avocados and avocado culture. One evidence of this interest is the study now being carried on by the University of California, of which this paper is a preliminary report. The purpose of these investigations, as outlined by Dr. H. J. Webber, is to bring to light as many interesting facts as possible concerning the history and distribution of the avocado in Mexico; the botanical and horticultural classification of the various species and races involved; the conditions of climate and soil under which these species and races are found; methods of tillage, irrigation, pruning, and so forth, which are employed in connection with their culture; their bearing habits and the character of the fruit under different environmental conditions; and the principal insect and fungus enemies which attack them.

To investigate thoroughly the subject in all sections of the republic in which avocados are grown would necessitate an immense amount of work. When it is remembered that Guatemala is a country whose total area is less than that of any one of half a dozen Mexican states, and that it required sixteen months to complete the study of Guatemalan avocados undertaken in 1916 and to introduce successfully into the United States the varieties selected for trial, it is obvious that the completion of a similar investigation of Mexican avocados would require several years' time. The present investigations have not been planned to extend over such a period, hence it will not be possible to go into such detail in regard to certain features of the work as it was in Guatemala.

This paper is a report upon the first six months' work. It has not yet been possible to visit Atlixco and certain other important avocado regions, and fruits of the Guatemalan race have not been in season since my arrival in the country; hence it is felt that this must be termed a preliminary report, since it cannot cover in a complete or final manner any of the important features of Mexican avocado culture. In preparing it, I have limited myself to an attempt to present certain observations which I believe should be of interest to Californians, and to give an idea of some of the results it is hoped will be achieved before the work is finished.



Plate III.

Along the Stream

A glimpse along the stream which flows through the avocado groves of the Canyada at Queretaro. The trees on both sides are avocados.

HISTORY

We have always considered that the avocado played an important part in the life of the ancient Mexicans. It would be interesting, however, if we could obtain a more definite idea of the extent to which it was used by them as food, and their attitude toward it. Did they esteem it highly, and did it play any part in their intellectual life? The mango, we know, is of such great importance among the inhabitants of Hindustan that it has come to be used in religious ceremonies and to appear in their legends and folklore.

Two means of investigating this subject suggest themselves to me. One is to study the

accounts written after the Conquest, and the other is to observe the extent to which the avocado is used and esteemed by the Indians of the present day. The latter method, while it may at first glance seem to be of no value, appears to me very promising. We know that many of the customs of the ancient Mexicans have persisted down to the present time. There are regions, in fact, where four hundred years of contact with European civilization seems scarcely to have made any impression upon the habits of the people. I had particular occasion to observe this during my stay in northern Guatemala, as it is especially true of the Maya race which occupies northern Guatemala and southern Mexico. The staple foodstuffs of the people are largely the same as at the time of the Conquest. Indian corn, black beans, squashes and a few other vegetables are still the principal articles of diet. The most important change which the Conquest seems to have brought is the introduction of cane sugar and coffee, two plant products not known in the New World in earlier times. Will it not be true, therefore, that the position held by the avocado at the present day among the tribes of Mexico, especially among those which have not come in such close contact with European civilization as have the Aztecs of the Mexican plateau, is very much the same which it occupied four hundred years ago? I believe we are safe in considering that it is. After all, four hundred years is a short time in which to change entirely the habits of a people. Particularly does this hold true in regard to habits of eating.

We must depend upon the accounts of the early Spanish voyagers, and the writings of recent students of archaeology, to give us the traditions concerning the avocado. I have already found one instance in which the name of this fruit enters into Aztec mythology. According to Róbelo, the mythical Yaotl was appointed by the gods to be guardian of the penitent Yappan; he treated Yappan and his wife with such excessive cruelty that he was transformed into the insect Ahuacachapulín. The latter name is composed of two words, *ahuacatl* and *chapulín*, or "avocado-grasshopper." The method of designating the avocado in the picture writing of the Aztecs is known, and has been published in the United States. The Aztec name for this fruit, *ahuacatl*, from which we derive our name *avocado*, has been the subject of recent researches in the literature, but I will not here enter into detail regarding the origin and significance of the word.

Practically our only knowledge of the avocado among the ancient Mexicans is based upon its uses among a single tribe, the Nahuatls or Aztecs, who occupied the Valley of Mexico at the time of the Conquest and were the most powerful of Mexican nations. Compared to the study given this tribe,—its language, religion, daily life, and so on,—by archaeologists and historians, the amount given to the other peoples of Mexico, with very few exceptions, has been inconsiderable. As the result of this, our knowledge of the avocado among the ancient Mexicans is mainly a knowledge of it among a single people of Mexico, the Aztecs. In order to broaden the range of our knowledge we must have as much information as it is possible to obtain regarding the extent to which this fruit was grown by other tribes, their names for it, and the uses to which it was put by them.

The accounts of the early Spanish travelers are interesting, and by studying them carefully and correlating the statements of these early students with our present knowledge of the avocado I believe we can extract more of value from them than has yet been obtained. Particularly is this true in regard to the distribution of the various

races of the avocado at the time of the Conquest; by a careful examination of the different accounts it is possible to tell in most instances precisely what race is being described, and this, together with the mention of a geographical location which usually accompanies each account, will throw much light upon our study of the races and their distribution. It is to be regretted, however, that nearly all of the early travelers had a better eye for medicines than foods, and they devote too much of their attention to the medicinal virtues of the avocado. From our point of view it would have been much better if they had given us more information concerning its culture among the ancient Mexicans.

If we are safe in assuming that the avocado is of more or less the same importance as a foodstuff among the Mexicans of today that it was in pre-Columbian times,—and I believe in general this must be true,—then it can be said that this fruit did not play such an important role in the daily life of the Mexicans as it did among the Maya tribes of Guatemala. For I have seen no place in Mexico, as yet, where the avocado is so extensively used,—where it is such a veritable staple,—as it is in northern Guatemala. Nor does its use among Mexicans of European blood seem to be so extensive as among Guatemalans of European blood. Recently, while working in the highlands during the height of the season for avocados of the Mexican race, I was somewhat surprised to observe that not even in Queretaro, an important center of avocado culture, were there quantities of fruit in the market at all comparable to the huge piles seen in the markets of Guatemala City almost any day in the year. I am certain that for every bushel of fruits I saw in the markets of Queretaro, I could, on the same day, have found three in the markets of Guatemala City.

CLASSIFICATION

To those interested only in the practical side of avocado culture, the subject of classification may not possess a great deal of interest. Yet a moment's reflection is sufficient to convince nearly anyone of the immense practical importance of this subject, and the immediate necessity of its thorough study.

Horticultural science is founded upon botanical science, in certain very important particulars at least, and botanical science is founded upon classification. Without an adequate knowledge of the classification of avocados, the horticulturist begins his work of planting, cultivation, and those numerous other operations which have for their object the production of fruit, under a tremendous handicap. Let me illustrate. A certain horticulturist in California has learned, by empirical means, that avocados from Florida do not succeed in California. This is because they are of the West Indian race, but we are assuming that he knows nothing about races; to him an avocado is an avocado, and all he knows is that avocados from Florida have frosted down every time he has planted them in his orchard. A friend of his at Miami sends him a young tree with the request that he plant it. It happens to be an avocado of the Guatemalan race, which would succeed in California; but knowing nothing of races and remembering his previous experience with avocados from Florida, he throws it on the trash heap.

Another hypothetical instance to show the opposite state of affairs. An avocado is introduced into the United States from the lowlands of southern Mexico, and a tree is

sent to a man in California by the Department of Agriculture at Washington. This man knows that the avocados of the region whence this comes are mainly of the West Indian race, and he knows that the West Indian race has been tested pretty thoroughly in California and does not give satisfactory results. He is undecided for a moment; shall he plant it and see if by careful protection during the first few winters he can pull it through? It occurs to him to crush a leaf, and immediately he detects a familiar aromatic odor. It is of the Mexican race! Naturally he will plant it, for its chances of success are excellent.

The classification which we have been using in the United States for the last few years seems in general to be quite satisfactory. It covers the majority of the varieties now in cultivation. It does not, however, seem to cover every one of them, and we have not yet carried it to a point where we feel absolutely certain in every case that we have made a correct diagnosis. We must continue to study the matter until we have gone to the bottom of it. This involves an investigation of the avocados of all tropical America, a work which will require some years, but it is to be hoped that it may be carried to a conclusion. It will be a decided advantage if this important subject can be studied thoroughly while the avocado industry is yet in its infancy.

Mexico probably offers more material for this study than any other country. It is a vastly better field than Guatemala, because of its larger area and the abundance of all the known races. In Guatemala trees of the West Indian and Mexican races are comparatively scarce, the Mexican especially.

This subject must be studied first from a botanical standpoint, later from the horticultural point of view. We must first know with what species we are dealing, before we will be able to classify our horticultural races. The differences between a botanical species and a horticultural race or group are technical in character, and I will not here discuss them in detail; suffice it to say that the botanical species is the broader division, the horticultural races occurring within the species. The question which is now confronting students of avocado culture is this: Are the varieties with which we are dealing nothing more than horticultural forms of a single botanical species, or are there several different species involved? In the past, we have generally considered that all of the cultivated avocados belonged to the species *Persea americana* of Miller, formerly known as *Persea gratissima* of Gaertner; but it seems highly probable that we have held to this belief simply because the avocados have never been studied sufficiently to bring to light the specific differences which separate some of the groups we have termed horticultural races. Botanists who have worked on this genus have usually been able to examine nothing more than a very limited number of herbarium specimens, in the majority of cases without fruits, and the classification which has resulted has been somewhat unsatisfactory from the horticultural viewpoint.

I wish to mention briefly the most important species or races which are being studied here in Mexico, in order to give an idea of the present state of the investigations.

West Indian race. This seems to be the true *Persea americana*. In order to determine this beyond the possibility of a doubt it will be necessary to look up the original description of the species, study it carefully, and ascertain from what regions the specimens were obtained upon which the species was based. But as far as can be judged at present, the name *Persea americana* was originally given to the kind of

avocado which we term the West Indian race.

Several botanical varieties of this race have been created by botanists. Of those which Meissner described in De Candolle's *Prodromus* the varieties *vulgaris*, *oblonga*, and *macrophylla* have every appearance, so far as can be judged from the descriptions and the source of the specimens, of being nothing more than horticultural forms. Meissner did not see the fruits of any of them. Retaining them as botanical varieties, if they are in reality no more different from the type than hundreds of other cultivated forms (and I judge from the descriptions that this is the case), is setting a bad precedent and perpetuating the present confusion. Following this example, an almost innumerable series of botanical varieties could be created. In reality they would be nothing more than horticultural forms. So far as known to me, this race or species has not yet been found in an indigenous state. Some of the forms observed here in Mexico are very primitive in character, but none have been found in the wild.

Guatemalan race. This has probably received less attention from botanists than any of the others. I cannot find, in fact, any references to specimens from the Guatemalan highlands among the descriptions of *Persea americana*. The differences between this race and the West Indian, judged by the trees in cultivation, seem scarcely great enough to make them different species; it is possible that the wild forms of both will yet be found, in which case a more satisfactory determination can be made. As yet the Guatemalan race has not been found in a condition known certainly to be indigenous. It is of the greatest importance that the wild prototypes of all the races be found, if they still exist, as only in this way will it be possible to determine their botanical standing in a thoroughly satisfactory manner.

Mexican race. This avocado occurs abundantly in an indigenous state about the base of the volcano Orizaba, at elevation of 5000 to 6000 feet. Its range in elevation and its geographical distribution have not yet been fully worked out, but enough has been observed to make it certain that the species is truly indigenous in Mexico.

The wild trees of this species produce fruits usually of obovoid form, almost never larger than hen's eggs. It does not seem possible to believe that the thick skinned varieties of the West Indian race have been derived from this species by cultivation. The two should probably be considered distinct species, as was done by the botanists Chamisso and Schlechtendahl when they gave this species, in 1831, the name *Persea drymifolia*. Meissner, in De Candolle's *Prodromus*, retains this as a good species, and the *Biologia Centrali-Americana* does the same, but the botanist Mez, in 1889, reduced it to the standing of a botanical variety of *P. americana*. It appears that we have never gone into the matter thoroughly enough in California to ascertain the standing of this race, and have considered it nothing but a cultivated form,—not even a botanical variety,—of *P. americana*. I believe when the investigations now under way are concluded we will be justified in considering this to be a distinct species, *P. drymifolia*, as established in 1831.

The Chinini. We have not had to consider this fruit in making our classification for California use, but its importance in Mexico and Guatemala necessitates its inclusion in any general scheme of classification.

This is the fruit which I introduced from Guatemala last year under the name *coyo* or *shucte*. In southern Mexico it is known as chinini. I have seen it throughout the southern

half of Veracruz state, and am told that it is abundant in Tabasco. It will not be described here, but it may be said that a preliminary study of the literature seems to indicate that we are dealing with the *Persea schiedeana* of Nees, reduced by Meissner in 1864 to the rank of a botanical variety of *P. americana*. It seems that very few botanists have collected this species, and that it is imperfectly known botanically, the fruit having been seen by none of the botanists who have attempted to classify the plant. Since ample botanical material is now available its correct classification should be a simple matter, and I am convinced from my! observations of the tree and its habits that it is a distinct species, not to be included as a variety of *P. americana*.

The classification of the Fuerte and Puebla varieties is still in doubt, as I have not yet been able to visit Atlixco to see the parent trees and determine whether they represent a distinct race common in that region, or whether they are aberrant forms probably due to crossing. It is to be hoped that this matter can be settled before the termination of the investigations in Mexico. In the meantime, I do not believe these varieties should be included in the Guatemalan race, as they evidently are not true Guatemalans. This is indicated by the presence of the aromatic odor in the leaves, a character which the Guatemalan race does not possess.

In the past, numerous efforts looking toward a classification of cultivated avocados have proved unfruitful because the question was not attacked from a sufficiently broad standpoint. The result has been a classificatory system which included nothing more than a limited number of *varieties* belonging to one or more races. In glancing over one or two of these attempts, one comes upon such terms as "round pagua," "large pagua," "San Angel black," "Chalco green," and so on; these cannot be considered natural classes or groups in any sense of the word. The terms "round pagua" and "large pagua" would include in the one case all round fruits of the West Indian and Guatemalan races, in the other all large fruits of both these races, whether round or not. "San Angel black" and "Chalco green" would include all black fruits from San Angel and all green ones from Chalco. It happens that all of these belong to the Mexican race, but under these two groups we would get a motley collection of forms and sizes. The defect of the system is that it has no regard for the race to which the fruits belong, but classifies them upon the basis of form or color, a purely artificial arrangement and one that is only satisfactory where a natural classification,—one based upon relationship and not upon arbitrarily chosen characteristics,—is utterly impossible.

If a classification upon an arbitrary basis is undertaken, using form, color, and size of the fruit as classificatory characters, it must not be made to extend beyond the limits of a race. Some such classification may be desirable, later on, to bring together all varieties of similar characteristics within each race. Thus all varieties of the Mexican race can be classified upon the basis of form, size, season of ripening, or some other important characteristic.

DISTRIBUTION OF THE RACES

This subject can only be touched upon at the present time, since many sections of Mexico have not yet been visited. It is possible, however, to give an idea of the distribution of the various races and to mention the regions which have the reputation of

producing the finest fruits of each.

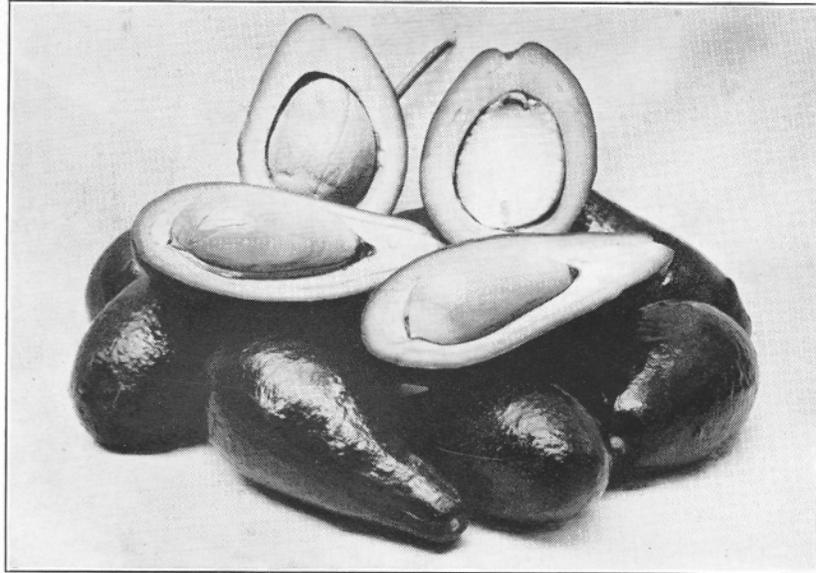


Plate IV.

Typical Fruits of the Mexican Race

The proportionally large seed is one of the greatest defects of this race.



Plate V.

A Market Scene in Puerto, Mexico

The avocados in the foreground are of the West Indian Race.

The West Indian race is predominantly a lowland avocado, as is well known to North Americans. I have observed it on the Gulf coast at Tampico, which I suspect may be the northern limit of its cultivation. Southward from Tampico it is common all along the

coast; in the state of Veracruz it is abundant, as also in Tabasco, Campeche, and Yucatan. Both Tabasco and Yucatan have the reputation of producing very fine fruits of this race.

The West coast I have scarcely been able to touch as yet, but I believe this race is found along most of its extension from Mazatlan, or perhaps farther north, to the Guatemalan border. In the vicinity of Tapachula, Chiapas, only a few miles from the Guatemalan frontier, I have found some excellent fruits, equal to the best produced in Cuba.

This race extends across the Isthmus of Tehuantepec, there being no high elevations in this region. I do not believe it is found on the plateau of central Mexico, but I have not yet visited many parts of this region. At Orizaba, in Veracruz state, it is cultivated in great abundance, and it is worth noting that this city lies at an elevation of 4200 feet, which is about 1 500 feet higher than I found the West Indian race to be grown anywhere in Guatemala.

The Mexican race is the predominant race on the plateau. From San Luis Potosi on the north to Puebla on the south it seems to be abundant, and beyond these limits it is grown to a certain extent.

Its culture is not limited to the highlands, but is most extensive there; I have seen a few trees in the state of Veracruz at sea level. As a wild tree it seems to occur abundantly in this state, notably about the base of the volcano Orizaba, and probably farther to the north. It is grown in the state of Oaxaca and also, I am told, in Guerrero, and I believe it to occur as far north as Nuevo Leon, though not in great numbers. Queretaro is probably the best know center of production.

The Guatemalan race I have scarcely seen in Mexico up to the present. We know it to be grown in the state of Puebla, and from descriptions of avocados grown in Jalisco and Nayarit which have been given me by Mexican horticulturists I take it that this must be the race found in the region north of Guadalajara, but this remains to be investigated. This race extends across the borders of Guatemala into the highlands of Chiapas, but I have not found it on the coast of that state.

CLIMATE AND SOIL

As in other tropical countries, climate in Mexico is largely a matter of altitude. It is the custom to speak of the three zones which I have ' treated in my paper on the avocados of Guatemala, published in the 1917 Report of the California Avocado Association. These zones are usually referred to as the *tierra caliente*, *tierra templada*, and *tierra fría*, or hot region, temperate region, and cold region, but as suggested in the paper mentioned the names tropical, subtropical, and temperate seem less misleading. The tropical zone extends from sea level to 2500 or 3000 feet; the subtropical from about 3000 to 7000 or 7500; and the temperate from 7500 to the upper limit of cultivation. The fruit trees mentioned in the discussion of these zones in Guatemala are in most cases characteristic of the zones in Mexico as well. A lengthy consideration of the climatic conditions in different parts of Mexico is not within the scope of this report. It will suffice to mention a few important characteristics of some of the principal avocado regions.

The West Indian race seems to find optimum conditions of growth and fruit production in regions where high temperatures are combined with reasonably heavy precipitation. The regions of very heavy rainfall do not seem to produce as good fruits as those where there is a dry season of considerable length and where the amount of precipitation during the year is not over 75 or 80 inches.

The Mexican race, on the other hand, does not seem to be as successful on the coast as at considerable elevations. This is probably due to the fact that its native home is in the mountains at elevations of 4000 to 6000 feet. It has seemed to me that it finds optimum conditions for growth and fruit production at elevations of 5000 to 6000 feet, and in regions where the climate is comparatively dry. I believe this race is naturally adapted to withstand a dryer atmosphere than the West Indian.

Taking the climate of Queretaro, for example, as representative of the optimum for this race, we find it to resemble rather strikingly that of southern California. The rainfall is perhaps slightly greater (I have not yet been able to obtain meteorological data), and occurs at a different season of the year, but the temperatures seem to be very much the same, and the relative humidity is low, though perhaps not so low as in California. With such a climate, good soil, and the proper irrigation, the conditions seem to be almost ideal for this race.

The soil in the avocado groves of Queretaro is a clay loam, in places heavy enough to be termed clay. I am coming more and more to believe, as I examine the soils of the different avocado regions of tropical America, that the avocado greatly prefers a heavy soil to a light one. In these countries it is very common to find trees growing and fruiting well on heavy clay; the best results which I have seen were obtained on clay loam. Very light soils are rare; I have seen nothing in Mexico so porous as the volcanic soil of Antigua, Guatemala. But volcanic soils, even though light and friable, are usually rich in plant food, I believe. From what I have seen, I would conclude that the avocado prefers a good strong soil; a soil well drained, but rather heavy, and not sandy or exceedingly friable. We know from experience, of course, that the avocado will succeed on a wide range of soils, but it is still something of a question which type may be considered ideal. If I were going to plant an orchard, I would look for a small valley where an alluvial soil had been formed of material washed down from mountains or hillsides where clay predominated. I am speaking now of Mexico; it might be dangerous to plant in a valley in California because of the exposure to frosts.

So far as I have been able to observe up to the present all races of the avocado have this same preference for a heavy soil. I have not been able as yet to distinguish any differences in this respect. At Orizaba the West Indian, the Mexican, and the Chinini are all three grown in great abundance, often side by side. The land is sloping, hence well drained, and the soil varies from a heavy loam to clay. It seems to give excellent results.

I believe it will be well for Californians to keep in mind this preference when selecting land for an avocado orchard.

CULTURAL PRACTICES OF THE MEXICANS

There are certain regions in Mexico where avocados are grown in more or less regular

plantations with the definite object of commercial fruit production. Queretaro is one of the most important of these. Here there is a small valley called the Canyada, some two and a half miles in length by a quarter of a mile in width, which presents, when viewed from the neighboring hillside, the appearance of a solid grove of avocado trees. Such a region as this gives us our best chance to observe the cultural practices of the Mexicans.

It is of interest to note that the Mexicans understand the principle of seed selection, and that intelligent orchardists are careful to choose seeds from the very best fruits when establishing a new plantation. Needless to say, all of the avocado plantations in Mexico are composed of seedlings; budding and grafting have been attempted only recently, and on a very limited scale. While I do not know that this principle of selection is applied generally, it is understood by the better class of natives, at least. It must be remembered that a large proportion of the trees in Mexico were never intentionally planted, but have sprung up from dropped seeds, in which case there is no opportunity for the application of this principle.

One of the most striking features of the groves at Queretaro is the immense variation in the size of the trees. Upon an acre of ground will be found trees of all sizes, varying from slender saplings struggling upward toward the light to rugged old giants sixty feet in height, with trunks four feet in thickness. The trees are nearly always too close together. Being seedlings, and planted on good soil, they would develop to enormous size if given the opportunity, but when they are often less than ten feet apart their development is necessarily limited. It is evident that under the conditions which obtain at Queretaro,—I am referring now to climate and soil,—the trees should not be planted less than 50 feet apart; this applies as well to many other sections of Mexico. Since we do not yet know what size budded trees will ultimately develop in California it is impossible to say whether the same rule should apply to our budded groves or not. I am inclined to suspect that our trees will ultimately reach large size and that it will be necessary to thin out most of the orchards.

When the groves are old and dense nothing is usually planted beneath the trees. The ground is never tilled. The deep shade prevents anything but a scanty growth of weeds and grass in most places. In those instances where the groves are less dense,—where there is open space between the trees,—such crops as barley and alfalfa are sometimes planted beneath the avocados.

I was deeply impressed by the appearance of a young grove which I encountered in the middle of the Canyada, after having rambled about for a couple of hours in the deep shade of the older plantations. None of the latter which I had so far seen were planted in regular order; the trees were scattered about promiscuously, rarely more than ten feet apart, and sometimes a group of three or four within a circle six feet in diameter. Suddenly I came upon a young orchard, perhaps five years old, in which the trees were planted in straight rows about 20 feet apart, with the ground between producing a splendid crop of alfalfa. Here at last, I thought, was something approaching the California method, and I would have an opportunity to compare the results obtained by the no-tillage, no-irrigation method and those obtained by a more modern system. I walked into this young grove, knee deep in alfalfa, and began to examine the fruits. Immediately I was struck by their superior size and the uniformly heavy crop over the

entire grove. I hunted up the caretaker and talked to him. He told me that they irrigated every three weeks; a good stream ran by the edge of the grove, and water was always available.

The impression which this grove made upon me has not yet commenced to fade from my memory. The system of cultivation was certainly the best I have seen in Mexico, judging by the results. Unfortunately, I have seen no groves here which are clean cultivated, or irrigated and tilled, as in California. I cannot, therefore, compare the effect of this system of combining avocados and alfalfa with clean cultivation, but when compared to the method usually followed in Mexico the results strike one as nothing less than marvelous. The alfalfa was planted close up around the trees; combined with the foliage of the latter the ground was effectively shaded. The trees were all branched low, and were fruiting right down to the ground.

As to the question of mulching versus tillage, I have as yet had no opportunity to make any comparisons, as tillage is rarely practiced in Mexican avocado orchards and the only mulching done is that accomplished by Nature. I do not believe the litter which results from fallen leaves and the accumulation of weeds is sufficient to mulch the trees effectively, but this is all they ever get.

Many of the old groves are so crowded that it is not possible for the trees to perform creditably. This crowding forces the crown to form high above the ground, unquestionably a bad feature. Rarely are any branches given off lower than eight to ten feet from the ground. In groves where there is not so much crowding the crown is formed lower and is of better shape.

No pruning seems to be done, nor are the trees encouraged to develop in any particular form. It seems to be left to Nature to take care of such matters, and where she has the slightest opportunity she usually succeeds in getting pretty good results. The great obstacle which prevents most of the trees from developing broad, well branched tops is the crowding to which they are subjected.

The interesting custom of tree renewal, practiced with various fruit trees in the American tropics, can often be observed in the avocado groves of Mexico. I have noticed it particularly at Orizaba and Queretaro. When the trees become old and decadent, sprouts develop around the base of the trunk. Several of these are allowed to grow, so that when the old trunk has finally to be cut away one or more vigorous young sprouts are ready to take its place. Sometimes these sprouts grow to considerable size before the original trunk is destroyed. Often as many as three or four of them are allowed to develop. It would seem better if only one were permitted to each tree, to replace the original. I have not yet been able to learn that anything *is* done to produce these sprouts; they seem to appear naturally and are simply allowed to remain.

Avocado culture is too young in California for this method of tree renewal to be of much value to us, but the day will come when it can be tried out with profit. Apparently the new tree which develops has a considerable life, and is as productive as the original.

FRUITING HABITS AND PRODUCTIVENESS

A comparison of the fruiting habits and productiveness of the different races brings out some interesting points of difference, some of which are of considerable importance from the standpoint of the avocado grower.

In productiveness, it seems to me that the races rank in approximately the following order: Mexican, Guatemalan, West Indian, and Chinini. In other words, the Mexican is the most productive of all races, the Guatemalan coming next, followed by the West Indian, and lastly the Chinini, which falls much below the others in this respect. The Mexican I would place at the top of the list because of its ability to produce heavy crops, combined with its regularity in fruiting. The Guatemalan in many instances produces as heavy crops as the Mexican, but as a race it shows a decided tendency toward irregularity in fruiting, there being many more "off" years than in the Mexican. The West Indian in some instances produces heavy crops,—the Trapp of Florida is a notable example,— but as a race it is decidedly less productive than the Guatemalan. The Chinini is markedly unproductive; occasionally a tree will be found which bears heavily, but it is safe to say that 90% of the seedlings growing in southern Mexico and Guatemala are shy bearers.

It is worthy of note that old trees of all these races, here in the Tropics, seem to be as productive as younger ones. I have seen huge trees of the Mexican race, which must have been nearly a hundred years old, bearing excellent crops. It seems to me we are justified in expecting the avocados we are planting in California to remain in profitable production much longer than citrus trees ordinarily do. At the same time, it is probable that trees grown under the constant stimulus of intensive cultivation and fertilization will exhaust themselves more rapidly than those grown under the more normal condition which obtain here in the Tropics. I use the word normal in the sense that the conditions found here more nearly approximate those under which the avocado has been accustomed to exist in the wild state. These conditions, it seems to me, should tend to prolong the life of the tree because there is no stimulus to excessive fruit production. When we plant avocados in California our object is to get as much fruit as possible out of them every year; the number of years which the tree may stand up under such treatment is a matter of secondary importance.

My studies in the Canyada at Queretaro left me impressed with the uniform manner in which seedlings of the Mexican race perform. In the lower part of this valley practically every tree was fruiting well, yet they are all seedlings, hence each one a distinct variety and consequently subject to varietal differences in fruiting habit as well as other characters. I do not believe you can duplicate this in any of the principal avocado regions of Guatemala. It will nearly always be found, when trees of the Guatemalan race are under consideration, that many of them do not bear regularly. They have a pronounced tendency to bear in alternate years. This probably is not true of every variety, but it is true of the race as a whole. I have never examined a group of seedlings in Guatemala and found every one of them in bearing. There are always some that are "descansando"—"resting," as they say in Guatemala; they produced the previous year, and are now taking a year off preparatory to bearing another good crop. As stated in my paper on Guatemalan avocados, we may be able to control this habit to a certain extent by judicious cultural treatment, so that the trees will tend to bear moderate crops each

year instead of an enormous crop one year and nothing the following. There may be varieties, also, which will not exhibit this tendency. But in general it is certainly a pronounced characteristic of the Guatemalan race, and it does not seem to be nearly so noticeable in the Mexican.



Plate VI. **One of the Patriarchs**

Trunk of an old avocado tree in the Canyada at Queretaro, showing approximately the maximum development attained by the Mexican race.



Plate VII.

Tree Renewal

When the old tree has to be cut down the three sprouts which arise from the base of the trunk will remain and form a new top. This is a common method of renewal.

The West Indian race, as observed in the Mexican lowlands, is not altogether satisfactory in regard to productiveness. An examination of numerous trees at Orizaba showed about half of them to be fruiting. Whether it is a case of this same tendency to fruit in alternate years I cannot say, as I have not yet had an opportunity to make sufficient observations on the question. I have noticed that large fruited varieties of this race are particularly unproductive. I have not seen a single one, in fact, which seemed to be producing to the maximum of its ability. This is in marked contrast to large fruited varieties of the Guatemalan race. I have seen several of the latter in Guatemala which bore so many fruits that the trees were not able to develop all of them to normal size. Many of them had to drop off before half grown, or if they remained on the tree to maturity they were small and stunted.

The average age at which seedlings come into bearing differs noticeably among the races. We have had ample evidence of this in California, insofar as the Guatemalan and Mexican are concerned. Under favorable cultural conditions, I believe we can consider that the Mexican will commence fruiting the third or fourth year from the seed, and the Guatemalan the fifth to eighth year, usually not earlier than the sixth. The West Indian has not been so carefully observed, but I believe it is rare for it to commence earlier than the sixth year. Here in the Tropics, where the growth of the trees is slower, due to

the lack of cultural attention, fruiting probably commences from one to three years later than in California, if good cultivation were given the trees, however, they would probably come into bearing fully as early as in California, if not a year earlier in some cases.

The tendency to produce two crops a year, which has been noted in California in the Northrup variety, seems to be a characteristic of the Mexican race, though not present in all varieties. At Queretaro, in the month of July, I observed a good many trees which were flowering and setting new crops of fruit, although the main crop was just getting ripe and the normal flowering season is not due until next February or March. This secondary crop of fruit appears always to be a small one, by no means equaling the main crop in quantity. I have never observed this habit of fruiting twice a year in any of the other races. It seems to be limited to the Mexican.

THE CROP: SEASON, HARVESTING, AND MARKETING

The season of ripening depends mainly upon two factors, race and elevation. The Mexican race, which is justly entitled to be considered the most important one in Mexico, though it is not so predominant as is the Guatemalan race in Guatemala, commences to ripen on the central plateau in the month of July, and continues until October or November. It remains in season during a much longer period than does the West Indian in the lowlands. Climatic conditions may account for a large part of this difference. The most important months are August and September. In the lowlands, where this race is not so common but nevertheless is occasionally seen, the season is somewhat earlier than on the plateau. At Orizaba I found it ripening in May. The elevation here is 4200 feet, but the climate is warmer than is sometimes the case at this elevation, due to the exposure. The season is by no means so long in the lowlands as on the plateau.



Plate VIII.

A Young Avocado in the Canyada at Queretaro

This is a tree of good form, and shows the cultural conditions under which the avocado is sometimes grown.



Plate IX.
**Harvesting the Avocado Crop in the Canyada at
Queretaro**
The bamboo pole held in the hand is used in pulling
the fruits from the trees.

The Guatemalan race I have not yet been able to observe, but it is said to ripen at Atlixco from November to March. I suspect that the fruits picked in November are not fully ripe, and that the season is more properly January or February to May. In the Guadalajara region the season for avocados is said to be December to March, and while I have not yet examined fruit from this region I believe the Guatemalan race to be the one grown there.

The West Indian race ripens on the coast from June to August. July is the principal month. A few fruits may hang on until September. At Orizaba, where it is extensively grown, it ripens slightly later than on the coast, due to the elevation.

The pernicious habit of picking avocados before they are fully ripe is as common in Mexico as in Guatemala. I wish to urge upon the members of the California Avocado Association the importance of suppressing this custom in the United States.

The methods employed in harvesting the fruit in Mexico are primitive, so far as I have seen them, and can give us nothing but negative suggestions. A boy is often sent up into the tree, where he picks all the fruits he can reach and drops them to the ground. Those which are far out on the ends of the limbs are reached by means of a long bamboo pole with a hook on the end. After they have fallen to the ground the fruits are gathered up and placed in baskets or sacks, in which they are carried to market.

The method of shipping avocados which is employed in Mexico seems to be an excellent one. Large baskets,—straight sided and open at the top, commonly 12 to 18 inches broad and deep,—are used in place of the wooden boxes or crates to which Californians are accustomed. The fruits are packed rather tightly in straw or excelsior, plenty of packing material being used. When the basket is full, the top is covered with burlap, which is sewed down tightly. Naturally, such a package as this requires more care in handling than a wooden crate, but as this method of shipment is extensively used in Mexico, not only for avocados but for many other products, railway employees seem to understand that a certain amount of care is required. In a warm climate this method of packing is probably better than that used in the United States, as it allows the air to circulate throughout and thus prevents the fruit from heating. It is generally recognized that avocados can be shipped long distances if kept cool, but if allowed to heat they spoil rapidly.

THE FRUIT: ITS CHARACTER AND QUALITY

The West Indian avocados of the Mexican lowlands are as a rule inferior in quality. The majority of them are small fruits, not over six ounces in weight, and they have enormous seeds. There are, however, a few excellent fruits of this race in Mexico. I am told that those of Yucatan and Tabasco are good. I have not been able to verify this, but I have examined the fruits of the Tapachula district, in the extreme southern end of Chiapas, right up against the Guatemalan frontier, and I found them to be splendid. The largest ones weigh about two pounds; the flesh is clean, deep yellow in color, and of rich flavor. The seed, while rather large, is not more so than in the West Indian varieties of Florida and Cuba. I would say that the avocados of Tapachula are in general fully equal to those of the latter regions, both in size and in quality. I have not found anything so superior, however, as to merit introduction into the United States.

The Mexican race is naturally of more interest to Californians than the West Indian. We have amply demonstrated that it is well adapted to California soil and climate, and it has been our hope that better varieties than those we now possess might be found, in order to make the cultivation of this race more attractive than it is at present. I will reserve my remarks on this subject for a separate paragraph, and here attempt to give an idea of the character of the fruits of this race which I have examined.

Knowing that Queretaro was one of the principal regions for the cultivation of this race, if not the most important of all, I visited it with the object of examining the fruits to see if any could be found superior to those we already have in California. The result was rather disappointing, for I found in general the fruits are too small to make them of interest to us, and good varieties are exceedingly scarce among them. To give you an idea of their character let me compare them to some of the varieties in California. , The Northrup and the Ganter are both considerably larger than the majority of them; in fact I found only a few varieties which come up to the Northrup and Ganter in size. Most of them are not over three inches long, and practically all have very large seeds. It is this characteristic, in fact, which is the greatest defect of the Mexican race, from my point of view. A fruit of six or eight ounces, if it had a very small seed, would be quite acceptable, but most of the Mexican varieties of this weight have objectionably large

seeds. The quality of practically all the fruits I examined was good. Very few of them contained any fiber, and they were all rich in flavor. I cannot help thinking that their small size was in a certain measure due to lack of cultural attention, and that if the entire Canyada of Queretaro could receive good cultivation for about two years every avocado in it would just about double in size.

There are a great many seedling trees of this race in southern California which produce small fruits, about the size of hen's eggs, black or green in color, usually obovoid or pyriform in shape. All of you are familiar with some of these seedlings; they are used principally by the nurserymen as a source of seed. Most of the avocados of Queretaro are precisely of this character; but they are held in much greater esteem by the Mexicans than they are by the Californians. They are here considered to be quite satisfactory.

All of the chininis which I have seen in Mexico have been of very inferior quality. The only ones I have ever found to be worthy of propagation were two or three in northern Guatemala. The common chinini of southern Mexico is a fruit about five inches long, slender, often with a well defined neck. It has a thick skin and contains a very large seed; between skin and seed is a layer of pale brown flesh through which run numerous tough fibers. The flavor is rich and oily, resembling that of the ripe cocoa-nut. A poor variety of the chinini is not a fruit which would appeal to a North American, but a good one is a worthy rival of the avocado.



Plate X.
An Avocado Grower's Home in the Canyada at Queretaro

All the trees are avocado trees.



Plate XI.

The Canyada at Queretaro.

View in the upper end of this famous valley. Practically all of the trees in the foreground are avocados.

THE MEXICAN RACE: ITS POSSIBILITIES

In drawing this paper to a close I wish to present for your consideration a few remarks on the Mexican race and its commercial possibilities in California. I do this with a certain hesitation and a profound feeling of distrust, for I have been present at some of the meetings of this association when the Mexican race was discussed. I have seen Mr. Thacher of Nordhoff, back to the wall, defend this race when every one else maligned it, and in all justice I must admit that I myself have previously been on the side of those that maligned.

Since coming to Mexico I am changing my views regarding this race, and while it is somewhat premature to express any decided opinions, I wish to point out what I consider to be some of the reasons why this race must continue to have a place in California orchards, and a rather prominent one at that. Not that I believe it will ever outrank the Guatemalan in importance, or even approach it. I am still convinced that the Guatemalan is the avocado *par excellence*, the *facile princeps* of its kind. But we should not let our prejudice in favor of the Guatemalan make us blind to the virtues of the Mexican.

We must remember that the ripening season of the Mexican race makes it of value. Although Sharpless and other Guatemalan varieties may come into market at the same season, we still look upon the Mexican race as our principal source of supply during the months from October to January. Even granting that the Guatemalan race will eventually cover this period completely, and there will be no need for the Mexican on this account, I still believe there are reasons for growing it.

I will qualify this last statement; there are reasons for growing it, *When we have obtained varieties which more closely approach the ideal*. I do not believe any of those grown in California today will be listed among the commercial varieties twenty-five years hence; but I do believe that it is going to be possible to find others which will have fewer

defects than those which we cultivate at present, and which we will be able to cultivate profitably on a commercial scale.

I base this belief mainly upon a fruit I have seen here in Mexico. I purchased it in the market of Orizaba, but it was said to have been grown at Atlixco,—that Mecca of avocado growers which I have not yet been able to reach. It was round, purplish black, glossy, of attractive appearance, about six ounces in weight with clean, yellow flesh of the richest flavor imaginable and a comparatively small seed tight in the cavity. Such a fruit as this,—it would probably go up to ten or twelve ounces under good cultivation,—would be worth growing.

The outstanding defects of the Mexican race, as I see them, are the small size of the fruit and the large size of the seed. It has in its favor hardiness, productiveness, ripening season, and a distinctive flavor which is preferred by some people to that of any other race. I am not sure that there is not an opportunity for it to be used to advantage in the tropics in supplying early markets. I found it in the markets of Veracruz a month before the West Indian race put in an appearance, and it would do the same in Florida.

But we must have better varieties. It is *indispensable*, as the Mexicans say. And they are going to be hard to find. I am already convinced of that. My search in the Canyada of Queretaro failed to bring to light anything that looked promising, but I cannot say that it was a thorough search. There are many other regions in Mexico where this race is grown, and one of these times we are going to run across a variety which is just the thing we are after.

We must remember that the distinctive flavor of the Mexican avocado places it in a class by itself. For this reason I believe it will always find a certain sale, even though placed on the markets in competition with fruits of the Guatemalan/ace.

On this question of flavor, however, let there be no misunderstanding. I am still of the opinion, after having eaten excellent fruits of the Mexican race in this country, that the best Guatemalan varieties suit me better than any other with which I am familiar. If I could choose between a twelve ounce Guatemalan fruit of good quality and two six ounce Mexicans, I would take the Guatemalan. I like its flavor just as well as that of the Mexican, and it is more convenient to eat.

After traveling in Mexico a few months I think I begin to realize why Americans who have lived in this country almost invariably swear by the Mexican avocado. They have eaten many of them, and they know they are usually of rich flavor. The only other avocados they have eaten are the West Indians of the seacoast, or mediocre Guatemalans of the highlands. The West Indians are in the majority of cases watery and insipid in comparison with a good Mexican, and none but the best Guatemalans are as rich in flavor. It is a simple matter; the Mexican avocado is the best they have eaten, and quite naturally they are prejudiced in its favor. But if they could have eaten some of the excellent fruits from the Guatemalan highlands which I had the pleasure of examining last year, I do not believe their prejudice would be so strong.

To my mind, the question is one of *flavor* rather than of *richness*. This perhaps sounds ambiguous. I mean that in point of richness, which I assume to depend upon the oil content of the fruit, the best Mexicans and the best Guatemalans are nearly equal, but

there is a certain flavor, not dependent upon the oil content, which characterizes each of the races.

Of course, if richness is not dependent upon the oil content but upon some other factor, then we will have to begin all over and find some other means of comparing the two races.

Some people prefer a Gravenstein, and some a Northern Spy, but no one maintains that both are not good apples. The flavor of the Gravenstein appeals to some, that of the Northern Spy to others. I believe it will be the same with these two races of avocados, the Guatemalan and the Mexican, and that there will always be a demand for both, though I do not expect the Mexican to sell so extensively, by any means, as the Guatemalan. H. Veracruz, September 20, 1918.

NOTE—"The classification of the Fuerte and Puebla varieties is still in doubt." Since writing this I have visited Atlixco and have examined the parent trees of both these varieties. It is evident that Puebla is a true Mexican, while Fuerte bears many indications of being a hybrid between the Guatemalan and Mexican. It is not representative of any group or class found in this region, but appears to be *sui generis*.



Plate XII.

Along the Aqueduct to Queretaro

Avocado groves on both sides with a few Cherimoya trees in the foreground.



Plate XIII.

The Best Orchard in the Canyon

This five-year-old orchard is planted to alfalfa. It is irrigated every three weeks, and is a heavy bearer.