UNITED STATES DEPARTMENT OF AGRICULTURE
BULLETIN No. 743

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief

Washington, D. C. ▼ April 17, 1919

THE AVOCADO IN GUATEMALA

By

WILSON POPENOE, Agricultural Explorer, Office of Foreign Seed and Plant Introduction

CONTENTS

WASHINGTON
GOVERNMENT PRINTING OFFICE
1919

UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 743

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief

Washington, D. C. April 17, 1919

THE AVOCADO IN GUATEMALA.

By Wilson Popenoe,
Agricultural Explorer, Office of Foreign Seed and Plant Introduction.

CONTENTS.

IMPORTANCE OF THE AVOCADO.

Probably no other country possesses such an abundance of fine avocados as Guatemala. Not all Guatemalan avocados are exceptionally choice, but scattered throughout the highlands of the Republic are many trees of unusual merit. A wide variation in characteristics exists. Fruits of some varieties are no larger than hens' eggs; others weigh fully 3 pounds. The shapes range from long and slender to oblate. The surface is sometimes rough and warty, sometimes smooth. The color may be green, maroon, purple, or almost black. Many varieties have proportionately large seeds, others small. Most important of all, there are numerous varieties whose deep yellow flesh is of the smoothest texture and has the richest, most agreeable flavor.

Since the soil was cleared in the lower Motagua Valley for banana plantations—now thousands of acres in extent—the production of avocados is insignificant in comparision with that of bananas; but to the native Guatemalans, especially the Indians, who represent more than half the total population, the avocado is still in most regions the more important. Bananas are grown mainly for export, while the entire avocado crop is consumed locally.

The abundance of avocados, their cheapness, and the long season during which they are available make it possible for even the poorest

natives in all the principal avocado regions to use them as a daily article of food throughout more than half the year. An avocado, four or five tortillas (small round cakes of coarsely ground maize), and a cup of coffee—by many Indians these are considered the constituents of a good meal. The cost of such a meal is seldom over 2 cents, for outside the larger cities avocados are rarely sold for more than half a cent each.

The three races of avocados at present cultivated in the United States are all found in Guatemala, but the Guatemalan race is the only one which is very common. The West Indian race is limited to the lowlands up to 2,500 feet in altitude, and even in this zone is much less abundant than the Guatemalan in the higher zone which it occupies, extending from 2,500 feet (rarely lower) to 7,500 feet, and above this in occasional instances to 8,500 feet. The Mexican race is found only in the highlands, and few trees are in cultivation. A distinct species of Persea, closely resembling the avocado and known as coyo or shucte, is as extensively grown in some sections of the country as the avocado itself.

EXTENT OF AVOCADO CULTURE IN GUATEMALA.

No orchards or regular plantations of avocados are found in Guatemala. Most of the trees occur singly or in small numbers around the houses of the natives. The avocado in Guatemala is essentially a dooryard tree. In certain regions, however, considerable numbers of trees are found in coffee plantations, owing indirectly to the use of shade for coffee bushes. Avocado trees often spring up in the plantations from seeds cast aside by laborers or coffee pickers after eating the fruit. Where they do not interfere seriously with other trees these avocados frequently are allowed to grow (Pl. I), ultimately becoming a part of the shade-tree system and at the same time in many cases furnishing fruit of commercial value.

Naturally the number of avocado trees in coffee plantations is comparatively small. Even the largest fincas, which contain thousands of shade trees, contain not more than one or two hundred avocados, and it is unusual to find more than 50 or 75.

No data regarding the annual production of avocados in Guatemala are available. While avocados are grown in practically all parts of Guatemala, certain regions are especially renowned for their product and supply most of the fruits sold in the larger cities and towns. These regions all lie at elevations above 2,500 feet and are not only the greatest producers of avocados but the great horticultural centers of the republic. Favored by climatic conditions and possessing an exceedingly fertile soil, they have long been cultivated intensively by the Indians.

Antigua, the former capital of Guatemala, which lies about 25 miles from the present capital, is the center of one of the leading avocado regions, perhaps also one of the greatest in the world both for quality and quantity of the fruit, though in quantity it soon will be outclassed by the avocado districts of Florida and California.

Antigua lies in a beautiful valley (Pl. II), whose floor is about 5,100 feet[1] above the level of the sea. It is protected on the north, east, and west by towering volcanos and high hills, and to the south there is an opening toward the ocean which permits warm breezes to enter from the Pacific and keep the valley at a fairly equable temperature throughout the year. The soil is of volcanic origin, deep, friable, moist, and very fertile. Practically every foot of ground in the valley is planted to some agricultural or horticultural crop. Coffee is the principal commercial product, but maize and black beans are grown extensively, and many fruits abound in the dooryards of the inhabitants. Besides the avocado, there are oranges, cherimoyas (called anonas in Guatemala), mombins or jocotes (*Spondias mombin* L.), guavas, injertos (*Achradelpha viridis* O. F. Cook), loquats, white sapotes or matasanos (*Casimiroa edulis* La Llave), and peaches. During the first six months of the year large quantities of avocados are carried from the gardens and coffee fincas of Antigua to the markets of the city of Guatemala.

Another important center of avocado culture is Panajachel, on the northern shore of Lake Atitlan, at an elevation of about 5,300 feet. This town lies on an alluvial plain at the mouth of a small valley, sheltered from cold winds off the highlands to the north by its position at the foot of high bluffs. It grows much coffee and immense quantities of onions, which are carried to all parts of the Republic on the backs of Indians. Many avocado trees are scattered through the coffee plantations and gardens of this little valley, and from here the fruit is carried by the Indians to Solola, Quezaltenango, and other towns of the highlands.

Far to the north of the city of Guatemala, in the great Vera Paz coffee district, lies the town of San Cristobal, situated on the border of a small lake in a valley surrounded on all sides by high hills. The elevation is about 4,500 feet, the climate being warm and moist. Considerable numbers of avocado trees are found in the dooryards and coffee plantations of San Cristobal. From here much of the crop goes to Coban, which is the capital of the Department of Alta Vera Paz and one of the principal cities of the Republic. Some of the avocados of San Cristobal are among the very finest in all Guatemala.

[1] The elevations given in this bulletin, with a few exceptions, were obtained with an aneroid barometer of standard make. Frequent comparisons of barometer readings with railway levels at some of the more important stations in Guatemala showed the former to be dependable within a range of 100 feet. This is a sufficient degree of accuracy for the practical purposes of this work.

Amatitlan, a small town about 25 miles from the city of Guatemala, at an elevation of 3,900 feet, produces a large proportion of the avocados marketed in the capital, Antigua being the other principal source of supply. Owing to the lower elevation, the avocados of Amatitlan ripen earlier than those of Antigua.

Momostenango, to the north of Quezaltenango, at an elevation of 7,400 feet, is the highest point at which avocados are abundant, and they probably would not be common here were it not for the fact that the town is particularly sheltered by its location and has a warmer climate than is usual in Guatemala at this altitude. A large part of the crop is marketed in Quezaltenango. Because of the elevation, the season of ripening is much later than at Panajachel; hence, avocados from the two regions do not compete in the Quezaltenango market.

In addition to the places mentioned, avocados are abundant in many other regions, but in some the quality of the fruit is uniformly poor. For example, the avocados of Senahu, in Alta Vera Paz, are small and have very large seeds.

The regions mentioned produce only the Guatemalan race of avocados. The West Indian race is found along the coast and up the valleys of the principal rivers to elevations of about 2,500 feet. Nowhere, however, are large numbers of trees of this race grown. Here and there one is seen in a dooryard, and in such towns as Livingston there are a few, but they are never seen in such abundance as trees of the Guatemalan race in places like Antigua and Amatitlan.

POPULAR USES OF THE AVOCADO.

In Guatemala nearly all the products of the soil are used in the simplest manner possible; hence little ingenuity is exhibited in the methods of utilizing avocados.

The Guatemalan Indians, who are among the greatest consumers of avocados in the world, merely break the fruit in halves (rarely is it cut with a knife) and sprinkle a little salt over it. Even the salt sometimes is dispensed with. The soft pulp—the Indians rarely eat the avocado until the flesh has lost its firmness—is then scooped out of the skin with the fingers or a bit of tortilla.

Among Guatemalans of European blood the pulp of the avocado is very commonly added to meat soups at the time of serving. It is the custom in many hotels to place a ripe avocado in front of each guest, who opens the fruit, removes the pulp, and places it in his soup. The flavor imparted is exceedingly pleasant. This mode of serving the avocado seems worthy of adoption in the United States. Another common practice is to serve a salad called guacamól. This is composed of thoroughly mashed avocado pulp, vinegar, salt,

AN AVOCADO TREE IN A COFFEE PLANTATION AT ANTIGUA.

Several kinds of quick-growing trees are used in coffee plantations to furnish shade for the delicate coffee bushes. Avocados spring up from seeds dropped by workmen, and where they do not interfere with other trees they are often allowed to grow and form part of the shade system. Some of the best avocados in Guatemala are found in such situations as the one here shown. In order to keep them from interfering with the coffee bushes the lower limbs are usually pruned off, and a slender, erect form of tree is encouraged. (Photographed at Antigua, Guatemala, May 3, 1917; P17250FS.)

GUATEMALA'S GREATEST CENTER OF AVOCADO CULTURE.

The valley of Antigua, once the seat of the Spanish colonial government for all the territory between Panama and southern Mexico, is a rich agricultural region. Its principal crop is coffee, but it also produces large quantities of maize, beans, vegetables, and fruits. Among the latter the avocado takes first place. Both for quality and quantity of fruit, Antigua must be considered one of the greatest centers of avocado culture in tropical America. The city can be distinguished in the right center of the picture. (Photographed near Santa Maria de Jesus, Department of Zacatepequez, Guatemala, October 20, 1916; P16882FS.)

pepper, and finely chopped onion. It is a popular and very tasty dish, though not especially attractive in appearance.

An oil to be used as a pomade and as an emollient for burns is said to be produced from the avocado. Many Guatemalans profess to be familiar with this oil, but none was found who could furnish a sample. By some it was said also to be used as a cooking fat, but this was not verified. The oil is said to be extracted as follows: Slightly overripe avocados are selected and the flesh scooped out and thrown into a large kettle, which is then placed over the fire without the addition of water. After boiling slowly for about two hours, to exhaust most of the water contained in the pulp, the kettle is removed from the fire and the pulp placed in a muslin bag between two heavy stones, arranged so that the oil, as it percolates through the cloth, will run to one side of the lower stone and collect in a dish placed to receive it. The amount of oil obtained by this process can be only a small proportion of that contained in the fruit.

Among the Guatemalan Indians, avocado pulp is often rubbed upon the hair and scalp, it being considered highly efficacious in stimulating the growth of the hair. This practice has given rise to the maufacture of avocado soap, which is recommended for washing the hair. To prepare this soap, avocado pulp is mixed with some kind of fat. The product is manufactured commercially in Guatemala, but it seems open to question whether all the brands on the market really contain avocado pulp.

Among the Kekchi Indians of northern Guatemala the avocado is considered an excellent diet for caged song birds. Young birds, recently caught and caged, are fed daily on avocados in order that they may learn to sing promptly and well.

It is also considered, in certain parts of Guatemala, that avocados are excellent food for laying hens, greatly stimulating the production of eggs.

Hogs thrive on avocados. To North Americans, accustomed to paying 50 cents for a single fruit, this may seem an expensive diet for hogs, but where inferior avocados can be purchased for 6 or 7 cents a hundred and lard is 25 cents a pound it is a good investment to turn avocados into pork.

The medicinal uses of the avocado are few. For those suffering from acute rhinitis (cold in the head) the fruit is considered by the Kekchi Indians to be an excellent food. The seed is sometimes used as a remedy for dysentery and diarrhea. For this purpose it is pulverized and boiled in a small quantity of water, after which the liquid is taken internally. Its beneficial effect is probably due to tannin, of which the seed contains large quantities.

The wood of the avocado tree has little value. It is light in color and does not check (crack or split) upon drying. For this reason it is used

by one factory in Antigua for the manufacture of potato mashers, rolling pins, and similar articles. It burns rapidly and gives off little heat; consequently it is not even esteemed as firewood, though it is commonly so used by the Indians.

CLIMATIC ZONES OF GUATEMALA.

In Guatemala, as in Mexico and some other parts of tropical America, three climatic zones are generally recognized. These are the tierra caliente (hot region), extending from sea level to an altitude of about 2,000 feet; the tierra templada (temperate region), comprising the territory between 2,000 and 6,500 feet; and the tierra fria (cold region), which extends from 6,500 feet to the upper limit of cultivation, about 10,000 feet.

It is not to be inferred that the temperate region has a climate similar to that of the Temperate Zone proper, but only that it is cooler than the lowlands of the hot region. The cold region, in turn, is not necessarily visited by snowstorms in winter, but is merely cooler than the temperate region, owing to its greater elevation. The lower and upper limits of each zone are exceedingly indefinite and are variously fixed by different writers.[1]

For the study of a particular horticultural product, such as the avocado, a clearer idea of conditions can perhaps be obtained if the climatic zones are based upon the presence of certain fruit trees whose requirements with regard to temperature are fairly well known to residents of the warmer portions of the United States. Working from this angle, it seems more appropriate to term the three zones tropical, subtropical, and semitropical, thus indicating more accurately the character of their climates viewed from a horticultural standpoint. However, it is impossible to fix definitely the limits of each zone, since the characteristic trees will be found occasionally in sheltered situations considerably above the ordinary limits of the zone, just as some of the tropical fruit trees which can not be grown in ordinary situations in California or Florida occasionally succeed in a protected spot. The limits must be fixed at the altitude where under ordinary conditions the characteristic trees commonly cease to be grown. With this understanding, the three zones of climate, or more properly of temperature, since rain-

[1] Pittier's classification of the climatic zones, based upon the distribution of vegetation with relation to temperature, though applying primarily to Costa Rica, doubtless will hold good in Guatemala as well. It seems one of the most accurate of these classifications, though, as explained by Pittier himself, it is artificial, the transition from one zone to another being quite unnoticeable. It is given here for comparison with the classification based upon the presence of characteristic fruit trees which is followed in this bulletin: Lower zone, from sea level to 3,300 feet (approximately), mean temperature 82° to 70° F.; intermediate zone, from 3,300 to 8,500 feet, mean temperature 70° to 57° F.; upper zone, from 8,500 feet to the highest summits, mean temperature 59° to 41° F.—(From "Plantas Usuales de Costa Rica.")

fall does not yet enter into the discussion, may briefly be described as follows:

Tropical zone.—The tropical zone includes the seacoast, the coastal plains, and the valleys of the larger rivers for a considerable distance back from the coast. It includes practically the entire department of El Peten, in northern Guatemala, but this region is very sparsely inhabited and of little horticultural importance. The characteristic trees of this zone are those which are commonly found on tropical seacoasts and will not tolerate cool weather. The breadfruit tree (*Artocarpus incisa* L.) is one of the best known. The most tropical of the anonas, such as the custard-apple (*Annona reticulata* L.) and the soursop (*A. muricata* L.), are at home in this zone. The tamarind (*Tamarindus indica* L.), although it can be grown in the lower edge of the subtropical zone, reaches its greatest development only in this. The same is true of the mango. The star-apple (*Chrysophyllum cainito* L.) is found only in this zone. All the commercial banana plantations of Guatemala lie within this zone, but the banana is cultivated on a small scale in the subtropical zone up to altitudes of 5,500 or 6,000 feet. The pineapple is grown commercially only in this zone. The only race of avocados commonly cultivated is the West Indian. The mamey (*Mammea americana* L.) and the sapote (*Achradelpha mammosa* (L.) O. F. Cook) are two other characteristic fruits.

The upper limit of altitude of this zone may be placed between 2,500 and 3,000 feet. The breadfruit tree is not cultivated quite as high as 2,500 feet, but on the other hand the mamey and the sapote are sometimes found above the 3,000-foot line. The highest point at which the West Indian race of avocados has been found is 2,500 feet.

Subtropical zone.—It may be considered, in general, that the principal horticultural zone of the Republic is the subtropical, which begins at the upper limit of the tropical zone, at altitudes between 2,500 and 3,000 feet, where the climate is decidedly warm but without the intense heat of the coast. At 4,000 to 6,000 feet it is rarely hot enough to be uncomfortable, but on the other hand there never are severe frosts. Toward the upper limit of this zone, which can be placed at 7,000 to 7,500 feet, frosts are more common, but rarely severe. Only in the semitropical zone are killing frosts experienced.

It is in this zone that the orange is most extensively grown. It is also the most important zone of avocado culture in Guatemala, being the one in which the Guatemalan race is cultivated. This race ascends occasionally into the semitropical zone, but most of the important centers of avocado culture lie at altitudes between 3,000 and 6,500 feet. The loquat is commonly seen in gardens throughout this zone. The cherimoya (*Annona cherimola* Mill.), the jocote (*Spondias mombin* L.), and the white sapote or matasano (*Casimiroa edulis* La Llave) are other fruits which may be considered characteristic.

The climate of certain parts of this zone will receive more detailed consideration under the discussion of the Guatemalan race of avocados.

Semitropical zone.—In the semitropical zone the principal fruits are those which have been introduced from farther north and are well known in the Temperate Zone. The peach, the apple, the pear, and the quince are abundant, replacing the avocado, the loquat, the orange, and the other fruits of lower elevations. The upper limit of orange culture seems to be about 7,500 feet. Taking this as the boundary of the subtropical zone, it is found that several of the characteristic fruits of that zone extend into the lower edge of the semitropical. Ascending above 7,500 feet, the cherimoya is the first to disappear, 8,000 feet seeming to be its uppermost limit; the avocado follows next, growing as high as 8,500 feet; and, finally, the matasano, which reaches 9,000 feet at the town of San Francisco el Alto, but was not found at greater elevations.

The fig is also grown in this zone; and the indigenous cherry (*Prunus salicifolia* H. B. K.), which is very common in gardens, descends into the subtropical zone, but is most frequent at elevations of 7,000 to 9,000 feet.

The upper limit of this zone is the upper limit of cultivation. One of the highest towns in Guatemala is San Francisco el Alto, north of Quezaltenango, at an elevation of 9,000 feet, but above this there are occasional huts, around which a few fruit trees may be found, while the grain fields extend to 10,000 feet or higher.

Summing up the characteristics of the three zones, it may be said that the lower or tropical zone is a region of comparatively high temperatures throughout the year, never experiencing cold weather, and hence adapted to the cultivation of those fruits which horticulturists term strictly tropical in their requirements. The subtropical zone, owing to its greater altitude, is free from the extreme heat of the tropical zone, but is never subjected to severe freezing. The lower levels of this zone are fairly warm throughout the year, but toward the upper limit the winters are decidedly cool, strongly resembling those of southern California. The uppermost zone, here called the semitropical, is too cold for the orange and the lemon, yet does not experience the type of winter weather familiar to residents of the eastern United States. Its minimum temperatures probably more closely approach those of southern Texas and central Florida. The principal fruits grown in this zone are the apple, peach, and pear.

In regard to rainfall, the quantity varies greatly in different parts of Guatemala, but the season during which it occurs is more or less the same throughout a large part of the country. Figures for several regions are given in considering the Guatemalan race of avocados. In general, it may be said that the rainy season begins in May and continues until October, being at its maximum during August and September. In the Vera Paz district of northern Guatemala, however, it rains during most of the year, the only dry months being March and April. On the coast the precipitation is usually much heavier than in the highlands, and in certain regions, such as the valley of the Motagua River between El Rancho and Gualan, there is comparatively little rainfall at any time of the year. In the highlands the dry season is often severe, practically no rain falling from November until April or May. The roads become deep in dust, the herbage turns brown, and many of the woody perennials drop their foliage.

CLASSIFICATION OF AVOCADOS.

The classification of avocado varieties has been the object of much investigation in California and Florida during the last few years. As with many other cultivated fruits, it has been found that the horticultural varieties fall into several distinct groups. Three of these, termed generally the Guatemalan, West Indian, and Mexican, are now recognized by most investigators.

Material on which to base a classification has been somewhat inadequate in the United States. Hence it has been thought that when the great avocado regions of tropical America came to be explored groups or races not yet known in the United States might be discovered. A canvass of the avocado-producing regions of Guatemala, however, has failed to bring to light any new groups, the investigations tending only to confirm the classification already in use in the United States. Mexico, with its vastly greater area of territory, may perhaps yield groups as yet unknown to horticulturists, but no critical study of the avocados of that country has yet been undertaken.

Perhaps the horticultural groups have been derived from distinct species of Persea. If not, they have at least become differentiated through the accumulation of variations during a long period of cultivation under different environmental conditions. In order to determine their exact status it becomes highly desirable to locate the wild prototype of each, if such a wild prototype still exists. This has not yet been done by anyone having in mind the classification of the cultivated avocados. The task is made difficult by the fact that the southern Mexican and Central American region, where the wild prototypes are probably to be sought, has been the scene of intense agricultural activity for centuries. The primitive forest has been leveled to the ground to make way for maize fields; the maize fields have been abandoned, the inhabitants of the region have emigrated to other parts, and the forest has again taken possession. After a period new peoples have arrived upon the scene, and the process has been repeated. This is indicated by archæological remains in many parts of this region.

Under these conditions the wild species from which our cultivated avocados are derived may have disappeared, and, on the other hand, trees which are found in the forest at the present day and have every appearance of being indigenous may have been placed there by the hand of man.

Lacking exact knowledge of the wild prototypes of these cultivated races, a comparison of the most primitive forms which can be found at present will bring out more racial characters, or at least emphasize existing ones more strongly, than will a comparison of the highly developed varieties found in cultivation, for cultivation tends to conceal the racial characters by bringing the various races to a common level. Thus, the exceedingly thick and hard outer covering of the fruit which is typical of the Guatemalan race and conspicuously present in the primitive avocados of Alta Vera Paz becomes thinner in many of the cultivated varieties and closely approaches the skin of the West Indian race in character. The fruit increases vastly in size, assumes various shapes, and the seed becomes proportionately smaller. Since cultivation tends to work the same changes

in all of the races, it tends at the same time to conceal many of their distinguishing characteristics.

The term "race," which is here applied to the groups of varieties known in cultivation, seems more appropriate than the term "type," which is commonly used. The word "type" in this connection means nothing; the word "race," on the other hand, has a definite horticultural meaning which seems to be applicable here. A race is a group of seedlings which possess certain well-defined characteristics in common and will transmit these characteristics to their seedling progeny. This applies to the avocados under consideration, for each race has certain characteristics which never fail to be inherited by its seedlings.

The three cultivated races may be distinguished by the following characters:

Guatemalan race.—The foliage of the Guatemalan race is not anise scented; hence, is easily distinguished from the Mexican. It is usually deep green in color, a somewhat deeper green than that of the West Indian. The flowers are not so heavily pubescent as those of the Mexican. The fruit varies greatly in form and size, but always has a woody outer covering one-sixteenth to one-fourth of an inch thick. In some of the cultivated forms the skin or outer covering is scarcely thicker than in the West Indian race, but it is rarely so soft and pliable. The seed is comparatively smooth, and the two thin closely united seed coats adhere closely to it. The seed is very rarely loose in the cavity within the fruit.

West Indian race.—In the West Indian race the foliage is slightly lighter in color than in the Guatemalan, but, like the latter, devoid of the anise scent. The flowers are sometimes less pubescent than those of the Guatemalan, never more so, and always less pubescent than in the Mexican race. The fruits are variable in form and size, but the outer covering is soft and pliable and is rarely more than one-sixteenth of an inch thick. The seed is often rough, and the two seed coats frequently are thick and separated, at least over the distal end of the seed, one adhering to the cotyledons and the other being loose or adhering to the lining of the seed cavity.

Mexican race.—The foliage and sometimes the fruit of the Mexican race are distinctly anise scented, and both are usually smaller than in the Guatemalan and West Indian races. The flowers are more heavily pubescent than in either of the latter. Its fruits have a very thin, often membranous skin. The seed is commonly smooth; the seed coats are thin, either closely united and adhering to the cotyledons (occasionally three in number), as in the Guatemalan race, or separating, as in the West Indian.

AVOCADO CULTURE IN THE GUATEMALAN HIGHLANDS.

In reading the statements which follow it must be kept in mind that the Guatemalan race of avocados is being considered. None other is grown to any extent in the highlands, the Mexican race rarely occurring in Guatemala and the West Indian being confined to the lowlands. Separate paragraphs will be devoted to these two races farther on.

ORIGIN OF CHOICE VARIETIES OF THE PRESENT DAY.

The splendid avocados of to-day are doubtless the product of centuries of more or less unconscious selection on the part of the Guatemalan Indians, just as the choice fiberless mangos of East India have been produced through selection by the Hindus. In the case of the mango, however, the Hindu has been enabled to perpetuate an unusually choice variety by resorting to vegetative propagation. This appears never to have been practiced in Guatemala; hence, when a choice avocado tree grows old and dies the variety is lost.

Because of the moist climate of Alta Vera Paz, an avocado seed dropped by the roadside nearly always sprouts and develops into a tree. This has led to the avocado being found in a semiwild state throughout that region, often in the edge of the forest and at such distance from any present habitation as to suggest that the species is truly indigenous. The suspicion always arises, however, that a seed may have been dropped by some passing Indian or that a hut may have stood close to the spot at some past time. When going to work in their clearings the Indians commonly carry avocados with them as part of their noonday lunch. The seeds of these fruits, cast aside wherever the Indian chances to be at midday, give rise to many avocado trees in little-frequented places.

Though a careful search was made in the most promising sections of Alta Vera Paz for the wild avocado, no trees were found which it was felt could safely be considered indigenous. The primitive, half-wild forms so commonly seen, however, can without doubt be looked upon as the nearest approach to the wild species in so far as character of fruit is concerned, and a comparison of these forms with the choicest varieties in cultivation brings out some striking differences.

These half-wild avocados of Alta Vera Paz (Pl. III) are nearly always round, small in size, with a hard, thick outer covering and a very large seed, leaving little flesh. The smallest are no larger than walnuts. Most of them are little more than 2 inches in diameter. The shell—for it can be called such—is either green or purple and rough externally; in texture it is so hard and brittle that it breaks irregularly when an attempt is made to cut it. Occasionally it is as much as a quarter of an inch thick. The flesh is of good quality, but the quantity is very small. The seed is tight in the cavity, with the cotyledons smooth and the thin seed coats adhering closely. The fact that nearly all of these fruits are round would indicate that this can be considered the primitive shape, the pyriform and elongated avocados being found in cultivation.

When such fruits as these are contrasted with the splendid varieties of the Antiguan fincas, for example, the development which has

been brought about in the avocado appears quite equal to that which has taken place in the northern fruits. The latter have been in the hands of horticulturists who have called to their aid not only the art of grafting but much skill in cultivation. The improvement of the avocado, on the other hand, has scarcely been a conscious process and has been carried on by a people who are preeminently agriculturists and not horticulturists.

Cook and others have spoken of the intimate knowledge which the Indians of Central America possess concerning the plants among which they live and of their specialized methods in the cultivation of staple food crops. They have a name for nearly every tree in the forest, are familiar with the habits of many plants, and possess well-defined beliefs concerning the medicinal uses of a large number. Their agricultural practices, though based upon tradition, are in many respects admirable. They have highly specialized varieties of maize to meet the various conditions of climate which are found throughout the region which they occupy, and they are well acquainted with the particular merits of these varieties.

They seem, however, to have devoted all their energies to the cultivation of field crops, fruits having received very little attention. With regard to the avocado, for example, it does not appear that the Indians cultivate the soil around the base of the tree, apply fertilizers of any sort, prune the tree, or bestow any care upon it. Ideas regarding the age at which seedling trees come into bearing are nearly always vague and rarely based upon accurate observation of even a single instance. It is rather remarkable, in fact, that the Indians should have so few definite ideas regarding a fruit which plays such an important part in their daily life as the avocado, for they are an intelligent and in many ways a capable people.

It can not be doubted, however, that the avocado has been planted by the Indians in their dooryards since a remote time. The native name for the fruit, *oh*, *okh*, or *on* in the principal Maya dialects of Guatemala,[1] and many other circumstances, indicate that it has been known to the Guatemalan Indians since the earliest times. The evolutionary processes which can be observed at the present day have doubtless been going on for centuries, and could the Indians have taken advantage of vegetative propagation to perpetuate the best varieties obtained by selection, avocados even more

[1] The aboriginal names of the avocado in the dialects of southern Mexico and Guatemala, according to Dr. Karl Sapper (Das Nördliche Mittelamerika), are as follows: *Ju* (Huasteca, according to Stoll); *ou* (Chicomulcelteca); *on* (Maya of Yucatan, according to Stoll); *on* (Maya of Peten, according to Stoll); *um* (Chol); *un* (Chorti); *un* (Chontal, according to Stoll); *on* (Tzental); *un* (Tzotzil, according to Stoll); *on* (Tozolabal); *on* (Motozintleca); *oj* (Mam); *on* (Jacalteca); *oj* (Aguacateca, according to Stoll); *oj* (Quiché, according to Stoll); *oj* (Cakchiquel, according to Stoll); *oj* (Tzutihil); *oj* (Uspanteca); *o* (Quekchi); *oj* (Pokonchi, according to Stoll); *oj* (Pokomam of Jilotepeque); *oj* (Pokomam, according to Stoll).

remarkable than those of to-day would certainly have been the result. Seed propagation has prevented the perpetuation of choice varieties, and it is only by raising the general level of the whole species that improvement has been accomplished.

Among the several factors working in unison toward the horticultural development of the avocado, the first which must be mentioned is the change brought about by removing the tree from its native home in the forest and planting it in dooryards and gardens, where the struggle for existence is eliminated and more favorable conditions for growth are supplied. This in itself would undoubtedly tend to increase the size of the fruit.[1] Among many trees seen in a half-wild state in northern Guatemala, growing among thick scrub along the roadside or maintaining a foothold in the edge of the forest, not one produced fruits of large size. It is not reasonable to believe that all of these trees are from seeds of inferior fruits, since many of them come from avocados brought from the villages by the Indians. Unfavorable conditions of growth must have an important effect in limiting the development of the fruit.

Once removed from the forest and planted around the huts of the Indians, other factors come into play. The most important of these, as far as can be observed at present, are (1) the destruction of trees producing inferior fruit and the preservation of good ones, and (2) the carrying to market of nothing but the best fruits, thus disseminating seeds of good parentage and restricting the dissemination of poor ones. Both these factors perhaps can be considered unconscious selection on the part of the Indians. The second is not the result of a desire to improve the avocado by disseminating good seeds, but is due to the market demand for good fruits.

Both factors can often be seen in operation. In coffee plantations, when it is necessary to cut down avocado trees to make room for coffee or other crops, the trees known to produce inferior fruits are taken first and the best ones are often spared. The Indians when cutting out old trees around their houses will frequently save the avocado which bears the best fruits.

During the ripening season the fruit from the best trees is the first to be picked and taken to market, many of the poorer trees going unpicked, in which case the fruits fall to the ground and are eaten by the zopilotes (buzzards). The fruits purchased in the market are often carried many miles, since the Indians come into the small towns of Guatemala from great distances. When the fruits are eaten the seeds are cast aside. The climatic conditions are so favorable, at least during a part of the year, that a seed dropped upon the ground will sprout, take root, and develop into a tree. Once sprouted and estab-

[1] Increase in the size of the fruit due to increased supplies of food is believed at the present time not to be inherited.

lished, the Indian is loath to destroy it; hence, many new trees are started each year. It appears that comparatively few avocados are intentionally planted by the Indians, most of the trees being volunteers.

SOILS.

The principal avocado districts of the highlands differ considerably in their soil types. Clays, alluvial loams, and loose soils of volcanic origin are most common.

Alta Vera Paz is a limestone region in which most of the soils are clays or clay loams of reddish, tawny, or blackish color. When wet many of these soils have an almost greasy consistency. They are usually of considerable depth. In the Valley of San Cristobal, the most important avocado center in northern Guatemala, blackish clays predominate. In many spots there is a surface deposit of rich loam washed off the hillsides.

The clay soils of Vera Paz seem to produce a large and long-lived tree (Pl. IV). In no other part of Guatemala were larger avocados seen than in the vicinity of Coban and San Cristobal. If not well drained these soils would be objectionable, but Vera Paz is of such rough, rugged contour that it is rare to find an avocado standing on level ground.

Typical alluvial loam occurs at Panajachel, on the border of Lake Atitlan. This town lies at the mouth of a small valley, scarcely more than half a mile broad, with the mountains rising abruptly on both sides. When viewed from above, it can plainly be seen that the sediment carried down this valley is gradually building a delta in the lake. Most of the gardens which contain avocado trees are situated about half a mile up the valley from the present shore of the lake. The valley floor at this point is level, the soil varying from a fine black alluvium to gravelly loam, most of the cultivated area possessing rich black loam, easily worked and well adapted to the growing of truck crops and coffee, for which it is used. The avocado succeeds excellently here.

At Momostenango, north of the city of Quezaltenango, a curious mixture of red clay and volcanic tufa is encountered. Large masses of tufa, many feet in depth, are frequently exposed by erosion.

In the Antigua district the soil is more uniform in character than in many other sections of Guatemala. It is a loose, black, sandy loam of volcanic origin, mixed with alluvium and becoming a true loam on the valley floor, while on the slopes it is often so loose and coarse in texture as to suggest cinders. In most of the coffee plantations the soil seems to be of uniform character to a considerable depth. It is easily worked, fertile, and from several points of view an admirable avocado soil. Even at the end of the long dry season it is found to be moist a short distance below the surface, and it never becomes hard

or cracks open, as the heavy clays do. It does not seem to produce quite so large a tree as the clay soils of Alta Vera Paz.

Everything considered, it seems that the clay loams or light clays are best adapted to avocado culture. Other soils, however, give good results. In the United States the avocado will succeed under a wide range of soil conditions; witness the excellent growth made in Florida on very sandy soils and in California on heavy clays of the adobe type, heavier and more tenacious than any seen in Guatemala.

GROWTH AND HABIT OF THE AVOCADO TREE.

At elevations of 4,000 to 5,000 feet in Guatemala the growth of the avocado tree is not so rapid as it is in California and Florida. This is mainly due to the mildness of the climate; there is none of the hot summer weather which produces such rapid growth in the United States. Another cause is the prevailing lack of cultural attention. Naturally a tree which is manured regularly and irrigated when rainfall is lacking will make more rapid growth than one which is supplied with an abundance of water during part of the year, is forced to withstand a long drought during the remainder, and never receives manures or fertilizers in appreciable quantities. In Guatemala, it must be remembered, many avocados are not even planted in favorable situations, but spring up from seeds cast aside by the natives. Under these conditions the first few years are often a severe struggle with the surrounding vegetation.

Under the comparatively favorable conditions of coffee plantations, the most trustworthy accounts place the bearing age of seedlings at six to eight years. In a few instances it was possible to verify the age at which certain trees produced their first fruits; this was never found to be less than 5 years and sometimes as much as 10. Many large trees with no fruit may be seen in practically any district, but these are trees that have borne in previous years.

Many large trees in Guatemala still in profitable bearing are said to be 50 or 60 years old. A 50-year-old tree seems to yield just as good fruit as younger ones. Some avocado growers affirm that a tree does not produce its best fruit until it is 20 or 25 years old.

In habit of growth there are two types of trees, the slender, erect type and the broad, spreading type, though there is no lack of intermediate forms.

Most of the trees seen in Guatemala have straight trunks which do not branch within 6 feet of the ground, and the crowns are broad, dome shaped, and fairly dense. The erect, slender type of tree with an open crown is less common except in Alta Vera Paz. The average size of mature trees, those 15 to 25 years of age, as seen in coffee plantations and gardens, is 30 to 40 feet in height, with a spread of equal distance when the trees are of the broad, spreading type, or

with a spread of about 20 feet when they are of the slender type (Pl. V). Such trees as these have trunks 12 to 18 inches thick.

A tree 50 feet in height may be considered large, and one which is 60 feet has probably reached its maximum development under most conditions. The trunk of such a tree may be 4 feet thick, and the crown may be 50 or 60 feet in spread. Probably these dimensions are not attained until a tree is at least 50 years old.

There are differences in the character of the growth—its stiffness, brittleness, size, and so on—which do not appear of importance in old trees, but which will stand out more prominently when young budded trees are planted in the orchard and must be trained to a desirable form. In some trees the growths are long and slender, supple, and scarcely able to bear their own weight. Ultimately these growths tend to produce descending branches, keeping the crown close to the ground. Other trees make very short, weak growths, seeming to indicate a lack of vigor. In still others the wood is so brittle that the branchlets snap off when bent. The best trees make strong, healthy-looking growths, smooth and round (angular branchlets frequently indicate a weak grower), with the leaves placed about an inch apart and the axillary buds short, plump, and well developed.

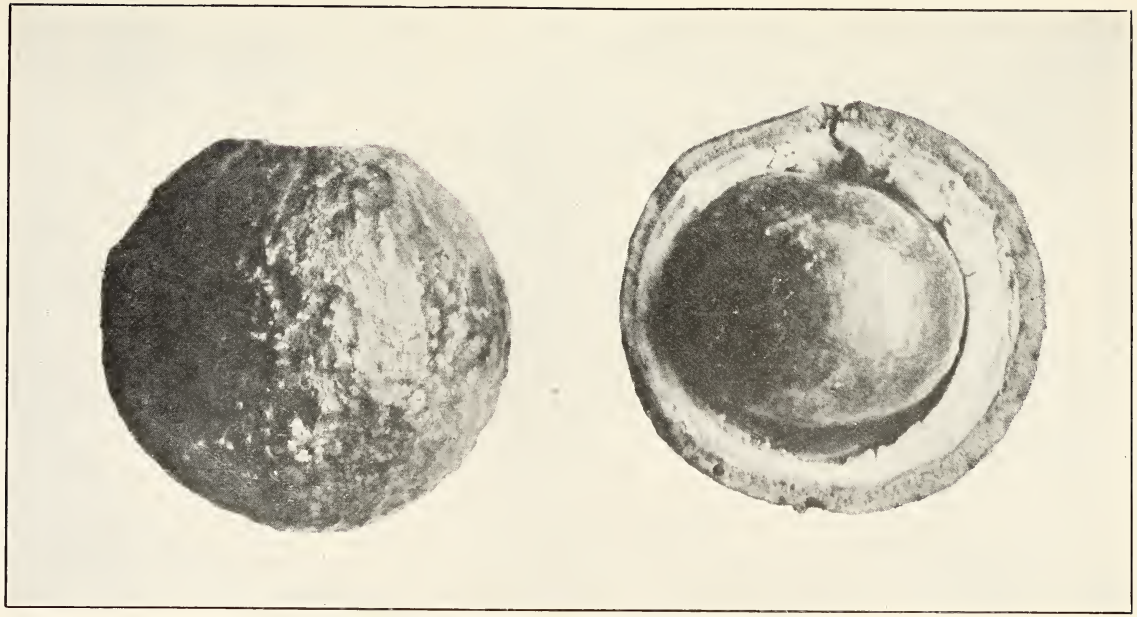
CULTURAL PRACTICES.

The amount of systematic attention given the trees by Guatemalan avocado growers is almost negligible. It is of interest, however, to consider the cultural conditions under which the trees occur and the apparent effect of these conditions upon growth as well as fruit production.

As already stated, comparatively few avocados in Guatemala are planted intentionally. It speaks well for the climate and soil that trees which develop under such conditions can reach large size and produce fruit. They do not receive the least attention from any one; the ground is never cleared of weeds or undergrowth, and the tree must in some instances carry on a constant struggle for existence.

In coffee plantations or in dooryards of the natives, however, conditions are more favorable. Especially is this true of coffee plantations, since the cultural attention given the coffee bushes necessarily affects the near-by avocado trees as well. Two or three times a year the ground is cleared of weeds with a heavy hoe. It is never cultivated deeply, and, in fact, the surface beneath avocado trees in many instances is not even scratched, since a heavy mulch of leaves collects and few weeds require to be removed.

The only pruning practiced is the removal, when the trees are young, of the lower branches, in order that the crown may be formed above the tops of the coffee bushes. This means that the trunk frequently does not give off any branches at less than 8 to 12 feet from



A PRIMITIVE FORM OF THE GUATEMALAN AVOCADO.

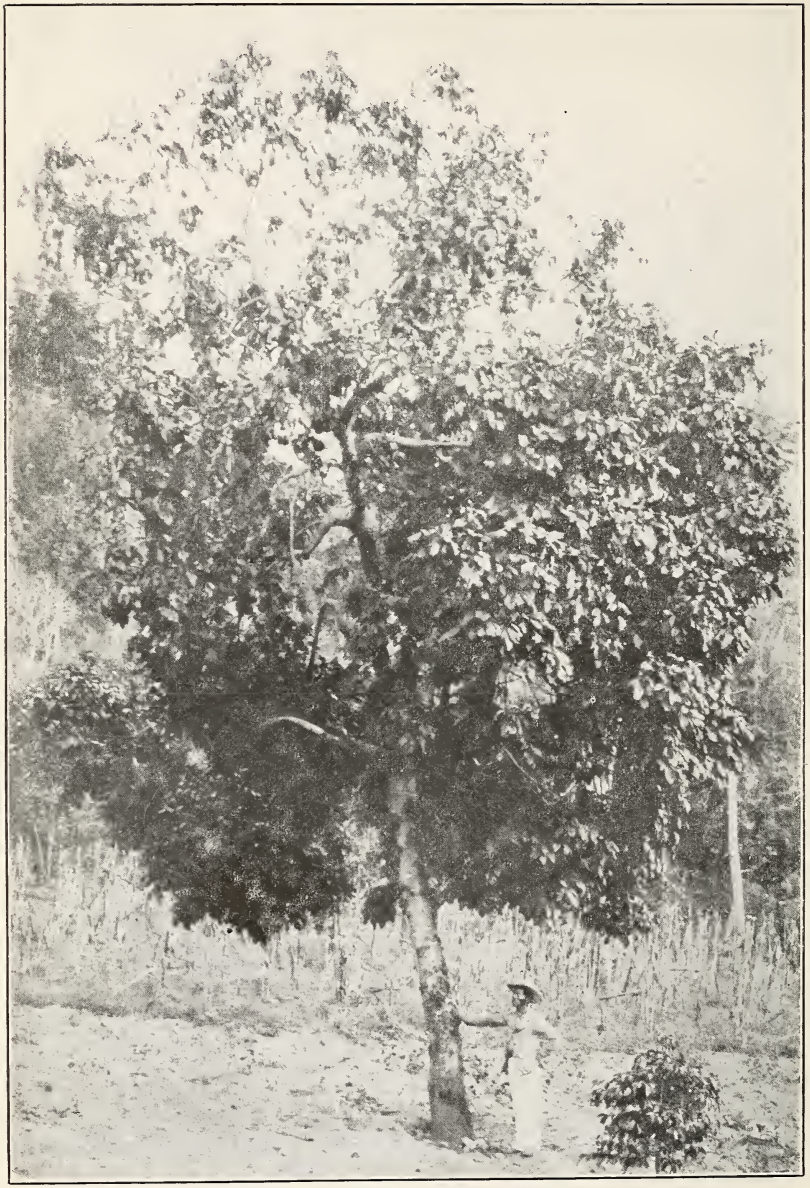
This fruit, which was produced by a half-wild tree on the edge of the forest near Senahu, Alta Vera Paz, is the most primitive in character of all those seen in Guatemala and probably may be considered as representing closely the prototype of the splendid varieties of the Guatemalan race which are found in dooryards and coffee plantations throughout the Guatemalan highlands. The outer covering is so thick and hard that it is difficult to break it without the use of some heavy instrument, and the seed is so large that there is little room for flesh. It is noteworthy, however, that there is no fiber running through the flesh, as is commonly the case in primitive avocados of the Mexican race. (Photographed, natural size, at Sepacuite, Alta Vera Paz, Guatemala, November 27, 1916; P16960FS.)

A LARGE AVOCADO TREE IN NORTHERN GUATEMALA.

The maximum size attained by the avocado in Guatemala is illustrated by this magnificent tree, which is growing near the town of Santa Cruz, Alta Vera Paz. The soil here is a heavy clay loam, the altitude about 4,500 feet, and the climate very moist. While its age is not known, the tree can not be much less than a hundred years old, and it is probably more. It is still bearing fruit, though it does not produce such heavy crops as younger and more vigorous trees. (Photographed at Santa Cruz, Alta Vera Paz, Guatemala, December 11, 1916; P16986FS.)

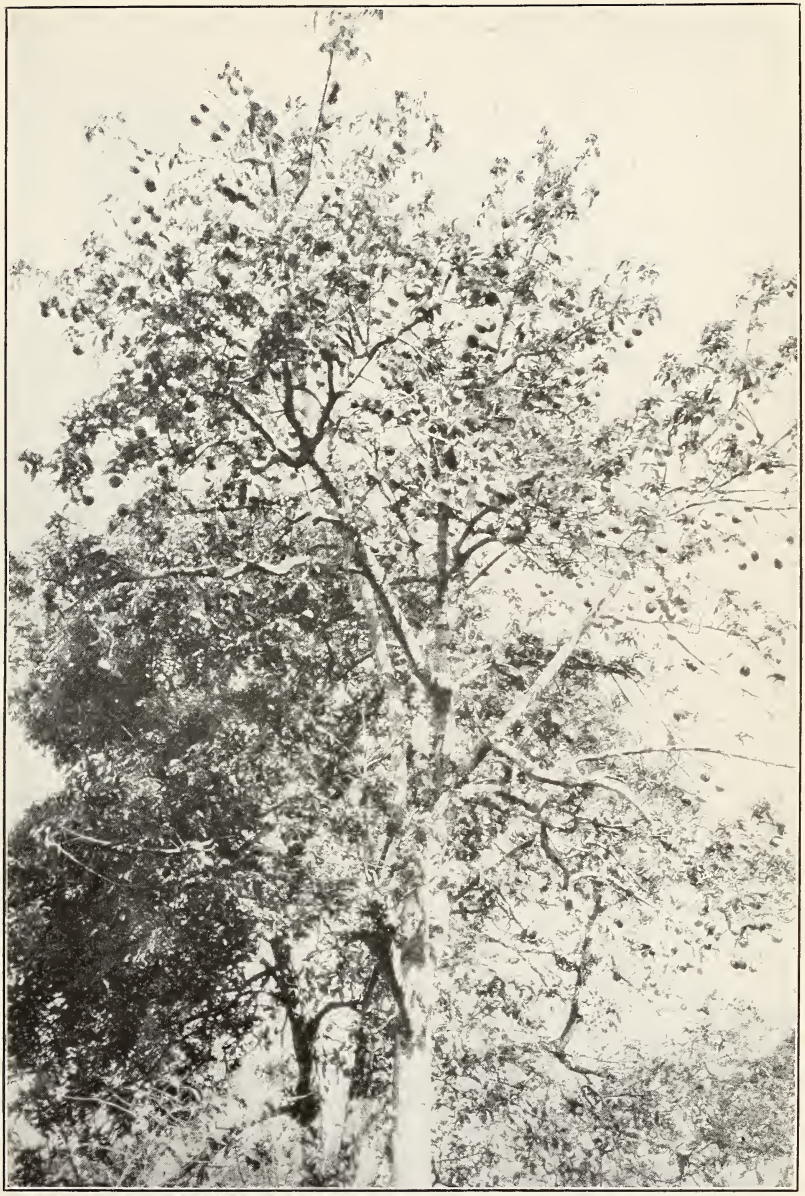
AN AVOCADO TREE DURING THE FLOWERING SEASON.

At the time of coming into flower the Guatemalan avocado commonly sheds most of its foliage, the new growth which appears bringing with it flowers as well as foliage to replace that which has been lost. The fruit is generally considered to be ripe when the tree comes into bloom, but it will remain on the tree for several months longer if allowed to do so, the flavor becoming richer with the passage of each month. The tall, slender tree here shown illustrates the common form which the avocado assumes in the moist climate of northern Guatemala. (Photographed at Purula, Baja Vera Paz, Guatemala, March 27, 1917; P17159FS.)



AN AVOCADO TREE OF GOOD FORM.

The common tendency in Guatemala is for avocado trees to become tall and slender. Trees such as the one here shown are of more desirable form, as they possess much more fruiting wood. It would be advisable, however, to head the tree much lower except for the fact that the Guatemalans desire to have the lowest limbs far enough above the ground to permit the soil to be worked close around the tree. Black beans have been planted under this tree, while maize, or Indian corn, can be seen in the background. (Photographed at Antigua, Guatemala, January 28, 1917; P17055FS.)



AVOCADO TREE AT ANTIGUA IN FULL BEARING.

This tree, which is growing in a coffee plantation, is not carrying an unusually heavy crop for a variety whose fruits do not weigh more than 1 pound. Rarely, however, will two such crops as this be produced consecutively, the Guatemalan avocados showing a strong tendency to irregularity in bearing. It will be noted that the fruit is all in the top of the tree. It is the custom in coffee plantations to prune off the lower branches of avocado trees to prevent their interfering with the growth of the coffee bushes. (Photographed at Antigua, Guatemala, February 22, 1917; P17100FS.)

AVOCADOS ON SALE IN ONE OF THE MARKETS OF THE CITY OF GUATEMALA.

Among the Guatemalans avocados are looked upon more as a food than as a salad fruit; hence, they are offered in the markets alongside bananas and coconuts, two other staple foodstuffs. The avocado is one of the cheapest foods obtainable, and there is scarcely a day in the entire year when an abundance of them is not offered for sale in this market. Avocados like those seen in the photograph are sold singly for the equivalent of half a cent, and a hundred of them can be purchased for 30 to 40 cents. (Photographed at the city of Guatemala, October 29, 1917; P17375FS.)

the ground (Pl. VI), and the lowest limbs in the crown are far out of reach. Where high winds are unknown, as in Guatemala, this method is not disadvantageous except that it reduces greatly the amount of fruiting wood and makes it somewhat difficult to pick the fruit. Even when not grown in coffee plantations the trees usually are encouraged to branch high, the crown being formed at least 6 or 8 feet above the ground.

During the dry season, which is long and severe in Antigua and several other regions, the trees are not irrigated. Yet they do not often show the effects of drought. Apparently the soil in Antigua is retentive of moisture, though toward the end of April orange trees in Antigua gardens often turn yellow and wilt from lack of water, while avocados in the same garden appear in perfect condition. This is not saying, of course, that avocado trees in the United States (or in Guatemala, for that matter) should not be abundantly irrigated during the dry season, for experience indicates that they should.

In Alta Vera Paz the climate is exceedingly moist, the rainfall exceeding 100 inches in some sections, distributed over 10 or 11 months of the year. The avocado seems perfectly at home in such a climate. Evidently it is able to stand extremes of moisture or drought without suffering.

As to the effect of unfavorable conditions upon fruit production, trees growing by the roadside or in waste places are often very productive, but their fruit is never as large as that from trees grown in the more favorable environment of the coffee plantations and the dooryards of the natives. Half-wild trees nearly always produce small fruits containing very large seeds. Often these fruits are so inferior that the natives do not even pick them.

REGULARITY OF BEARING.

Practically all Guatemalan avocado growers admit that the trees do not bear regularly; that is, a good crop is not produced every year. It is generally considered that a heavy crop will be followed by a light one or even by a crop failure, but no rule can be laid down which will apply to all trees. Individual trees differ in regularity of bearing. Some have been seen which bore a heavy crop one year and nothing the next; others which bore a heavy crop one year and an equally heavy one the next. While it may perhaps be stated as a general principle that a heavy crop will usually be followed by a lighter one, the question must be studied from the standpoint of each particular variety.

Irregularity in bearing is doubtless encouraged in Guatemala by the failure to practice thinning when an unusually heavy crop is produced and by inattention to cultural details. In the spring of 1917 there was a prolonged dry spell at the time when the young

avocados were the size of marbles, and many trees cast their fruit. It seems quite probable that irrigation at this time would have saved the crop. In another case a crop was lost through the attacks of some insect when the fruits were about one-third grown. In many instances trees are allowed to overbear one season, crop failures the following year being the natural result.

Doubtless much can be done in the United States to control this matter. The most important thing, however, is to plant a variety which bears fairly regularly. There is certainly a wide range of variation in this respect.

YIELD.

Very large trees of the smaller varieties, whose fruits weigh 6 to 8 ounces, produce as many as 3,000 fruits in a single crop. Larger varieties, whose fruits are 18 ounces in weight, may produce as many as 1,000 fruits provided the tree is of mature size. A few examples of good production may be cited to illustrate what can be expected of Guatemalan varieties. A young tree in Amatitlan, not over 20 feet high, produced in 1916 a crop of 125 fruits, each weighing 16 to 18 ounces. In 1917 this tree produced double the number. A young tree in Antigua, scarcely 20 feet high, very slender, and with little fruiting wood, produced 300 fruits weighing 8 to 12 ounces each. Another young tree in Antigua, about 25 feet high, produced 100 fruits weighing 20 ounces each. This also was a very slender tree with little fruiting wood. Another, 35 feet high, with a broad well-branched crown, produced 300 fruits, each weighing 14 to 16 ounces.

These trees are not branched close to the ground, as they would be grown in the United States, and hence have much less fruiting wood than trees of similar height in a California or Florida orchard. They are commonly branched about 10 feet from the ground. A count of numerous trees ranging from 30 to 40 feet in height, which is about the average size for trees 15 to 25 years old, showed that they were producing from 50 to 500 fruits each (Pl. VII). The average was about 200 or 250 and the average size from 12 to 14 ounces. This can be considered a very satisfactory yield, considering the small amount of fruiting wood which these trees possess.

Most of the Guatemalan avocados produce their fruits singly, but there are occasional trees which have clusters of two to five fruits. No very large varieties have been observed to fruit in clusters, but the small and medium-sized ones, whose fruits are from 6 to 15 ounces in weight, occasionally do so.

SEASON.

It has been remarked by travelers that avocados are present in the markets of the city of Guatemala every month in the year (Pl. VIII). This observation, accurate enough in itself, has led to the

assumption that the avocados of Guatemala must exhibit unusually wide variation in season. The fact that the capital city is supplied with avocados from several different regions has been overlooked, and this oversight has been responsible for a misconception; for these several regions lie at different altitudes, and in Guatemala elevation is the factor which determines the ripening season of avocados.

In any given avocado district of Guatemala it is not possible to market ripe avocados more than six or seven months of the year. There may be an occasional tree which lengthens this period (it may be mentioned in passing that these occasional trees which fruit out of season are the very ones which are of greatest interest to avocado growers in the United States), but such trees are so scarce that their influence is not felt in the market. By picking immature fruits, a common practice in Guatemala, the market is often supplied during two months more.

The variation in the ripening season, due to differences in elevation, may best be shown by the following list of important avocado districts, with their main seasons of ripening; that is, the periods during which fully ripe fruits are available in abundance:

Senahu, Alta Vera Paz	3,200 feet,	November to February.
Amatitlan	3,900 feet,	January to April.
San Cristobal, Alta Vera Paz	4,600 feet,	February to May.
Antigua	5,100 feet,	March to June.
Purula, Baja Vera Paz	5,100 feet,	March to June.
Panajachel, Solola	5,300 feet,	February to May.
Chimaltenango	6,000 feet,	April to July.
Momostenango, Totonicapam	7,400 feet,	May to August.

Ascending from 3,000 to 7,000 feet, the change from a warm to a comparatively cool climate produces a corresponding retardation in the ripening season. For every thousand feet of altitude ripening is retarded at least one month, except in those rare cases where unusual conditions come into play. Panajachel, for example, at an elevation of 5,300 feet, has an earlier season than Antigua, at 5,100 feet; this can be accounted for by the peculiar situation of Panajachel, in a sheltered valley opening toward the south on a large body of water, whose influence upon the climate must be considerable. This section is doubtless much warmer than most other towns in Guatemala which lie at similar elevations.

In general the ripening season at various altitudes may be considered approximately as follows:

3,000 feet	November to February.
4,000 feet	January to April.
5,000 feet	March to June.
6,000 feet	April to July.
7,000 feet	May to August.

To what elevations in Guatemala do the climates of southern California and southern Florida correspond? It appears that the climate at 6,000 to 7,000 feet in Guatemala corresponds very closely in so far as its effect upon the development and ripening of avocados is concerned to that of the citrus-growing regions of California. The maximum temperature may not be as high as in California, but the time required for avocados to develop and ripen appears to be about the same. Southern Florida, on the other hand, seems more nearly to approximate an elevation of 3,000 to 4,000 feet in Guatemala.

If an avocado which ripens at Senahu (3,200 feet) from November to February is planted in California, it would be an error to assume that it will ripen during the same months in that State. It would probably be at least three months later, making its season January to April. If planted in Florida, however, it would be expected to ripen only slightly later than at Senahu.

In any given section of the Guatemalan highlands nearly all avocados ripen at approximately the same season. Very early or very late varieties are exceedingly rare. Considering Antigua as an example, out of the hundreds in that region only a very few trees were found which commenced to ripen their fruits in October and November. Most of the trees do not begin to ripen any fruits until late in February, and the height of the season is during March, April, and May.

The length of time avocados will remain on the tree after they have reached maturity depends mainly upon two factors: (1) The variety and (2) the condition of the soil as regards moisture. Some trees carry their fruits much longer than others in the same location. In very moist regions, such as Senahu, however, no trees carry fruit after maturity for as many months as the trees of Antigua, a much drier section. At Senahu rainfall is abundant from November to February, and avocados fall quickly after reaching maturity. At Antigua it is quite dry from November to May, and after that it is not excessively moist until August. As a result many trees carry their fruits until late in July.

The earliest varieties, as a rule, are of inferior quality, not having the rich flavor possessed by some of the later sorts. Occasionally an early variety of satisfactory quality is encountered. The very best avocados in point of flavor are the midseason and late sorts when they have been allowed to hang on the tree three or four months after reaching maturity.

PICKING, RIPENING, AND MARKETING THE FRUIT.

When is an avocado ripe? Because of the fact that the fruit does not soften while it remains on the tree, or in the case of green-fruited varieties change its color appreciably upon maturing, it is often diffi-

cult to determine when it is ready to be picked. Among the Guatemalans there is a rule covering this point which, if experience proves it will hold good in the United States, may be useful to avocado growers. *The earliest moment at which avocados may be picked is when the tree has come into full bloom.* At this time they are usually mature enough to be of satisfactory flavor and do not wilt or shrivel on softening, but the flesh becomes of a deeper yellow color and much richer flavor if the fruit is allowed to remain on the tree two to four months longer.

In the case of purple varieties, there is another indication of maturity. When immature the fruits are green in color and only assume a purple shade on approaching maturity. At the first appearance of this purple color they are considered ready for picking, but are not at their best until the color has become deep and pronounced over the entire fruit.

In order to supply the markets of the city of Guatemala during October, November, and December, many fruits are picked in Antigua while still immature. On softening, these fruits wilt and often shrivel around the stem end, while the flavor is sweetish, lacking in richness, and at times almost unpalatable. Thousands of these immature fruits are picked every year. This practice is one which must be guarded against in the United States. Unless evidences of wilting are present, the purchaser, even though he be familiar with avocados, can not distinguish with certainty an immature fruit from a mature one solely by examining its exterior. The only exceptions are those varieties known to change color on ripening.

The methods of picking employed in Guatemala are primitive and can offer nothing but negative suggestions to North American orchardists. Frequently the fruits are knocked from the tree with a club thrown by a person standing on the ground, or they may be broken off with a long bamboo pole and allowed to fall to the ground. It is fortunate that the avocado can stand such severe treatment without serious injury.

When the fruit must be carried several miles to market it is usually shipped as soon after picking as possible, since it would be impossible for the Guatemalans, with only the most primitive means of transportation in many cases, to ship it without bruising if it had commenced to soften. The commonest means of transportation in regions remote from the railway are oxcarts, pack animals, and Indian cargadores—men who carry on their backs a load of about 150 pounds.

When picked for marketing in the immediate vicinity the fruits are ripened in the house and carried into the plaza on market day in a fully ripened condition.

It is almost universally believed in Guatemala that avocados must be picked when the moon is full. If not, it is believed that they do

not ripen evenly, one end remaining hard after the other is soft and ready for eating. Many growers will refuse to pick an avocado if the moon is not in the right phase.

Ripening is commonly effected by placing the fruits among straw, litter, pine needles, or leaves in large wooden boxes, which are kept in a warm place. Even when the fruits are from the same tree, however, they do not all ripen at the same time; hence, the box is gone over every day or two and the ripe ones picked out. The time required for ripening is 3 to 10 days, fully mature fruits commonly requiring 5 or 6 days. Much depends on how warm the fruits are kept.

If ripened in a moist place the fruits often develop rot, fungous spores probably getting a foothold through bruises or injuries to the skin, the result of careless picking. If ripened in the sun, the fruits commonly soften on one side while remaining hard on the other. If ripened in a very cool place, they take a long time to soften. In order to keep them warm they are sometimes placed upon the rafters in the Indian huts, directly over the fireplace. Here the smoke and heat reach them very effectively.

In the larger cities of Guatemala avocados are sold in the public markets by all the fruit dealers, and throughout the city in the small tiendas, or shops, which deal in foodstuffs. In the smaller villages the Indian women bring in small baskets of avocados (Pl. IX) on the regular market days, which are commonly Thursday and Sunday. In the cities, where avocados are sometimes brought from great distances, single fruits bring from 2 to 4 reals each, or the equivalent of five-eighths to 1¼ cents; in the villages the price is rarely more than 2 reals. When avocados are sold in Guatemala at more than 1 cent each they are considered very high in price.

THE FRUIT.

The character of the fruit is subject to nearly as much variation in the Guatemalan race as it is in the West Indian and Mexican. It is impossible, in fact, to find two seedlings whose fruits are identical in every respect. In order to present in detail the range of variation which has been found in Guatemala, it is well to consider each of the important fruit characters separately.

Form.—In the primitive or semiwild state, avocados of the Guatemalan race seem to be nearly round in form. Under cultivation, a variety of shapes are seen, ranging from oblate through spherical, broadly oval, obovoid, elliptical, pyriform, and slender pyriform to slender, almost oblong. Most of the small fruits are round, while among the large fruits oval and pyriform are the prevailing shapes. The largest ones found were pyriform.

SELLING AVOCADOS IN AN INDIAN VILLAGE.

Once or twice a week the Indians of the Guatemalan highlands take their produce to the nearest village, where a public market is held in the plaza, or central square. During a large part of the year avocados are conspicuous in these markets, the choicest varieties produced in the vicinity being brought together here. Seeds from these fruits are scattered widely, and many of them give rise to new trees. Having good parentage, these trees are apt to produce superior fruit. The process amounts to seed selection and probably has a marked effect in improving the general level of the avocado in many regions. (Photographed at San Cristobal, Alta Vera Paz, Guatemala, April 2, 1917; P17188FS.)

Considering the fruits of medium size, which constitute the vast bulk of those seen in the markets, round and pyriform are the two predominant shapes. In Alta Vera Paz there are a good many more round fruits than pyriform ones, while in Antigua oval and pyriform avocados are more common.

Size.—The smallest variety seen in Guatemala weighed 3 ounces, while the largest weighed 3 pounds. Between these extremes are many weighing 8 to 16 ounces, and a few from 16 to 24 ounces. Avocados weighing less than 6 ounces are not common in cultivation, but trees growing in abandoned clearings or by the roadside frequently produce fruits weighing no more than 4 or 5 ounces. Most of the fruits seen in the markets weigh from 10 to 14 ounces. Avocados weighing more than 24 ounces are very rare.

In some sections of the country large varieties are unknown. In the Senahu district of Alta Vera Paz, for example, no fruits were seen which weighed more than 10 ounces.

In Antigua, in Amatitlan, and in the vicinity of the city of Guatemala, on the other hand, large varieties are comparatively common.

To the average Guatemalan the value of an avocado depends mainly upon its size. The largest fruits are the most highly prized, even though they may have very large seeds. The quality of the flesh, however, justly receives much consideration. If a tree produces large fruits of good quality it usually gains a local reputation.

Surface.—The rough surface, which is often considered typical of the Guatemalan race, occurs almost invariably in small half-wild fruits, but in the large varieties found in the coffee fincas of Antigua and in other regions the surface is often quite smooth. It must not be assumed, therefore, that an avocado which does not have a rough surface is not a Guatemalan.

Roughness of surface is correlated with thickness of skin. The thickest skinned varieties, such as the small round avocados of Alta Vera Paz, are usually very rough and even warty externally. In medium-sized or large varieties the skin is often much thinner and at the same time smoother on the surface. No avocados were seen in which the skin was very thick and yet smooth on the surface, and, conversely, no thin-skinned forms were observed which had very rough surfaces. The surface of the thinner skinned varieties is sometimes pebbled or very slightly roughened, especially around the base of pear-shaped or elongated fruits.

In some smooth-surfaced varieties a decided tendency toward glossiness is notable in the ripe fruit. This adds greatly to its attractiveness, especially when the fruit is purple or maroon in color.

Color.—The two common colors of ripe avocados are dull or deep green and deep purple. When immature, all Guatemalan avocados are green in color. As they become mature they may either remain

green or turn purple, according to the variety. In all parts of Guatemala these two colors seem to be about equally common.

Besides the common green and purple, variations of these two colors are often seen. A light yellowish green is not rare, and a bright maroon-purple is sometimes encountered. Very rarely a variety is crimson-maroon, and very rarely also one is of such deep purple as to suggest black.

Seedlings grown in California from a tree producing green-colored fruits have in some instances produced green, in others purple fruits. It appears, therefore, that the color of a variety is not necessarily the same as that of its parent.

Skin.—While its thickness may vary from a sixteenth to a quarter of an inch, the skin of all Guatemalan avocados is coarsely granular in texture, becoming hard and brittle when it is removed from the fruit and dried. It is always sharply differentiated from the flesh. If the fruit is at the proper stage of ripeness, the skin can usually be peeled from it as from a banana; in some varieties the skin is so thick, however, that it is not sufficiently pliable to peel. In most cases the skin peels readily if the fruit is fully ripe but still firm, with the flesh the consistency of soft cheese.

Commonly the skin of Guatemalan avocados is about one-eighth of an inch thick. It is often thicker toward the apical end of the fruit than toward the base, but in some varieties the reverse is the case, and in others it is of about the same thickness throughout. The thickest skin seen was that of an avocado from Santa Cruz, Alta Vera Paz. This skin measured slightly more than a quarter of an inch in thickness. Many of the Vera Paz avocados have thick skins, and as these skins are very brittle and can not easily be cut with a knife the common practice is to open an avocado by breaking it in half. When an attempt is made to cut such fruits, the hard woody shell breaks indiscriminately, and a smooth cut can not be made.

The thickest skins are not found at the highest altitudes, as has sometimes been thought. Thickness of skin seems to be in no way correlated with elevation. At 7,500 feet there is the same range in thickness as at 4,000 or 5,000 feet. The thickest skin seen in Guatemala was at an elevation of 4,500 feet.

No sharp distinction can be drawn between the thickest skinned and the thinnest skinned varieties of the Guatemalan race. Each is the extreme of variation in this particular character, and there are all intermediate stages between the two. There are no other characters which differentiate the thick skinned and the thin skinned; hence, they must both be considered nothing more than variations of the same race. A classification attempting to consider them as distinct groups is purely artificial.

Flesh.—There is a great deal of difference in the color and texture of the flesh among Guatemalan avocados. Assuming that fully ripe specimens are being considered (immature ones are very common in the markets during a certain portion of the year), it will be found that in some the flesh is a pale cream color, in others a deep-cream color, while in a very few it is of a rich, bright yellow, almost identical with that of creamery butter. In a general way, the color of the flesh indicates the flavor, for pale cream-colored varieties are nearly always lacking in richness. They may have, however, a peculiar nuttiness which is very agreeable.

It was noted that a few varieties which possessed deep-yellow flesh and promised at first glance to be of rich flavor had a pronounced bitter taste which disqualified them for market use. These varieties could be distinguished, it was found, by a peculiar translucence of the flesh, a character which is not possessed by most avocados.

The very best varieties seen in Guatemala have flesh of deep cream-yellow or yellow color, quite opaque, firm, and when fully ripe cutting like soft cheese. The texture is dry, fine grained, and oily.

The remnants of the vascular system, which persist in many avocados in the form of fine, stringlike fibers running through the flesh from the stem of the fruit to the base of the seed, are rarely found in Guatemalan avocados. The position of these fibers can frequently be traced by slight discolorations in the flesh, but the presence of stringy fibers, which are often noticeable in the other races, especially in the Mexican, was not noted in Guatemala among fruits of the Guatemalan race. Many varieties were found in which there was not even the slightest discoloration of the flesh. Those in which there is a slight discoloration are just as good for eating, but they are not equal in appearance to those with perfectly clear flesh; hence, they are less valuable commercially.

The percentage of Guatemalan avocados which have deep-yellow flesh free from all discoloration is small. Many have cream-colored flesh, often somewhat watery in texture. This is correlated with poor flavor and quality. No variety with pale, watery flesh has been found to be of excellent quality.

Flavor and quality.—These two closely related characters must be considered the most important of all, since an avocado of poor quality is undesirable, no matter how attractive its appearance may be. Fortunately, the best of the Guatemalan avocados not only present an attractive exterior but are nowhere excelled in texture and flavor of flesh.

The subtle differences which distinguish the flavor of many varieties are impossible of description. Inferior varieties, of which there are many, lack richness and may even have a rank or bitter flavor which is disagreeable. They may be watery and sweetish, especially

if picked before they are fully mature. The best varieties, on the other hand, are characterized by a delicate richness which is highly pleasing to the palate. When combined with a smooth, fine-grained flesh of attractive appearance, the result is a variety of excellent quality. Many such varieties are found in Guatemala, yet they do not constitute more than a small percentage of the total number of trees. The proportion of good fruits varies in different localities; in some it is difficult to find a single one of really good quality; in others, such as Antigua and San Cristobal, as many as 10 per cent of the trees examined may be quite satisfactory in this respect.

Seed.—The size of the seed and its condition in the seed cavity are the two points which interest horticulturists. With regard to the latter, it may be said that, with a single exception, all the avocados of the Guatemalan race which were examined had seeds which fit snugly in their cavities, with both seed coats adhering closely to the cotyledons. The exception noted was a variety from Amatitlan in which the seed was loose in the cavity, as it often is in the West Indian race. Possibly this was not a true Guatemalan variety.

The size of the seed is commonly larger in proportion to the size of the fruit than is considered desirable by North American avocado growers. This defect, in fact, disqualifies more of the varieties than any other. Round or oblate varieties are especially likely to have large seeds, but in an occasional one the seed is medium sized or even small. Not every round avocado has a large seed, but until an examination has been made a large seed may be expected.

Pyriform and elongated fruits are not so likely as round fruits to have objectionably large seeds, yet in many instances they do have them. The proportion of such fruits with comparatively small seeds is not large.

The best means of judging the size of the seed is by comparing its weight with that of the entire fruit. If it is not over 10 per cent of the whole fruit, it may be considered that the seed is small; if it is 15 per cent, it is not objectionably large; but if it is 20 per cent or more, it is undesirably so.

The shape of the seed conforms to that of the fruit; oblate varieties have round or oblate seeds, round varieties the same; pyriform and oval varieties have ovoid or conical seeds. The great extremes in seed form which are found in the Mexican race are not seen in the Guatemalan, the range being from oblate to conical. The cotyledons are always smooth or nearly so, differing in this respect from those of the West Indian race, which are often rough and warty toward the apex.

CLIMATIC CONDITIONS IN THE PRINCIPAL AVOCADO REGIONS.

Climatic conditions are by no means uniform throughout that portion of the Guatemalan highlands in which avocados are grown.

Differences of elevation, the proximity of mountain ranges which interfere with the passage of moisture-bearing clouds, the presence of large bodies of water in the immediate vicinity, and many other factors are responsible for local variations in temperature and rainfall.

Antigua may be taken as one of the most interesting avocado regions of the Republic. As has already been stated, this town lies in a small valley, protected on the north, east, and west by towering volcanos and high hills, while to the south there is an opening through which warm breezes enter from the Pacific Ocean. This region is not a cold one, as is shown by the presence of coffee plantations, and even more definitely by magnificent royal palms (*Roystonea regia* (H. B. K.) Cook) reaching 40 feet or more in height. As everyone knows, the royal palm is not a species which withstands much frost.

Lacking meteorological observations, the temperature and rainfall of the city of Guatemala may be taken as offering a very close approximation to those of Antigua, since the two towns are at practically the same level and not more than 15 miles apart in a direct line. According to the observations of the Laboratorio Químico Central in the city of Guatemala, the mean (average) maximum and minimum temperatures during each month of the year 1902 were as shown in Table I.

TABLE I.—*Mean monthly temperatures at the city of Guatemala for the year 1902.*

Month.	Mean maximum.	Mean minimum.	Month.	Mean maximum.	Mean minimum.
	° *F.*	° *F.*		° *F.*	° *F.*
January	72.1	50.9	July	78.9	59.7
February	78.9	55.5	August	79.8	59.1
March	82	55.7	September	78	68.2
April	82.9	57.3	October	76.4	59.7
May	81.3	60	November	75.7	57.5
June	82	60	December	72.6	54.8

The mean temperature for the entire year (1902) was 65.3° F., as opposed to a mean temperature of 65.1° for the year 1901. The highest temperature recorded during the year was 90.3°, on April 4; the lowest temperature was 42°, on January 1.

Table I, it must be remembered, contains mean temperatures. The absolute maxima and minima during the 12 months of the year 1906 are shown in Table II.

The lowest temperature recorded at the city of Guatemala by the Laboratorio Químico Central during the past 15 years was 39° F.

TABLE II.—*Maximum and minimum monthly temperatures at the city of Guatemala for the year 1906.*

Month.	Maximum.	Minimum.	Month.	Maximum.	Minimum.
	° F.	° F.		° F.	° F.
January	83	47	July	85	58
February	88	49	August	83	57
March	90	48	September	86	59
April	89	50	October	82	53
May	92	52	November	78	50
June	92	58	December	82	41

As will easily be deduced from the above tables, the climate of this region is notable for the very limited range in temperature. The minima are not so low as in either California or Florida or the maxima nearly so high as in California.

The total amount of rain which fell annually in the city of Guatemala during nine years is shown in Table III.

TABLE III.—*Annual precipitation at the city of Guatemala for the 9-year period, 1894 to 1902, inclusive.*

Year.	Precipitation.	Year.	Precipitation.	Year.	Precipitation.
	Inches.		*Inches.*		*Inches.*
1894	41.13	1897	51.36	1900	60.59
1895	38.07	1898	56.07	1901	52.06
1896	45.64	1899	41.57	1902	52.32

From these figures it will be noted that the rainfall is considerably greater than in the avocado-growing districts of California, closely approaching the rainfall of southern Florida.

The distribution of the rainfall during the 12 months of the year is also of interest. Table IV shows the number of rainy days and the total precipitation during each month at the city of Guatemala.

TABLE IV.—*Monthly precipitation at the city of Guatemala for the years 1915 and 1916.*

Month.	1915		1916		Month.	1915		1916	
	Rainy days.	Precipitation.	Rainy days.	Precipitation.		Rainy days.	Precipitation.	Rainy days.	Precipitation.
		Inches.		*Inches.*			*Inches.*		*Inches.*
January	0	0	1	0.03	August	22	11.99	25	10.56
February	1	.01	3	.20	September	20	7.76	24	13.24
March	10	2.36	2	.02	October	15	4.02	13	5.01
April	1	.25	10	2.13	November	6	.97	6	.58
May	9	3.38	19	8.76	December	3	.11	0	0
June	22	12.83	20	8.14					
July	19	10.88	25	10.81	Total	128	54.56	148	59.48

Most of the precipitation in this region occurs during the months from May to October, inclusive. January is quite dry, there being nothing more than a light shower at most. February and March are about the same, but toward the end of March there are sometimes a few good showers. April is usually dry, and the heat becomes most intense in this month. In May the rainy season commences. Coincident with the first good rains comes a change in temperature, the hot weather being dispelled, not to return until the following year. The rainfall during June, July, August, and September is heavy. Toward the middle of October the rains cease almost suddenly.

The following notes on the climate of this region, taken from "La America Central Ante la Historia," by Antonio Batres Jáuregui, are of interest in connection with this study:

> The temperature of the capital of Guatemala is mild, with the well-marked characteristics of the intertropical regions. In 1797 there was a severe drought in all Central America, causing sickness and famine, and being followed in the south by a terrible plague of locusts. In 1802 the same disaster was repeated. In 1803 the rains commenced in March and ended in July, being followed by a terrible drought. In 1826 the extreme heat caused immense losses in Guatemala. In 1861 excessive rains resulted in very injurious floods. In 1864 extraordinarily strong north winds blew during January and February. In 1869 Quezaltenango suffered a disastrous flood. After three years of scanty rainfall a plague of locusts overtook the country, until the present year (1915), when it seems to be disappearing, due to the heavy rainfall we have had. The seasons have varied somewhat, the weather occasionally being hot in November and December and cold in February and March, contrary to the usual sequence. The minimum temperature is ordinarily 46° F., the maximum 82°, and the mean 64°. On the 24th of December, 1856, it went down to 39°, and as low as 37° on the 29th of January, 1863; but these are unusual cold spells, produced by northeast winds.

Turning now to a consideration of the conditions in other parts of the republic, Alta Vera Paz is one of the most interesting and important regions. Here the range of temperature is even less than at the city of Guatemala, and the rainfall is much greater. Observations of the temperature at San Cristobal, the most important center of avocado culture in Alta Vera Paz, are not available; lacking them, data from Coban may be taken as offering a close approximation, since Coban and San Cristobal are at approximately the same altitude and but a few miles distant from each other. The figures in Table V, covering a period of nine years (1892 to 1900), show the mean or average maximum and minimum during each month of the year.[1]

[1] The tables showing temperature and rainfall at Coban and rainfall at Senahu and San Cristobal are taken from "Die Alta Vera Paz," by Dr. Karl Sapper (Mittheilungen der Geographischen Gesellschaft in Hamburg, Bd. 17, 1902).

TABLE V.—*Monthly maximum and minimum temperatures of Alta Vera Paz, Guatemala, during the 9-year period from 1892 to 1900, inclusive.*

Month.	Mean maximum.	Mean minimum.	Month.	Mean maximum.	Mean minimum.	Month.	Mean maximum.	Mean minimum.
	°F.	°F.		°F.	°F.		°F.	°F.
January	73	52	May	79	58	September	77	60
February	75	52	June	77	60	October	75	59
March	77	53	July	76	59	November	72	56
April	78	55	August	77	59	December	75	53

The rainfall and the number of rainy days during each month at Coban, averaged for a period of 10 years, are shown in Table VI.

TABLE VI.—*Monthly precipitation at Coban, Guatemala, during the 10-year period from 1891 to 1900, inclusive.*

Month.	Rainy days.	Precipitation.	Month.	Rainy days.	Precipitation.	Month.	Rainy days.	Precipitation.
		Inches.			Inches.			Inches.
January	13.5	5.18	June	22.3	11.03	November	20.5	9.02
February	10.1	4.36	July	24.9	11.31	December	17.3	6.78
March	9.0	4.09	August	22.3	8.50			
April	9.5	3.39	September	23.1	9.82	Total	211.8	94.60
May	16.2	8.03	October	23.1	13.09			

The rainfall at San Cristobal is slightly less than at Coban. Few figures are available, but observations for the year 1900 (Table VII) may be compared with the figures given above for Coban.

TABLE VII.—*Monthly precipitation at San Cristobal, Guatemala, for the year 1900.*

Month.	Precipitation.	Month.	Precipitation.	Month.	Precipitation.
	Inches.		Inches.		Inches.
January	1.01	June	10.35	November	4.05
February	1.48	July	19.34	December	1.79
March	1.87	August	7.48		
April	3.68	September	12.71	Total	80.34
May	9.04	October	7.52		

San Cristobal lies in the western part of the Department of Alta Vera Paz. In the eastern part the rainfall is much heavier than at Coban or San Cristobal. Since the town of Senahu has been mentioned several times in this bulletin, it may be worth while to present figures (Table VIII) showing the rainfall in that region.

TABLE VIII.—*Monthly precipitation at Senahu, Guatemala, for a 2-year period, 1892 and 1893.*

Month.	Precipitation.	Month.	Precipitation.	Month.	Precipitation.
	Inches.		Inches.		Inches.
January	5.77	June	30.61	November	7.95
February	2.30	July	28.62	December	5.88
March	2.57	August	19.82		
April	4.17	September	17.82	Total	165.24
May	19.85	October	16.88		

It is in the Senahu region that the avocado grows almost spontaneously, springing up everywhere from seeds dropped by the Indians. The appearance of the trees, however, is not so healthy and vigorous as in San Cristobal, where the rainfall is approximately half as great.

The distribution of rainfall in Alta Vera Paz seems to be less regular than it is in the vicinity of the city of Guatemala, at least during the first four months of the year. The rainy season in this city is well defined and nearly the same every year; the inhabitants are accustomed to expect the first heavy rains about May 15 and the last ones about October 15. In Alta Vera Paz the "dry season," January to April, is sometimes characterized by a considerable amount of precipitation every month; in other instances there is almost no precipitation for one or more months.

The climate of San Cristobal, besides being drier than that of Senahu, is characterized by a greater range of temperature. It is considerably warmer during the first four months of the year (the dry season), and the minima are slightly lower because of the greater elevation of San Cristobal. In neither of these regions, however, are freezing temperatures ever experienced.

Purula (5,150 feet), in the Department of Baja Vera Paz, is considerably cooler than San Cristobal; much more so, in fact, than the comparatively slight difference in elevation would lead one to expect. It is considered by natives to lie within the "tierra fria," or cold zone, because it grows many peaches, quinces, and apples. It lies in a small mountain valley opening to the west. Judging from several visits to the spot during the coldest portion of the year, it experiences lower temperatures than Antigua, but the plants which are grown indicate that it can not ordinarily be subjected to greater cold than 35° to 40° F. Clouds sweep up the valley and hang over the town much of the time, making it a very moist spot, which receives much less sunshine than Antigua or the city of Guatemala. It never becomes very warm.

Returning across the Sierra de las Minas, which divides the moist Vera Paz from the comparatively dry plateau of central Guatemala, the town of Amatitlan (3,900 feet) comes up for consideration. This town lies only a few miles from Antigua, but is separated by the broad slopes of the Volcan de Agua. Its situation is such as to give it a warm climate, since it is in the upper end of a valley opening toward the Pacific Ocean and is in close proximity to Lake Amatitlan, a body of water 10 miles or more in length. The presence of the soursop (*Annona muricata*) and the mamey (*Mammea americana*) in Amatitlan shows that it must have a warmer climate than is usual in Guatemala at this elevation. Its rainfall closely approximates that of the city of Guatemala.

Panajachel, westward from the city of Guatamala some 60 miles, has already been mentioned as enjoying a particularly favorable situation. Its climate seems to be slightly warmer than that of Antigua, though its elevation is practically the same. Its rainfall is in general that of Antigua and the city of Guatemala.

Momostenango (7,400 feet), the highest point at which avocados are extensively grown in Guatemala, has a cooler climate than any of the other regions which have been considered, but it is not so cold as most towns in Guatemala which lie at this elevation, owing to its protected situation. Little is known regarding its temperatures, since it is a remote spot. A mango tree of good size was seen at this place; it is safe, therefore, to assume that it does not get very cold.

Going to the other extreme, Mazatenango (1,150 feet), on the west coast of Guatemala, and Chama (1,000 feet), in Alta Vera Paz, are the lowest situations at which Guatemalan avocados were seen in bearing. Both have hot climates, typical of tropical lowlands, with no cold weather and a heavy rainfall. It is generally believed that avocados of the Guatemalan race do not succeed at low elevations. The trees seem to grow well, but they are said to fruit very sparingly. Judging from the very few instances in which trees of this race were found at elevations lower than 2,500 feet, it seems that there must be some basis for this belief.

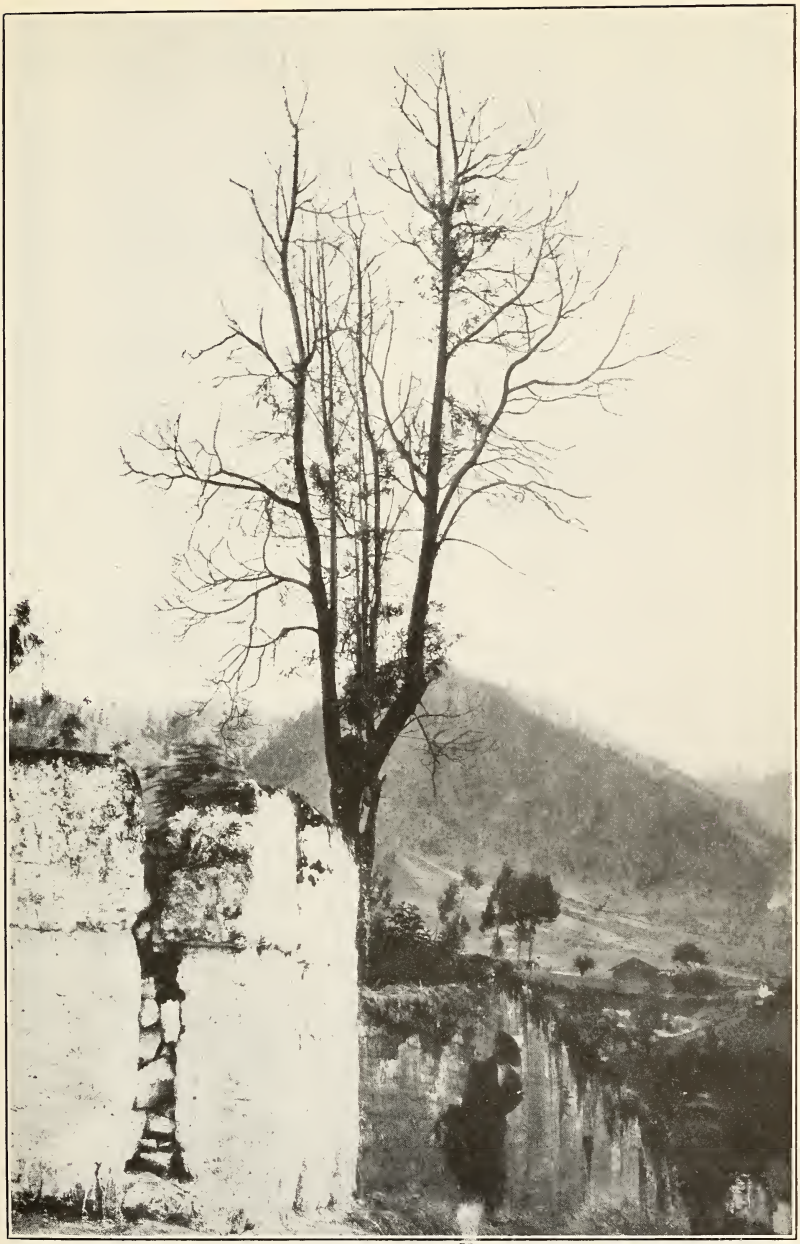
HARDINESS OF THE GUATEMALAN AVOCADO.

Severe frosts are not experienced in Guatemala at altitudes lower than 7,000 feet. In searching for avocados of the Guatemalan race likely to prove unusually hardy in the United States it is necessary, therefore, to ascend to 8,000 or 8,500 feet, at which altitude the winters are sufficiently cold to injure varieties not particularly frost resistant, thus bringing to light the hardiest.

At 5,000 feet in Guatemala avocados are subjected to a mild, and at times cool, climate, but never enough frost to test their hardiness severely. At 7,500 feet, the upper limit of orange culture, severe frosts are probably occasional, but no meteorological data are available to show the minimum temperatures experienced. It seems very doubtful whether the temperature goes as low at this elevation as it does occasionally in the orange-growing districts of California and Florida.

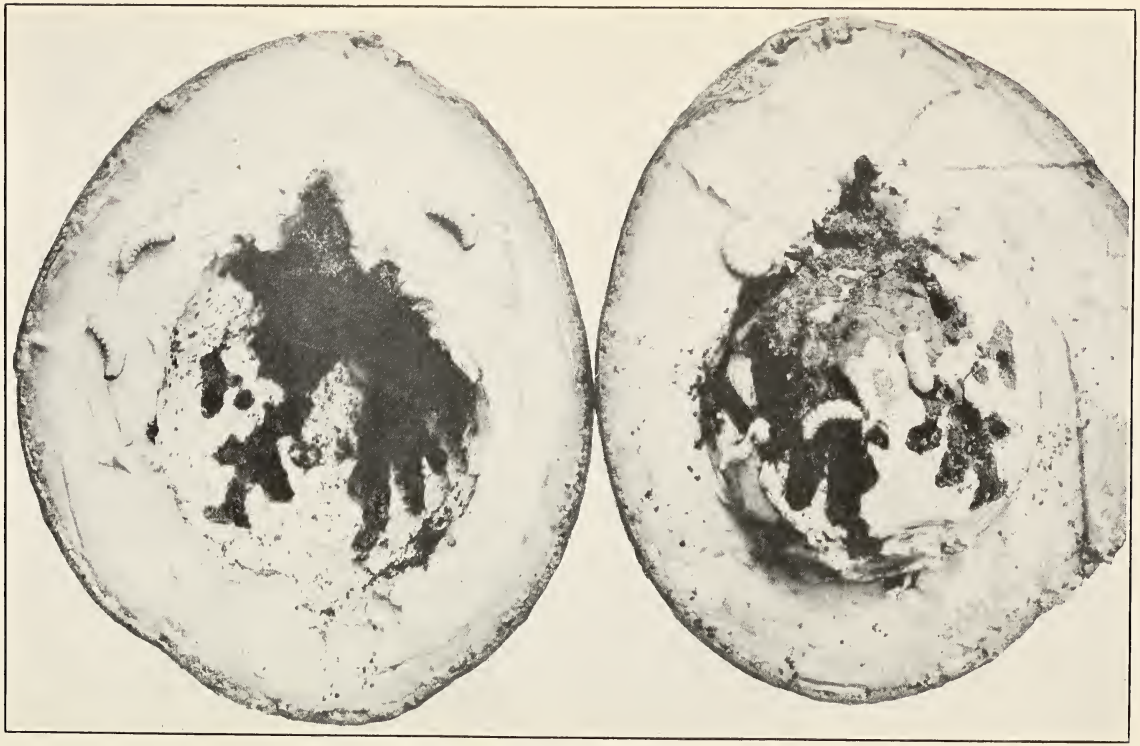
Above 8,000 feet it is cold enough to freeze large trees of the Guatemalan race, and trees at this elevation which show no frost injury after a hard winter must either be more resistant than the average or must be grown in a protected situation. (Pl. X.)

There are no records of minimum temperatures at elevations of 8,000 or 8,500 feet in Guatemala, to show how much cold avocados



THE UPPER LIMIT OF AVOCADO CULTIVATION IN GUATEMALA.

The city of Totonicapan, at an altitude of 8,500 feet, in western Guatemala, is the highest point at which the avocado is cultivated in this Republic. Its existence here is precarious, as is shown by the condition of this tree. Heavy frosts occur from time to time, and unless an avocado tree is unusually hardy it may be injured severely. The only other subtropical fruit grown in Totonicapan is the matasano, or white sapote (*Casimiroa edulis*). Apples, peaches, and pears are characteristic of the region, but citrus fruits are not grown above altitudes of 7,500 feet. (Photographed at Totonicapan, Guatemala, May 25, 1917; P17327FS.)



A SERIOUS AVOCADO PEST.

In some parts of the Guatemalan highlands many avocados are attacked by the insect shown above, a larva of the genus Conotrachelus. The larvæ, several of which are seen here, tunnel in the seed, sometimes reducing it to powder. Later, they burrow out through the flesh and drop to the ground, where they pupate and emerge as small grayish brown weevils. It is of the utmost importance that pests such as this be prevented from becoming established in the avocado orchards of California and Florida. (Photographed, natural size, at Panajachel, Department of Solola, Guatemala, January 10, 1917; P17034FS.)

have withstood without serious injury. In general, nothing was found to indicate that certain strains of the Guatemalan race are particularly hardy or that certain individual trees appear to be characterized by greatly superior frost resistance. One tree was found in Totonicapam (8,500 feet) which gave evidence of being somewhat hardier than the average, and bud wood was obtained for introduction into the United States.

It is true that the avocado is cultivated in Guatemala a full thousand feet above the zone in which citrus fruits, even the orange, are grown. It must not be assumed, however, that this indicates greater hardiness in the avocado than in the orange. Experience in the United States does not lead to any such conclusion, and though the varieties found at high elevations in Guatemala may be slightly hardier than those at present grown in the United States, it may also be true that the Guatemalans have not pushed orange culture to its uppermost limit. It is the custom in California and Florida to grow tropical fruits right up to the frost line, so to speak; they are planted where protection is necessary in winter and where severe losses are experienced occasionally from an unusual degree of cold. In Guatemala conditions are different. If the orange when left to care for itself did not succeed at 7,000 feet, it would die off, and its culture would be restricted to lower levels. With attention and slight protection it might succeed far above 7,000 feet, but since this attention and this protection are lacking in Guatemala, it would not be found far above 7,000 feet by the traveler who chanced to pass through the country.

The question of hardiness in the avocado seems to depend to a much greater degree upon race than upon variety. No variety of the West Indian race has yet been found which is nearly as hardy as many of the Guatemalan, and no variety of the Guatemalan has been discovered which will stand as much cold as the Chappelow or other varieties of the Mexican race. For this reason the proper classification of varieties is essential. Within the race there doubtless is a certain variation in hardiness, but experience indicates that the amount of variation is not so great, expressed in degrees of temperature, as the difference in the average hardiness of the three races now known to horticulture.

ENEMIES OF THE AVOCADO.

Everything considered, the avocados of Guatemala are less subject to the attacks of insect and fungous parasites than would be expected. Citrus trees in all parts of the highlands are commonly infested with scale insects (notably the purple scale, *Lepidosaphes beckii*) to a severe degree. Avocados in the same region are comparatively free from serious parasites. This is not saying that the avocado does not

have insect enemies; it is merely stating that the tree seems to be less seriously affected by parasitic insects than citrus trees under the same environmental conditions.

One insect stands out above all others observed in Guatemala, both for the damage which it occasions and the apparent difficulty of controlling it. This is a small brownish gray weevil (*Conotrachelus* n. sp.[1]), whose larvæ are found sometimes in mature avocados purchased in the markets.

No external evidence of its presence is noticeable (at least to the unskilled observer), but on cutting the fruit in half the seed is found to be more or less riddled with large, round tunnels (Pl. XI), and 1 to 10 or more fat, wriggling larvæ, varying from white to pinkish in color, greet the eye. While the larvæ are rarely seen working in the flesh itself, they often burrow along the outside of the seed in contact with the flesh, discoloring the latter with their brownish powdery castings. In some avocados examined the seed had been so thoroughly honeycombed that it was reduced almost to powder.

Needless to state, a fruit attacked by this insect is rendered practically unfit for use. Even though the flesh itself may not have been damaged, the sight of the white larvæ and their tunnels in the seed is sufficient to nauseate any housewife. The widely known Mediterranean fruit fly (*Ceratitis capitata*) produces no more disgusting results than this insect.

The distribution of this weevil in Guatemala seems to be wide. It was found from El Rancho on the eastern slope to Mazatenango on the western, and from Antigua in central Guatemala to the Vera Paz district in the north. The lowest elevation at which it was found was about 1,000 feet, the highest 5,300. It was seen most abundantly at Panajachel, where most of the fruits offered in the market in early January, 1917, were found to be infested. Little is known of its life history. The larva is about one-half inch long, with a brown head and 12 white segments composing its body. After tunneling in the fruit it works out through the skin and drops to the ground, where it pupates, the mature weevil emerging some days later. Nothing has been learned with regard to the habits of the adult.

Next to this insect, which easily outranks all others in destructiveness, as far as was observed during the course of a year's work in Guatemala, among the most troublesome pests are gall-making psyllids,[2] which are abundant in the Antigua region and fairly common in several others. Probably more than one species are represented. These insects produce elongated conical galls which stand erect on the upper surfaces of the leaves. They are sometimes so thickly placed

[1] This species is described by H. S. Barber (Proc. Ent. Soc. Wash.; in press).
[2] Probably *Trioza koebelei* Kirkaldy.

as scarcely to leave space for even one more. Unquestionably they must have an injurious effect upon the tree.

The avocado weevil (*Heilipus lauri* Boh.), whose presence in Mexico has been the chief motive for the quarantine order prohibiting the importation of avocado seed from that country into the United States, was not observed in Guatemala, nor were any specimens found among more than 25,000 seeds shipped from Guatemala to Washington in 1916 and 1917. Another weevil, however, was found in these shipments. This species, the broad-nosed grain weevil (*Caulophilus latinasus* Say), is already known in the United States. According to Chittenden (Bull. 96, pt. 2, Bureau of Entomology), it appears to be permanently established in this country as an enemy of dried cereals and other food materials. In Guatemala it was observed to be exceedingly abundant in avocado seeds which had remained for some days upon the ground beneath the trees, and it was also common among seeds obtained from the markets, where they had been stored for two or three weeks. It bores in the seeds, leaving small tunnels.

Larvæ of a small brownish gray moth (*Stenoma* sp.) were found in a few avocados purchased in the markets of the city of Guatemala. They burrow in the seed and are similar in size and general appearance to the weevil larvæ (*Conotrachelus* sp.), but the damage which they occasion is by no means so great. The presence of these larvæ can be detected by a small round hole on the surface of the seed. No instances of severe infestation were observed.

Numerous scale insects attack the avocado in Guatemala, though severe infestations are very rare. At Almolonga, near Quezaltenango, a tree was found rather badly infested with *Pulvinaria floccifera* West. Other scale insects which are found on the avocado in various parts of the country are the following: *Aspidiotus lataniae*, *A. subsimilis*, *Chrysomphalus dictyospermi*, *C. perseae*, *C. personatus* (masked scale), *C. scutiformis*, *Diaspis boisduvalii*, *Pseudoparlatoria ostreata*, and *Lepidosaphes miniosarum*. These were all determined by the officers of the Federal Horticultural Board from material sent to Washington.

While none of the scale insects mentioned are very destructive in Guatemala, their introduction into the avocado groves of California and Florida must be strictly guarded against. Under the different environmental conditions which exist in those States, they might quickly become much more serious than they are to-day in Guatemala.

Of parasitic fungi, three species were found on material sent to Washington from Guatemala. One of these, *Colletotrichum gloeosporioides*, is already well known in California and Florida, espe-

cially in the latter State, where it is particularly injurious to the mango. The two other species are *Diplodia perseana* and an undetermined species of Fusarium.

THE WEST INDIAN RACE OF AVOCADOS IN GUATEMALA.

It is safe to state that 95 per cent of all the avocados in Guatemala belong to the Guatemalan race. From this it will readily be seen that the West Indian race is of little importance there. Its cultivation is limited to the lowlands, the highest point at which trees were seen being near Sanarate, Department of Guatemala, at an elevation of about 2,500 feet. On the Pacific slope, a few trees were seen at Mazatenango, Coatepeque, and Ayutla. Doubtless they are to be found scattered here and there all along the coastal plain which stretches from Mexico to Salvador. On the Atlantic slope, occasional trees were seen in the Motagua Valley from El Rancho down to the sea; in the Polochic Valley they were seen at Panzos. The best varieties encountered were at Chiquimula; while of good quality, they were not equal to those grown in Florida and Cuba. Guatemala does not appear to possess any varieties of this race worthy of introduction into other countries.

In the Motagua Valley, trees of this race flower in February and mature their fruits from the latter part of June until the end of August. Both the flowering and the fruiting seasons correspond very closely, therefore, to those of the West Indian race in Florida.

The quantity of fruit produced is by no means sufficient to supply the markets of lowland towns; hence, fruits of the Guatemalan race, brought from the highlands, are frequently seen in these towns. It is noteworthy, however, that the avocado is not consumed so extensively in the lowlands as it is in the highlands; as previously stated, it is a staple article of diet in the latter regions, while in the lowlands its consumption is limited.

It is strange that the West Indian race is never seen in such towns as Amatitlan and Antigua. Experience in Florida indicates that the trees will withstand more cold than is experienced in either of these regions, and both of them are only a few miles from the tierra caliente where the West Indian race is grown. It must be assumed that during the long period in which both races have been grown in Guatemala each has become restricted to the zone in which it is most successful. The West Indian race might succeed in Antigua, but by nature it is much better adapted to the lowlands. The Guatemalan race, as has been noted, is occasionally seen at low elevations, and in some instances may be reasonably successful there; but only in the cooler climate of the highlands does it appear to be really at home.

THE MEXICAN RACE OF AVOCADOS IN GUATEMALA.

Only two trees of the Mexican race were seen in Guatemala, one growing by the roadside near Santa Maria de Jesus (6,900 feet) in the Department of Zacatepequez, and the other at Chimaltenango (6,000 feet). In the latter place the Cakchiquel Indians have a name for this race, matuloh, distinguishing it from the Guatemalan race, which is called simply oh. Conversation with the Indians brought out the information that a few trees of this race were known in the vicinity of Tecpam (7,500 feet) and Chimaltenango, and also on the slopes of the Volcan de Agua, but at best the race must be considered exceedingly rare in Guatemala.

The fruits of the two trees examined were primitive in character, broadly obovoid in form, and scarcely 2 inches long. The pronounced anise scent possessed by the foliage, the heavy pubescence on the flowers, and the membranous skin of the fruit left no doubt that they were of the true Mexican race. It is much easier to distinguish this race from the other two than it is to distinguish between the other two, Guatemalan and West Indian, themselves.

Among the Indians who know this race its fruits seem to be held in very little esteem. This is not strange, in view of the fact that the varieties found in Guatemala are the most primitive imaginable. In the fruits examined the seed was so large that there was scarcely enough flesh to pay for the trouble of eating it.

Choice varieties of this race, such as some of those which have reached the United States from central and northern Mexico, would be of great value for cultivation in Guatemala at high elevations, where the Guatemalan race is injured by the cold.

THE COYO.

It is strange that a fruit so well known in northern Guatemala as the coyo should have escaped the attention of horticulturists in other countries, but aside from a brief reference to the species by Collins in his bulletin on the avocado[1] nothing seems to have been written regarding it.

While the fruit so closely resembles that of the avocado as to deceive one at first glance, the tree is distinct in foliage and flower. The coyo and the avocado are two distinct species of Persea.[2]

The coyo is found in Guatemala both wild and cultivated. Like the avocado, it varies greatly in the form and character of its fruit. Most coyos are very inferior in quality, having large seeds and many coarse fibers running through the flesh, but an occasional one is found

[1] Collins, G. N. The avocado, a salad fruit from the Tropics. U. S. Dept. Agr., Bur. Plant Indus. Bul. 77, p. 23. 1905.

[2] Nees's description of *Persea schiedeana* appears to cover the coyo, but his herbarium specimens are not available (they are supposed to be in Austria), and the fact can not now be definitely determined.

which has a small seed and flesh quite free from fiber. A coyo of this character is a worthy rival of the best avocados. The flavor is distinct and agreeable. Indeed, it is considered by many people in Alta Vera Paz to be superior to that of the avocado.

DISTRIBUTION AND COMMON NAMES.

While adapted to a greater range of elevation than the Guatemalan race of avocados, the coyo is not so widely distributed in Guatemala as the latter. It is grown most extensively in the Department of Alta Vera Paz. It is frequently met with in the mountains of this part of Guatemala, where it grows among other trees in the forest and has every appearance of being indigenous. It is also common in most of the villages and towns, where it is planted in gardens and dooryards. In San Cristobal it is particularly abundant, there being about as many coyo trees as avocados in the dooryards of the inhabitants.

Directly south of Alta Vera Paz, across the Sierra de las Minas, the coyo is found in the Motagua Valley from El Rancho down to Gualan. At Zacapa and Chiquimula it is well known. With the exception of a single tree at Amatitlan, however, it was not seen on the Pacific slope of Guatemala.

The lowest elevation at which the coyo was found is about 500 feet, the highest 5,500. It seems to be quite successful at both these elevations.

North of the Sierra de las Minas, in Alta Vera Paz, the species is known as coyo, coyocte, or kiyau. South of the Sierra de las Minas it is called shucte, chucte, or chaucte. It has been stated that the coyo and the coyocte are different fruits; a careful investigation in Alta Vera Paz, however, indicates that they are not specifically distinct. Many Indians who were questioned on the subject were unable to define the difference between the two, and trees which were pointed out as coyo and coyocte proved to be of one and the same species. As far as could be determined the difference in nomenclature is as follows: Trees which are planted in dooryards or gardens are always called coyo, while those growing wild in the mountains are sometimes called coyocte. The coyocte, or wild, trees usually produce very poor fruit.

THE COYO TREE.

It is not difficult to distinguish the coyo tree from the avocado. In both habit and character of growth it is quite distinct. While the tree is about the same size as that of the avocado (Pl. XII), the branches have a tendency to extend horizontally from the trunk, and the young branchlets are stouter and stiffer than in the avocado, with the leaves clustered toward the ends of the growths. The tips of the branchlets as well as the lower surfaces of the leaves are covered with a heavy brown pubescence, not seen in the avocado. The leaves differ

somewhat in form from those of the avocado, being as a rule broader and less pointed at the apex.

The coyo flowers during the same season as the avocado, which in Alta Vera Paz is from February to April. As pointed out by Collins, however, it matures its fruit in less time than the Guatemalan avocado; hence, coyos are all gone before avocados appear in the market. The flowers of the coyo are borne on shorter and stouter racemes than those of the avocado and are easily distinguished from the latter by the blotch of deep orange or red at the base of each segment of the perianth; the perianth segments have the appearance of petals, but as the corolla is absent in this species they can not properly be called by this name. All parts of the inflorescence are covered with a heavy pubescence.

When grown from seed, the coyo seems to come into bearing somewhat later than the avocado. While it was impossible to obtain accurate information on this subject, it is the general opinion among Guatemalans that the trees commence to bear when 8 to 10 years old. As with the avocado, all coyo trees in Guatemala are seedlings; consequently nothing is known concerning the behavior of budded or grafted trees.

Unquestionably the trees live to great age. Old specimens, however, do not seem to bear so well as younger ones, i. e., those between 15 and 30 years of age.

THE COYO CROP.

It is noticeable that the coyo, as a general thing, does not produce such heavy crops as the avocado. For this reason coyos, even in a region like that of San Cristobal, where the trees are as plentiful as those of the avocado, are never so abundant in the market as avocados and consequently are never so cheap. It was noticed, however, that an occasional tree produced very heavily. From this it can be assumed that it will be possible to obtain varieties of satisfactory productiveness for cultivation in the United States.

In the Motagua Valley, at elevations of 500 to 1,500 feet, the coyo ripens from the latter part of June until August, the season thus corresponding to that of the West Indian race of avocados. In Alta Vera Paz, at elevations of 3,000 to 5,000 feet, the season is from July to October, with a few fruits available until the first of December. As in the avocado, there is a certain amount of variation in the season of ripening among different trees.

When mature, the fruits are picked and placed in the house to ripen. The ripening process requires less time than it does with avocados, three or four days usually sufficing. When the fruits yield to pressure of the thumb they are ready for eating and are carried to the market for sale. In San Cristobal they bring 1 to 2 reals each (one-fifth to two-fifths of a cent), while avocados rarely sell in the same town for more than a real and often two for a real.

THE FRUIT.

A good coyo (Pl. XIII) strongly resembles in appearance a medium-sized avocado of the West Indian race, such as many of those grown in Florida and Cuba. The color of the flesh, however, easily distinguishes it from all avocados.

In form most of the coyos are slender and bottle necked, with a slender neck, sometimes 3 inches long. The best varieties are broadly pyriform, somewhat like the Pollock avocado in shape. A few obovoid varieties were seen, but no round ones. Irregularly shaped and deformed fruits are much more common than they are in the avocado.

The size varies from about 6 ounces to more than 2 pounds. In the Vera Paz the commonest size is 6 to 10 ounces. The best varieties in this region weigh 16 to 20 ounces. At El Rancho one variety was seen which weighed about 2 pounds. The 16 to 20 ounce fruits seem to be the most desirable.

Most coyos are light green in color when ripe, with numerous large yellowish green dots. Sometimes a bronze-colored fruit is seen, or a deep brown one. The deep-purple color found in the avocado has not been observed in the coyo.

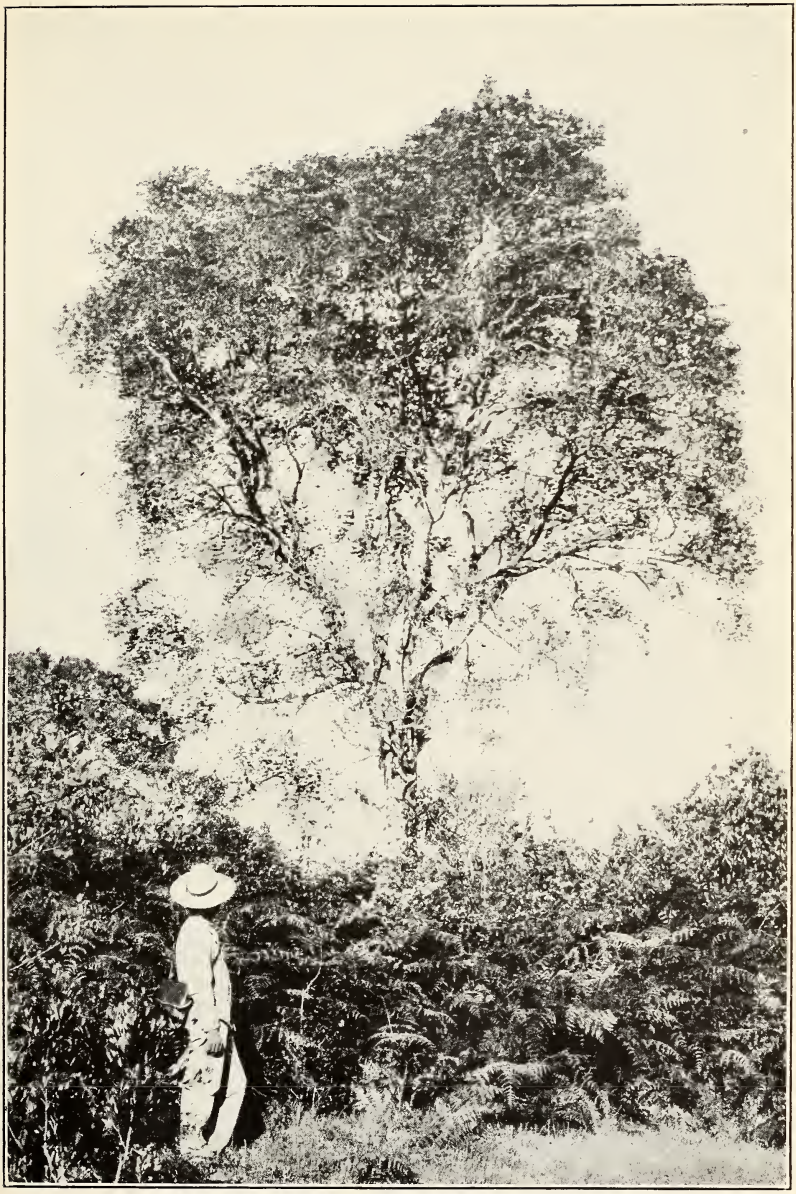
The skin is thick, but soft and pliable, resembling in texture the skin of the West Indian avocados, but approaching in thickness the thickest skinned varieties of the Guatemalan race. At the proper stage of ripeness the skin peels readily from the flesh.

The surface, like the texture of the flesh, is similar to that of the West Indian avocados. It is commonly slightly undulating, but never warty or very rough.

The color of the flesh, as has already been noted, is distinct from that of all avocados. It varies from brownish white to pale brown. In the best varieties it is brownish white and free from fiber, but in 90 per cent of the coyos seen in the Vera Paz there are coarse, tough fibers running through the flesh from the stem end of the fruit to the base of the seed. When squeezed, a milky juice exudes from the flesh. The latter is commonly of about the same texture as the flesh of a good avocado. It is coarser in many of the inferior varieties.

In flavor the coyo is quite distinct from all avocados at present known in the United States. It has a peculiar and very agreeable richness, similar to that of the avocado, but is characterized by a well-marked flavor of ripe coconut. Good coyos are exceedingly rich in flavor and for this reason are referred by many Indians, as well as some of the American and European coffee planters of Alta Vera Paz, to the best avocados. The coyo is eaten in the same way as the avocado.

The quality of 90 per cent of the coyos seen in Guatemala is poor, owing to the unattractive color of the flesh and the presence of ob-



A COYO TREE DURING THE FLOWERING PERIOD.

Like the Guatemalan avocado, the coyo sheds most of its foliage during the flowering period. The tree here shown is in full bloom and at the same time is making new growth, which will soon result in an abundance of leaves. In size and general habit of growth the coyo strongly resembles the avocado. The branchlets, however, are stouter and stiffer than those of the avocado, and the leaves and new growths are covered with a heavy reddish down or pubescence. (Photographed near Tactic, Alta Vera Paz, Guatemala, March 30, 1917; P17168FS.)

INFERIOR AND GOOD VARIETIES OF THE COYO.

The coyo strongly resembles the avocado, yet it belongs to a distinct species of the genus Persea. The fruit of the average seedling, of which the specimen on the right is a good example, has a large seed, much fiber running through the flesh, and is in general greatly inferior to the average avocado; occasionally, however, seedling variation results in the production of a very superior variety, such as the one shown on the left in this illustration. This fruit will stand comparison with the best avocados and seems to merit cultivation in other countries. The flavor is distinct from that of the avocado, being very rich and suggesting a ripe coconut. (Photographed at Tactic, Alta Vera Paz, Guatemala, October 7, 1917; P17364FS.)

jectionable fibers. In a few varieties, however, the quality is very good. Two trees were found in Alta Vera Paz whose fruits would stand comparison with the best avocados.

As a rule, the seed is proportionately larger in the coyo than in the Guatemalan race of avocados. In many coyos the layer of flesh between the seed and the skin is not half an inch thick. In the best varieties, however, the seed is proportionately no larger than in good avocados. In all the coyos seen in Guatemala the seed was tight in its cavity. The seed coats are much thicker than in the avocado, the outer one being somewhat corky in texture.

The coyo seed is much more perishable than that of the avocado and can be kept or shipped only with great difficulty. It is quickly killed by drying in the sun. If kept too wet it rots very soon. It must be kept moist, but not excessively so; it was noticed that seeds lying on the ground beneath trees in the Vera Paz kept for several weeks in good condition, finally sprouting and sending up vigorous shoots. Such seeds were in the shade and were moistened practically every day by rain, but the drainage furnished by the fallen leaves upon which they lay and the exposure to the air kept them from rotting.

CULTURAL REQUIREMENTS.

The coyo tree grows under a wide variety of conditions. In the valley of the Motagua, between El Rancho and Gualan, it is found near the banks of streams. There is little rainfall in this part of Guatemala, and the air is exceedingly hot and dry during a large part of the year. The hillsides are covered with typical desert vegetation—cacti, euphorbiads, and thorny leguminous shrubs. Contrasted with these conditions, the upper Polochic Valley, in Alta Vera Paz, is a very moist region, with a rainfall of approximately 150 inches per annum.

Like the Guatemalan race of avocados, the coyo is abundant at elevations of 4,000 to 5,000 feet; unlike the former, it is fairly common in the tierra caliente, or hot zone, at elevations of 500 to 1,000 feet. Whether it will stand as much cold as the Guatemalan avocado can not be stated, but everything indicates that it is reasonably hardy.

Judging from its behavior in Guatemala, the coyo ought to be successful in both California and Florida. It grows on soils of various types, from sandy loam, at El Rancho and Zacapa, to heavy clay in some parts of Alta Vera Paz. It withstands the heat of the tropical zone and the cool climate of the subtropical equally well. It is a vigorous, robust tree, requiring no more care than the avocado and apparently subject to the attacks of no more enemies. The coyo can be recommended as a fruit worthy of attention on the part of horticulturists in the warmest regions of the United States, as well as in the Tropics and subtropics generally.

SELECTED GUATEMALAN AVOCADO SEEDLINGS INTRODUCED INTO THE UNITED STATES.

The 23 avocados described on the following pages have been introduced into the United States for trial in California and Florida. They were carefully selected from a large number of trees examined in the Guatemalan highlands, special consideration being given to characteristics of commercial value. Some of them promise to ripen very early in the season; others are late. Fruits of various shapes and sizes are represented, as well as all the common colors found in Guatemala. The quality of every variety was critically tested, and no variety was included in the collection which did not appear entirely satisfactory in this respect.

In order to distinguish these avocados from varieties originated in the United States, names taken from one of the Maya dialects have been given them. Inasmuch as they come from the Maya territory, this may not be inappropriate. Following the name of each variety is the number under which it was collected in Guatemala, these numbers running from 1 to 36, inclusive. It will be noted that several of the numbers are missing; the varieties originally represented by these were found, upon later examination, to have certain defects which disqualified them, and they were dropped from the collection before its introduction into the United States. Following the collection number is the serial number under which the introduction is recorded in the inventory of the Office of Foreign Seed and Plant Introduction.

LAMAT. (No. 3.) S. P. I. No. 43476.

The Lamat is a variety combining unusual productiveness with good size, attractive appearance, and good quality of fruit. In addition, it seems to ripen earlier than many other avocados, which suggests it for trial as a winter-ripening variety in California. It has no claim to unusual hardiness, since it is grown at an altitude where frosts are not experienced.

The parent tree is growing in the chacara of Angel Samayoa in the town of Amatitlan (elevation 3,872 feet). It stands close to the corner of a small field in which tomatoes and maize are planted annually. The soil is a loose sandy loam, apparently of excellent fertility and considerable depth. The age of the tree is not known, but judging from its size it is probably 6 to 8 years old. It stands about 20 feet high, with an erect crown, extending almost to the ground, about 10 feet broad, and well branched. The trunk is 6 inches thick at the base. The tree shows every indication of being a strong, vigorous grower, as its branches are stout and shapely and not so brittle as in many weak-growing varieties. The bud wood furnished by the tree is quite satisfactory; the growths are of suitable length,

and the eyes are strong and well developed, showing no tendency to drop at an early date, as they do in some varieties.

During the period in which this tree was under observation it showed a peculiarity in flowering which was not noticed elsewhere in Guatemala. In November, 1916, flowers were produced and a few fruits set. Since a heavy crop was produced in 1916, it was thought that the fruits set from the November bloom were all that would be developed during 1917, but in January the tree flowered again and set a very heavy crop of fruit.

The production in 1916 amounted to more than 100 fruits, which can be considered a heavy crop when the size of the fruits and the small size of the tree are considered. The crop for 1917 promised to be considerably larger. In 1916 the fruits were practically all picked in November, at which time they were considered by the owner to be mature. Doubtless they would have been much better if left on the tree two or three months longer.

The fruit is broadly oval, quite uniform in shape, with a smooth green surface when ripe. The weight varies from 14 to 20 ounces. The skin is about as thick as in the average variety of the Guatemalan race, which is one-sixteenth of an inch or slightly more. The flesh is free from fiber, clear, of good texture, and of pleasant flavor. Specimens sampled in November, 1916, were not as rich as would be desired, but it may reasonably be assumed that they would have been much better if they had been left on the tree two or three months longer. Perfectly ripened specimens of this variety have not been tested; hence, the quality of this fruit when at its best must remain somewhat in doubt until it comes into bearing in the United States. The seed is comparatively small and always tight in its cavity.

A formal description of this variety follows.

Form uniformly oval; size above medium to large, weight 14 to 18 ounces, at times up to 20 ounces, length 4½ inches, greatest breadth 3½ inches; base rounded, with the stem inserted obliquely without depression; stem stout, about 6 inches long; apex rounded, with the stigmatic point to one side and slightly elevated; surface nearly smooth, slightly undulating, and sometimes obscurely ribbed, deep green in color, almost glossy, with a few scattering, large, yellowish green dots; skin thick, slightly over one-sixteenth of an inch at base, nearly one-eighth of an inch at apex, coarsely granular, brittle; flesh cream color, pale green near the skin, of fairly rich flavor, and free from fiber or discoloration; quality very good; seed rather small in comparison to the size of the fruit, almost spherical, about 2½ ounces in weight, tight in the cavity, with both seed coats adhering closely to the nearly smooth cotyledons.

KANOLA. (No. 6.) S. P. I. No. 43560.

The Kanola variety (Pl. XIV) possesses several valuable characteristics. It is one of the earliest found in the Antigua region, commencing to ripen at the end of October. This makes it of particular interest to avocado growers in California, since early-ripening va-

rieties are much desired in that State. The tree is exceedingly productive, and the fruit, though small, is of desirable round form and attractive glossy purple color. The flesh is yellow, free from fiber, and of rich flavor, while the seed is comparatively small for a fruit of round or oblate form.

The parent tree is growing in the sitio of Victor Garcia, who keeps a small estanco on the road from Antigua to San Antonio Aguas Calientes, just above the church of San Lorenzo del Cubo. The elevation is approximately 5,600 feet. Beneath the tree, which stands on a rather steep hillside, coffee has recently been planted. The soil is a very loose black sandy loam, doubtless of volcanic origin. Judging from the crops grown in the vicinity it must be quite fertile. The age of the tree is not definitely known. Victor Garcia says that it was already of large size when he was a lad, so it may be considered at least 40 years of age; most likely 50 or more. It stands about 35 feet high, with a spreading but rather open crown 35 feet broad. The trunk is 1½ feet thick at the base. The first branches are about 8 feet above the ground. The young growths are stout, shapely, and vigorous. The indications are that the variety will be a strong grower. The bud wood is excellent, having strong well-developed eyes well placed on the round, smooth, clean young twigs. There is no tendency for the eyes to drop from the young twigs, as there is in some varieties. The wood is not unusually brittle.

Varieties growing at this altitude in Guatemala are not subjected to severe frosts, but should be as hardy as the average of the Guatemalan race.

The flowering season of the parent tree is from the end of October to the first of December. It flowers very profusely and in good seasons sets heavy crops of fruit. The crop which ripened at the end of 1916 was enormous. It was impossible to make an accurate count, but a conservative estimate would place the number of fruits at 1,500 to 2,000. After such a heavy crop, it is to be expected that a light crop will follow. Very few fruits were carried to ripen at the end of 1917. Victor Garcia states that at least a few fruits are always produced; that some seasons the crop is small, while in others it is very heavy, as it was in 1916. This is commonly the case with Guatemalan avocados.

As already stated, the fruits commence to ripen at the end of October. Maturity is indicated by the appearance of a purple blush on one side of the fruit. At this stage it is considered ready for picking, but its flavor is much richer if left on the tree some months longer until the entire fruit is deep purple in color. Apparently this variety has an unusually long fruiting season, for a few fruits (which had been overlooked in picking) were found still hanging on the tree at the end of April, 1917. As observed during the past harvest, the

ripening season appears to be as follows: First fruits maturing at the end of October; most of the crop maturing in November and December, but better if left on the tree until January; a few fruits, at least, remaining on the tree until March and April.

The fruit is uniformly oblate in form, resembling a grapefruit. In size it is small, weighing from 6 to 10 ounces. Under better cultural conditions, however, the weight will probably go up to 12 ounces. The color when the fruit is fully ripe is deep purple. The surface is pebbled, not distinctly roughened. The skin is of good thickness, hard, and brittle. The flesh is deep yellow in color, free from fiber, but with slight fiber discoloration (not, however, of an objectionable nature), of fine texture, and rich, oily flavor. The quality can be considered excellent. The seed is round, not large for a fruit of round or oblate form. It is generally found that fruits of this shape have seeds considerably larger in proportion to the size of the fruit than is common in good varieties of pyriform or oval shape. As in nearly all Guatemalan varieties, the seed is quite tight in the cavity.

A formal description of this variety follows.

Form roundish oblate; size small to below medium, weight 6 to 10 ounces, length 2¾ to 3 inches, greatest breadth 3 to 3¼ inches; base truncate, the stem inserted squarely without depression; stem fairly stout, 4 inches long; apex flattened, sometimes slightly oblique; surface pebbled, deep purple in color, sometimes almost glossy, with numerous small yellowish dots; skin one-sixteenth of an inch thick at basal end of fruit, about one-eighth of an inch thick at apex, separating readily from the flesh, rather finely granular, woody, brittle; flesh deep cream yellow to yellow near the seed, changing to very pale green near the skin, quite free from fiber and with unobjectionable fiber discoloration, firm in texture, and of rich, oily flavor; quality excellent; seed small in comparison to size of fruit, oblate, about 1½ ounces in weight, sometimes excentric, tight in the seed cavity, with both seed coats adhering closely.

ISHKAL. (No. 7.) S. P. I. No. 43602.

Few avocados are grown in the city of Guatemala which are considered to be of excellent quality. This tree is looked upon as one of the very best and has a considerable reputation locally for the rich flavor of its deep-yellow flesh.

The parent tree is growing in the patio of the Masonic Building, Callejon Manchen No. 4. The elevation here is approximately 4,900 feet. Apparently the tree is old, at least 50 years, and probably nearer 75. It is about 60 feet high, with a trunk more than 2 feet in diameter at the base, branching about 15 feet from the ground. The crown is erect, dense, with abundant foliage of good color. The bud wood is excellent, having well-developed eyes which are not inclined to drop and leave a blind bud. Everything seems to indicate that the variety will be a reasonably strong grower, as the branchlets are long, stout, well formed, and vigorous.

Avocados growing at this altitude in Guatemala are not subjected to heavy frosts, but should be as hardy as the average of the Guatemalan race.

The tree did not produce any fruit in 1916, but bore a good crop from the 1917 bloom. The great age of the tree and the unfavorable conditions under which it is growing seem to have resulted in the fruit becoming small and inferior of late years, according to the story of the caretaker. Specimens examined were not large in size, and they had undesirably large seeds, but under better cultivation the size of the fruit might be increased greatly without the seed becoming any larger. The quality of the fruit is so good and its reputation so great that the variety seems worthy of trial in the United States, though it can not be recommended with as much confidence as many other varieties included in this series of importations.

In productiveness the variety promises to be satisfactory. In season of ripening it is a little earlier than the average, the fruits commencing to mature in January. They are not at their best, however, earlier than March. Some of them will remain on the tree until June or July.

The fruits examined were small, but they are said to be normally nearly a pound in weight. In form they are spherical to broadly obovoid. The surface is rough and deep purple in color. The flesh is deep yellow, clear, and free from fiber, and of very rich and pleasant flavor.

The fruit, as produced in 1917, may be described as follows:

Form spherical to obovoid; size small, weight 6 to 8 ounces; length 3 to 3¾ inches, greatest breadth 2¾ to 3 inches; base rounded to pointed, the stem inserted obliquely without depression; apex slightly flattened obliquely; surface rough, deep purple when ripe, with very few large yellowish dots; skin moderately thick, one-sixteenth to one-eighth of an inch, coarsely granular and woody; flesh deep yellow in color, free from fiber discoloration and of very rich and pleasant flavor; quality excellent; seed large, nearly spherical in form, 1¾ to 2 ounces in weight, tight in the seed cavity, with both seed coats adhering closely to the smooth cotyledons.

COBAN. (No. 8.) S. P. I. No. 43932.

The Coban variety possesses something of a reputation in Coban as an avocado of unusually fine quality. In addition, it has a small seed and other good characteristics, which combine to make it a promising sort.

The parent tree stands in the sitio of Filadelfo Pineda, in Coban, Department of Alta Vera Paz. The elevation is 4,325 feet. The ground beneath the branches is given over to a vegetable garden with the exception of that to the east side, which is cut off by a tall hedge of chichicaste (*Loasa speciosa*). The soil is a heavy clay loam, probably underlain by stiff clay. According to the owner, the

tree is 30 or more years of age. It is about 40 feet high, with a dense, dome-shaped crown fully 40 feet broad. The trunk is 18 inches in diameter at the base, branching some 10 feet from the ground. At present the tree is badly attacked by several insect pests and is not in good condition. It appears normally to be reasonably vigorous in growth, the young branches being somewhat slender but not very brittle. The bud wood furnished by the tree is fairly good, the eyes being well developed and showing no tendency to drop at an early age. The twigs are at times slender and angular.

The climate of Coban is mild; hence, there is nothing to indicate that this variety will be any hardier than the average of the Guatemalan race.

The flowering season is February and March. Up to a few years ago the tree is said to have borne large crops of fruit, but at present it does not seem to be doing so well, perhaps owing to weakened condition as a result of the attacks of insects and other pests. When first examined in December, 1916, there were only a few fruits on the tree, perhaps a dozen, and after the flowers which were produced in 1917 had fallen only a few fruits were found to be left on the tree for the next season, most of them having fallen before they attained the size of walnuts. They were malformed, as though from the attacks of some parasite. The ripening season is said to be February to March, a few fruits being picked in December and January and some hanging on the tree until April or May.

This is a fruit of medium size, weighing about 15 ounces. In form it is pear shaped, tending to obovoid. The surface is slightly rough, deep green in color, while the skin is moderately thick, hard, and woody. The flesh is of unusually deep yellow color, quite free from discoloration of any kind, smooth and oily, and of unusually rich flavor. The seed is rather small in comparison to the size of the fruit and is perfectly tight in the seed cavity.

This variety may be formally described as follows:

Form obovoid, obovoid-pyriform, or pyriform, slightly oblique; size above medium, weight 15 ounces, length 4⅝ inches, greatest breadth 3⅜ inches; base rounded, the stem inserted obliquely without depression; apex rounded; surface slightly rough, deep green in color, with a few small yellowish dots; skin moderately thick, one-eighth of an inch or slightly more, coarsely granular, woody, and brittle; flesh deep yellow in color, changing to pale green near the skin, of fine, smooth texture and free from discoloration of any sort; the flavor rich and pleasant; quality excellent; seed rather small in comparison to the size of the fruit, rounded oblate in form, about 1¾ ounces in weight, with both seed coats adhering closely and fitting tightly in the seed cavity.

KASHLAN. (No. 10.) S. P. I. No. 43934.

In quality the Kashlan variety is one of the finest avocados in the series. It has the additional advantages of good size, convenient shape for handling, and a seed which is unusually small. Taken all

around, it seems to be an exceptionally promising variety, and it ripens earlier than many others, which makes it particularly worthy of trial in California, where early-ripening varieties of the Guatemalan race are greatly desired.

The parent tree stands among coffee bushes in the sitio of Diego Muus in the town of San Cristobal. The elevation here is 4,550 feet. Close to the tree, on the west, is a much larger avocado tree which crowds it considerably, and there is an inga tree a few feet away on another side. The tree must be considered, therefore, to be growing under unfavorable conditions. The soil is a heavy clay loam, blackish and very fertile. While the owner is not certain as to the exact age of the tree, it is thought to be 8 or 10 years old. It is about 25 feet high, with a slender, open crown rather sparsely branched. The trunk is 8 inches thick at the base, branching about 8 feet from the ground. The tree bears every indication of being a strong grower; the young branchlets are stout, long, and extremely healthy in appearance. The wood is no more brittle than the average. The bud wood furnished by the tree is excellent, having strong, vigorous eyes which are not inclined to drop at an early stage. The twigs are smooth, round, stout, with the eyes conveniently placed for cutting buds, i. e., not too close together.

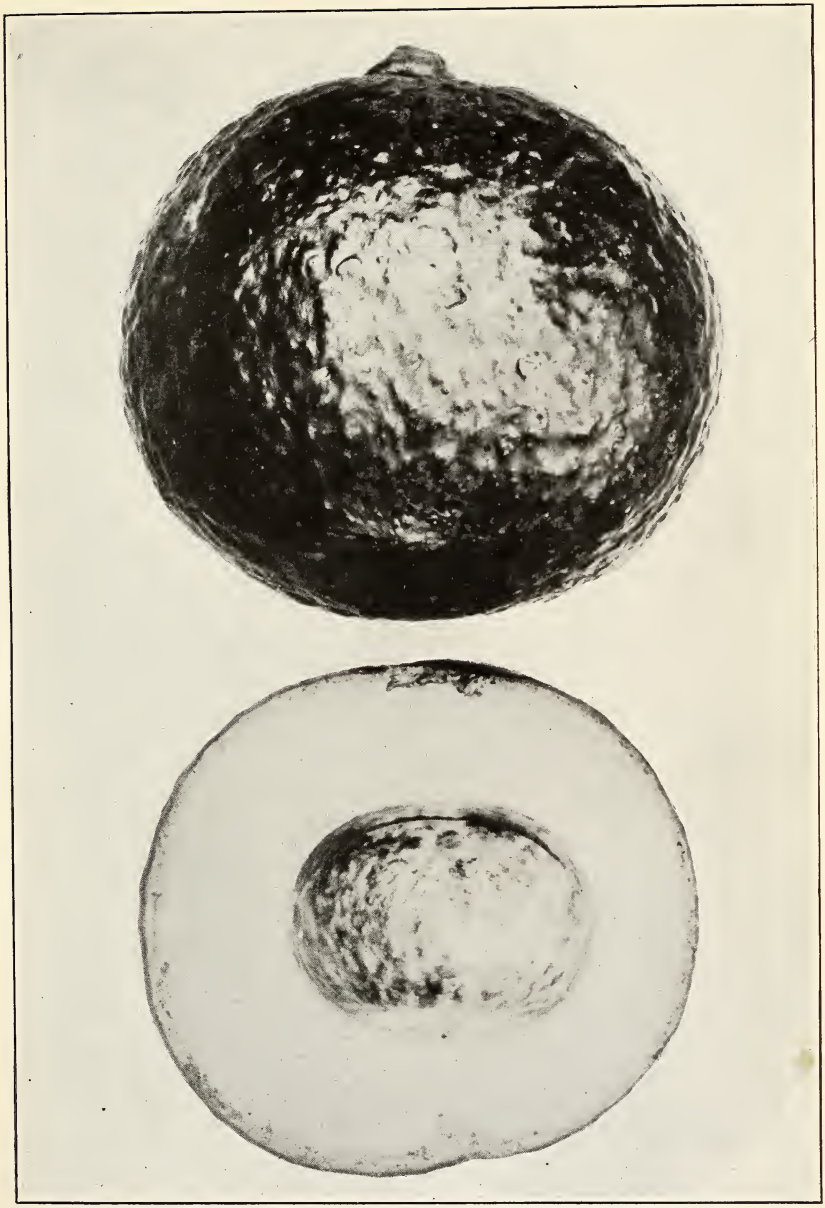
No frosts occur in San Cristobal; hence, there is no means of determining whether varieties growing here are hardier than the average. Until further evidence is obtained in the United States it must be assumed that varieties from elevations such as that of San Cristobal are of average hardiness.

The flowering season is February. The tree is said to have come into bearing three years ago. It produced an excellent crop the past season, considering the size of the fruit and the unfavorable conditions under which it is growing. In 1917 it set no fruit. The crop which developed in 1916 was picked in January and February, 1917, at which time the fruit was considered to be mature. None was left on the tree, so it is impossible to say how late the fruits might hang on if they were allowed to do so.

This fruit is broadly oval in form, slightly oblique, and weighs 20 to 22 ounces. It is green in color when ripe, practically smooth on the surface, with a hard, brittle, but not unusually thick skin. The flesh is smooth, deep yellow in color, clean, and free from fiber. The flavor is very rich and pleasant. The seed is unusually small, weighing but 2 ounces, and fits tightly in its cavity.

Following is a formal description of this variety.

Form broadly oval, slightly oblique; size very large, weight 20 to 22 ounces, length 4½ inches, breadth 4 inches; base obliquely flattened, the stem inserted without depression; apex obliquely flattened, slightly depressed around the stigmatic point; surface pebbled, deep green in color, with



THE KANOLA AVOCADO, AN EARLY VARIETY OF GOOD QUALITY.

Among the many seedling avocados in Guatemala, very few are distinctly early in season. The variety here shown, from San Lorenzo del Cubo, near Antigua, ripens its fruits three to four months earlier than most of the trees in the same region. While early varieties are commonly lacking in flavor or otherwise undesirable, the Kanola is a fruit of good quality. It weighs 6 to 10 ounces, is deep purple in color, with a woody outer covering and yellow flesh of rich flavor. The parent tree bore a heavy crop in 1916 (Photographed, natural size, at the city of Guatemala, November 1, 1916; P16923FS.)

A CROP FROM THE PARENT TREE OF THE NABAL AVOCADO.

Fruits to the number of 315 are here shown at the base of the parent Nabal avocado tree, growing in the finca Santa Lucia at Antigua. As indicated by the small size of the trunk, the tree is quite young, and the crown, which is formed 10 feet above the ground, is slender and sparsely branched. The crop may therefore be considered a heavy one. The fruits weigh about 12 ounces each, have rather small seeds, and are of excellent quality. (Photographed at Antigua, Guatemala, January 28, 1917; P17051FS.)

numerous rather large yellowish dots; skin one-sixteenth of an inch thick, slightly thicker over some portions of the fruit, coarsely granular, and brittle; flesh of an unusually rich yellow color, changing to pale green near the skin, free from fiber or discoloration, and of very rich flavor; quality excellent; seed very small in proportion to the size of the fruit, oblate, weighing 2 ounces, tight in the cavity, with both seed coats adhering closely to the cotyledons, which are slightly rough for this race.

CHISOY. (No. 11.) S. P. I. No. 43935.

As a commercial variety the Chisoy avocado seems to be particularly promising. In form and size it is almost identical with the Trapp avocado of Florida, but it has a smaller seed. The quality is excellent, and the tree has borne two heavy crops in succession, which indicates that it will probably be as satisfactory in productiveness as any in the series. Taken all around, the Chisoy variety seems to be one of the best.

The parent tree is growing in the cafetal (coffee plantation) of Señor Don Eusebio de la Cruz, in the town of San Cristobal. The elevation is 4,550 feet. Eusebio de la Cruz is the alcalde, or mayor, of San Cristobal and owns coffee plantations containing many avocado trees, but he always reserves the fruits of this particular tree for his private consumption and to present to his friends. Beneath the broad-spreading branches of this tree are numerous large coffee bushes, which benefit by the shade cast by the avocado. The soil is a heavy blackish clay loam, of excellent fertility. No one knows the exact age of the tree; it is very large and probably very old. Fifty years can be considered the minimum. It is fully 50 feet high, with a broadly spreading much-branched crown which is 60 feet in diameter. The trunk of the tree is 4 feet thick at the base. It branches about 12 feet above the ground. The growth seems to be vigorous, though the young branchlets are not so long as they would be if the tree were much younger. The wood is no more brittle than the average, and the branchlets are well formed and stout. The bud wood furnished by this tree is good; owing to the age of the tree the twigs are not so long as would be desired for most convenient handling, but the eyes are well formed and show no tendency to drop at an early stage.

The hardiness of the variety can not be ascertained, since there is no frost in San Cristobal. Until subjected to cold weather in the United States it can only be assumed that the variety is of average hardiness for the Guatemalan race.

The flowering season is slightly later than the average, the tree being in full bloom on April 1, 1917. The crop produced from the 1916 bloom was very large. No count could be obtained, but it may be said that the bearing habits of the tree, as indicated by the 1916 and 1917 crops, seem highly satisfactory. In spite of the heavy

crop from the 1916 bloom, the 1917 bloom set an equally heavy one, which was carried to maturity. The fruits can be picked in February, but are probably not at their best until the first of March. The season, therefore, is a month or more later than the average. If allowed to remain on the tree many of the fruits will hang on until April, or perhaps even later.

The fruit is handsome, and its quality does not belie its looks. It is as large as a good grapefruit (20 to 24 ounces), with a slightly rough skin of yellowish green color, somewhat thicker than the average, so that the fruit is bruised with difficulty. The flesh is of deep-yellow color, firm and rather dry in texture, entirely free from discoloration of any sort, and of the richest possible flavor. No better avocado in point of flavor has been found in all Guatemala. The seed in large specimens of the variety is comparatively small, while in small specimens it is a trifle large, appearing to develop to more or less the same size in every case, independent of the size of the fruit. Under good cultural conditions in North America the fruits should be of large size, and if the seed remains small, as it does in the large specimens produced by the parent tree, this will almost surely be one of the choicest avocados of the series. It is scarcely necessary to add that the seed is tight in the cavity, for this is the case with all of the avocados included in this list.

This variety may be formally described as follows:

Form spherical to oblate; size large to very large, weight 17 to 24 ounces, length 3⅞ to 4⅛ inches, greatest breadth 4 to 4½ inches; base rounded, the stem, which is about 5 inches long and moderately stout, inserted somewhat obliquely without depression; apex slightly flattened; surface uniformly pebbled, somewhat coarsely so, deep green to yellow-green in color, with numerous large pale yellow-green dots; skin moderately thick for this race, varying from one-sixteenth to one-eighth of an inch, hard and woody; flesh rich cream yellow to yellow in color, changing to pale green near the skin, free from fiber or discoloration, not watery, but very oily, smooth, and of rich, very pleasant flavor; seed oblate, 2 to 3 ounces in weight, tight in the cavity, with both seed coats adhering closely to the cotyledons, which are slightly rough for this race.

PANKAY. (No. 12.) S. P. I. No. 44785.

The Pankay variety has been included in this list primarily for its probable hardiness. The parent tree is growing at an elevation of 8,500 feet, which is more than a thousand feet above the zone in which citrus trees are seen in Guatemala. Avocados are rarely found at this elevation. Several other avocado trees in the same town (Totonicapam) had been badly injured by a recent frost at the time Pankay was selected, but this variety had escaped practically untouched. How much may have been due to situation or other circumstances, however, is not known, and not too much confidence should be placed in the superior hardiness of this variety until it has been thoroughly

tested in Florida and California. Since, in addition to its probable hardiness, it is a fruit of very good quality, it can be strongly recommended for trial in the United States.

The parent tree is growing in the patio of Jesusa v. de Camey, corner of Calle Cabanas and 10a Avenida Norte, Totonicapam. The elevation of this town is approximately 8,500 feet, perhaps a little higher. The situation is somewhat sheltered, since the tree stands in the patio of a house, close to the north wall. Since the top of the tree, however, extends 10 feet or more above the roof of the house, the protection can not be of great importance except from one point of view: The tree may have been effectively protected when young, being thus enabled to develop uninjured during the first few years of its growth, after which it was better able to withstand severe frosts. The age of the tree is said to be about 25 years; it stands 40 feet high, with a broadly oval, dense crown, the top of which has been cut out to avoid the danger of its breaking in high wind and falling upon the tile roof of the house. The trunk is about 20 inches thick at the base, dividing 8 feet from the ground to form two main branches, which give off secondary branches at 20 feet from the ground. While the tree appears to be vigorous and hardy, it may be found somewhat difficult to propagate, as it does not make the best type of bud wood. The "eyes" are not plump, but somewhat slender, with the outer bud scales falling early, and the bud itself shows a tendency to fall at an early stage. The wood seems to be rather brittle.

The flowering season is late April and May. The tree is quite productive, bearing its fruits often in clusters. It produced a good crop from the 1915 blooms and another good one from the 1916 blooms. Owing to the great elevation of Totonicapam and the consequent lack of heat, the fruits are very slow in reaching maturity. The season of ripening is from September until the end of the year, but the fruits which ripen at this time are those from the previous year's bloom; that is, flowers which appear in May, 1918, develop fruits which will not be fully ripe until September or October, 1919.

The fruit is of medium size, of attractive pyriform shape, smooth, and green in color. The flesh is of good quality, free from fiber, and the seed is comparatively small. It can be considered a fruit of very good quality and desirable from other points of view than that of its probable hardiness.

Following is a formal description of this variety.

Form pyriform, rather slender, and slightly necked; size medium, weight 12 ounces, length 4¾ inches, greatest breadth 3 inches; base tapering, narrow, the stem inserted almost squarely without depression; stem 3½ inches long, stout; apex rounded, slightly depressed around the stigmatic point; surface smooth or nearly so, light green and almost glossy, with numerous yellow dots; skin moderately thick, about one-sixteenth of an inch, woody, and brittle; flesh deep-

cream color, changing to pale green near the skin, free from fiber, and of very rich flavor; quality excellent; seed rather small, conical, weighing about 1½ ounces, tight in the cavity, with both seed coats adhering closely.

NABAL. (No. 15.) S. P. I. No. 44439.

For productiveness combined with desirable form and excellent quality of fruit, the Nabal variety (Pl. XV) seems particularly worthy of trial in the United States. While not a large avocado, it is excellent in every way, having a smooth, green surface, rich yellow flesh of good flavor, and a seed not unduly large in comparison with the size of the fruit. In addition, it seems to be slightly earlier in season than the average.

In June, 1917, the parent tree was accidentally destroyed by a laborer who was planting coffee. It stood among coffee bushes in the finca Santa Lucia, 7a Calle Poniente, near the Alameda de Santa Lucia, Antigua. The soil in this finca is a rich black sandy loam of volcanic origin, deep and apparently very fertile. The tree was young, probably not more than 6 or 7 years old. It stood about 25 feet high, with a trunk 6 inches in diameter at the base, branching 10 feet from the ground. The crown was open, scantily branched, with little fruiting wood. The young growths were strong, stout, vigorous, and the bud wood was excellent, having large vigorous eyes. The variety should not be difficult to propagate, and the indications are that it will be a good grower, though it is impossible to speak with certainty in regard to the latter point. The wood is rather tough for an avocado.

The elevation of Antigua, 5,100 feet, is not great enough to insure unusual hardiness in a variety, but it seems reasonable to expect that varieties from this elevation will be as hardy as the average of the Guatemalan race. There is no way of determining whether they may be hardier than the average until they are tested in the United States.

The parent tree did not flower in 1917. Since flowers are nearly always produced at the same time as the spring flush of growth, however, it may be suspected that the flowering season of the variety will be rather late, since the spring growth did not appear this season until the end of March. The heavy crop of fruit produced last year probably prevented the tree from flowering this season. When first examined, in October, 1916, the tree was carrying more than 300 fruits. It ripened this crop—an unusually large one for such a small tree when the size of the fruit is considered—in February and March, 1917, at which time all the fruits were picked. They would probably have remained on the tree until June if they had been allowed to do so.

The fruit of this variety is nearly spherical in form, of convenient size for serving a half fruit as a portion. It weighs 10 ounces or a little more. The surface is smooth, bright green, very attractive in

appearance. The skin is sufficiently thick to make the fruit a good shipper and is of the characteristic Guatemalan texture. The flesh is rich yellow in color, quite free from fiber or discoloration, and of very rich flavor. The seed is tight in the cavity and slightly below the average in size. Considered from all points of view, this bears every indication of being an excellent little fruit.

A formal description of this variety follows.

Form almost spherical; size below medium, weight about 10 ounces, length 3½ inches, breadth slightly over 3 inches, base scarcely extended, the stem inserted almost squarely without depression; apex rounded, with a slight depression around the stigmatic point; surface undulating to finely pebbled, dull green in color, with numerous very minute yellowish dots; skin not very thick, scarcely up to one-eighth of an inch over any portion of the fruit, separating readily from the flesh, woody, brittle; flesh yellow, greenish toward the skin, free from fiber or discoloration, of firm, smooth texture and rich flavor; quality excellent; seed rather small, nearly spherical in form, weighing slightly more than 1 ounce, tight in the seed cavity, with both seed coats adhering closely to the cotyledons.

NIMLIOH. (No. 17.) S. P. I. No. 44440.

It is rare to find a large-fruited avocado which is at the same time very productive. In the Nimlioh variety (Pl. XVI), however, both these characteristics are combined to an unusual degree. In addition, the quality of the fruit is excellent, the flesh being rich yellow in color, free from discoloration, and of very rich flavor. The habit of the tree and the character of the wood indicate that the variety may not be a very strong grower.

The parent tree is growing in a sitio belonging to Trinidad Hernandez, Callejon de Concepcion No. 28, Antigua. The elevation is approximately 5,100 feet. The soil is a very sandy loam, black, loose, deep, and undoubtedly very fertile. The tree stands close to a wall, with no other large trees close to it. It is very poorly cared for. Its age is not known, but is probably 15 years or more. It is about 25 feet high, the trunk 14 inches thick at the base, and the first branches 12 feet from the ground. The crown is broadly oval, of good form, and rather dense. It looks, however, as though the variety might be a diffuse grower when young, with long, heavy shoots inclined to droop. The wood is unusually brittle, and the bud wood very poor, the eyes being stalked or losing their bud scales and falling early. The tree is badly attacked by leaf-gall, and there are a good many scale insects on it.

The elevation of Antigua, 5,100 feet, is not great enough to insure unusual hardiness in a variety, and pending a test in the United States it can only be assumed that this avocado is of about average hardiness for the Guatemalan race.

The flowering season is from the latter part of February to the end of March. According to the owner of the tree, it always bears

at least a few fruits, but it is to be expected that a tree which produces such a crop as this one did in 1917 will not bear heavily the following year. While an accurate count was not made, the crop this season was estimated at 300 to 400 fruits. The normal size of the fruits is between 2 and 3 pounds, but owing, doubtless, to the large number on the tree, many do not develop to a greater size than 1 pound. Probably good culture and thinning would result in a crop of uniformly large fruits. The season of ripening is earlier than some, most of the fruits being fully ripe in February and March.

In form this avocado is broadly oval, usually somewhat oblique. The surface is deep green and rather rough, while the skin is thick and woody. The flesh is rich cream yellow in color, smooth, and entirely free from fiber or discoloration. The flavor is of the very best, being rich, bland, and pleasant. The seed, while large, is not large in comparison to the great size of the fruit, and the proportion of flesh to seed is quite satisfactory.

Those who are interested in large avocados should by all means give this variety a trial. Its only visible defect is the tendency to produce weak branches, but if pruning and good culture can produce a reasonably shapely and vigorous growth the variety seems likely to prove of value in the United States.

A formal description of the fruit follows.

Form broadly oval, sometimes oblong-oval, and always more or less oblique; size extremely large, perfectly developed fruits weighing 36 to 45 ounces and measuring 5½ to 6 inches in length by 4½ to 5 inches in breadth; stem rather short and very stout, inserted obliquely without depression; base slightly flattened obliquely, not decidedly so; apex rounded to obliquely flattened; surface heavily pebbled in most instances, occasionally lightly pebbled, deep green in color, with numerous irregular large yellowish dots; skin moderately thick, one-sixteenth of an inch toward the base of the fruit and one-eighth of an inch toward the apex, separating readily from the flesh, coarsely granular, and brittle; flesh firm, oily, smooth, rich cream yellow, tinged with green toward the skin, free from fiber or discoloration, and of very rich, pleasant flavor; quality excellent; seed medium sized, roundish conic or oblate conic, weighing 4 ounces, tight in the cavity, with both seed coats adhering closely.

PANCHOY. (No. 18.) S. P. I. No. 44625.

The fruit of the Panchoy avocado is very thick skinned and of unusually good quality. It is rather above medium size (Pl. XVII), weighing 15 to 18 ounces, and is of pleasing form—broadly obovoid. The seed is small. Perhaps its most striking characteristic is its unusually thick skin; but its quality deserves even more notice, for in this respect it is one of the very best in the collection.

The parent tree is growing in the finca La Polvora in Antigua. The elevation is approximately 5,100 feet. The ground beneath the tree is planted to coffee bushes, which are now about 8 feet high. The soil is rich sandy loam, friable, black, and fertile. The tree is about

45 feet high, with a straight trunk 18 inches thick at the base, giving off its first branch 18 feet from the ground. The crown is not very broad, but open and sparsely branched, some of the limbs showing a tendency to droop. The age of the tree is not definitely known, but is probably 15 to 20 years. The character of the bud wood produced by the tree is fairly satisfactory; the growths are short, but the buds are well formed and show no tendency to drop.

Lacking a definite test in the United States, it must be assumed that the variety is about average in hardiness. The climate of Antigua is not sufficiently cold to demonstrate the hardiness of a variety.

The flowering season is February and March. The fruits ripen rather early for this region, the first ones commencing to drop in February, while a few hang on until April or May. The season may be called January to April. This rather early season of ripening is of especial importance to California, where the variety should have a careful trial. Its productiveness is satisfactory. The crop ripened in the spring of 1917 was good, but few fruits were set from the blooms of 1917. This is nothing unusual, since trees of the Guatemalan race do not as a rule bear heavily every year.

The fruit is broadly obovoid, 1 pound in weight, rough and yellowish green on the surface, with a skin almost as thick as a coconut shell, but easily cut. The flesh is almost as yellow as butter, clean and free from discoloration, and of very rich flavor, while the seed is comparatively small and tight in the cavity. The variety has every appearance of being an excellent one.

The fruit may be formally described as follows:

Form obovoid, slightly oblique at the apex; size above medium to large, weight 15 to 18 ounces, length 4½ inches, greatest breadth 3½ inches; base rounded or obscurely pointed; stem stout, 4 inches long, inserted obliquely without depression; apex obliquely flattened, depressed around the stigmatic point; surface heavily pebbled to rough, green to yellowish green in color, with numerous small rounded yellowish dots; skin thick, about one-eighth of an inch throughout, not thicker toward the apex than near the base, as in many avocados, woody, very brittle; flesh firm, smooth, rich yellow in color, tinged with green near the skin, fiber or discoloration entirely lacking, the flavor very rich and pleasant; quality excellent; seed medium sized or rather small, roundish conic in form, weighing 2 ounces, tight in the cavity, with both seed coats adhering closely.

TUMIN. (No. 20.) S. P. I. No. 44627.

The Tumin variety is remarkable for its unusual productiveness, the fruits often being borne in clusters of two to five, a characteristic which is quite rare in the Guatemalan race. The fruit is almost identical in form with the Trapp as grown in Florida; it weighs about a pound, and is of handsome appearance, with a smooth, glossy skin of purple-black color. The flesh is of excellent appearance and flavor. The seed is medium sized. Taken all around, this seems a

very promising variety, especially for Florida, where many of the Guatemalan avocados do not bear heavily.

The parent tree is growing in the finca La Polvora in Antigua. The elevation is approximately 5,100 feet. On all sides of the tree, and crowding it somewhat, are large coffee bushes. The soil is a rich sandy loam of volcanic origin, deep and friable. The tree is probably 6 or 7 years old. It is 20 feet in height, very slender in habit, the trunk 6 inches thick at the base, branching at 8 feet from the ground. The crown is slender, sparsely branched, with very little fruiting wood. Its growth seems to be reasonably vigorous, the young branchlets being stout, though very short. The wood is rather brittle. The bud wood furnished by the tree is rather poor, owing to the shortness of the growths and the fact that the buds are too closely crowded together. The eyes, however, are well formed and show no tendency to drop and leave a blind bud. It may be found that the tree will require training when young to keep it stocky and of good form.

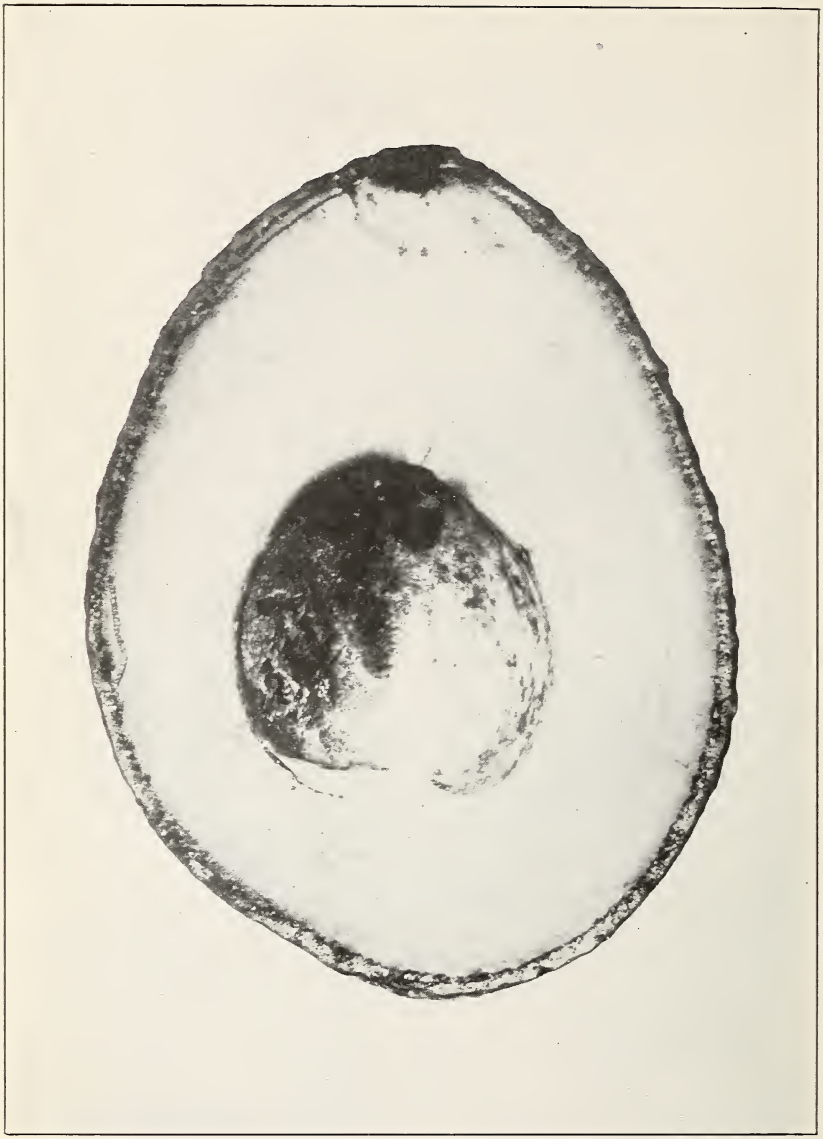
The hardiness of the variety can not be ascertained at present, since the climate of Antigua is not cold. It may be assumed, until a test is made in the United States, that it is about as hardy as the average of the Guatemalan race.

The tree did not flower in 1917, owing, most likely, to the heavy crop which it ripened from the 1916 blooms. Probably under better cultural conditions and by thinning heavy crops, greater regularity in bearing could be induced; in Guatemala, where no cultural attention is given to the trees, it is common for them to bear very heavily one season and fail to bear the next. Judging by the appearance of the spring flush of growth, which always accompanies the flowers, the variety will flower in March. The fruits ripen from March to May. Although the tree has very little fruiting wood, it produced 125 fruits in 1917, which can be considered a very heavy crop. Several of the branches, in fact, were broken by the weight of the fruits they were carrying.

The form of the fruit, as already mentioned, is practically the same as that of the Trapp—oblate or roundish oblate. The average weight is 12 to 16 ounces, but it may be expected that the weight of this and all other varieties in the collection will be slightly greater under good culture in the United States than it is in Guatemala, where the trees receive no attention. The skin is rather thin and smooth on the surface. The color is deep purple, almost black. Unlike most Guatemalan avocados, the surface possesses a decided glossiness. The flesh is rich yellow in color, free from discoloration or fiber, and of very rich flavor. The seed varies from small to slightly large. In this connection it may be noted that seeds of round or

THE NIMLIOH AVOCADO, A PRODUCTIVE AND LARGE VARIETY.

Few large varieties are as productive as this one. In 1917 the parent tree, growing in a dooryard in Antigua, bore so many fruits that it was unable to develop them all to normal size. The largest specimens weighed nearly 3 pounds; many were more than 2 pounds in weight. The quality of the fruit is excellent, the flesh being yellow, free from all discoloration, and of very rich flavor. While large varieties may not be as desirable as medium-sized ones for general planting in the United States, a limited demand for large fruits seems certain, and avocados such as this are promising. (Photographed at Antigua, Guatemala, February 21, 1917; P17085FS.)



THE PANCHOY AVOCADO, ONE OF THE VERY BEST.

For deep-yellow color of flesh and richness of flavor this variety is not excelled by any other in the entire series introduced into the United States from the Guatemalan highlands in 1916 and 1917. It is a medium-sized fruit from Antigua, green in color, with a very thick skin and an unusually small seed. The surface is rough, as is generally the case in very thick skinned varieties. (Photographed, natural size, at Antigua, Guatemala, February 24, 1917; P17115FS.)

THE BENIK AVOCADO, A HANDSOME PURPLE VARIETY.

Upon dividing this fruit into halves the contrast between the bright maroon-purple skin and the yellow flesh is exceedingly pleasing. The parent tree, which is growing in the finca La Polvora at Antigua, has proved to be very productive, and the quality of the fruit is excellent. (Photographed at Antigua, Guatemala, May 1, 1917; P17244FS.)

THE KEKCHI AVOCADO, A PRODUCTIVE EARLY VARIETY.

This is the smallest avocado included in the series introduced into the United States from the Guatemalan highlands in 1916 and 1917. It commonly weighs but 5 or 6 ounces. The surface is deep purple in color, the skin thick and woody. There is a slight amount of discoloration in the flesh, but no fiber. The flavor is rich, and the seed is not large. The fruits commence to ripen two to three months earlier than those of other trees in the same section (Purula, Baja Vera Paz), and continue through a period of nearly six months. The fruits being so small, the tree is able to carry a large number. (Photographed, natural size, at Tactic, Alta Vera Paz, Guatemala, April 4, 1917.)

oblate avocados frequently are found to vary considerably in size, even among the fruits of a single tree. In this particular variety the average is not large, but occasional fruits were found in which the seed was a trifle too large. In others it is comparatively small. It is always tight in the cavity.

The following is a formal description of the fruit.

Form roundish oblate or oblate; size medium to above medium; weight 12 to 15 ounces, length 3¼ inches, greatest breadth 3⅜ to 3⅝ inches; base rounded, the very short, stout stem inserted almost squarely and without depression; apex flattened, not depressed; fruits borne singly or in clusters of two to six; surface almost smooth or very lightly pebbled, deep purple in color, glossy, with very numerous, minute, yellowish dots; skin thin for this race, one-sixteenth of an inch at apex and slightly less toward the base of the fruit, pliable, peeling readily; flesh firm, smooth, rich cream yellow, changing to pale green near the skin, free from fiber or discoloration, and of rich, pleasant flavor; quality excellent; seed roundish oblate, variable in size, weighing 1¾ to 3, commonly 2, ounces; tight in the cavity, with both seed coats adhering closely to the cotyledons.

BENIK. (No. 21.) S. P. I. No. 44626.

The fruit of the Benik avocado is very handsome (Pl. XVIII) and of fine quality. When cut in half the contrast of its purplish maroon skin with its rich yellow flesh is very pleasing, the purple of the skin intensifying the yellow of the flesh. The tree is a good bearer, and the variety seems well worthy of a trial in the United States.

The parent tree is growing in the finca La Polvora in Antigua. It has recently been girdled, with the intention of killing it to make room for more coffee bushes, so that it will probably not be in existence by 1919. The elevation of this spot is about 5,100 feet. The tree stands among coffee bushes, some of which grow beneath its branches. The soil is a loose, sandy loam, deep and fertile. The tree is about 35 feet high, the trunk 18 inches in diameter at the base, and the first branches 12 feet from the ground. The age of the tree is not known, but it appears to be at least 20 years. The growth is vigorous and shapely, though the branchlets are rather short. The bud wood furnished by the tree is quite satisfactory, the eyes being well developed and not losing their outer bud scales or falling early. The bud sticks, however, are short.

The hardiness of the variety must be considered about average until the facts can be ascertained by a test in the United States. The climate of Antigua is not cold enough to show the hardiness of an avocado of the Guatemalan race.

The tree flowers in late February and March. It ripened a fairly good crop of fruit in 1917 from the 1916 blooms and set a very heavy crop to ripen in 1918. Its productiveness, therefore, seems to be above the average. The season of ripening is from February, when

the fruits change from green to purple and thus indicate their maturity, to May, when the last ones fall to the ground. It is a midseason sort, commencing to ripen a trifle earlier, perhaps, than the average.

The fruit is broadly obovoid to pear shaped, about 20 ounces in weight, with a rough surface of rich purplish maroon color. It presents a very attractive appearance. The skin is rather thin and somewhat pliable, but coarsely granular in texture. The flesh is rich cream yellow in color, free from discoloration, and of very rich, pleasant flavor. The seed is medium sized and tight in the cavity.

A formal description of the fruit is as follows:

Form broad pyriform to obovoid; size very large, weight 20 ounces, length 5 inches, greatest breadth 3¾ inches; base pointed, the stem inserted obliquely without depression; apex rounded, slightly depressed immediately around the stigmatic point; surface pebbled to rather rough, deep purplish maroon in color, almost glossy, with few inconspicuous light-colored dots; skin rather thin for this race, about one-sixteenth of an inch throughout, fairly pliable and peeling from the flesh when fully ripe, the purplish maroon color of the surface extending clear through the skin; flesh rich cream yellow in color, changing to pale green close to the skin, firm, of rich flavor; quality excellent; seed medium sized, weighing about 3 ounces, roundish conical in form, tight in the cavity, with both seed coats adhering closely to the cotyledons.

KEKCHI. (No. 22.) S. P. I. No. 44679.

The remarkable little fruit of the Kekchi avocado (Pl. XIX) is valuable not only for its earliness and good quality, but the tree is also noted for its productiveness. The fruit commences to ripen in December, at least two months before most of the other avocados of the same region. Though small in size, the seed is proportionately small, leaving a good proportion of flesh of rich flavor. The variety has a long ripening season, which suggests its use as an avocado for the home garden.

The parent tree is growing in a sitio belonging to Santiago Mendoza in the town of Purula, Department of Baja Vera Paz. The elevation is approximately 5,150 feet. The soil is a heavy clay loam. The tree stands on a slope, in the midst of a small maize patch. It is about 35 feet in height, with a trunk 2 feet thick at the base, branching about 10 feet from the ground. The crown is broad and spreading, but sparsely branched. Judging from the size of the tree it must be at least 30 or 40 years old. It seems to be a vigorous grower, the branchlets being stout, well formed, and of good length. The bud wood is quite satisfactory, having well-developed eyes which do not show a tendency to drop and leave a blind bud. The tree is uncared for and has much dead wood in it.

While Purula is scarcely higher than Antigua, it has a colder climate. It is not, however, sufficiently cold to test the hardiness of avocados of the Guatemalan race.

The tree has not been seen in bloom, but probably flowers in February. In good seasons it carries an enormous crop of fruit. This would be expected of a small-fruited variety. The first fruits turn color about the first of December and can then be picked. The height of the season, however, is not until February, at which time the fruits are fully mature. If allowed to remain on the tree, many of them hang until April or May.

The fruit is pear shaped or obovoid, small, weighing not over 6 ounces (it will probably weigh more when grown under cultivation in California and Florida), somewhat rough on the surface, and maroon in color. The skin is thick and woody. The flesh is yellow, sometimes slightly discolored with fiber streaks, but with no objectionable fiber. The flavor is rich and pleasant. The seed is medium sized in comparison with the size of the fruit. In comparison with the seeds of most other 6-ounce fruits it would be called small.

The variety may be formally described as follows:

Form broadly obovoid to pyriform; size small, weight 5 to 6 ounces, length 3¼ to 3½ inches, greatest breadth 2⅜ to 2¾ inches; base tapering, the moderately stout stem, which is 5½ inches long, being inserted slightly obliquely without depression; apex rounded or almost imperceptibly flattened; surface rough, deep dull purple-maroon in color, with rather few small russet dots; skin thick, one-sixteenth of an inch at base, nearly one-eighth of an inch toward the apex of the fruit, coarsely granular and woody in texture; flesh rich cream yellow, changing to pale green near the skin, sometimes marked with fiber traces but without any tough fibers, buttery in texture, of very rich and agreeable flavor; quality very good; seed roundish oblate, small to medium in size, weighing less than 1 ounce, tight in the seed cavity, with both seed coats adhering closely to the cotyledons.

MAYAPAN. (No. 23.) S. P. I. No. 44680.

The Mayapan avocado (Pl. XX) possesses several excellent commercial characteristics—round form, desirable size (nearly 1 pound), attractive purple color, thick, firm skin, and flesh of excellent quality. In this latter respect it is one of the very best varieties in the collection. The seed is not large and the tree is very productive. It seems a very promising avocado.

The parent tree is growing in a sitio owned by Arcadio Saguirre in the town of Purula, Department of Baja Vera Paz. The elevation of this town is approximately 5,150 feet. The soil is a heavy clay loam, black, very fertile, and retentive of moisture. The tree stands in the rear of the property, close to a chichicaste hedge. It is apparently not more than 15 or 20 years old, slender, about 40 feet high, with a trunk 1 foot thick at the base. The crown is slender, but well branched, with an abundance of fruiting wood. The young growths are shapely and vigorous, indicating that the variety will probably be a good grower. The bud wood is satisfactory, the branchlets being of good length, round, smooth, with the eyes well

placed, strong, and not inclined to fall. If the young trees show a tendency to grow tall and slender, they can easily be kept in hand by judicious pruning.

The climate of Purula is colder than that of Antigua, though the elevation is about the same. It is not sufficiently cold, however, to test the hardiness of avocados of the Guatemalan race. It must be assumed that this variety is of average hardiness until it can be put to a test in the United States.

The flowering season of the parent tree is in March and early April. It blooms profusely and sets a heavy crop of fruit. The crop produced in 1917 from the 1916 blooms was very heavy, and another equally heavy one was set from the 1917 blooms. The productiveness of the variety gives promise of being well above the average. The ripening season commences about the middle of March and extends to the first of July. It can probably be termed midseason or slightly later than midseason.

The fruits are of attractive round form, nearly a pound in weight, with a slightly rough surface of purple color. The skin is much thicker than the average, but not very brittle. The flesh is rich yellow in color, absolutely free from discoloration of any sort, dry and oily, cutting like soft cheese. The flavor is exceptionally rich and nutty. The seed is rather small and is tight in the cavity. The size of the fruit conforms admirably to hotel and restaurant requirements, where it is desired to serve a half fruit as a portion, and the quality is so unusually good that it would seem that this variety is of exceptional promise.

Following is a formal description of the fruit.

Form spherical to roundish obovoid, sometimes slightly oblique; size medium to above medium, weight 13 to 16 ounces, length 3¾ to 4 inches, greatest breadth 3½ to 3¾ inches; base rounded or obscurely pointed, the stem rather slender, 7 inches long, inserted obliquely, without depression; apex rounded or slightly flattened obliquely; surface decidedly rough, greenish purple to dull purple in color, with numerous large greenish yellow dots; skin very thick, varying from as much as three-sixteenths of an inch near the stem, where it is thickest, to somewhat more than one-sixteenth of an inch near the apex, coarsely granular in texture, woody, but separating readily from the flesh at the proper stage of ripeness; flesh rich cream yellow in color, without fiber discoloration, firm, meaty, of rich and pleasant flavor; quality excellent; seed oblate-spherical to spherical in form, medium sized, weighing 1½ to 2 ounces, tight in the cavity, with both seed coats adhering closely to the smooth cotyledons.

KAYAB. (No. 25.) S. P. I. No. 44681.

Fruits of the Kayab avocado are of excellent quality and desirable shape. This variety resembles the Trapp of Florida and the Chisoy variety of this collection in form and size. Some of the specimens examined had large seeds, but the best ones had seeds which could be termed medium sized or almost small in comparison

with the size of the fruit. In small specimens of any variety the seed commonly appears large. This variety was not studied as thoroughly as some of the others, but it is considered well worthy of a trial in the United States.

The parent tree is growing in the cafetal of Francisco Muus, called Chiquitop, in the edge of the town of San Cristobal, Department of Alta Vera Paz. The elevation is about 4,600 feet. The soil is heavy reddish clay, which is very tenacious when wet. The tree stands among coffee bushes 6 to 8 feet high. It is about 40 feet in height, with the trunk 18 inches thick at the base, branching 12 feet from the ground. The crown is broad and spreading, well branched, and dense. The branchlets are rather short, but of good appearance, being well formed and stout. The bud wood is good, but it is difficult to get long bud sticks from the parent tree. The eyes are well developed and do not drop early.

Varieties growing at this elevation in Guatemala are not subjected to severe frosts; hence, there is no way of telling whether they are hardier than the average until they are tested in the United States.

The tree probably flowers in late February and March. It is said to fruit heavily, but at the time it was examined in 1917 only a few fruits were left on it. The ripening season is from February to May, which is the main season for avocados at San Cristobal.

The fruit is round, about a pound in weight, yellowish green in color, with a moderately thick skin. The flesh is yellow, clear, dry, of very rich flavor, and free from any discoloration. The seed is medium sized in large specimens, being rather large in some of the smaller ones examined. In many instances the seed is placed to one side of the center of the fruit.

A formal description of the variety follows.

Form obliquely spherical, sometimes slightly narrowed toward the base; size medium to very large, weight 14 to 20 ounces, length 3¾ to 4 inches, breadth 3⅝ to 4 inches; base slightly flattened, oblique, the stem inserted obliquely without depression; apex obliquely flattened; surface pebbled, most conspicuously so around the base of the fruit, deep green to yellowish green in color, almost glossy, with numerous small russet or yellowish dots; skin moderately thick, one-sixteenth to one-eighth of an inch, hard and woody; flesh cream yellow in color, without fiber or discoloration, firm, dry, of very rich flavor; quality excellent; seed medium sized, weighing about 2 ounces, sometimes excentric, tight in the seed cavity, with both seed coats adhering closely to the cotyledons.

MANIK. (No. 26.) S. P. I. No. 45560.

The Manik avocado is a productive and rather early variety of excellent quality. The fruit is medium sized, of pleasing form, and has clear yellow flesh of unusually rich flavor.

The parent tree is growing in the finca La Polvora in Antigua. The elevation is about 5,100 feet. While it is growing among coffee

bushes and grevilleas, the tree is not crowded and has developed to large size. It stands about 50 feet high, with a rather slender trunk and a dense crown, the trunk being 2 feet thick at the base and branching about 8 feet from the ground. The age of the tree is probably 30 years or more. It is badly attacked by leaf-gall, but in general has the appearance of a strong, vigorous variety, the branchlets being well formed, long, round, and stout. The bud wood is good, having strongly developed eyes well placed for cutting.

Antigua does not experience severe frosts; hence, it is impossible to determine in advance of a trial in the United States whether or not the variety is any hardier than the average of the Guatemalan race.

The flowering season is February and March. The tree blooms profusely and in some years sets enormous crops of fruit. In 1917 a very heavy crop was ripened. The 1918 crop is much smaller. In general, the bearing habits of the tree give promise of being unusually good, there being a tendency for the fruits to develop in clusters. The season of ripening is properly from February to June, but fruits picked early in December develop fairly good flavor upon being ripened in the house. The season may be termed early to midseason.

The fruit is more variable in form than that of most other varieties. The range is from oval to slender pyriform, nearly all the fruits being of the latter shape, without, however, a well-defined neck. The weight varies from 8 to 12 ounces. The surface is slightly rough and green in color. The skin is moderately thick, the flesh rich yellow in color, quite free from all fiber or discoloration, and of very rich and pleasant flavor. The seed is a trifle large in some specimens, small in others, being medium sized or rather small on the average. It is tight in the seed cavity.

The variety may be formally described as follows:

Form oval to elliptic-pyriform; size below medium to medium, weight 8½ to 12 ounces, length 3¾ to 4¾ inches, breadth 2¾ to 3¾ inches; base rounded to pointed, the stem inserted slightly to one side without depression; apex rounded to broadly pointed; surface sparsely pebbled, uniformly so, bright green in color, with comparatively few small yellowish dots; skin not very thick for this type, one-sixteenth of an inch near the stem and slightly more toward the apex of the fruit, hard and coarsely granular; flesh rich cream yellow in color, free from fiber and with no discoloration, firm and unusually dry, of rich and pleasant flavor; quality very good; seed ovoid conical, medium sized, weighing 1 ounce more or less, tight in its cavity, with both seed coats adhering closely to the smooth cotyledons.

CABNAL. (No. 27.) S. P. I. No. 44782.

The Cabnal avocado is a very productive variety (Pl. XXI), whose fruits are of pleasing round form, good size, and rich flavor. It gives promise of being slightly later in ripening than most other Antiguan varieties.

The parent tree is growing in a sitio occupied by Atanasio Salazar in the outskirts of Antigua, a short distance beyond the first kilometer post on the Guatemala road. The elevation is approximately 5,100 feet. The tree stands beside a small stream, with several jocote trees (*Spondias mombin* L.) close around it. Its age is unknown, but it appears to be at least 25 years old, perhaps more. It stands about 30 feet high, the trunk, about 15 inches thick at the base, giving off its first branches 10 feet above the ground. The crown is rather broad, dense, and well branched. The young branches are erect, stout, stiff, and well formed, indicating that the tree is a vigorous grower. The wood is not unduly brittle. The bud wood is excellent, the branches being of good length with the buds well placed. The eyes are large, well developed, and show no tendency to fall and leave a blind bud.

The climate of Antigua is not cold enough to test the hardiness of Guatemalan avocados, but it may reasonably be assumed that this variety is of average hardiness.

The flowering season is late February and March. The tree produced a heavy crop of fruit from the 1916 blooms and set an equally heavy crop in 1917 to be ripened in 1918. The bearing habits of the variety give promise of being excellent. The fruit ripens in March and April, but can be left on the tree until June or even later. The ripening period may be termed midseason to late.

The fruit is round, weighing 12 to 16 ounces, rather rough, and dark green or yellowish green externally, with a skin of moderate thickness. It is attractive in appearance and of convenient and desirable size and form. The flesh is cream yellow, very oily in texture, and of rich flavor. There is a peculiar nuttiness about the flavor which is not found in the other varieties of this collection. It may, perhaps, be said to suggest the coconut. The seed is variable in size, but on the average is rather small for a round fruit. It is tight in the cavity.

A formal description of the fruit is as follows:

Form spherical; size below medium to above medium; weight 10 to 16 ounces; length 3¾ to 3⅞ inches; breadth 3¼ to 3¾ inches; base rounded, the slender stem inserted slightly to one side without depression; apex flattened and slightly depressed around the stigmatic point; surface pebbled, usually rather heavily so, dull green in color with a few small yellowish dots; skin thick, about one-eighth of an inch, coarsely granular toward the flesh, hard and woody; flesh rich cream yellow in color, with no fiber and only very slight discoloration, pale green near the skin, fairly dry, and of rich, nutty flavor; quality very good; seed round or oblate, medium sized, varying from 1 to 2 ounces in weight, tight in the cavity, with both seed coats adhering closely to the cotyledons.

CANTEL. (No. 28.) S. P. I. No. 44783.

The parent tree of the Cantel avocado is just coming into bearing and produced but few fruits in 1917. While it is too early to know

definitely what its bearing habits will be, the character of the fruit is so unusual as to make it worth while to test the variety in the United States. Most round avocados have medium-sized or large seeds. This one, however, has an unusually small seed, and if it proves desirable in other respects it will be well worth cultivating. In quality it is good.

The parent tree is growing in the finca La Candelaria in Antigua. The elevation is approximately 5,100 feet. The tree has been planted to shade coffee bushes and is still young, its age not being more than 5 or 6 years. It is tall and slender in habit, about 20 feet high, with a trunk 6 inches thick at the base. As is customary in fincas, the tree has not been allowed to branch low, the first branches being more than 6 feet from the ground. The growth looks unusually strong and healthy, the young branchlets being stout, long, stiff, and well formed. The bud wood is excellent, having the vigorous buds well placed.

Little can be determined regarding the flowering and fruiting habits of the tree at this early day. When it was first seen, early in May, 1917, it had only three fruits on it. It may have borne more, as the crop had already been harvested from most of the trees in the finca. The ripening season is probably March to May.

The hardiness of the tree can not be determined until it is tested in the United States, as it is never very cold at Antigua.

The fruit is round, about a pound in weight, green, with a moderately thick skin. The flesh is of good color and quality, and in quantity much greater than in the average round avocado, since the seed is quite small.

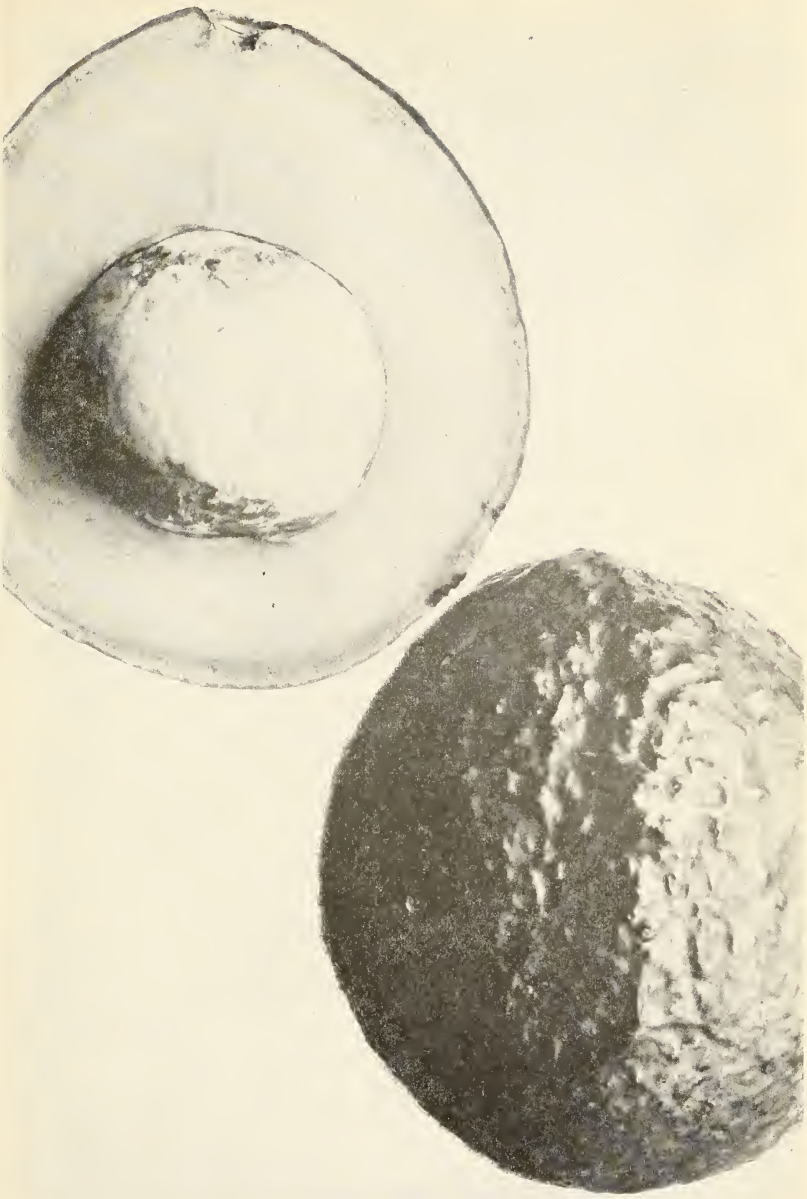
The variety may be described as follows:

Form oblate; size medium, weight 16 ounces, length 3½ inches, breadth 3¾ inches; base slightly flattened, the long slender stem inserted without depression almost in the longitudinal center of the fruit; apex flattened, slightly depressed around the stigmatic point; surface pebbled, deep yellow green in color, with numerous minute yellowish dots; skin not very thick for this race, one-sixteenth of an inch or slightly more, hard, granular toward the flesh; flesh cream colored around the seed, becoming pale green close to the skin, very slightly discolored, with brownish fiber tracing, but with no fiber; flavor rich and pleasant; quality very good; seed very small for a round fruit, oblate, weighing less than 1 ounce, tight in the cavity, with both seed coats adhering closely to the cotyledons.

TERTOH. (No. 30.) S. P. I. No. 44856.

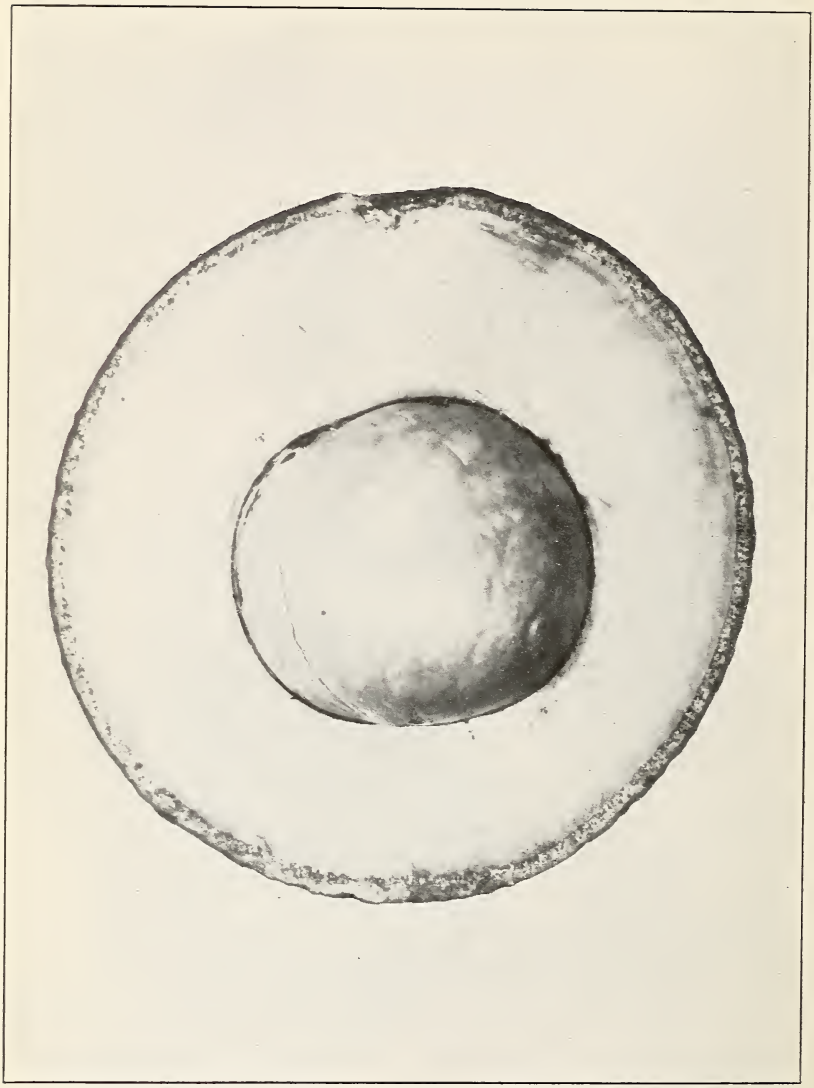
The Tertoh avocado is a famous variety from Mixco, near the city of Guatemala, noted for its immense size and excellent quality. (Pl. XXII.)

The parent tree is growing in the sitio of Leandro Castillo, just above the plaza of Mixco, at an elevation of approximately 5,700 feet.



THE MAYAPAN AVOCADO, A PRODUCTIVE MIDSEASON VARIETY OF EXCELLENT QUALITY.

This avocado is characterized by flesh of fine, smooth texture, deep-yellow color, and very rich flavor. In quality it is the equal of any variety in the collection. The surface is deep maroon-purple in color and the skin moderately thick. The seed is medium sized and tight in the cavity, as it is in nearly all avocados of the Guatemalan race. The parent tree is an excellent bearer, as far as can be judged from its behavior during two seasons. (Photographed, natural size, at Purula, Baja Vera Paz, Guatemala, April 10, 1917.)

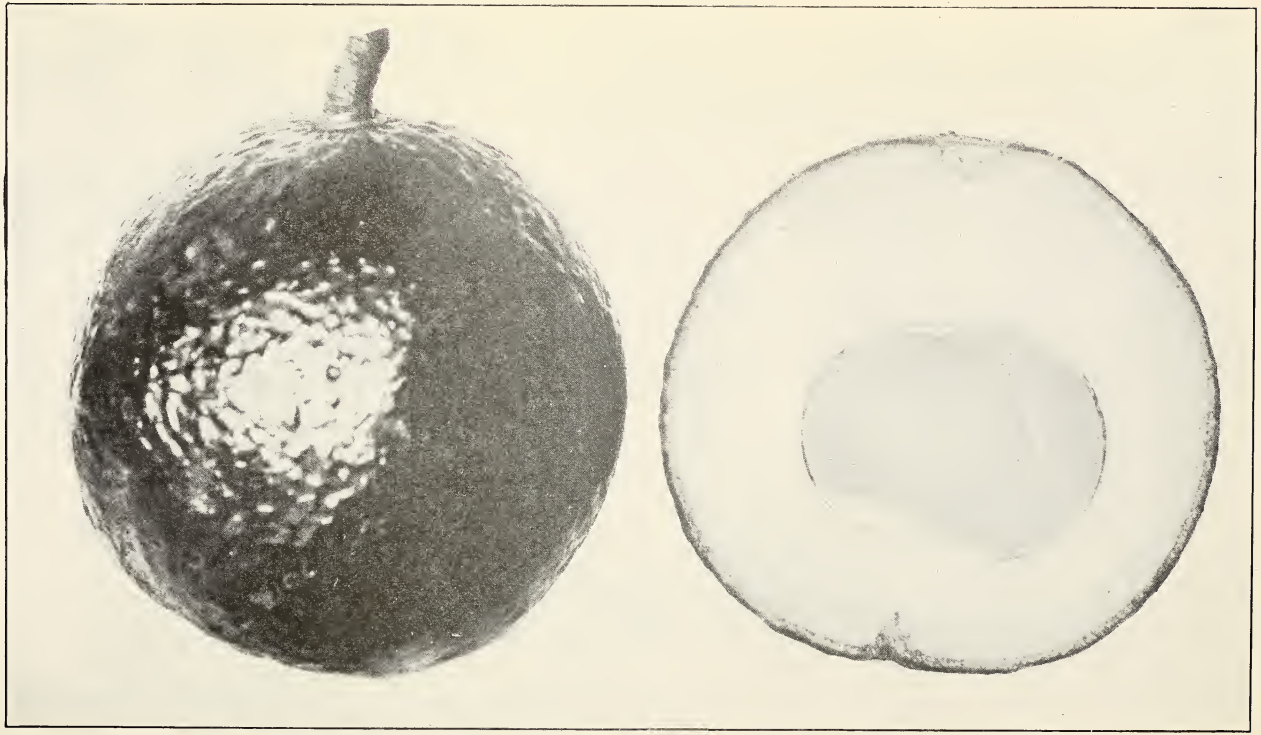


THE CABNAL AVOCADO, AN EXCELLENT MIDSEASON VARIETY.

The present ideal of avocado growers in the United States is a round fruit of about 1 pound in weight, with a small seed and flesh free from fiber and of rich flavor. In the variety here shown these characteristics are combined to an unusual degree. The surface is slightly rough and green in color, the skin thick and woody. The flesh is cream yellow in color and of distinctive flavor. The parent tree bore an excellent crop in 1917, ripening from March to June, which is about a month later than the average. (Photographed, natural size, at Antigua, Guatemala, May 4, 1917; P17262FS.)

THE TERTOH AVOCADO, ONE OF THE LARGEST GUATEMALAN VARIETIES.

The fruits here shown are not yet fully grown. Good specimens of this variety weigh 3 pounds and are of excellent quality, the flesh being rich yellow in color, free from all discoloration, and of nutty flavor. The seed, as will be noticed in the illustration, is comparatively small. This variety has a considerable reputation in the vicinity of the city of Guatemala, owing principally to its large size. Avocados weighing more than 2 pounds are rare in Guatemala. (Photographed at the city of Guatemala, December 2, 1917; P17466FS.)



THE KANAN, AN EARLY AVOCADO OF EXCELLENT FORM AND QUALITY.

This variety comes from the same region as the Kanola, and while not so early as the latter by at least one month it is a larger fruit and one of excellent quality. It weighs about 1 pound. The surface is green in color, the skin moderately thick and woody, while the flesh is cream yellow, free from fiber or discoloration, and of rich flavor. Round avocados usually have seeds somewhat larger in proportion to the size of the fruit than pyriform or elongated avocados, but in the case of the Kanan the seed is comparatively small. The fruits shown are here considerably reduced in size. (Photographed at Antigua, Guatemala, November 16, 1917; P17424FS.)

The tree is said by the owner to have been planted by his grandfather from a seed brought from Moran, a small village about 10 miles distant. While its age is not definitely known, it is estimated at about 60 years. It is about 25 feet high, broad and spreading in habit, with a trunk 15 inches thick at the base, branching 7 feet from the ground to form a dense crown fully 30 feet broad. A peculiarity of the tree is its very brittle wood. This may be against the variety in California and Florida, where strong winds occasionally do much damage. The growth seems to be vigorous, and the bud wood is very satisfactory, the twigs being stout, well formed, and supplied with vigorous buds.

The climate of Mixco is cool, but not cold enough to test the hardiness of the variety. This can only be determined by a trial in the United States.

The tree flowers in March. According to the owner, it has not borne as well in recent years as formerly. He attributes this to the fact that the tree is getting old, but it seems in addition to have been weakened by the attacks of insects. No fruits were produced from the 1916 blooms. The 1917 blooms resulted in a good crop, but many of the fruits dropped to the ground when nearly full grown. Upon examination they appeared to have been attacked by some insect, whose burrows could be seen toward the base of the fruit. The season of ripening is said to be from February to April, the fruits being at their best in March. They can, however, be picked as early as January. Toward the end of the season they become very rich in flavor.

The fruit is long and slender, tending toward pyriform. It weighs as much as 3 pounds in some instances. It is deep purple in color when fully ripe and has a rather thin skin for this race and deep cream-colored flesh of very rich flavor. The seed is very small in comparison to the size of the fruit.

An American relates that he once brought a fruit from this tree to his home in the city of Guatemala, where it sufficed to make salads for two meals for a household of 10 people.

The variety may be formally described as follows:

Form oblong to slender pyriform; size extremely large, weight 28 to 36 ounces, and occasionally up to 48 ounces, length 7 to 8½ inches, greatest breadth 3¾ to 4¼ inches; base broad to narrow, sometimes pointed, the slender stem about 5 inches long inserted slightly obliquely without depression; apex rounded; surface nearly smooth, deep dull purple in color with numerous russet dots and patches; skin moderately thick, about one-sixteenth of an inch or slightly more, coarsely granular and woody; flesh cream yellow in color, free from fiber or discoloration, and of fine texture; flavor rich and pleasant; quality excellent; seed very small, slender conical in form, about 1½ ounces in weight, tight in the seed cavity, with both seed coats adhering closely to the cotyledons.

AKBAL. (No. 32.) S. P. I. No. 45505.

The Akbal avocado is a variety noteworthy for earliness, and it has been included in this collection primarily because of this characteristic. It is, however, of very good quality and has no visible defects except a somewhat undesirable shape. Judging by its behavior in Guatemala, it should be the earliest variety in the collection, but it is not safe to depend upon its retaining this characteristic in the United States, since slight local variations in soil or climate sometimes affect the time of ripening very noticeably, and its earliness may not be altogether an inherent characteristic.

The parent tree is growing in the grounds of Eulogio Duarte, near Amatitlan. The location is known as Los Rastrojos and is about 2 miles from the plaza of Amatitlan, on the road which leads past the cemetery toward the hills. The altitude is approximately 4,200 feet. The tree is about 40 feet high, spreading but of compact growth, the crown being fairly dense. The trunk is about 20 inches thick at the base and branches 10 feet from the ground. According to the owner, the tree is 6 years old, but judging from its size it can not be less than 20. It seems to be vigorous and in good condition. The bud wood which it yields is fairly satisfactory, the growths being well formed though not very stout, while the eyes are vigorous and do not drop quickly.

This is rather a warm region; hence, there is nothing to indicate that the variety will be unusually hardy.

The crop harvested in the fall of 1917 was a good one. According to the owner, it was 600 fruits, but it seems probable that it was considerably more. The bearing habit of the tree gives promise of being very satisfactory. The flowering season is in November and December, and the fruit ripens from the following August to November. It is fully ripe and in perfect condition for picking by the middle of October, whereas the average variety of the same region is not mature until January at the earliest.

In two characteristics this variety does not seem to agree with the Guatemalan race. It has a thin skin and the seed coats do not adhere closely to the cotyledons. A few other varieties showing these same characteristics were seen in the same locality, and it is possible that they may not be true Guatemalan avocados, though in most respects they appear to belong to this race.

In form the fruit is long and slender, sometimes slightly curved, and sometimes becoming pyriform. It is medium sized, weighing about 12 ounces. The surface is smooth and deep green in color. The skin is thin and surrounds deep-yellow flesh of good quality, without fiber or discoloration. The seed is medium sized, and while it never rattles in its cavity it does not fit as snugly as it does in nearly all other Guatemalan varieties.

A formal description of this variety is as follows:

Form elongated to slender pyriform, sometimes curved; size medium, weight 12 ounces, length 5½ to 6½ inches, greatest breadth 2¼ to 3 inches; base narrow, rounded, the short, stout stem (2 to 3 inches long) inserted obliquely; apex rounded to broadly pointed, the stigmatic point slightly depressed; surface quite smooth, uniformly bright green in color, with very numerous minute yellowish dots; skin very thin, less than one-sixteenth of an inch, but firm and tough; flesh rich yellow near the seed cavity, changing to light green near the skin, firm, or fine texture, free from fiber, and of rich, nutty flavor; quality very good; seed medium sized, weighing about 1½ ounces, conical to slender conical in form, the cotyledons smooth, with the seed coats adhering loosely.

ISHIM. (No. 34.) S. P. I. No. 45562.

While most avocados in the Antigua region do not ripen their fruits until February or March, the Ishim tree matures its entire crop by the end of November. It can be considered, therefore, a very early variety, and as such is worthy of a trial in California, where early varieties of the Guatemalan race are much desired. Its only visible defect is its somewhat large seed. The quality is good, and the fruit is attractive in appearance.

The parent tree is growing in a small coffee plantation belonging to Ignacio Hernandez, situated on the hillside above San Lorenzo del Cubo, a village some 3 miles from Antigua. The elevation is about 5,500 feet. The tree is about 35 feet high, broad and spreading in habit, with a fairly dense crown 40 or 45 feet broad, slightly inclined to droop. The trunk is divided into two main branches, one about 1 foot thick at the base, the other 9 inches. The larger branch divides 8 feet above the ground into two main limbs. The growth seems to be reasonably vigorous and the branchlets are well formed and stout. The bud wood appears to be quite satisfactory.

This location is not sufficiently high to experience very cold weather; hence, the variety must be assumed to be of average hardiness for the Guatemalan race until it can be tested in the United States.

The productiveness of the variety is somewhat in doubt. The crop harvested in 1917 was not large. The tree bloomed heavily in December, 1917, and was setting a good crop when last seen. The season of ripening extends from October to the first of December. Probably the fruits would remain on the tree later than December if allowed to do so, but as avocados are very scarce at that season of the year they are picked as soon as they mature.

The form of the fruits, pear shaped to obovoid, is attractive, as is the deep maroon-purple color which they assume upon ripening. They are of convenient size, about 12 ounces, and the flesh is yellow and of good quality. The seed is larger than in the best late varieties, but not unreasonably so. It is tight in the cavity.

Following is a formal description of the variety.

Form most commonly pyriform, but sometimes obovate; size below medium to medium, weight 10 to 12½ ounces, length 4 to 5 inches, greatest breadth 2⅞ to 3⅛ inches; base narrow to rounded, the stem inserted obliquely almost without depression; apex rounded or obtusely pointed, somewhat flattened around the stigmatic point; surface almost smooth, sometimes pitted, deep, dark maroon-purple in color, with numerous small light maroon dots; skin unusually thin for this race, slightly less than one-sixteenth of an inch, soft, tender, peeling fairly readily when the fruit is fully ripe; flesh fine grained, buttery, cream yellow in color, with slight fiber discolorations in some specimens but no actual fiber, the flavor moderately rich and nutty; quality good; seed large, broadly conical to nearly spherical in form, weighing 1½ to 2¼ ounces, tight in the seed cavity, with the seed coats adhering closely to the cotyledons.

KANAN. (No. 35.) S. P. I. No. 45563.

The Kanan avocado is an early variety (Pl. XXIII) from the Antigua region, of rather large size, desirable form, and excellent quality. Although a round avocado, the seed is not large in proportion to the size of the fruit, but on the contrary is rather small. On the whole this seems like a very promising variety.

The parent tree is growing in a small coffee plantation belonging to Ignacio Gonzales, situated on the road to San Antonio Aguas Calientes, just beyond the village of San Lorenzo del Cubo. The elevation is approximately 5,300 feet. The tree is about 35 feet high, with a trunk 30 inches thick at the base, dividing 2 feet above the ground to form two main limbs each 1 foot in diameter. These give off their first branches about 12 feet from the ground. The bud wood is excellent, the branchlets being stout, well formed, with vigorous buds conveniently placed.

The tree did not produce a heavy crop from the 1916–17 blooms, but is said to have borne more heavily in past seasons. It flowers in December and January and commences to mature its fruits the first of the following December. They are not at their best until January.

The climate of this location is not sufficiently cold to test the hardiness of the variety; hence, it must be assumed, pending a trial in the United States, that it is of about average hardiness for the Guatemalan race.

In form the fruit resembles the Trapp of Florida, being round to oblate. It also resembles the Trapp in size and color, but the surface is somewhat rough and the skin thick and hard. The flesh is cream yellow in color, free from discoloration, and of a rich and pleasant flavor. The seed is small and tight in the cavity.

The variety may be formally described as follows:

Form nearly spherical, varying to slightly oblate and more rarely to broadly obovoid; size above medium to very large, weight 16 to 20 ounces, length 3½ to 4½ inches, greatest breadth 3½ to 4 inches; base rounded, the stem inserted very slightly to one side and almost without depression; apex flattened; sur-

face pebbled, bright green in color with a few large yellowish dots; skin moderately thick, nearly one-eighth of an inch, coarsely granular, woody, and brittle; flesh cream color, greenish close to the skin, free from fiber or discoloration, of rich and pleasant flavor; quality very good; seed rather small, weighing about 2 ounces, oblate in form, tight in the cavity, with both seed coats adhering closely to the smooth cotyledons.

CHABIL. (No. 36.) S. P. I. No. 45564.

The Chabil avocado is a small, early variety of attractive appearance, desirable form, and excellent quality. It is similar to the Kanola of this series and is from the same region.

The parent tree is growing in a small coffee plantation belonging to Ignacio Hernandez, situated on the hillside above San Lorenzo del Cubo, about 3 miles from Antigua. The elevation is approximately 5,500 feet. The tree is 45 feet high, the crown round, of good form, 45 feet broad, formed high above the ground. The trunk is 2 feet thick at the base and the branches are 15 feet above the ground. The age of the tree is not known.

The elevation of this location is not sufficient to show whether the variety is unusually hardy or not. It may be assumed to be of average hardiness for the Guatemalan race until it has been tested in the United States.

The crop ripened at the end of 1917 was a very large one, indicating that the productiveness of the variety is likely to prove satisfactory. The flowering season appears to be December and January, the fruiting season November to March.

The fruit is round, weighs about 9 ounces, and is deep purple when fully ripe. The skin is thick and woody. The flesh is of yellow color. The seed is rather small for a round fruit and is tight in the cavity.

Following is a formal description of the variety.

Form spherical or nearly so, usually slightly oblique; size below medium, weight averaging 9 ounces, length 3½ inches, greatest breadth 3⅜ inches; base slightly flattened, the stem inserted somewhat obliquely without depression; apex obliquely flattened but not prominently so; surface practically smooth, deep dull purple in color when fully ripe, with scattering large yellowish dots; skin thick, sometimes more than one-eighth of an inch, very coarsely granular, hard and woody, rather unusually so; flesh rich cream yellow in color, with a few fine and almost unobjectionable fibers running through it, flavor rich and nutty; quality good; seed medium sized, averaging about 1½ ounces in weight, oblate in form, tight in the cavity, with both seed coats adhering closely to the smooth cotyledons.

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
30 CENTS PER COPY

▽