



Ficus Carica

Courtesy Chicago Natural History Museum

have originated; but it may well have been in Arabia or some adjacent subtropical region. It is today one of the important crops of several countries which border on the Mediterranean. It was brought to America by the Spaniards shortly after the Discovery and has attained great commercial importance in California, to a lesser extent in the southern United States, and in the southern part of South America. In Central America it is principally a fruit of the home garden, though figs are to be seen, in small quantities, in the markets.

There are three important groups of figs, (1) the common or Adriatic group, (2) the Smyrna group, and (3) the Capri-fig group. The first is the only one generally cultivated in this part of the world. The varieties grown are not many. One of the commonest appears very similar to, if not identical with, the *Mission* fig of California which was taken to that state from Mexico by the Franciscan fathers at an early day. Figs of the Smyrna group need to be fertilized with pollen from trees of the Capri-fig group. This must be carried by a small wasp of the genus *Blastophaga* which has to be introduced into regions where the cultivation of Smyrna figs is new.

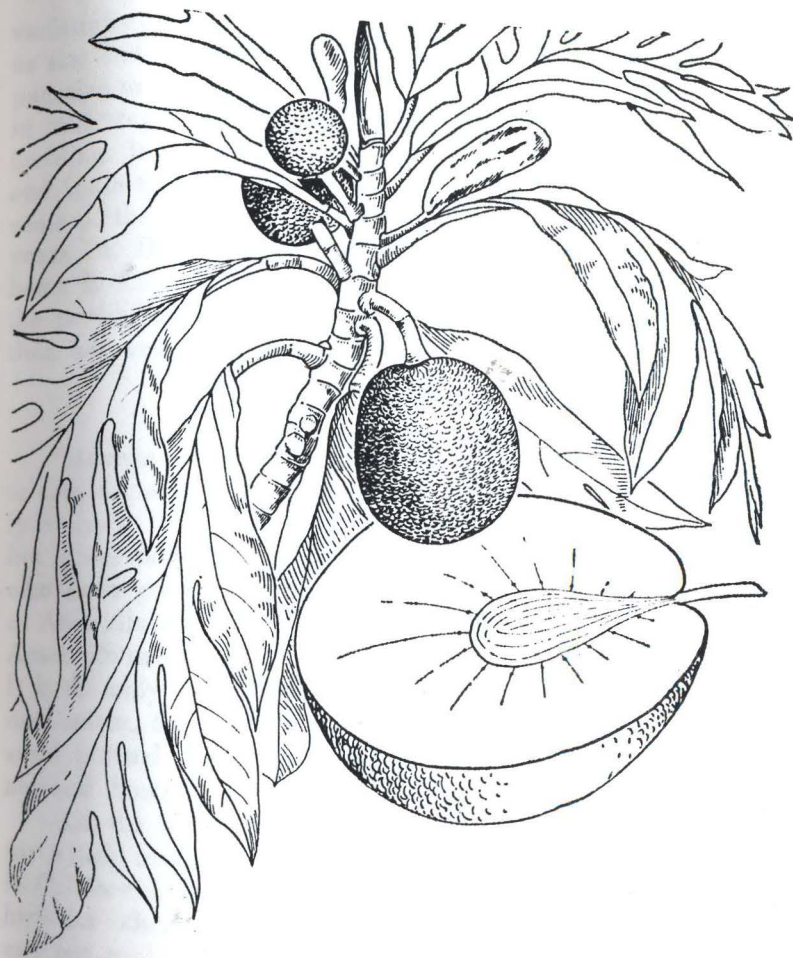
In Central America this tree is cultivated from sea level up to elevations of 3000 meters. The fruits ripen well in dry regions at low elevations especially if grown in patios where they get the benefit of heat reflected from the walls. The trees are not exacting as to soil, though they do not thrive on heavy, poorly drained ones. Propagation by cuttings is extremely simple. It is only necessary to select strong young branches, half-mature, and about 1 cm. in thickness, cut these into lengths of about 30 or 35 cms., and insert them in soil or sand, leaving about one-third of the cutting exposed above the surface. Trees in Central America rarely attain large size; it is sufficient, therefore to plant them 6 or 7 meters apart. Proper formation must be assured by pruning during the first two or three years. Production should commence by the third or fourth year at latest.

Moist weather at ripening time will often cause the fruit to crack or turn sour on the tree. The roots are attacked by microscopic worms called nematodes which sometimes do much damage.

THE BREADFRUIT TREE

This species, *Artocarpus altilis* (*A. communis*, *A. incisa*), is a native of Malaya, where it fills much the same place in the life of the people as the plantain does in tropical America. It was brought at great expense to the British West Indies toward the end of the XVIII century, but it has not proved so useful in that region as was anticipated.

Since it has long been customary to propagate the tree vegetatively, many varieties exist in Polynesia. In Central



Artocarpus altilis

Courtesy Chicago Natural History Museum

America only two are known, the common form which contains many seeds, and a seedless one which is not so abundant though well known in the West Indies, Brazil, and to a certain extent in Costa Rica.

This is definitely a tree of *tierra caliente*. It is occasionally seen at elevations up to 800 or 1000 meters, but it does best in the hot, humid climate of the Atlantic coast. It is not exacting with regard to soil and it withstands poor drainage, for a time at least, better than many other trees. It is propagated

by root cuttings which should be about 2 cm. in diameter and 25 or 30 cms. long. These are placed horizontally in the ground and covered with a thin layer of soil. Since the trees attain large size they should be planted at least 12 or 14 meters apart. They require practically no pruning, even when young, and they come into bearing at the age of three to five years.

FAMILY ANNONACEAE

Horticulturally this large family is best known for the genus *Annona*, which includes a number of fruit-bearing trees native to the American tropics. Closely related is *Asimina triloba* which grows wild in the southeastern and central parts of the United States. This tree has never been given much attention but the fruit, known as pawpaw, is liked by many people.

The anonas are important fruits in Central America. Similarity in the appearance of the trees and fruits of several species, and lack of distinguishing common names, has led to much confusion regarding their identification. For this reason it has seemed worth while to present illustrations of the more commonly grown ones.

In this genus the fruit is formed by the fusion of numerous carpels. Sometimes this fusion is complete, as in *Annona reticulata*; in other cases, as for example *A. squamosa*, the carpels remain more or less separated. Frequently the ovules of many carpels are not fertilized, in which case they do not develop, and this results in malformation of the fruit, a condition with which everyone who has eaten anonas is familiar.

One reason for malformed fruits and scanty production is the following: pollen usually is not shed until the pistils of the same flower have ceased to be receptive (perhaps the following day). This means that pollen must come from another flower, transferred by insects or some other agency. In California it has been found that hand pollination increases production and results in more perfect fruit. This practice is now carried out commercially on a small scale.

Climatic requirements of the various species are sometimes different, hence they must be discussed under the respective headings. Throughout the tropics propagation has in the past been almost universally by seed. Since there is considerable

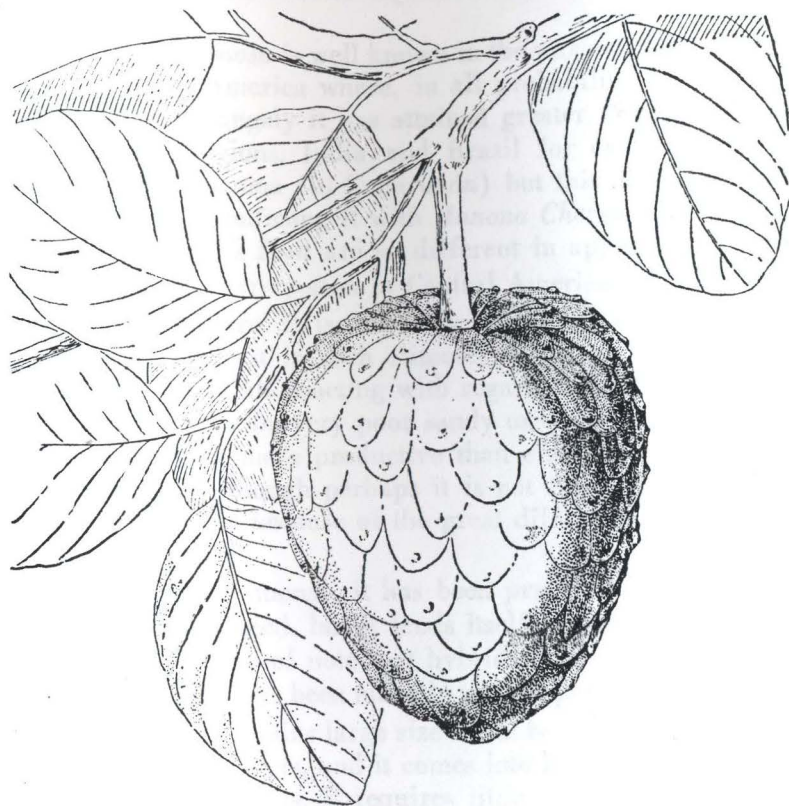
variation among seedlings with regard to productiveness as well as size and quality of fruit, the application of vegetative propagation to this genus offers great promise. It has been shown in other regions that anonas lend themselves readily to shield budding. It has also been found in Florida, the Philippines, and India that hybrids can easily be produced thus combining some of the valuable characteristics of two species. For many years Dr. David Fairchild has worked with this genus at his home in Coconut Grove, Florida, where he has demonstrated the possibilities of improvement through selection, hybridization, and vegetative propagation.

ANNONA CHERIMOLA

Annona Cherimola is the best fruit of its genus if we are to consider anonas from the standpoint of quality. It is probably native to the Andes of southern Ecuador and northern Peru, but it was early carried to Mexico and Central America. It has also been grown for many years in such far-distant regions as Australia and Madeira. In Mexico it is known by the South American name *chirimoya*, but in Guatemala it is called *anona*. It is the only species which has been improved, even to a limited extent, through selection and vegetative propagation; several grafted varieties are offered by nurserymen in California and Australia.

Of the good anonas, this is the most resistant to cold, for which reason it has been possible to grow it successfully in California. It is found at elevations in Central America too high for other species of its genus. It is not, in fact, suited to any but cool climates. When grown in *tierra caliente* it bears sparingly and the fruit is of poor quality. Its zone in Central America extends from 1000 meters to nearly 3000. It prefers a semi-arid climate, one with a dry season of several months duration such as that found in the highlands of Guatemala. It does best on sandy loam soils but will grow successfully on others provided they are sufficiently fertile and drainage is satisfactory.

The *chirimoya* can be grafted on rootstocks of its own species, or on *Annona reticulata* and several others. Experience is still lacking on this point. For the moment it is probably best to use the same species. The technique of grafting is essentially the same as that used with the citrus fruits.



Annona Cherimola

Courtesy Chicago Natural History Museum

Trees grow to considerable size, hence should not be spaced closer than 10 x 10 meters. They require very little pruning; there is, however, a tendency to produce watersprouts; these should be removed as soon as they make their appearance. Fruit production usually commences about the fourth or fifth year.

The most serious pests of the *chirimoya* are insects whose larvae feed on the seeds and frequently cause decay of the ripening fruits. In the West Indies a common one is *Bephrata cubensis*; this or another species is present in Central America. Dr. Edson J. Hambleton reports similar damage done by the larvae of *Stenoma annonella* in Guatemala. Little investigation

has been given methods of control; possibly some of the newer insecticides may be effective against the Bephrata wasps. Trees are sometimes infested by scale insects which can easily be controlled by standard methods.

ANNONA MURICATA

Annona muricata is a smaller tree than the chirimoya with a fruit so distinct in appearance and uses as not to be confused with the latter. It is even distinguishable by its common name, which everywhere is guanábana or guanaba (in English, sour-sop). It is a native of tropical America, cultivated in gardens and dooryards of *tierra caliente*, rarely above the upper level of that zone. Its large ovoid or conical green fruits, sometimes weighing as much as four or five kilograms, are covered with short soft spines (each one representing a carpel) and are rarely eaten out of hand. The white cottony pulp is juicy and extremely popular for the preparation of refreshing drinks and ice creams.

This tree likes a moist climate and is not particular as to soil, but sandy loams are probably the best. So far as known, it has not been propagated commercially except by seed, but experiments have demonstrated that grafting is successful. Since there is considerable variation in the size and quality of fruit produced by different seedlings, it is worth while to perpetuate the best ones by this method. Pending experiments to determine which species of *Annona* is the best rootstock for Central American conditions it is probably advisable to graft on *Annona muricata* itself.

Trees can be planted about 8 meters apart. They usually assume satisfactory form without pruning, a practice that can therefore be limited to the removal of dead and malformed branches. Production usually commences about the third or fourth year. Large crops are rare, as in the case of the chirimoya. It remains to be seen if production can be increased by hand pollination of the flowers. Most certainly it is worth trying.

The worst enemies are insects whose larvae infest the seeds, as in the case of the chirimoya. In dry climates red spiders are sometimes troublesome, and scale insects may occasionally require attention.

ANNONA SQUAMOSA

Annona squamosa is well known in the warmest and driest parts of Central America where, in all probability, it is indigenous. Rather strangely it has attained greater importance in several distant regions, India and Brazil for example. It is commonly called anona (in Cuba *anón*) but this does not necessarily result in confusing it with *Annona Cherimola* because both the tree and its fruit are so different in appearance.

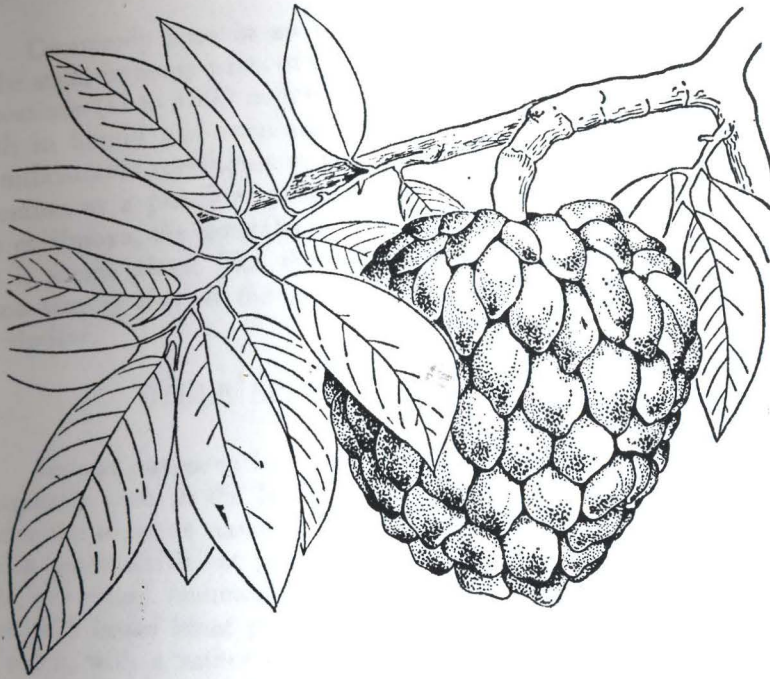
This plant is rarely seen in Central America above elevations of 1000 meters. It is not fully successful in humid regions. It is at its best in such climates as that of the Pacific littoral. It is not at all exacting with regard to soil; it is often seen growing lustily on very poor sandy or stony ones. In general it seems to be more productive than either the chirimoya or the guanabana though perhaps it is not fair to compare it with the last named because of the great difference in the size of the fruits.

Like the other anonas, it has been propagated in Central America solely by seed, but it lends itself readily to grafting, and it is also worthy of note that hybrids between this species and the chirimoya have been made in several parts of the world.

Since it never attains large size it can be planted as closely as 5 x 5 or 6 x 6 meters, and it comes into bearing at an early age, three or four years. It requires little or no pruning. The tree is sometimes attacked by scale insects and the fruits suffer from infestations of seed-boring larvae, most likely the same ones which so often attack the fruits of the chirimoya and the guanábana.

ANNONA DIVERSIFOLIA

Annona diversifolia is probably the least known of those species of *Annona* which produce really good fruits. Its distribution seems to extend from western Mexico down the Pacific littoral to Nicaragua. In a few parts of this region it is quite popular, especially at Tapachula, Chiapas, where it is known as papauce, and in El Salvador where it is usually called anona blanca. In Mexico north of the Isthmus of Tehuantepec it is said to be called ilama.



Annona squamosa
Courtesy Chicago Natural History Museum

The fruit is very similar to the chirimoya in size and appearance except for the color. Sometimes it is covered with a thick whitish bloom, sometimes it is deep pink or almost red. The seeds are larger than those of the chirimoya.

Since this tree grows in *tierra caliente* where the chirimoya is not successful and since its fruit is so closely similar to that of the latter it has been suggested that it might well be called "chirimoya de tierra caliente". There is sufficient variation among the fruits of different seedlings to indicate that it will be worth while to select the best individuals and propagate them by grafting.

The papauce definitely prefers a semi-arid climate, but does not seem to be exacting with regard to soils, being in this respect somewhat like *Annona squamosa*. An appropriate spacing would seem to be 6 x 6 meters and, as with other anonas, practically no pruning is required. Since this tree has received little attention at the hands of horticulturists no information is available regarding pests.



Annona reticulata
Courtesy Chicago Natural History Museum

ANNONA RETICULATA

Annona reticulata, while one of the most widely cultivated species of its genus is also one of the poorest so far as fruit is concerned. It resembles the chirimoya so closely in size and appearance of fruit as to be confused frequently with the latter but is easily distinguished by the foliage. The chirimoya has broad leaves, velvety on the lower surface, while *A. reticulata* has more slender leaves, glabrous throughout. The usual common name in Spanish is anona, which increases the confusion.

Commonly seen in an indigenous state, or what appears to be such, in many parts of Central America at low to medium elevations (0 to 1500 meters), it is also planted in dooryards both in humid and semi-arid climates. It is highly resistant to unfavorable conditions of soil, and for this reason deserves attention as a possible rootstock for superior anonas such as the chirimoya, the guanábana, and the papauce. In productivity it seems about like the chirimoya. The tree attains the same size as that of the latter and cultural practices should be similar.

OTHER SPECIES OF ANNONA

Annona purpurea is a small to medium-sized tree not infrequently seen in the lowlands of both coasts where it goes under the common name of soncuya, chincuya, etc. Its fruits, which enjoy sufficient popular esteem to be sold in the markets, are round, commonly about 15 cm. in diameter, and covered with broad blunt protuberances. The flesh is deep yellow in color, with a rather strong flavor. Two other species, *Annona scleroderma* and *A. testudinea*, grow wild in parts of Guatemala, but are not common. Their fruits are about the size of small chirimoyas and are sufficiently good to merit horticultural attention. *Annona glabra* is a large shrub or small tree which grows in swampy places such as the edges of lagoons. Its fruits are oval in shape, smooth on the surface, 10 or 12 cm. long, and have bright orange-colored flesh. They are scarcely edible, but it has been suggested that the species may have value as a rootstock for better anonas because of its adaptability to unfavorable conditions of growth. It is highly resistant to water, as shown by its habitat, as well as to cold, as shown by the fact that it grows abundantly in southern Florida.

FAMILY LAURACEAE

To the Lauraceae, a large and important family, belongs the classic laurel (*Laurus nobilis*) of the Mediterranean region, as well as the trees which produce cinnamon and camphor. It is not, however, a family notable for edible fruit-bearing species, with exception of the genus *Persea*. The fruit of *Persea*

americana (*P. gratissima*), known universally in Central America by the name aguacate (from the Aztec *ahuacatl*) and in parts of South America as palta, is a favorite in many tropical and subtropical regions. In prehistoric times, by the laborious process of selection and propagation by seed, the avocado was developed from small-fruited wild forms, of which many are still to be found in the forests of Mexico and Central America, to the splendid varieties now being propagated vegetatively, varieties which so admirably meet the needs of man that modern science has not yet been able to better them materially.

THE AVOCADO

Whether or not the avocados of today had their origin in a single wild species or whether they represent a combination of several cannot be stated, though the problem has received much investigation during the past thirty or forty years. The situation is perhaps comparable to that of the mango, a tropical fruit of Asiatic origin. Both have been in cultivation for such long periods that it is now impossible to trace their early history. But it is fairly clear that the wild ancestor, or ancestors, of the cultivated avocados grew on the mainland of tropical America, most probably in the region between central Mexico and the Isthmus of Panama. When the Spaniards arrived, they found avocados cultivated from Mexico to Peru. They seem to have been carried from Ecuador to Peru by the Incas shortly before the Conquest; but they were not in eastern South America nor in the West Indies.

Whatever may have been their origin, three rather distinct races of avocados came into being, whose distinguishing characteristics from the horticulturist's point of view are shown in the following key:

The leaves when crushed have an anise-like odor
Tree relatively cold-resistant. The fruit, which matures six to eight months after appearance of the flowers, is small, thin-skinned, usually with a large seed

MEXICAN RACE

The leaves when crushed do not have an anise-like odor
Tree less cold-resistant than the above. The fruit matures 10 to

15 months after appearance of the flowers; it is medium to large, frequently rough on the surface, and has a thick woody skin

GUATEMALAN RACE

Tree still less resistant to cold. The fruit matures six to eight months after appearance of the flowers; it is medium to large in size, with a thick but not woody skin

WEST INDIAN RACE

The Mexican race was given that name because it is most common in Mexico, though it was carried at an early day to Ecuador and Chile, in both of which countries it is now well known. The West Indian race was so named because it was, until recently, the only one found in the Antilles although it is not native there, but was probably carried from the mainland by the Spaniards soon after the Conquest. The Guatemalan race is so named because it is abundant in the highlands of Guatemala, though it has been grown for a long time in a few parts of Mexico, notably at Atlixco, state of Puebla, where it appears to have hybridized naturally with the Mexican Race. The result of this hybridization has been the formation of a group of trees, in character more or less intermediate between the two races. This group has furnished the most important commercial avocado of the present day, the variety *Fuerte*.

Natural hybrids seem also to have been formed between the Mexican and West Indian races, and between the West Indian and the Guatemalan. As a result of all this it is necessary to think in terms not only of the three races, but also of hybrids between any two of them; and it is the hybrids which are now taking the lead, commercially speaking, in many of the principal avocado growing regions of the world.

The consumption of avocados in the United States, where the fruit was practically unknown before 1900, is increasing annually. In a recent publication, Professor Robert W. Hodgson of the University of California shows that since 1940 it has several times passed 25,000 tons. California has been the largest producer; Florida and Cuba have alternated in taking second place in supplying the North American market. These figures are cited merely to indicate the growing importance of the avocado in other regions. Every Central American knows and appreciates the value of this fruit.

Though orchards planted with grafted trees of the best varieties are still rare in this part of the world, primarily because there has been an abundance of fruit from seedlings, it can not be doubted that many orchards will be established in the future, if not for the export trade at least for the production of high-class fruit for local use. Such a development is already taking place in Mexico.

The West Indian race is adapted to tierra caliente. It has not proved satisfactory above 1000 or 1200 meters. One of the best varieties is *Simmonds*, which originated in Florida; its fruit is of relatively large size, attractive appearance, and excellent quality. It is a regular and abundant producer. *Waldin* is later in ripening and in Florida is a popular commercial avocado for this reason. In many parts of Central America, notably in the region of Chinandega, Nicaragua, there are seedlings of this race so good as to merit vegetative propagation.

The Guatemalan race is suitable for elevations of 1000 to about 2000 meters. *Nabal* has proved to be one of the best; it came originally from Antigua, Guatemala. Its fruit is medium to large in size, round, of excellent quality. Another good one is *Hass*, which originated in California where it is assuming commercial importance. *Hass* is a small fruit, dark purple in color, of good quality, and the tree is very productive. It is also more regular in bearing than *Nabal* — an important feature for avocados of the Guatemalan race unfortunately have a tendency to yield a heavy crop one year, a very light one the next.

Varieties of the Mexican race are suited for cultivation at high elevations — about 1500 to 3000 meters. They are scarcely known in any part of Central America at present. Several good ones are grown in California where this race has the advantage of superior resistance to cold, but because the fruits do not withstand shipment very well, they have not become popular commercially. *Topa Topa*, *Duke* and *Mexicola* are among the best.

In addition to varieties of the three races, it is necessary to mention a few of the hybrids which have special value because they mature at seasons of the year when avocados may be scarce in local markets. Hybrids between the West Indian and Guatemalan races are abundant in Florida and ripen con-

siderably later than avocados of the West Indian race. Some of the more important ones at present are *Lula*, the *Booth* numbers 1, 7 and 8, and a few like *Hall*, *Simpson*, *Choquette* and *Hickson* which have not been tested sufficiently on a commercial basis. These have fruited at Escuela Agrícola Panamericana and look promising.

The most important group of hybrids, however, is that which had its origin in Atlixco, Mexico and which is represented by *Fuerte*. These hybrids are believed to be the result of crossing and recrossing through several generations. There are many of them but only a few have attained commercial importance. They combine, to a certain extent, the resistance to cold of the Mexican race and the large size and thick skin of the Guatemalan. They should prove valuable in Central America at elevations of 1000 to 2500 meters. *Fuerte* has already been tested rather widely in this part of the world.

It will be understood from the above discussion that the proper climate for avocados in Central America is largely a matter of race, or the kind of hybrid. There are varieties suitable for all elevations from sea level to nearly, if not quite, 3000 meters. In semi-arid climates it is necessary to irrigate the trees every 15 to 30 days during the dry season, though in regions such as the highlands of Guatemala mature trees survive this season without irrigation. As to soil, the matter is quite clear. Avocados do well on many kinds, from light sandy loams to clays, but they must have perfect drainage. This will be mentioned later in connection with the discussion of diseases.

In spite of the fact that avocados have been grown from seed since ancient times, Central American horticulturists now realize that the best results can only be obtained through vegetative propagation, just as in the case of the citrus fruits. Fortunately this tree is easily propagated by grafting, the kind of graft used depending to some extent upon the climate. In wet coastal regions what is known as the herbaceous cleft graft has proved very satisfactory, also the side graft. With these methods a very young rootstock is grafted with a cion. In the dryer regions of middle elevations shield budding, similar to that practiced with citrus fruits, has given excellent results. The rootstock must be in vigorous condition and the bud must be chosen carefully. Some varieties do not produce good budwood and it is difficult to achieve 50% success; others produce

excellent budwood and 90% may be attained. For best results, grafted trees should always be transplanted with soil around the roots ("balled out"). More losses must be expected when they are moved with bare roots.

Since grafted trees do not grow to such large size as seedlings they need not be given so much space. As a general thing it may be said that they should be planted about 8 x 8 or 10 x 10 meters, depending on the variety. Pruning should be held to the minimum. There are varieties which tend to grow laterally, others which tend to grown tall and straight. This should be remembered. To a limited extent only can the tree be formed during its early years. There is no reason for cutting off all the lower branches, a custom prevalent in Central America, not only with regard to the avocado but also with trees in general. There is no objection to limbs close to the ground. Grafted trees should come into bearing two or three years after planting in the orchard, whereas seedling trees usually take longer; and as everyone knows, seedling trees are subject to much variation in other respects as well.

The most serious problem which is encountered, not only here but in most other avocado-growing regions, is what is known as "root rot" or "decline". This has been investigated in numerous countries, and the present opinion of experts is that it is caused by the fungus *Phytophthora Cinnamomi* but that this fungus rarely destroys trees growing in well drained soils. Experience in Central America seems to bear this out. Perhaps the fungus is present almost everywhere. But avocados live many years in such soils as the volcanic sandy loams of the Guatemalan highlands, and they live only a few years on heavy clays which become filled with water during the rainy season. In western Cuba, on porous soils derived from limestone, avocados are an important commercial crop; in eastern Cuba on heavy clay lands they do not thrive.

The fruits of some varieties may be disfigured by a scab-producing fungus, *Sphaceloma perseae*, which can be controlled by spraying with Bordeaux mixture.

Regarding insect pests, Dr. Edson J. Hambleton writes: "In spite of the large number of such pests, there are few occasions where artificial control measures need be conducted consistently to insure a good crop. Perhaps this may be due to the fact that most avocado trees grow sporadically and not

in commercial plantings." This agrees with experience in California, where in the early days of the industry not much trouble was experienced from insect pests. These have increased as the plantings became more extensive. There are several insects present in Central America, the larvae of which tunnel through the seeds and often destroy the value of the fruit. One of these is the avocado weevil *Heilipus lauri*, another a moth of the genus *Stenoma*. No satisfactory control measures have been found. In some regions the last-named is a serious pest. During dry weather red spiders sometimes cause much damage to the foliage. And in many parts of Central America trees may be seen with numerous long conical protuberances on their leaves. These are caused by flies of the genus *Trioza*, for which there seems to be no simple method of control at present. Fortunately they rarely do serious damage.

THE CHININI, COYO, CHUCTE OR YAS

Only one other species of *Persea* is of any importance as a fruit-bearing tree. This is *Persea Schiedeana* known in various regions by the names listed above, as well as by several variations of these. It is indigenous from southern Mexico to Panama but only occasionally seen in cultivation outside the vicinity of Orizaba, Mexico where it vies with the avocado in popularity. Its fruits resemble avocados, though they are commonly more slender in form. They have large seeds, the flesh is not so yellow, and usually contains many rather tough fibers. The flavor is different from that of the avocado; it has a suggestion of coconut and is very pleasant.

There is much variation among seedling trees of this species, particularly with regard to size and shape of the fruit and the amount of fiber in the flesh. Occasional trees produce fruits sufficiently good to merit propagation by grafting. Experiments at the Escuela Agrícola Panamericana have shown that this is feasible. It has been thought, in fact, that the coyó might serve as a rootstock for the avocado on soils which are too heavy for the latter. Experiments to test this possibility are under way.

Persea Schiedeana is more adaptable with regard to climate than any of the horticultural races of avocado, for it grows and produces fruit in Central America from the seacoast up to altitudes of 1500 meters or more.

FAMILY ROSACEAE

The most important fruits of the Temperate Zone belong to the Rosaceae, a large family which includes more than ninety genera with 2000 to 3000 species. Some members of the family, for example, the strawberries, are small herbaceous plants, others are scrambling shrubs such as most species of the genus *Rubus*, while still others, the most important ones, are trees of good size; for example apples, pears, plums and peaches.

Few fruit-bearing plants native to tropical America belong to this family and these are mostly to be found in the cool highlands. But ever since the days of colonization there has been widespread interest in growing the fine fruits of the Temperate Zone, developed through centuries of selection and vegetative propagation in Asia, in Europe, and more recently in North America and elsewhere. The first Spanish settlers planted them in the highlands where they thought conditions most favorable. Many problems were encountered, many failures were experienced.

Much has been learned, more remains to be learned. Apples, pears and peaches have long been cultivated in Guatemala and other Central American countries. Until recent years, however, little attention was given the problem of varieties. Apples were apples and peaches were peaches. No effort was made to search for the finest seedling forms of local origin and propagate them by grafting. Few improved varieties were brought from abroad. This state of affairs is rapidly changing.

Two major factors must be taken into account by the horticulturist who wishes to grow these trees in the tropics. First, they require a dormant or rest period during which the climate must be sufficiently cool to complete the normal biological cycle; and second, the amount of cold required to do this varies not only from species to species but even between different varieties of the same species. This latter point is of great im-

portance. It may often mean the difference between success and failure.

The "chilling requirement" is a definite, measurable factor. It has been studied intensively in the United States where, for example, it is stated that the commonly grown peach varieties require 600 to 900 hours of temperature below 7° C. in order to produce good crops.

Meteorological records are scarce in Central America. There are not many places where the number of hours per year of any given temperature is known. Much has been learned, however, by experience. For example, plums do not as a rule produce well in the valley of Antigua, Guatemala, but seven kilometers distant at an altitude 400 meters greater they are grown commercially. This small difference in altitude has proven sufficient to provide the additional cold necessary for normal development of the tree and the production of good crops. But again, it should always be remembered that much depends upon the variety. Certain plums need more cold than others. Since the Rosaceous fruits in general come from regions colder during part of the year than the populated areas of Central America, the most useful feature of the discussion which follows may well be the recommendations concerning varieties which do not require very low temperatures to fulfill their chilling requirements.

In general it may be said that the peach needs the least cold of the principal Rosaceous fruit trees. The pear and plum come next, while the apple requires the most cold. These fruits will, therefore, be discussed in this order. It should be remembered that climatic conditions peculiar to the locality and hard to define may come into play, as well as adaptations which are the result of long continued cultivation in a given region. For example, apples are grown at Güinope in Honduras, altitude 1400 meters, though in many other regions recently introduced apple varieties have not been successful at elevations this low. What is the explanation? The apple grown at Güinope, a very inferior one, may have become adapted through long cultivation in the region. Or some peculiar feature of the local climate may be responsible in part.

There are similar cases in other regions. The horticulturist should beware, however, of hoping that he can "acclimatize" a fruit tree if local conditions are definitely unfavorable.

Acclimatization is an extremely slow process. To illustrate the point: the idea prevalent in some quarters that by protecting a plant during its first few years it can gradually be made to grow successfully in a climate by nature too cold for it has little foundation in fact. Of course, this does not mean that plants will not stand more cold when they have developed woody branches than they will when young and soft.

THE PEACH

The peach, native to China and known botanically as *Prunus Persica*, is grown more widely in Central America than the other important Rosaceous species, the reason being its adaptation to a wider altitudinal range. The great majority of peach trees seen in this part of the world are seedlings descended from trees introduced in colonial times. They vary in the size and quality of their fruits, most of which are small and practically all of the kind called in Spain "pavías", that is, clingstones. Freestone varieties, called "abridores", are extremely rare. Incidentally, the name "melocotón" used for this fruit in Spain is not common in Central America and is generally applied only to the largest and finest, usually imported, varieties.

Because peaches of European origin need more cold weather than do those from southern China, varieties from the latter region, or hybrids between them and European peaches, have long been cultivated in the extreme southeastern part of the United States and more recently in Southern California. They have been planted in Central America to a limited extent and have proved better adapted to local climates, especially the lower elevations, than others. In many cases they have the advantage of being freestones of excellent quality. Of the numerous varieties available in Florida, *Jewel*, *Angel* and *Waldo* have proved very satisfactory in Guatemala and Honduras. In California several new ones are offered. *Babcock* is one of the best known. Others are *Hermosa*, *Sunglow* and *Weldon*. While horticulturists in Central America should not limit themselves to these varieties, they would do well in most cases to plant those which have been developed from the south Chinese race.

The best climates for peaches are those of the semi-arid regions between 1000 and 2500 meters elevation. Light porous

soils are definitely preferable; the peach does not thrive on heavy ones. Propagation should be by shield budding on rootstocks of the common peach. In other parts of the world certain varieties of plums (especially *Prunus cerasifera*) are sometimes used but seeds of these are not yet easily obtainable here.

Spacing can be 6 x 6 or 7 x 7 meters since the trees do not grow to large size. They require intelligent pruning during their early years to form well branched crowns. Later, since most of the fruit is borne on new wood, old branches should be shortened annually to induce new growth. The trees come into bearing at an early age, usually by the third or fourth year at latest, but are not long-lived. In this they differ from the other Rosaceous fruits, notably the apple.

Not much is known regarding enemies of the peach in Central America. The trees are attacked by some of the scale insects which can easily be controlled with oil emulsions. Brown rot of the fruit is common.

THE PLUM

In recent years plums have become so abundant in Guatemala as to appear regularly in the markets of the capital and a few other cities. Unlike peaches, plums do not seem to have been cultivated in Central America to any extent until recent times and it is interesting to note that the small but growing plum industry is based on the use of an imported variety propagated locally by grafting.

Of major importance in the development of cultivated plums are two distinct species of the genus *Prunus*. One of these is *Prunus domestica*, a native probably of southwest Asia, and the other is *Prunus salicina*, a native of China. From the last-named species have been developed varieties such as *Santa Rosa*, the one most commonly grown in Guatemala, much better adapted to subtropical climates than are most European plums.

Professor W. H. Chandler of California writes that the varieties *Inca* and *Mariposa*, now available there, need less chilling than *Santa Rosa*, but they require cross pollination. This brings up a feature of plum culture which must be kept in mind. Many varieties are not fruitful unless they receive the pollen of others which must blossom at the same time.

It would also seem worth while to plant experimentally some of the plums which have originated in Florida as hybrids between *Prunus salicina* and native species. The Glen St. Mary Nurseries of Glen St. Mary, Florida, recommend *Excelsior*, *McRae*, and *Terrell* as the best of this group. The Japanese variety *Satsuma* seems worthy of trial in regions where it has not yet been tested.

Plums can be grown successfully in the highlands, at least in semi-arid regions, at altitudes between 1800 and 2500 meters. Further experience, and possibly new varieties with a wider range of adaptability, may extend these limits. Plums do well in nearly all good soils, but the lighter ones are probably the best.

In northern countries propagation is commonly by shield budding, but other methods of grafting can be used. In Guatemala cleft grafting is popular. For rootstocks the common peach is considered good provided the trees are not to be grown on heavy wet soils. The small fruited plum, *Prunus cerasifera*, is excellent but is not easily obtainable here, as was mentioned in connection with the discussion of peach rootstocks.

Since plum trees do not grow to large size it is customary in Guatemala to plant at 5 x 5 or 6 x 6 meters, sometimes even closer than this.

Like other Rosaceous fruit trees, plums need intelligent pruning during the first years. Later, they need less than peaches. They come into bearing at three or four years of age and if properly pollinized yield abundant crops. The grower should investigate carefully the requirements, in this latter respect, of the variety or varieties he proposes to plant.

Little information is available regarding enemies of the plum tree in this part of the world.

THE PEAR

Among major Rosaceous fruits the pear is perhaps the one which has been least successful in Central America, though planted here since early days. Pears which can vie in quality with those of Europe or the United States are practically never seen in the markets. Large fruits are produced, but rarely do they have the juiciness and aroma of fine pears.

Varieties of the European species, *Pyrus communis*, were probably the only ones known here until recent years when

several hybrids between that species and the Japanese *Pyrus serotina* (*P. pyrifolia*) were introduced. Some of these seem likely to be more successful than the European pears, but the quality of their fruits, unfortunately, is inferior. Professor Chandler suggests that *Forelle* and *Winter Nelis* of the latter group perhaps have the best chances of success in the tropics; among the hybrids two good ones are *Kieffer* and *LeConte*.

To insure good production it is recommended that two or more varieties be planted in close proximity to each other.

In the southern United States pear trees of the European species are subject to a serious bacterial disease known as fire blight, which in many regions renders their successful cultivation impossible. Hybrids between this species and *Prunus serotina* are relatively resistant and at the same time need less cold weather. When planted in the highlands of tropical America some of these hybrids have shown a strong tendency to make long unbranched growths and it has even been impossible to form good crowns by pruning severely.

Pears are usually grown in the semi-arid highland regions at elevations between 2000 and 2500 meters. The best soils seem to be the heavier ones but they must have good drainage. Some of the hybrids, however, do well on light soils. Propagation should be by shield budding, through cleft grafting is often used in Guatemala, on rootstocks of the common pear or on quince. The latter produces a dwarf tree.

A suitable spacing seems to be about 6 x 6 meters, since pears rarely grow to large size in this part of the world. Trees should come into bearing about the fifth or sixth year and are long-lived in comparison with the peach.

THE APPLE

The apple, a most important fruit in many European countries and in North America, has not been as successful in Central America as one could wish, most probably because to produce abundant crops it requires more cold than is experienced in most regions where it has been planted. Crops such as those commonly seen on apple trees in the temperate zone are rarely to be observed in this part of the world. Nor does the fruit in general seem to attain the high quality which is characteristic of apples produced in more northern regions.

Botanically known as *Malus sylvestris* (*Pyrus Malus*), the apple tree is a native of the colder parts of Europe and Asia, which explains why it is not really at home in the tropics, even at high elevations. A thousand or more varieties are known. Professor Chandler suggests that the following should be given particular attention in this part of the world: *White Astrakhan*, better suited for cooking than for eating fresh, and *Winter Banana*, a vigorous grower producing fruit of fair dessert quality. *White Winter Pearmain* and *York Imperial* he thinks promising. In addition to these older varieties there are several new ones developed especially for climates which do not have much cold weather. His own variety *Beverly Hills* is one of these; *Hume* is another.

Though apples are sometimes grown at elevations as low as 1400 meters, the best zone is probably that which lies between 2200 and 3000 meters. Very wet climates should be avoided, but at high altitudes in Central America rainfall is not usually heavy. Deep sandy loams are the best soils.

Propagation is by shield budding or cleft grafting on rootstocks grown from the seeds of cultivated apples. Since the trees live for many years and attain fairly large size, they should be planted about 8 x 8 or 9 x 9 meters. During the first few years they require the same careful pruning as most other Rosaceous fruit trees in order to form well branched crowns. Later they require relatively little pruning. They should come into bearing by the fifth or sixth year after planting.

In some regions the woolly aphis is a serious pest. This attacks superficial roots just under the surface of the ground and is, therefore, difficult to reach. There are also several insects which may infest the fruit. In general it may be said, however, that apple trees in Central America suffer from the attacks of few pests.

OTHER TREE FRUITS OF THIS FAMILY

Doubtless for climatic reasons European cherries (*Prunus avium*) have never become generally cultivated in any part of Central America. It is reported that they have produced fruit in the valley of Quezaltenango, Guatemala which lies at an altitude of about 2400 meters.