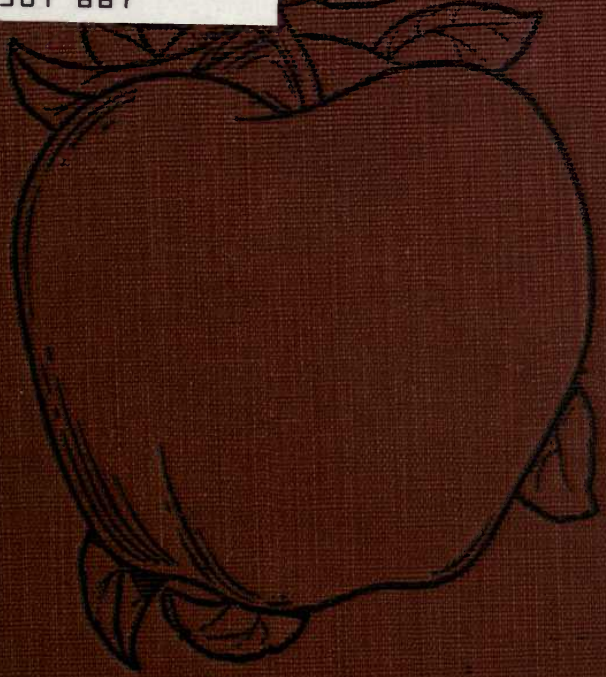
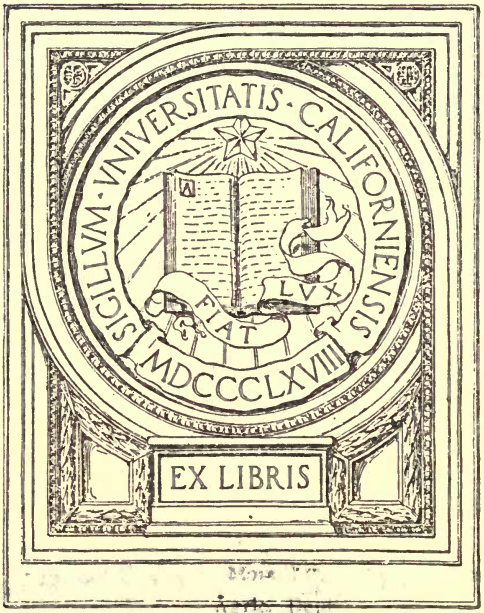
The Fruit-Growers Guide-Book




SIGILLVM · VNIVERSITATIS · CALIFORNIENSIS
LVX
FIAT
MDCCCLXVIII
EX LIBRIS

J. C. Whitten

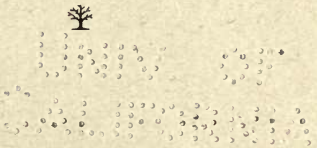
THE FRUIT-GROWERS GUIDE-BOOK

The Fruit-Growers Guide-Book

BY

E. H. FAVOR

Associate Editor
THE FRUIT-GROWER



Published by
THE FRUIT-GROWER
St. Joseph, Mo.
1911

PREFACE

This little book has been prepared as a means of assisting many persons who have answered the call "back to the land," and who are undertaking the growing of fruit on a commercial scale. It is not intended as an exhaustive treatise on fruit growing, as such is manifestly impossible within the size of such a book. Neither is it expected to tell all that is to be told about fruit growing. Its purpose is to serve for the guidance of the beginner and as a handy reference manual for the busy orchardist.

The foundation upon which this little book is based is the many letters which reach the office of The Fruit-Grower, containing inquiries about many phases of fruit-growing. These inquiries come from all parts of the United States and from Canada, and cover almost every phase of horticultural work, although in preparing this book only the general problem of growing the ordinary deciduous orchard fruits has been considered. This problem has been considered in a very general way without specific directions for any particular fruit. Where details for a given fruit have been needed, the treatment of the subject has been boiled down to as concise a form as possible.

The present age is witnessing a remarkable advancement in fruit growing, as well as all other lines of agriculture. This development is coming about through the fact that greater individual attention is being given to each line of work. Fruit-growing has been largely a matter incidental to the general line of farming. But as it is the specialist in any line who succeeds, so it has come that the business of growing fruit has been drawing away more and more from its connection with other phases of farming. This very fact is one of the great reasons for the rapid advancements which have been made in orcharding. So rapid is the advancement in fruit-growing that the progressive orchardist must be continually on the alert to keep up with the new ideas and practices which are being developed. Ten years ago the box as an apple package was practically unknown. The spraying machine was a novelty and was looked upon with suspicion; fruit-growing under irrigation was a novelty in the extreme and cold storage plants were rare. Even so recent as three years ago, but few fruit-growers had ever heard of really effective means of beating Jack Frost at his own game. But the orchard man of the hour knows how to spray effectually, how to pack his fruit, how to fight frost; recognizes all of these things as vital factors in the management of his business.

The facts which are outlined in this volume have been culled and compiled from many of the important articles which have appeared in the columns of The Fruit-Grower during the past two or three years, as well as from some of the bulletins which have issued from the Bureau of Plant Industry of the United States Department of Agriculture and the State Experiment Stations. These articles

have been condensed and only the essential facts retained, to bring them within the space of one small book. The publishers have for a long time felt the need for such a book as this, and it is their hope, as well as the hope of the writer, that it will be of assistance to many persons in paving the way for more profitable orchards and better homes.

January, 1911. E. H. FAVOR.

CONTENTS

ILLUSTRATIONS

"BROTHER JONATHAN"
Trade Mark of The Fruit-Grower
St. Joseph, Mo.

CHAPTER I

The Orchard

One of the first questions that confronts a person who is starting an orchard is the problem of where to put it. It is true that fruit trees will grow and thrive under a variety of conditions, but there is always one which is best. This condition is based on such factors as the soil, site, location, kind of fruit that is to be grown and markets that are to be supplied.

Soils for an Orchard

Apple trees will grow on a great variety of soils, but they do best on well drained, deep, rich clays and loams. The early summer apples do well on light sandy soils, because they ripen their fruit before the dry weather of summer reduces the amount of available soil moisture. Late maturing varieties can be made to ripen their fruit a little earlier by planting on warm soils, such as the lighter clays. Late apples do best on heavy soils, as such are usually more retentive of moisture. Excessively rich soils, such as some of the muck lands of the Northern and Eastern states, will produce very rank-growing trees, but they will not be very good fruit producers, as the energy of the trees is spent in producing wood. On such soils there is the added danger of the wood growth being so soft at the time winter comes that the branches will be severely frozen back.

Orchard soils should be rich, however, as it takes a great amount of soil fertility to supply the necessary elements to build up the wood in the tree, and this must

always be done before the fruit can be developed. Nursery trees are very hard on the soil, and for this reason nurserymen know that it is necessary to fertilize their lands very thoroughly, as by that means only can they produce good, strong and vigorous trees. If trees con-

A wash through deep soil. Such a soil is ideal for fruit, as it allows the roots to penetrate to a great depth.

tinued to grow as thriftily in the orchard as they do in the nursery, there would be a thousandfold greater returns from the orchard than there are today. A very large proportion of the trees that are planted in the orchard today are lost by starvation before they reach bearing age. A

soil which has been cropped to death and worn out before being planted to trees is not suitable for orchard land until after it has undergone several years of soil improving culture.

New Land

New land is very desirable for an orchard, and especially land which has just been cleared of a heavy growth of timber. The decaying foliage and roots of the forest growth leaves the soil with a generous supply of humus, and will produce a luxuriant growth of wood in the young trees. However, the land should be freed from all stumps and roots before the orchard is planted, as this work is done more easily and cheaply while the entire area is open and free for the movement of the teams necessary in clearing the land.

In lands that are covered with a growth of scrub oak there is much danger from root rot becoming troublesome and planting immediately after the timber is removed is not advisable. In any land from which the timber has just been removed it is always best to put the ground into some cultivated or soil building crop such as corn, potatoes, clover or cow peas for a couple of years before planting the trees.

Stony land is not at all objectionable for orchards, as on steep slopes the stones help in protecting the soil from excessive washing, and no doubt help materially in warming up the soil in the spring. A stony soil is usually a well drained soil. On lands which have a very steep slope the stones can easily be made into terraces below the trees or they may be placed in the form of terraces between each two rows of trees. Unless the soil is very thin stones may be considered as a benefit rather than otherwise, because of the value they are to the land in assisting in drainage and in protecting the soil from washing.

Where virgin soil cannot be had for the orchard, only rich land should be used. An orchard will occupy the land for many years, and very thorough preparation should be given before the trees are planted. Never set the trees

on poor or dry land, for if they do start they are so stunted that it is next to impossible to ever get them to make a satisfactory orchard. Lands which have been used for grain crops for several years, without the addition of plenty of manure, or green manuring crops, should not be planted until the soil has been built up. Old pasture lands, while possibly rich in fertility, should be in some cultivated crop for at least one season before planting to orchard, so as to get the soil into better tilth. It is always cheaper and easier to prepare land for an orchard before the trees are planted than afterwards.

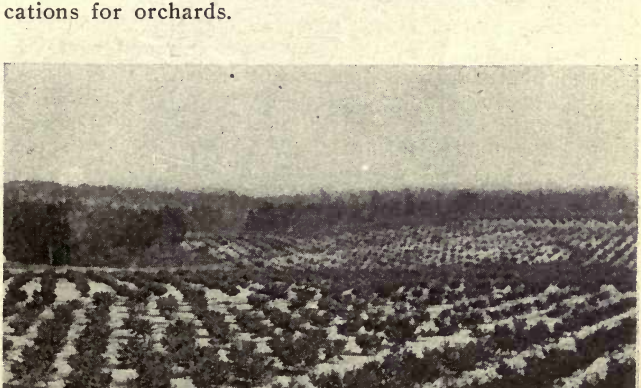
Before trees are set in an orchard the land should be deeply and thoroughly plowed and put into the best possible tilth. In soils that are excessively stony, or in which it is very expensive to plow the entire area, a strip through the field where the rows are to stand should be made, and the soil worked deep. In case the soil is shallow, and underlaid by a hardpan, it is always desirable that a subsoil plow follow the furrow after the turning plow, so as to break up the hardpan immediately under the trees, and let the young roots penetrate as deep as possible, thereby increasing their feeding area, and affording a better anchorage for the trees.

Selecting a Site for the Orchard

The site of the orchard has great influence on its fruitfulness, and in a commercial orchard the site needs due consideration with reference to the surrounding conditions, such as the slope of the land, and the direction it faces, the nearness to a large body of water or high bluff or mountain, etc. For the home orchard the site is often predetermined, and the orchard has to be planted on whatever land is left after the house and lawn have been provided.

For a commercial orchard it is always to be desired that the orchard should be somewhat elevated over the surrounding country, in order that free air drainage be secured, and thereby reduce the tendency toward late spring frosts. In many instances this will give material

assistance in preventing frost in the late spring, as it is well known that cold air is heavier than warm air, and flows to the lower levels. To get the benefit of this air drainage, the orchard must be on high land with lower land immediately near, such as a ravine or valley. Hill tops afford the most ideal positions as regards air drainage and if other conditions are satisfactory make excellent locations for orchards.



Rolling land, such as this, gives good air drainage and furnishes a good orchard site.

Northern and eastern slopes are regarded as best for apple orchards, owing to the fact that they are slower in warming up in the spring than slopes in other directions. This condition results in retarding the blooming period of trees, and is often sufficient to avoid injury from frost in many seasons. A site facing the direction of the prevailing winds will often have a marked influence on the lessened damage from frost in spring. This is especially true of those sections in the mountainous states where there are strong canon winds, as the constant movement of the

air prevents frostiness. Soils on the northern and eastern slopes are generally deeper and richer than those found on southern or western slopes, possibly because the sun does not strike such slopes so directly and does not burn out the humus so quickly.

Southern slopes are earlier and permit of a longer growing season. Trees which are situated on southern exposures receive more sunshine, and usually develop fruits of higher color than on the north and east. In regions where the growing season is short, it is always best to select a strong southern exposure for the orchard. In high altitudes this fact is often of great importance, as any element which will prolong the season for late apples and induce them to take on their full color should be favored. Early varieties in high altitudes will usually mature on northern or eastern slopes.

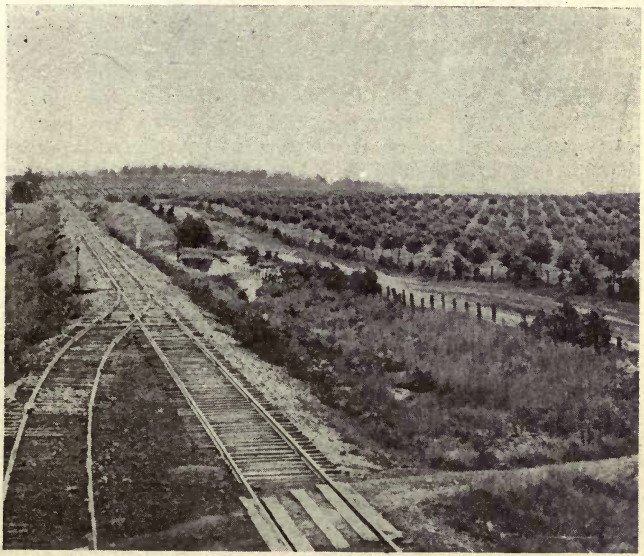
The soil on southern and western slopes is usually drier than on the opposite sides, and for this reason it frequently happens that fruits from orchards having strong southern or western slopes is smaller than from orchards on the other sides. The dryness of soils on southern exposures may be easily controlled by the use of manures and cover crops, together with intelligent cultivation and handling of the soil.

Large bodies of water, either a lake or river, has an ameliorating influence upon the climate in their immediate vicinity. Orchards on lands which slope towards large bodies of water are more immune from radical atmospheric changes. The slope on the side of such body of water towards which the prevailing winds blow is preferable, because the air in passing over the water becomes modified in temperature and its moisture content is increased.

Location for a Commercial Orchard

The location of a commercial orchard is a matter that varies widely with the local conditions, and is dependent largely on the part of the country, nearness to transpor-

tation and market, condition of the soil and water, altitude, latitude and climate and the kind of fruit to be grown. In selecting a location for a commercial orchard it is always best to get into a community where fruit is being grown commercially, as in such a location there will always



This orchard, situated on rolling land and right along the railroad, has all that could be asked for in the way of site and location.

be found the right conditions for that particular kind of fruit, as well as persons who are acquainted with the locality and able to give reliable advice.

With a commercial orchard, about the first consideration is the transportation facilities. It is always best to get where there are satisfactory means of carrying the product to market, and where one can have the advantage

of competing lines, such as two or more railroads or steamboat lines. It is true that transportation lines will enter any section where there is business for them, but it takes many thousands of acres of fruit to produce enough business to induce a railroad to build into one's territory. It is always best to locate the markets and ways of reaching them, and then the location of the orchard can be more easily selected.

In the eastern portion of the United States it is less difficult to get easy means of reaching one's market than it is in the far western states, and in such locations the matter of transportation may not be of such serious importance, as soil which is adapted to the particular kind of fruit that it is desired to grow. For the general run of our orchard fruits, soils which are not excessively wet, or too very sandy, will serve, although this may be varied to some extent under local conditions.

Altitude and latitude will affect the possibilities of commercial orcharding, directly as it influences the climate. In most of the mountainous sections of the country, however, fruit growing cannot be carried on at an altitude much above 6,000 feet, as the growing season is generally too short for a crop of fruit to be matured. Climatic conditions influence the variety of fruit that may be grown, although the greatest orchard fruit, the apple, is grown in every state in the union and in every country in the world. It, however, has its climatic limitations as a commercial crop, doing better where the winters are cold and the summers not too long and hot. In the Southern states the possibilities of apple orcharding are more limited than in the Northern states, and the list of varieties confined more particularly to the summer, or early maturing kinds. Peaches have limitations of much the same kind, as some types of peaches, the Peen-to especially, cannot be grown with satisfaction outside of the extreme southern Gulf coast country.

The distance of the orchard from the shipping point has an influence in the location of the orchard, as the labor of transporting the fruit to the shipping point reduces the profits, and increases the danger of spoiling the fruit by

bruising. In some of the Western states, where the fruit growers are well organized into compact communities, the growers find that it is best not to get farther than three miles under general conditions from the shipping point when peaches are to be handled. The apple grower, on the other hand, can get farther away than that, and the grower of strawberries may not profitably get so far away. Where the fruit producing area extends to a distance of several miles away from the railroad station, spur tracks can sometimes be constructed to reduce the distance.

If one is not acquainted with the possibilities of any particular location, when it comes to selecting the fruits for a commercial orchard, it is always best to consult with someone who is able to give the desired advice. Many mistakes can be thus avoided.

Preparing Land for an Orchard

A serious mistake that is commonly made in planting an orchard is to be in too great a hurry. An orchard is planted to last for years, and undue haste at the beginning will generally result in a shorter life for the trees. This great hurry to get the orchard planted is most apparent in lack of preparation of the soil. It takes time to put any soil in the best condition to receive the trees, and frequently, to get the trees planted as cheaply as possible, they are put into the ground before the soil is ready to receive them. This is especially true when orchards are planted on land from which the native growth has just been removed.

Land that is to be planted to orchard should be under cultivation for at least two years before the trees are planted, and especially so on lands which have a heavy growth of timber. With such land all of the stumps and roots should be removed, and this can be done at a much smaller expense before the orchard is planted than afterwards. New land is always hard to cultivate, because of the roots which sprout and try to grow, and among young orchard trees such sprouts cause endless trouble until they are removed. It is best on such new land to plant some

crop that must be cultivated, such as potatoes, corn, sugar beets or cotton, and follow this the second year with a leguminous crop, such as cowpeas, soja beans or crimson clover. The cultivation necessary for such a crop as potatoes will keep the soil so continually disturbed during the first summer that many of the roots will be dragged out and few of them will have a chance to grow. The heavy growth made the next season by the leguminous crop will so shade the soil that any sprouts that appear will be smothered out, so that they can make but little if any growth. This crop of legumes should not be cut for hay, but turned under, where their fiber will become humus. Most soils are deficient in humus, and especially in nitrogen so that a two-fold purpose can be obtained by growing and plowing under a leguminous crop.

Land which has been under cultivation a long time will be materially helped by having a crop of green manure plowed under, as old fields generally have the humus supply so worn out as to be badly impoverished, and not in a fit condition for trees to do their best. A young orchard should make a strong and vigorous growth during the first few years so as to build up a large framework for fruit production, and this framework cannot be obtained on weak soil. The soil in an old pasture is generally excellent for an orchard, as it will contain a larger supply of humus and nitrogenous food materials than any other ordinary fields.

In preparing the ground for an orchard it should be plowed as deep as possible, so as to loosen up the soil and make it possible for the tree roots to penetrate into the lower soil. Shallow rooted trees do not live long, and are easily influenced by dry weather. It is best to do everything to make the tree roots go deep into the soil, as they will thus have a better anchorage, and be nearer a more constant source of water than when the roots are allowed to run close to the surface. The land should be plowed in the fall and not less than six weeks before planting time if a very heavy crop is to be turned under. This is to give time for the crop to decay before the trees are planted. When a heavy crop is turned under it is best in most cases

A Compact Orchard Community.

to wait until spring to do the planting. The soil will then be in the best condition and the planting can proceed rapidly.

Preparing Irrigated Land for Planting

Most orchards in irrigated sections are planted in raw land, and when well and carefully done it is satisfactory, but when done by inexperienced and uninformed persons it does not always result in a good orchard. Raw irrigated lands should be cultivated for at least one season with either grain or alfalfa, and are materially improved if a green manure crop is turned under the fall before planting.

The land should be plowed thoroughly and deeply all over and not just down the tree rows. Fruit trees are shallow rooted at best in the majority of irrigated soils because of the dry and hard subsoil, and unless the soil is loosened up deep and the subsoil well soaked with water, the trees will not root as deeply as could be desired.

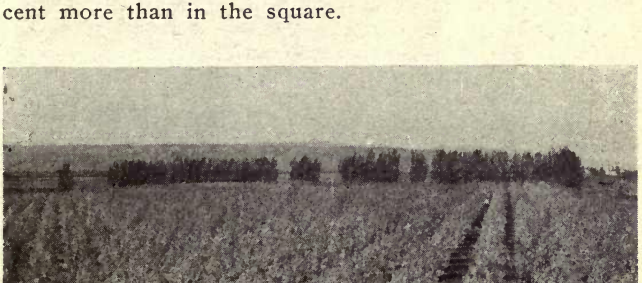
Lands which settle after being put under irrigation should be thoroughly watered and settled before planting, and all irrigated lands should be perfectly leveled before the orchard is planted. This will materially assist in laying out and planting the trees, and do away with releveling after the trees are planted. It is always best to plow the land in the fall and allow the soil to lay rough all winter. It will be loose and friable in the spring and be much more easily worked than if not fall plowed. Fall plowing has the additional advantage of enabling the soil to take up more of the winter precipitation, and hence it will water more easily when irrigation is attempted. It is often very difficult to get the water over spring plowed land the first time it is irrigated.

Laying Out the Orchard

The plan for laying out the orchard can be arranged in any manner that suits the convenience of the planter, although there are two systems that are in common use,

one of them being the square or rectangular, and the other the hexagonal system, or system of equilateral triangles.

In the square system of planting, the trees are planted at right angles to each other and at the same distance apart each way, the distance apart varying according to the kind of tree and to the ideas of the planter. The hexagonal system allows the maximum number of plants per acre at a given distance apart, being approximately 15 per cent more than in the square.



These trees are set in perfectly straight rows.

The great advantage of the square system is that it allows cultivation in either direction with the same ease. In the hexagonal system the trees are planted so that they have the same amount of space all around, and alternate in the rows, making the space between the rows narrower than the distance between the trees in the rows. The distance apart at which any variety of fruit should be set will depend largely on the distance at which the planter cares to set them, and to some extent on the habit of the variety and on the soil. Missouri Pippin and Wagener apples can be set closer together than varieties having the wide spreading habit of Mammoth Black Twig.

With apples, the customary distance for planting varies somewhat with the section of the country, being wider

apart in the Eastern states than in the far Western. In the far Western states apples are frequently set as close as twenty feet, while in the extreme East they will be double or treble this distance. The usual, and perhaps the best distance apart for apples in commercial orchards, is about thirty feet. At this distance there will be ample room between the trees for a number of years after they

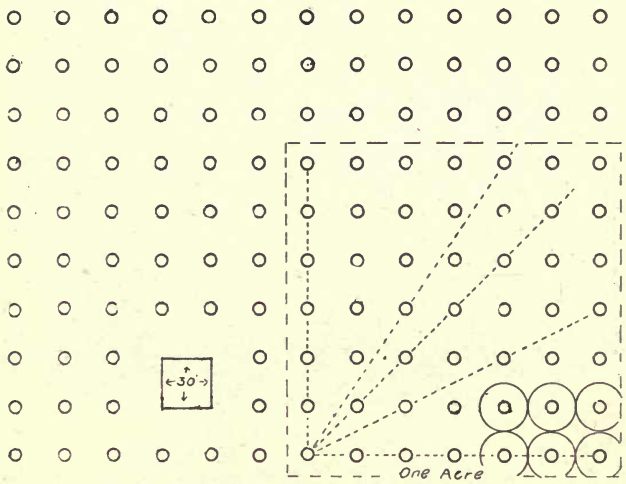


Diagram of an orchard with trees planted in squares. This system gives greatest amount of room between rows.

come into bearing. With pears the distance can be somewhat less, as most varieties are of a more upright habit than the apple. Peaches are generally set about eighteen or twenty feet apart, although when trained with an open center it crowds the trees after they have reached their maturity.

Before laying out the orchard it is always best to figure out how the trees can be arranged to best advantage. They ought to be set so as to allow of ample room around the

sides to do the necessary work without crowding against the boundary fence. It is better always to plant the trees so that they have the same, or nearly the same, distance on all sides, rather than to have twice the distance in one direction as in the other.

There are a number of different ways of laying out an orchard and some of the simple plans are very satisfactory. In using any plan the effort should be to get all of the trees set in perfectly straight rows, so that they may be sighted over in any direction and perfect rows can be seen. This is simply to improve appearances.

Begin the rows sufficiently far inside the fence line to enable all operations to be done without crowding against the fence when the trees get large. This will vary a good deal with circumstances, but ought to be not less than twenty or twenty-five feet.

Along one side of the orchard, say the north, lay off a line indicating with stakes that can be plainly seen. Along the east side of the orchard lay off another line at right angles with the first, and mark it plainly in the same manner. Lay off two more sets of lines in the same manner through the middle of the orchard and on the other two sides, making all lines at right angles and erecting substantial stakes that can be plainly seen. Along each of the lines now put in a stake at the exact place the tree is to occupy. This will make three guide stakes in every tree row, and with a plow following along each line of stakes the tree rows can be quickly laid off ready for planting. A shovel plow is most useful for this marking, especially where a large area is to be marked off at one time.

Another plan that works very satisfactorily, but takes a little longer is to lay off the first rows as above described and instead of plowing lines across the field a small stake is placed at the exact spot a tree is to occupy. This has the advantage of enabling the planter to line up all of his rows perfectly straight before a tree is planted. In either case the holes are dug with a spade, and in the latter case the tree is set in the exact position of the stake by use of a board some three or four feet long having a hole in each

end and a notch in the middle. Before the stake is disturbed lay the board down so that the notch is at the stake, then drive a peg through the holes at the end of the board. The board can be removed and the hole dug without further care for the original stake. When the hole is ready place the board back over the pegs and place the tree in the notch, and it will occupy the same position exactly of the original stake. If the stakes are lined up perfectly,

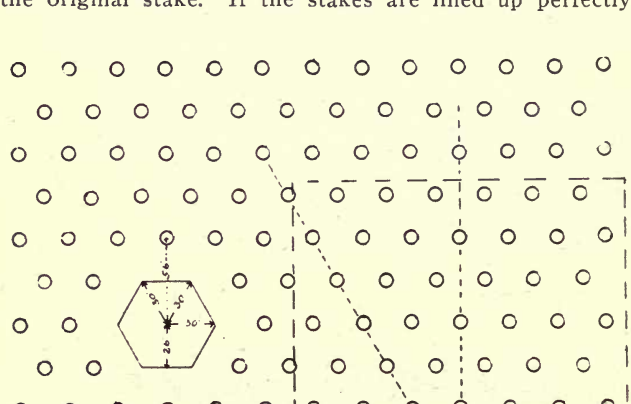


Diagram of an orchard with trees planted in triangles. This system gives a greater number of trees per acre than when planted in squares, but leaves less room between rows.

the trees will also be in perfectly straight rows when the planting is finished.

Where the trees are set in triangles, a common method for small plantations is to plant only one outside row. Then with a large triangular frame whose sides are the distances between the trees in the triangle, is placed so that two corners are in contact with two trees in the row. At the third corner a third tree is set. By moving this tri-

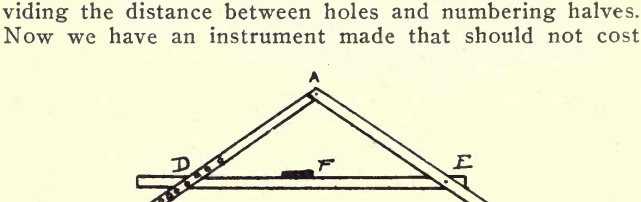
angle from tree to tree across the field and setting so that a tree is in exact contact with each corner, the trees will all line up perfectly and be in exact triangles. This method does not give perfectly straight rows unless used carefully. All trees must be in contact with the triangular frame each time.

Laying Out an Orchard on Rough or Steep Hill Land

It is a comparatively easy matter to lay out an orchard on land that is level or approximately so, but it is a different matter where the ground is very rough or steep, and which may need to be terraced. In some of the mountain cove lands of the Eastern states planting in contours or terracing may be necessary in order to prevent the soil from being washed away, or to facilitate the tillage of the crops. In many instances these terraces can be easily constructed without the use of instruments, but in others a surveyor's level, or instruments of the same nature may have to be put into use. Mr. F. T. Meecham describes a home-made instrument called an "'A' level" that serves very well in laying out terraces on hill land as follows:

"To construct an A level, use well-seasoned timber, pine being preferable because it is light and does not tend to warp. Take three pieces 10 feet long, 3 inches wide and ½ inch thick. Now lay on a level floor so as to get the instrument of a rod span. The rod is commonly used in measuring land and is generally best, as it gets over land faster than a ten-foot level. Drive two nails in the floor just a rod, or 16½ feet apart, saw off the ends of the two pieces to be used for legs so that the ends will rest on the floor. Now place one end of each leg against the nails and let the pieces cross above your head and just exactly over the center of the rod span. Put a bolt here through both pieces fasten them together at the point A then we have two legs of the level, AB and AC. Now take the third piece and use as the crossbar, DE. Fasten the piece DE to AC at about D, bolt so as to permit it to work easily. Now at F securely place a spirit level, such as you can get from almost any hardware store for 10 cents.

Bring DE, at E end, to a point on leg AB, where the spirit level indicates level; then mark or put a hole through both for bolt to work in. This hole on AB leg we call zero, which means level. Now we wish to make a scale that will enable us to run a terrace having a fall anywhere from an inch to four inches. Let some one raise the foot of AB one inch and lower crossbar DE until level; then put a hole through AB leg, and call this hole No. 1. Now raise foot of AB two inches and put another hole in AB leg and call it No. 2, and so on until we make our scale to four or five inches. The half-inch is then gotten by dividing the distance between holes and numbering halves. Now we have an instrument made that should not cost



Meecham's "A" Level.

more than 50 cents at the outside, and will, if properly handled, suffice for most of this kind of work.

"In terracing a field start about three feet from the top of the hill, and begin to lay off the first terrace. Usually about one or two inches fall to the rod will be sufficient. Try to put the second terrace so that it will be about three to four feet lower than the first, and so on down the hill until the whole field is terraced. Now, if a field has a swag about the center and water collects from both directions in this swag, to avoid this begin the terrace in the swag and go both ways, providing there is a good outlet at each end. Lay off the terrace, giving one to two inches fall, as desired, by fastening the cross-bar DE at E in the hole giving the fall desired. Start at the point we have selected to begin, and let the short leg, or the leg with the

scale on it, be up-hill. The place for the terrace is found by raising the foot of the instrument up or down hill until the proper level is obtained, then let the boy carrying pegs stick one at the front end of the level; then go with the instrument to that point, and repeat same operation until all the terraces are laid off. When you come to a gully make half sets with the instrument and set up-grade stakes to tell how high to build the banks to prevent breaking over by heavy rains. Now walk back over the line of stakes and when a place is found where there is too short a turn in the terrace, straighten a little or give a more gentle curve by moving the upper stakes a little down hill; never move lower stakes uphill.

"After the terrace has been staked out a furrow can be run connecting the stakes. If desired, the terrace can be listed up by throwing several furrows together and the trees planted on the terrace. In planting orchards on contours it is impossible to have the trees line-up as they would do on even land. The first row is set by simply spacing the trees along the contour at the regular distance desired. The second row is set by alternating, as nearly as possible, the trees with those in the first row. As the work of setting proceeds the trees in each row will be alternated with those in the row preceding it. On account of the variability of slope it will be found impossible to exactly alternate the trees. Occasionally a tree will have to be shifted one way or the other, or one left out, in order to keep the spaces between the trees fairly uniform."

In irrigated sections land can be planted in contours and terraced, with the irrigation ditch flowing on the upper side of the terrace. This will let the water percolate through the soil to best advantage. In case the hillside is long it may not be necessary to water the lowermost rows as they will sub-irrigate.

Clearing Sage Brush Land

The method adopted by Western farmers in clearing their land of sage brush varies a good deal with the sec-

tion of the country, and the means that may be at hand. It also varies to a greater or less extent with the condition of the land, whether the brush is thick or scattering, and whether the brush is large or small and whether the soil is dry or wet at the time the clearing is to be done. One of the commonest methods consists in what is known as the "railing and raking" system. This consists in dragging a heavy railroad rail back and forth over the land, mashing down the brush and pulling out more or less of it.

These rail drags are generally home-made affairs, consisting of a 10x12 timber that may be about 12 feet long, to the edge of which is bolted the railroad rail or a heavy iron plate that is flat and the edge of which can be drawn down and sharpened to a cutting edge. On the opposite side of the timber fasten a little platform supported on shoes so that the front edge of the rail will dip forward and not slip over the brush without mashing it down or pulling it out.

A lever can be conveniently arranged on the back of the frame so as to lift the cutting edge and let it free itself when clogged with brush. It will take four or six horses to pull such a drag, although this will depend largely on the condition of the soil and the brush, and the size of the horses.

The land will have to be gone over several times in different directions with such a drag to get the brush loosened up, and when this is done the brush is gathered into windrows by means of a rake. This rake can be made from a heavy piece of timber in which steel teeth about two inches wide and half an inch thick are placed about six inches apart in the timber. This rake should be arranged to dump when it gets clogged. With this rake, drag the brush into windrows and set on fire. Any brush that remains will need to be grubbed out with a grubbing hoe.

Where the sage brush is small and scattering and the soil is not too hard and dry the brush may be plowed out. The plow for this purpose should be a 14 or 16-inch plow having the mould board removed, and using nothing but

the share and land side. The share will need to be kept sharp and possibly have to be drawn down a little so as to hug the ground better. After the land has been plowed the brush can be dragged out with a rake into windrows for burning, and if the brush is not too heavy an ordinary sulky rake is very satisfactory.

Land which is cleared from sage brush by grubbing is difficult to plow and harrow because of the roots that are in the soil. These may be so numerous in some fields that it will be necessary to rake them up and burn.

What Kind of Nursery Stock to Plant

There is always more or less uncertainty in the minds of the inexperienced fruit growers as to the kind of nursery stock to buy. It always pays to get the best, and if the planter is uncertain whether to buy one-year-old stuff instead of two-year-old trees of the same variety it will pay to write to your state experiment station, or to The Fruit-Grower, and find out. The tendency is now for fruit growers to prefer the one-year trees, rather than trees that are older. There are a number of advantages in this, as the trees are smaller and more easily handled, and the head has not been formed, leaving it possible to head the tree just at the height the orchard man wants it. In the Middle West and Western states a low-headed tree is most desired, as it facilitates all of the operations of caring for the trees throughout their life. In the Eastern states it has been the custom to head the trees high, often times above the head of the average man. It is a hard job to pick the fruit off of such trees, especially while they are young. But in general the trees of the Eastern states seem to be longer lived than the Western, and when these trees reach the age of forty years their lateral branches have so spread out that they hang down within easy reach, although the tops are high in the air.

It sometimes happens that the buyer orders one-year-old trees, and when the order is delivered he has two-year-old trees, the side branches of which have been carefully removed, leaving a whip that looks quite like a one-year-

old tree. Such trees cannot be handled to advantage, for as a rule they must be headed very much too high on account of the lower limbs having been cut off, the very limbs that the orchard man wanted to form the head.

It does not pay to buy trees just because they are cheap. Good trees cost money to grow, and the buyer must expect to have to pay a good round price for good trees. Cheap trees, cheap just because the nurseryman wants to get rid of them, are too many times fit only for the scrap pile. Buy nothing but good trees and then insist on having that kind. If you can visit the nursery and pick out your trees, so much the better.

Time to Plant

Fruit trees can be set out in either the late fall or early spring months. In the Western states spring planting is preferred, as the soil is then in much better condition and more easily worked than in the fall. But in the rest of the country the land is generally in good shape in the late fall, unless excessively wet or unusually dry.

Fall planting has the advantage of getting the trees into their new location with the least amount of time in storage, and trees set out in the fall will make some root growth during the winter and be in good shape to start into growth in the spring. There is generally more time for planting in the fall than in the spring and the work can be done in better shape.

When the planting must be deferred until spring care must be taken that the trees are set out at the earliest possible date. In rare instances it happens that the trees have started into growth slightly at the time of planting. Such condition is not serious, provided the trees have not been allowed to make a growth of a few inches before being planted. In any event it is always necessary to prune the tree back somewhat at the time it is set. This is done in order to equalize the balance between the roots and the top. In digging the trees from the nursery the greater portion of the root system is removed, and if the trees are planted without an equal reduction of the top

the roots will not be able to supply the large top with crude sap, and the trees will not make as strong a growth.

The amount of cutting back of the tops that is necessary at the time a tree is set depends largely on the age of the tree, the kind, whether peach, apple, plum, etc. Peach trees are generally cut back to a whip; two-year-old apples are usually shortened back not more than one-half; pears, plums, cherries, etc., when two-year-old stock is used, are cut back about one-third, and where one-year-old whips are used, the cutting back should as a rule be about one-third of the length of the tree.

How to Plant a Tree

Many persons inexperienced in handling trees lose a number of trees in setting an orchard because of their lack of skill or acquaintance with handling such plants. It must be remembered that from the time the trees leave the soil of the nursery until they are firmly planted in the orchard, the roots should be exposed to the air as little as possible, and especially to air that is moving rapidly, or which is dry. Trees should not be left with their roots exposed to the sun or wind any longer than can possibly be avoided. When waiting to be planted they should be heeled in, that is, have their roots covered with moist soil, and should be taken out only as actually needed for immediate planting. Where it is necessary to transport a number of trees from the heeling-in grounds to the orchard, it is best to pack the trees in a tight wagon box, mixing the roots with a plentiful supply of wet straw. Small quantities of trees may be placed in a barrel containing a little water. In the Western states it is a common practice to load the trees into a barrel filled with water and then as a tree is planted to pour a little of the water around the roots of the tree before the hole is filled with soil.

The hole that is dug for the tree should be large enough so that the roots may be spread out naturally, without any crowding. These holes need not be very wide but need to be deep enough to allow the tree to be set a little deeper than it stood in the nursery. All of the long-

est roots need to be shortened in to about six inches and cut with a smooth clean cut. Any roots that are broken or bruised need to be removed, and all cut surfaces need to be made smooth so they will heal quickly.

Filling in the soil about the trees is a very important step in tree planting. To get the best results the soil must be packed closely about the roots, so that there are no air holes or crevices. The best way to do this is with the hand. When the tree is in place spread the roots out and throw a shovelful of soil over them, shake the tree up and down several times and then work it into the crevices between the roots with the fingers. Throw in a little more soil and work into the remaining crevices, and then with the feet tramp the soil solid. Throw in more soil and tramp, repeating until the hole is full and the dirt about the tree is packed down solid and tight. Moving the tree up and down while the earth is being thrown in will assist materially in avoiding air holes and in bringing the soil in close contact with the roots. There is little danger of packing the soil too tightly about the roots. The greatest danger is in not getting it packed tightly enough and leaving air holes that will let the roots dry out and the tree die.

The trees should be set just a little deeper than they stood when in the nursery, although not over an inch deeper. Setting too deep is as dangerous as not setting deep enough. The best guide is the line marking the change in color of the bark at the crown where the tree enters the ground.

After the tree has been firmly packed in the hole throw an inch or so of loose earth over the packed soil to serve as a dust mulch and prevent from drying out. Watering at the time the tree is planted is not necessary in the Eastern or Middle Western states, but in the semi-arid country, where the trees cannot be irrigated immediately after being planted, it is often advisable to pour a bucketful of water about the newly planted tree. This should be done before the hole is filled with soil, and the water allowed to percolate away. Then fill up with the dry soil and do

not pack the surface, but rather let this soil lie loose and prevent the water from evaporating. A dust mulch will very effectively conserve the moisture in the soil for the use of the tree.

Use of Fillers

The use of "fillers," or temporary trees, in an orchard is not always to be recommended. Such trees can in many instances serve a useful purpose, but they too often become permanent. After they come into bearing the

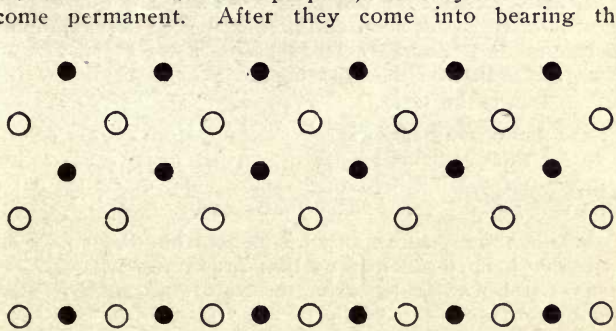


Diagram of an orchard planted with "fillers." The black spots represent the temporary trees. In the upper portion of the diagram the fillers are in the centers of the squares, making the "quincunx" system of planting. In the lower rows the fillers are in the rows of permanent trees.

owner always wants just one more crop from them before they are removed. Years pass by in this way and the orchard becomes so crowded that the yield from all the trees is less than from what the permanent trees would be if the fillers were out.

When the kinds of trees to be used as fillers are carefully selected and then removed at the right time they can be made profitable. Peaches can sometimes be used as fillers in an apple orchard, if the soil and climate are suitable.

Pears are not advisable as fillers, especially in an apple orchard, on account of their susceptibility to fire blight, which can be communicated to the apple trees.

Quick maturing varieties of apples make the best fillers in an apple orchard, and especially so if the fillers have an upright habit, such as Missouri Pippin, Wagener, or Rome Beauty. Such kinds can be handled to advantage in an orchard laid out on the rectangular plan, with the filler in the center of the square. This will double the number of trees per acre, and give each tree the maximum of room. It is not so easy to plant fillers to advantage when the orchard is laid out on the hexagonal plan without crowding the trees.

A common and satisfactory method of arranging fillers is to set the permanent apple trees thirty feet apart, with a filler midway between the trees in one direction only. This will put the trees 15x30 feet apart.

While good returns can be made from the fillers in an orchard, it is safe to say that practically as good returns can be made by using crops of other kinds. In small orchards some of the small fruits, such as strawberries, blackberries or currants are good money makers. In large orchards it is better to grow some kind of cover crop and work towards building up a large framework and strong trees that will be heavy bearers when they come into fruiting, rather than to try to get an extra amount of fruit from the temporary trees.

One of the great dangers of intermixed planting is that nine persons out of ten will not take the fillers out when they ought to. There is danger in it to the whole enterprise and the system should be recommended very guardedly, if at all. Peaches should not be planted among apples as a rule. It is better to stick to one kind of fruit.

Orchard Tillage

The style of tilling used in the Eastern and Western fruit sections are vastly different. In the Western sections, where irrigation is practiced, clean cultivation is in-

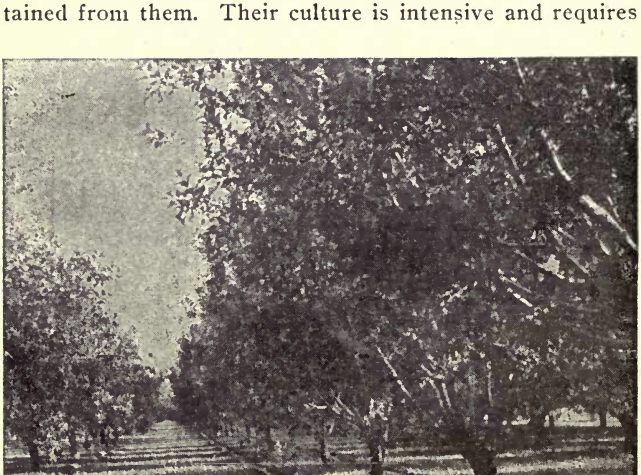
variably the rule, and the soil is often cultivated continuously year after year until every trace of humus has been consumed and the soil bakes after each irrigation so hard that it takes a good sharp pick to make a hole in it. In the Eastern states, where rainfall is abundant, it is a common practice to sow the orchard down to grass, and allow it to remain in sod for a number of years. Either practice alone is not the ideal which the modern orchardist should follow.

The excessive cultivation as practiced in the irrigated sections burns the humus out of the soil, making it very difficult to work in the course of a few years. Under the cloudless skies and burning sun of those regions the trees are in a continual glare of light, and the reflected light from the soil has a tendency to cause more or less sun scalding on the trunks and lower limbs of the trees. The continual cultivation not only wears out the soil, but wears out the trees as well. The tendency of trees in the irrigated sections of the West is to overbear, and the continuous cultivation stimulates this condition.

On the other hand, the sod mulch, or as too many times happens, the weed mulch, of the rainy sections, harbors a multitude of orchard pests that sooner or later bring destruction to the trees, unless means are taken to prevent their depredations. The ideal system of cultivation for any orchard, either East or West, is to combine the tillage with a cover crop. Stirring the soil is a necessity, not only for the purpose of improving the physical condition of the soil, but for liberating the fertility. In soils that are plowed early in the spring air is admitted and the soil warmed up and drained of excess moisture through evaporation. In summer the plowed layer serves as a means of preventing the evaporation of moisture that is deeper down in the soil, by breaking the capilarity. It also increases the water holding capacity of the soil. By increasing the moisture in the soil decomposition of the organic materials is hastened, and their fertility made available for the use of the plants.

The exact manner of cultivation in an orchard will be governed largely by the kind of trees and the location.

It is best in most instances to put the young orchard into a crop of some sort which will necessitate the cultivation of the land. Crops like corn, cotton, potatoes, strawberries, cantaloupes, or other crops of that nature make excellent crops in a newly planted orchard. These crops are temporary, and are planted for the profit that can be obtained from them. Their culture is intensive and requires



An Orchard in Clean Cultivation.

a frequent stirring of the soil, and these are just the conditions which are needed for the young trees. During the first few years of an orchard the effort should be directed along the line of promoting as much wood growth as possible, in order to get a large framework for the future production of fruit. A tree that is starved and stunted in its early life will not make a productive tree when it comes into bearing.

Where strawberries are grown between young trees they will occupy the ground for at least three years, after which time they should be plowed under, and the land planted to clover or some other legume. This is for the purpose of restoring nitrogen to the soil and stimulating the wood growth of the trees. Where corn, cotton or other "hoed" crop is grown, the land will be occupied by any one crop no longer than one year. It is considered to be the best practice not to plant the same kind of crop in the orchard for more than two years in succession. In fact soil experts will advise that any particular crop occupy the land but one year and then be followed by a crop of a different sort. This is because the soil quickly becomes impoverished where one kind of crop is repeatedly grown on the same area. In the young orchard this is especially true, as the trees are to remain for many years and the soil's fertility must not be reduced. A good rotation of crops in a young orchard is to plant cotton or corn the first season and follow with potatoes the next year, following it the next season with a legume of some kind.

Vegetables of all kinds may be grown in a young orchard in place of the crops mentioned, and will serve well in keeping the ground of the orchard well stirred and the trees growing thriftily. Sugar beets are extensively used in the irrigated districts, but are not always desirable because of the late watering that is needed to get the beets to mature. This late watering induces late growth in the trees and makes them liable to winter killing.

Under no condition should small grain be planted in an orchard, as it will not permit of cultivation, and cultivation is necessary in a young orchard for reasons which have been mentioned. This statement applies to the growing of a grain crop that is to be allowed to reach maturity and be harvested either as grain or hay. Rye, wheat, oats and buckwheat are frequently planted in an orchard, but they are used altogether for green manures and under the best systems of culture are not allowed to remain for more than a few weeks, or over winter at the longest.

In plowing the ground in a young orchard, the plows should be run six or eight inches deep, so as to provide a

deep covering of plowed soil, and to cut the surface roots of the new trees, and make them penetrate into deeper soil where they will be cooler during the hot summer weather and away from the freezing of the winter's cold and into a zone of more regular supply of moisture.

When it comes to the bearing orchard, no crops are grown to be removed. If any crop is grown it is for the purpose of being turned under and adding to the fertility and humus supply of the soil. It takes an immense amount of soil fertility to provide a bearing orchard with the foliage and wood each year, and it takes a still larger supply to furnish the fruit. Under such conditions it is too much to ask the orchard ground to produce a crop of some other sort when that crop returns nothing to the land.

The bearing orchard does best when the soil is plowed in the spring as soon as it can be worked, and then kept in cultivation until at least mid-summer, when a crop of some sort is planted to serve as a shade or cover crop. Professors Whipple and Paddock have pointed out to the orchardists of the irrigated sections of the West the importance of growing a shade crop in their orchards, not alone for the improvement it will produce in the physical condition of the soil, but to shade the ground and prevent reflection of the sunlight and scalding the branches.

With the system of tillage practiced by Western fruit raisers the humus supply of the soil is depleted quickly, and because of this becomes light colored. Running the irrigation ditches close to the trees on hot sunny days in summer has caused the death of many trees by sun-scalding, because of the light reflected from the surface of the water in the ditches. The shade crops are planted early in the summer and serve to lessen the reflection from the soil, and from the water in the ditches.

Stirring the soil by plowing or discing has the effect of stimulating wood growth. If the cultivation is continued too late in the summer there is a possibility of the trees continuing to grow so late that they will go into winter with wood that has not been properly ripened, and may in consequence not be able to stand the cold. With

trees that are easily attacked by fire blight, as pears and quinces, soft wood, such as is produced by continuous cultivation, is not desired, because of the immense damage that can be caused by blight. Pear orchards are frequently planted to a permanent sod early in the life of the orchard, simply for the purpose of preventing very soft wood.

Orchards need to be plowed early in the spring and cultivated until mid-summer when they are sowed down to a cover crop that is to remain on the soil during the winter to be turned under the next spring. In the case of dry seasons when the normal precipitation is scarce, tillage throughout the summer will conserve the moisture in the soil, and by plowing the ground late in the fall and allowing to remain rough all winter a still larger amount of water can be stored up in the soil than if left smooth and level.

Cover Crops

Cover crop, called also green manures and shade crops, are such crops as are grown in the orchard for the purpose of clothing the surface of the soil during late summer and winter months. They are used to protect the soil from washing during the winter rains, and for this reason are always to be advised for orchards that are on steep, hilly land. In the arid section of the West they serve to cover the soil and protect it from the sun, thereby guarding somewhat against sun-scalding of the trees. They increase the humus supply when plowed under, and make available or conserve the mineral elements of fertility that might otherwise be leached out of the soil. This is especially true of the soluble nitrates. When some sort of leguminous plant is used for a cover crop it adds nitrogen to the soil.

Cover crops increase the water holding capacity of the soil through the addition of humus, and thereby improve the tilth and prevent the puddling and baking of the soil. On this account alone cover crops, or rather shade crops, are useful in the orchards of the irrigated sections. There

the custom has been of continuous cultivation, with the result that the tilth of the soil is ruined and that it bakes badly after each irrigation.

Cover crops are of three kinds: (1) Those grown in seasons between other crops; (2) those which occupy the land for one or more seasons before they are plowed under; (3) those which are sown late in the season for the purpose of protecting the soil during the winter.

In general orchard practice cover crops are sown late in the summer and allowed to remain throughout the winter when they are to be turned under the following spring and become a green manure. For such purposes a number of different kinds of crops are used, depending largely on the soil, climate and the needs in hand.

Winter rye is one of the most useful cover crops for the orchard. It may be sown at any time from the middle of August until November, and grows all winter where the climate is not too severe, resuming growth again early in the spring. It is very efficient in gathering the soluble nitrates that might be leached from the soil. It is especially well suited for light soils.

Buckwheat and oats are sometimes used, especially in the Northern states, but they are killed by the winter weather and need to be planted early in order to get a good cover over the soil before winter.

Winter vetch is useful on the medium loamy soils and is hardy as far north as Massachusetts in well drained locations. It is a legume, and consequently increases the nitrogen supply in the soil. It does best when sown with rye, and is not well adapted to stand hot weather.

Canada field peas are used as cover crops in the Northern states, and in the higher altitudes of the West where the climate is cool. They are very effective where they thrive.

Crimson clover is useful in sections where it will do well as along the eastern part of the United States. South of New Jersey it is hardy, but north it is uncertain. It is

a deep rooting legume, which opens up the subsoil and adds nitrogen.

The common red and mammoth clover are used very extensively as cover crops, although they require the use of the land for two seasons. They are deep rooting, gather nitrogen from the air and are hardy. They make a heavy growth of tops and generally need to be mown during the first summer. It should be the practice in most cases where clover is grown for a cover crop to not remove the hay, but allow it to remain in the orchard where cut to add to the humus supply. But where the soil is already quite well supplied with humus there is no objection to the removal of the hay. The clover should be turned under in the spring of the third year.

Sweet clover is used in a small way in some parts of the country as a cover or green manuring crop. Alfalfa, however, finds a much wider range of adaptability and is extensively used among the irrigated orchards of the Western states. It must be plowed under during the second year, otherwise the roots become so woody as to make plowing very difficult.

In the Southern states the cowpea takes first rank as a cover crop for orchard lands. It makes a rank growth, roots deeply and gathers nitrogen from the air. It is killed by the first frost, but its coarse herbage makes an excellent ground cover during the winter. It can be sown late in August and still make a good cover before being killed by freezing weather.

CHAPTER II

Orchard Heating

Every orchardist is agreed that spraying is an absolute necessity in order to produce fruit free from the defects caused by insects and fungi. Yet spraying as a commercial proposition is of only recent adoption, dating no farther back than 1872, when Le Baron, the state entomologist of Illinois, found that Paris green would control the potato beetle. Spraying began to be of commercial value in 1885 when the effectiveness of copper sprays was discovered by the vineyardists of France. Yet there is a still newer practice, viz: orchard heating, which is bound to take rank on a par with the practice of spraying as a means of securing crops of fruits against an unfavorable environment.

New Idea

Orchard heating as a commercial proposition is of very recent origin, although for many years fruit men and gardeners have tried various plans of preventing frost from injuring their plants and blossoms. Some of these attempts was by keeping the trees sprayed during the winter with whitewash, under the belief that since the whitewash would reflect much of the sun's rays the wood of the trees would not get so warm during sunshiny days of winter, and hence retard the development of the fruit buds. However, such methods in practice would hold the buds back for only three or four days behind those trees which were not sprayed, while the danger period in spring

would probably remain for as much as a month or six weeks.

Another method which had some advocates, and which is still practiced in some sections, although with but little commercial success, is the mulching of the ground very heavily in late spring before the frost leaves the soil. Another plan is to heap the snow around the roots and trunks of the trees, or, as one fruit grower in the region of the Cascade Mountains has done, to actually haul ice from the mountains and pack it around the trees in an effort to prevent the trees from starting into growth in the spring until after the danger period had passed. Such means, however, have not given success, for the reason that the branches of a plant can start into growth independently of root action, provided the branches are in a suitable temperature. Any person can prove this to his own satisfaction by pulling the branches of a tree or vine into a warm room late in the winter and blocking up around the opening through which it is passed to keep out the cold air. The roots may be frozen solid, but in the course of a few days the buds will start into growth, and may actually come into blossom. The only way in which a mulch packed over frozen ground to prevent its thawing out early, or storing snow and ice in the orchard could effect the blooming period of the trees, would be directly dependent on the way in which such means affected the temperature of the atmosphere surrounding the buds.

Influence of Environment

The relation which any district will bear to frostiness will depend to a great extent on the natural surroundings. Nearness to large bodies of water has a great influence on frost, and some sections, even though they are far north, have very mild climates and with a minimum of frosty days in late spring. In the northern part of the state of Washington, and in southern British Columbia, the climate is mild, considering the high latitude, due to the influence of the chinook winds which pass over the region directly

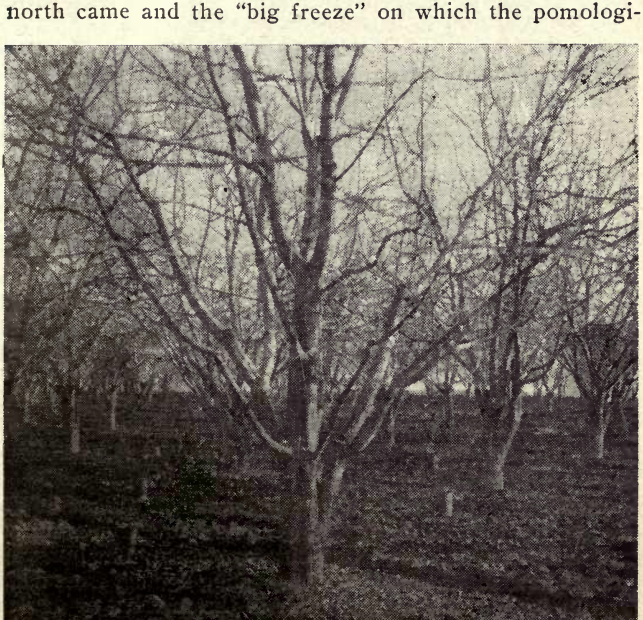
off the warm waters of the Japan current that sweeps the Pacific coast. The eastern shore of Lake Michigan has a warmer climate than the opposite side, on account of the lake currents which keep open water on the eastern side while the other shore is ice bound.

On account of the movements of warm currents of air oranges are being grown in the southeastern corner of North Carolina, two hundred miles north of the northernmost place at which it is considered safe to grow this fruit on the Atlantic coast. This is because the warm waters of the gulf stream come in close to shore at this portion of the coast and the temperature of the air is less frosty than farther south.

Natural prominences, such as high bluffs which absorb the heat of the sun during the day and then radiate it slowly at night have a great effect in ameliorating the night temperature in small localities, although this influence cannot be counted of any serious value in protecting an orchard against late frosts in the spring. In the mountain sections of the Western states districts near the mouths of great canons are frequently safe from serious damage from frost in late spring on account of the continual breeze which flows or blows out of the canons during the night. These breezes come from the cooler air which surrounds the high tops of the mountains, flowing down their sides into the lower grounds in the valleys.

While natural conditions are of material assistance, they cannot be depended upon as being of absolute certainty in protecting against frost, for the vagaries of air currents and frostless belts are as uncertain as the flight of a bird. In many fruit producing districts there are ardent promoters of certain areas as being frostless, because of some natural condition which provides favorable air currents or temperatures at critical times. However, it may be but a short time until those conditions change and the frostless area is seriously damaged by a freeze. It was not many years ago that the orange growers in Florida believed that the southern limit of frost was at the northern boundary of that state. However, in 1895 it

was demonstrated to the sorrow and dismay of thousands of orange men that even half way down the peninsula was not safe from frost, as in one night a cold blast from the north came and the "big freeze" on which the pomologi-



Troutman Oil Burning Orchard Heaters Properly Distributed.

cal chronology of Florida is founded, made hundreds of families homeless and hopeless. In every fruit district in fact it is expected at times to have an untimely frost cause damage of greater or less extent to the fruit crops.

Water as an Aid

Water has often been used as a means of preventing frost to plants, through the large amount of heat which can be stored up in it to be liberated more slowly in the field. In the irrigated sections of the West this method has been used to a large extent in some districts, although with but little real success. Spraying the plants with a continuous spray of water, however, has proven to be satisfactory, although finding little application just yet outside of the garden. That this system can be used to advantage though, is very evident in some sections of the South where truck patches and orange groves are provided with an overhead irrigation system, in which the water is carried at a high pressure and is applied through spray nozzles located at intervals of a few feet throughout the length of the pipe. Celery has been saved in this manner when the temperature reached as low as 12 degrees. Where a grower is equipped with such a watering system it is a comparatively simple matter to provide a heating device where the water can be heated as it is run through the pipes and plants be safely carried through a very hard freeze with entire safety.

Irrigation, either in ditches or overhead, cannot be relied on at all times as providing against low temperatures, and either system has many disadvantages. But horticulturists have another means of providing against frost damage by means of heating the air in the orchard or garden by means of numerous small fires. In the commercial orchards this method is the result of modern ingenuity striving to overcome some of the enormous losses which fruit growers have met with through the damage wrought by late frosts in spring.

Development of Modern Frost Fighting

In the Yearbook of the United States Department of Agriculture for 1909 Prof. G. B. Brackett, in an article on "Prevention of Frost Injury to Fruit Crops," briefly traces the development of means of fighting frosts. One of the

early methods used by fruit growers to protect their fruit from injury through unfavorable climatic conditions, was used by a vineyardist in Austria, who resorted to the use of explosives to dispel threatening hail storms. The region was one where hail storms were prevalent and wrought destruction to the grape crops. Mr. Albert Stiger, burgomaster, Windisch-Briestrits, Austria, owned extensive vineyards, and decided to drive away the threatening storms by firing small charges of powder from wooden mortars towards the storm clouds. These explosions had a tendency to break up the stratum of cold air and prevent its settling in the low ground. The experiments were continued for some time and were considered as successful.

It is a well known fact among farmers and fruit men that injury to plants after a frost is always more serious when the plants are allowed to thaw out rapidly. This observation led to many early experiments in devising means of shading crops so as to guard them from the early morning sun following the spring frosts. Smudges of many kinds were used for this purpose, the attempt being to make an artificial cloud over the orchard to shade the crops until after they had thawed out slowly. Combustible matter capable of producing an abundance of thick black smoke was used for this purpose. Heaps of fuel for this purpose were scattered through the fruit plantation, and at sunrise were set on fire to form a veil of smoke over the orchard to protect it from the rays of the sun, and also to prevent the radiation of heat from the earth's surface; thereby maintaining the general temperature at a point which would counteract the effect of frost.

A gentleman living in Bordeaux, France, invented a process of making thick black smoke for this purpose. This consisted of small wooden boxes, open at the top and filled with a compound consisting of equal parts of resinous and earthy substances reduced to a fine powder and compressed into a compact mass. A wick was placed in the center of the mass and served to light it. The boxes containing this mixture were made of pine wood and were eight inches long and six inches square and were placed

thirty feet apart in the vineyard. This scheme possibly led to the various smudging devices used in the orange growing sections of this country.

Vapor smudges were used first in this country and accredited to a Californian named Meacham. Small areas were covered with wet straw, manure and cypress brush, and the vapors furnished by these piles, when set on fire, together with the vapor from evaporating pans, was calculated to furnish sufficient vapor to cover the desired areas. This method gave little satisfaction, for several reasons. It necessitated the co-operation of every land owner in the region and the vapors even then would rapidly disappear into space. The vapor, too, was lifted high above the ground by the cold air flowing over the surface from higher altitudes.

The fruit growers of California seem to have been the most active in this early work of protecting against frost injury to their fruits. Edward Copley is credited with having invented a device for burning coal in baskets to be scattered through the orchard fastened to the limbs of the trees. This system proved satisfactory, but had its limitations.

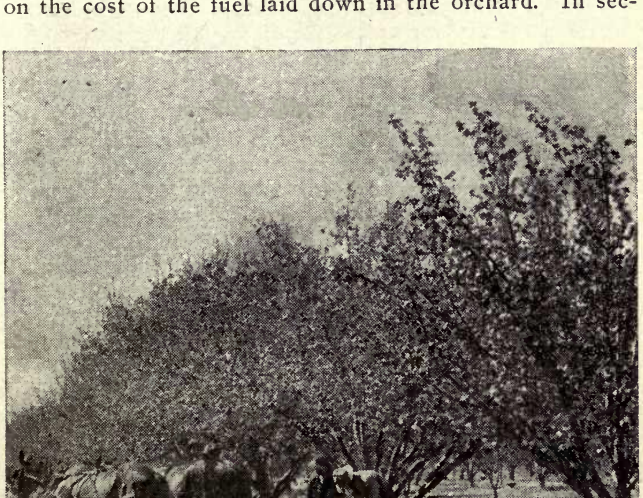
Briquets, composed of oil-refinery refuse, sawdust and low-grade oil were pressed into a tube and used with or without a wick. Cheap sheet iron stoves in which the briquets were burned then came into use, and proved still better than any of the devices yet introduced.

The next stage in the evolution of orchard heaters seems to have been an oil heater first manufactured at Fresno, Calif., and since its invention there have been a great many other styles put on the market.

Colorado has come to the front in this work of developing frost fighting methods, and through the efforts of the orchardists of that great state the present methods of orchard heating have been brought to commercial perfection.

Oil and Coal for Fuel

From the experiments that have been carried on there and elsewhere it seems apparent that the source of heat must come from any one of three available sources viz., wood, oil and coal. Which of these to use will depend on the cost of the fuel laid down in the orchard. In sec-



Filling "Ideal" Coal Burning Orchard Heaters.

tions where wood is still the most abundant and cheapest fuel, it will be the best to use. In sections where oil can be had cheaper than coal or wood, it will serve; and in other sections coal will be the cheapest fuel.

Doubtless at the present time more persons are using coal for fuel in some way than any other material, and

are more familiar with its combustion. In the work of orchard heating it has given great satisfaction, and many hundreds of acres of orchards have been kept from frost ruin by coal burners.

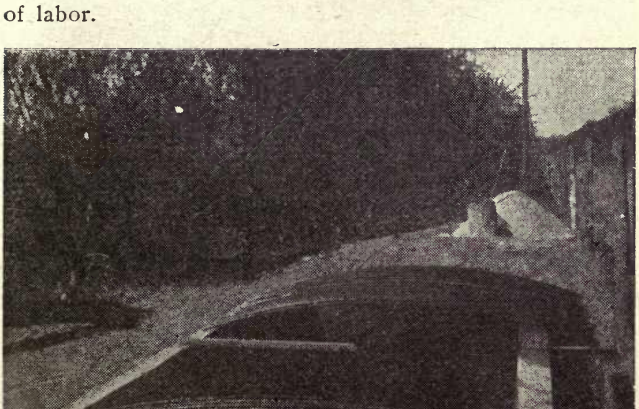
When oil costs 3 cents per gallon, and coal can be had for $5.00 per ton, it is the opinion of persons who are sufficiently experienced that coal is the cheaper fuel. Heaters are so constructed that they will burn about five pounds per hour, and at this rate, a heater holding fifty pounds will burn through most any one of the cold nights in spring without the necessity of refilling.

One of the great advantages in using coal for fuel, is that no expensive storage tanks are necessary, and no special equipment needed to enable the orchard man to carry it to the pots in the orchard. It can be kept in a pile at a convenient place in the orchard, merely covered with canvas or boards to protect it from the weather. Where oil is used some special means of storing must be had, such as a cement cistern or large iron tank, or even in numerous barrels, and for distribution there needs to be a special tank wagon. Coal, on the other hand, can be hauled in an ordinary wagon box, or what is better in a low sled, so as to enable one to get at the coal with the least amount of labor.

Heaters of this class require some special fuel for starting the fires, and this is most easily obtained from kindling made from broken-up bits of pine or from the tree trimmings that have been kept in a dry place. A bit of cotton waste should be soaked in oil and placed in the bottom of the heater, and on top of it a generous amount of kindling, with the coal on top of that. Egg or small lump coal is the best and should be handled with a fork so as to avoid the slack and small pieces that clog the fire and make it burn too slowly. The coal should be piled in the heater so as to leave the center open and afford a draft, and also to allow some of the coal to remain on the side of the heater, where it will be in reserve.

With coal burning heaters it is the general experience that fifty per acre will generally suffice to hold the tem-

perature up about 10 degrees above the minimum during the frosty period. The greater number of the heaters should go around the outer rows of the orchard with a smaller proportionate number through the middle. This arrangement protects the outside rows, which in turn keep the middles from low temperatures, and also enables the workmen to handle the heaters with the smallest amount of labor.



A Cement Tank used for Storing Oil.

Heaters need not be distributed until about the time the buds are beginning to open, and should remain in the orchard until well after the last frost has passed. The fires need not be lighted until the temperature has reached the freezing point, and if it is well past midnight, only about half of the heaters need be lighted on the start, so as to hold the remainder in reserve, and to economize on coal. Where the work has been arranged for in advance, and has been systematized, many growers have found that two men can look after the heaters on three acres.

In using oil as a fuel the largest item of expense, after the purchase of the fire pots and the oil, is the storage tank for the oil. Enough oil should be on hand at the beginning of the season to last through any possible cold snap that might come. This will mean that all of the oil will hardly be used in any one season, and perhaps good fortune will smile on the fruit grower and make it unnecessary to heat over a period of years. However it is highly necessary to have both heaters and fuel on hand in the case of an emergency. The most convenient way to store the oil is in a large storage tank located on an elevation such as a hillside where the oil can be emptied into the storage tank by gravity and withdrawn into the tank wagon or heaters in a similar manner. Lifting the oil out of the tanks with a pump is both laborious and costly, so that where the oil can be handled by running it down hill it is cheapest to do it that way.

Use Enough Heaters

It is advisable to have more heaters distributed through the orchard than will possibly be needed on any night. The advantage of this is that when the fires are required about one of every three pots can be lighted, and if there is danger of the temperature dropping still lower, and this many pots will not keep the temperature up to the desired point, there are still others to be lighted.

Whatever heaters are used, they should by all means be properly distributed throughout the orchard a few days before there is possibility of having to put them into use. They will need to be covered to prevent water getting on the fuel, as it will cause trouble. Coal that is wet will not ignite easily, and at best it is slow and troublesome to set on fire. With the oil, if water gets into it it will spatter and possibly fry or boil over on to the ground and not make as satisfactory a fire as when it is kept perfectly dry. Nearly all of the various makes of heaters that are on the market are provided with lids to protect the fuel from rain or snow. With some of them, however, it is

necessary to weight the lid down with a clod or stone to keep it from being blown away in a hard wind.

Cost of Heating

The expenses of heating an orchard will depend altogether on a variety of circumstances that vary with each orchard and each season. But the entire problem is nicely summed up by a practical orchardist on the western slope of Colorado, who makes this statement in The Fruit-Grower for January, 1911:

"My calculations of the expenses of heating an orchard, taken from my own experience, are as follows, based on a ten-acre orchard:

800 heaters at 45c each	$360.00
3 1,200 gal. storage tanks at $50 each	150.00
1 wagon tank	35.00
1 oil pump	17.50
2 oil pails at 65c each	1.30
6 torches	.40
100 pounds waste	8.00
4,000 gallons oil at 5c gallon	200.00
Total first cost of equipment	$762.20

"Now suppose we go on for ten years, for of course we are going to keep this outfit always in readiness, and we must allow $100 per year to keep our supply of fuel. We then have $900 more, making a total expenditure in ten years of $1,662.20, or an average of $166.22 per year for ten years. This is a cost of $16.62 per acre, making the cost from 15 to 25 cents per tree each year depending on the number of trees per acre.

"If I had a bearing orchard that I did not think would stand this expense, I would pull it out and grow potatoes, sugar beets or hay." These figures while illustrating very nicely the cost of equipment for heating, will vary in different localities according to the cost of the storage tanks, style of heater and the cost of oil, but such figures enable

one to get an approximate idea of the first cost of equipping an orchard for heating. The additional expenses of the operation will depend on the number of nights the heaters will be used, and the cost of the labor. As a rule the heaters are needed for four or five nights in the spring and with oil heaters it is the general experience that one man can take care of five acres while it will take possibly two men to handle that many acres where coal burners are used.

During the next ten years there will no doubt be as great a development in the styles of orchard heaters in use by the commercial orchardists as there are in the styles of spraying machines that are in use today, and which were in use ten years ago. This is to be easily surmised as the heaters, both coal and oil, which are now in use are not altogether satisfactory in many respects. One of the principal troubles with the oil burning pots is that when the oil has burned down half way or more in the pot the fires are not as hot as when the oil is at or near the top of the pot. This is because the upward currents of heated air prevent the oxygen getting down to the surface of the oil to make the flame. This slow combustion of the oil causes it to deposit larger amounts of soot around the top of the pot and throwing more of it off into the air. Several attempts have been made to perfect a heater that had a reservoir holding several gallons and fed through a pipe into the fire pan. But up to the present time no one has succeeded in perfecting such a reservoir heater which will satisfactorily burn gas or fuel oil in cold weather. These oils are thick and gummy, and even become almost solid in cold weather, so that when the oil must flow through a pipe, as is the case with all of the heaters of this class at the present time, the oil thickens so that it will not flow.

Aside from this trouble, the heavy oils which are used leave a thick deposit of residue or asphalt in the bottoms of the heaters, so that after burning for three or four nights this sediment must be scraped out. To do this it

is often necessary to heat the pots, and even at best it is a slow and nasty job.

The style of oil burning pot that is most needed is one that is inexpensive, in which the burning oil can be kept at the same distance from the top of the container all of the time, and which will make the maximum amount of heat with a given quantity, and also one that will require the minimum amount of labor in filling, cleaning and storing.

In heating an orchard it is important that the operator know what to do and how to do it, so that for persons who have never operated orchard heaters it is advisable by all means that several of the heaters be set out in the orchard, or an open place some time in advance of the time they are liable to be needed, and filled up with the fuel to be used and then lighted. Watch the way the fuel burns, and time the pots to see how long they will continue to throw off the greatest amount of heat they are capable of producing. It will take but little time and be very little expense to make such a test, while it will more than likely serve a good turn to the orchardist when the danger time comes in the spring.

Danger Points

It is commonly believed that the danger point for fruit buds is 32 degrees F., or the point at which frost forms and water freezes. This, however, is not correct, as the danger point to different kinds of fruits is variable, both with the kind of fruit and stage of development of the flowers. It will also vary with the conditions of the soil as to whether it is wet or dry or warm or cold. The Missouri Agricultural Experiment Station has found that dormant peach buds can stand a temperature of 8 or 9 degrees below zero with no injury. When the buds are appreciably swollen, zero weather is the danger point. When the buds are showing pink they can stand 15 degrees above zero. When the buds are almost open, 25 degrees is the danger point. When they are newly opened

about 26 degrees would be the point of danger. When the petals are beginning to fall, 28 degrees above zero is cold enough to cause uneasiness. When the petals are off they can stand 30 degrees above zero. When the "shucks" (calyx tubes) are beginning to fall off, 32 degrees above zero is the danger point.

The United States Department of Agriculture makes the statement that the danger point for apples when they are showing pink is 20 degrees above zero; in full bloom, 26 degrees above; pears showing pink, 20 above zero; in full bloom, 27 above zero; peaches showing pink, 23 above zero; in full bloom, 28 above zero.

Professor P. J. O'Gara stated that in southern Oregon the temperature at which apricot is injured when in the bud is 28 degrees above zero and at 30 degrees when in blossom; cherries are injured at 29 degrees just before the blooms open, and plums injured at 30 degrees above zero when the flowers begin to show white.

These figures are not absolute, and will vary slightly from year to year and with the conditions of the bud, but they will serve to indicate that the buds will not be injured when the temperature falls below the freezing point for a couple of degrees. Bearing this in mind it will be apparent to the orchardist that it will not be necessary to start up the heaters until the temperature has reached the freezing point, and if the prospects are for only a few degrees of frost it will not be necessary to light up all of the fires in the orchard, but to hold some of them in reserve.

In heating the orchard it is not necessary to run the temperature more than to the freezing point, or at most a couple of degrees above, as there is nothing gained. In fact it may be even objectionable through causing the buds to grow a little and become even more tender than they would be if the temperature is held close to the frost line. To be certain as to the departure of the temperature above or below the freezing point it is necessary that the orchard be provided with several thermometers located at

convenient places where they can be looked at frequently by the overseer of the operations.

It needs to be borne in mind when the work of orchard heating is begun that one has something else to do after the fires are started than to stand around and see the temperature in the heated zone rise to the point of comfort, while outside the frost will be forming over all. In fact, when orchard heaters are started to going it will keep all hands on the bounce looking after the fires, keeping them shut down or opened up so as to burn all the more vigorously. When a sudden drop in temperature does occur, and the heaters have been burning for several hours, it may necessitate filling the heaters while they burn. This is not an easy task, and especially when the coal burners are used, as it will mean that the pots must be cleaned out and sometimes that the fires must be rekindled. Then, after working all night with the heaters, it will be necessary on the day following to get them all cleaned up, kindled and refilled so as to be ready in case they are needed the next night. This day and night work is exhausting, and it is important that the orchardist prepare before hand and get sufficient help to do the work, and have the help well drilled in their work, so that the job can proceed with the least amount of trouble. Just a little systematizing of the procedure helps wonderfully in making a success of the work.

CHAPTER III

Thinning and Harvesting

Thinning

The practice of thinning fruit on the trees is not as extensively practiced by fruit growers as it will be in a few years in the future. The competition in fruit growing is becoming more keen each year, and the markets have less poor fruit each year, and the time is not far distant when the commercial orchardist cannot afford to grow fruit which will not measure up to the present standard of fancy. Thinning is done for the purpose of removing a portion of the fruit on the trees so as to allow that which remains to reach a larger size. It is profitable only on trees that are carrying a heavy load. To a certain extent the thinning can be done by pruning away some of the fruit producing wood, but in other cases it will take hand thinning to properly distribute the fruit.

It has been frequently argued that it costs too much to thin, but as a matter of fact, it will cost no more to pick the fruit when it is small than it will when it reaches maturity. In many instances it will not cost as much. It is money well invested at any rate, as the reducing of a heavy crop works to the advantage of enlarging each individual fruit left on the tree, and allows the tree to form fruit buds for the next year. In regions where the trees tend to an alternation in years of fruit production, the thinning of the crops will regulate the alternating habit. In the Western states where trees regularly overbear, thinning will allow the trees to make more wood growth

and to enlarge the size of the crop that remains on the trees.

It is impossible to lay down any formal set of rules for thinning as more depends on the size of the crop than any other factor. In years when there is a very light crop on the trees thinning may not be necessary, but in years when the crop is heavy it is always advisable.

Peaches in the Right Stage for Thinning.

Apples will usually produce their fruit in clusters of from three to half a dozen fruits in a bunch. All but the best apple in a bunch should be removed. On the tips of

the longest whips fruit is often formed, but will not develop into fancy fruit, so they had best be removed, allowing only the fruit on the spurs to remain, thinning out to only one on a spur.

Pears have about the same habit of fruiting as do the apples, and need to be thinned in the same way. With young trees and with trees that are not carrying a very heavy load of fruit, thinning is not always a necessity, as

Apples at the Right Stage for Thinning.

if thinned on such trees the fruit may become larger than is most desired for market fruit. Very large pears are not wanted by the average market, as when they have to sell at a price above 5 cents each the demands are not sufficient to warrant most dealers handling them.

Peaches, plums and cherries are thinned to a large

extent by the operation of pruning. Peaches especially set a far larger number of fruit buds than the tree can possibly bring to maturity, and thinning by removal of some of the fruit producing wood saves a large amount of labor later on. All of the fruit of the peach is produced on wood of the last year's growth, and the middle portions of such branches will have one or two buds at each node. The thinning should be done before the peaches get any larger than a pigeon egg, and need to be thinned out so that the fruit on any one branch is separated by at least six inches from any other fruit on the same limb.

In thinning stone fruits the work can be done by pulling the fruits off, but with apples and pears it is safest to clip the fruit with sharp pointed shears, as if pulled there is too much liability of breaking off the entire spur.

Harvesting

The harvesting of a fruit crop is only one of the several important operations connected with fruit growing, and yet it is an operation which has a great deal of influence over the final market value of the fruit, and takes a rank only second to spraying. If fruit has been carefully sprayed, three-fourths of the loss that occurs by the time the fruit reaches the consumer will be due to carelessness in picking.

To know when to pick a fruit is a fine art. To know how to pick a fruit can be learned by practice, but not every one can or will learn how to do the operation with all of the care that is necessary in handling a high class crop. The commercial fruit markets of today demand fruit that is in excellent condition, and will pay prices that warrant all of the care that the grower can give the fruit during the harvest.

All kinds of fruit must be picked by hand, rather than by raking off the tree, or shaking onto the ground to be picked up later on. Fruit that is picked from the tree must be laid carefully into a basket, bucket or bag and carried to the packers with the least possible shaking about.

Most of the fancy fruit that is produced is held in cold storage during the early part of the season, and its market price will be determined largely by its superiority as a cold storage product. This means that the fruit must be picked in the proper condition. Fruit which is fully ripe, but not overripe, well colored and placed in storage immediately after harvesting keeps best.

Picking Apples

High quality apples must be picked by hand. Just when to pick will depend on a variety of circumstances. It depends on the variety of apple, the market to which it is to go, the style of packing and the general excellence of the crop. Red apples are usually ready to pick by the time they have reached their full color; yellow apples cannot always be determined when ready for picking by the color of the skin. A better guide is by the size of the apple and by the color of the seeds. When the seeds have become a good brown color the apple has reached its maturity and is ready for picking. Some varieties of apples like Ben Davis and Northern Spy will hang on the trees for a long time after becoming ripe enough to pick, while varieties like Wagener and Wealthy or other early maturing kinds, will generally begin dropping by the time they have reached maturity.

The time to pick apples is determined to some extent by the distance to market. When apples are to be used in the local market, or to be shipped only short distances, they can be allowed to hang on the trees longer, and will take on a higher color. If the fruit is to be shipped great distances it must be picked as soon as possible after having reached its maturity, although in some instances the fruit may have to be gathered while it is still a little on the green side of maturity.

For high quality fruit it is the practice of many orchardists, especially in the Western fruit sections, to make several pickings, going over the trees at least three different times, picking only the largest fruits each time. This will

often result in increasing the grade of the fruit, as apples will continue to increase in size, and deepen in color, during the last few days they remain on the tree. Some varieties of red apples will not take on the highest color they can attain until after the leaves have begun to thin out a little in the fall and allow the sunlight to enter the tree.

The coloring of an apple is a character that has a great influence over the final price the fruit will bring in the market. Red apples that have reached maturity, and are perfect in every respect except that they are poorly colored, will not bring the same price as apples that are perfectly colored. In some of the Western fruit districts that make a specialty of fancy fruit, it is demanded by the associations that the growers put into their first grade or extra fancy fruit, only apples that are at least 70 per cent red. By making several pickings the color of much of the fruit can be increased materially, and the increased price for high colored fruit offsets the increased cost of making additional pickings.

In picking fruit every care should be exercised that the skin of the fruit is not injured by punctures from the fruit spurs, and from the finger nails of the pickers. It should not be knocked against any object that would cause a bruise. A bruise so slight as to not be noticeable will develop into a discoloration in many varieties, especially yellow apples, and possibly cause the tissue to break down and rot. The pickers should be warned and watched against pulling out the stems of the apples. Every fruit should have the stem left in the apple, and this can always be had if the fruit is not pulled off the twig. Each apple should be grasped firmly and lifted up at a sharp angle to the twig and given a quick twist. Unless very green, the stem will break easily from the spur. When a stem is pulled out of the fruit it always leaves a wound into which mould spores can enter and start the apple to rotting.

Mechanical pickers are of little value in harvesting a crop of fancy apples. They may be of some service in the

home orchard, or where cider apples are being harvested, but have no place in the orchard where fancy fruit is being grown. The principal objection to mechanical pickers is that they invariably pull the stems out of the apples and subject the fruit to more or less bruising and puncture the skin.

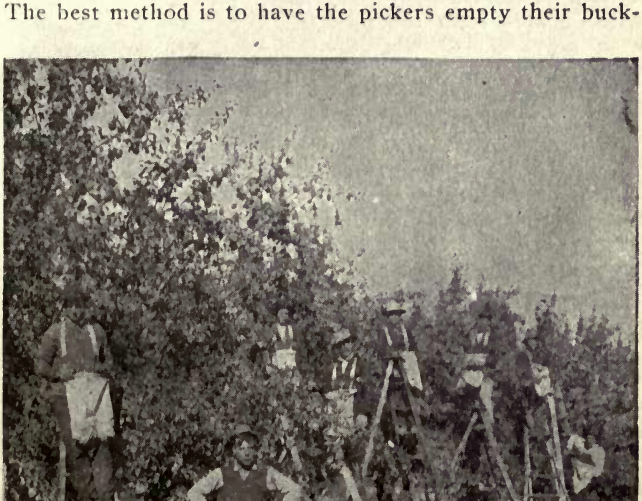
Buckets and Ladders

Tin or galvanized iron buckets are the best things to use in picking apples, and each bucket should be provided with a large, strong wire hook attached to the bail, in order that the bucket can be hung on a limb or on the ladder while being filled. It is better to have the bucket on the ladder or on a limb, rather than to be attached to the picker, as the fruit is subjected to less damage from bruising. Baskets holding a half bushel or less, and which are well padded inside, are very satisfactory for picking apples into, but are more unwieldy than the bucket. Some persons use buckets that have a canvas bottom which can be loosened so that the apples roll into the lug box or on the packing table. They answer very well in the hands of careful pickers, but the fruit is liable to be bruised by being set down on hard objects. Picking bags and baskets also serve their purpose very well in the hands of careful pickers, but as it makes it necessary for the pickers to carry the fruit about with them at every move, there is great danger of the fruit being bruised.

Ladders are a necessity, and the best ones, except for very high trees, are step ladders with three legs. Such a ladder will set more solidly than a ladder with four legs. The best for high trees are light ladders with two rails so shaped that the rails meet at the top and are continued upward for a couple or three feet. Ladders of this sort slip into the branches easily and are strong and substantial. It is an advantage in picking apples to have the picking crew graded according to height. Some of the pickers should work on the ground, picking no fruit they cannot reach easily from the ground. Another set of pickers should work from six-foot ladders, and the remainder work

from high ladders. This will facilitate the picking as the pickers will quickly adapt themselves to the height at which they must work and learn how to handle themselves and their bucket.

After the fruit is picked it must be kept out of the sun. The best method is to have the pickers empty their buck-



Step Ladders and Picking Bags used in Harvesting Apples in Western Colorado.

ets into lug boxes, filling the boxes no more than level full, and haul the boxes to the packers immediately. In emptying the buckets or bags the pickers should not pour or drop the apples into the boxes, but lift each apple carefully and lay it over by hand. A drop of only a few inches will in many cases, bruise the fruit. Apples must be

handled as carefully as eggs. The practice of transferring the apples from the picking bucket to a heap on the ground to await the packers in the orchard is not recommended for fancy apples. They will be more or less bruised; they will heat and unless carefully covered, they will be scalded by the sunlight. Some growers transfer the apples from the pickers directly to the wagon, where they are loaded in bulk and hauled to the packers and poured out on the packing tables. This always bruises the fruit to a greater or less extent, and is not recommended. The best practice is to transfer the fruit from the pickers' buckets into lug boxes of three-eighth inch sides and bottoms and three-fourths inch ends with a cleat across the top at each end to keep the boxes apart when piled on top of each other. It is an advantage in handling the boxes to have hand holds sawed in the ends by which they can be carried.

Apples should be hauled from the orchard to the packing house on low wheeled wagons equipped with good bolster springs. A low wheeled wagon will pass under the limbs of the trees more easily than the high wheels, and will cause less damage to the low limbs and to the fruit that hangs low on the trees. Where lug boxes are used, make a platform for the wagon, around the edge of which there is a one-inch strip to keep the boxes from sliding off. The boxes can be piled two or three high, and such a wagon is far more easily loaded and unloaded than an ordinary wagon box.

Pickers should be paid by the day rather than by the quantity. This will insure less injury to the fruit, as when paid by the quantity the pickers will have no interest than to get as many apples off in a day as possible. By receiving a certain sum for each day's work, they will exercise more care to pick each apple so as to retain the stem and to handle the fruit without bruising. Apples picked while wet from rain or heavy dew will rot quickly. It is better always to wait until the trees have dried off before commencing to pick after a rain.

Picking Peaches

Peaches for eating out of the hand are best when picked just before the fruit has become so ripe that it will fall off the tree. However, for the commercial peach, where the fruit will possibly be shipped a thousand miles or more, and where it may have to lay in the package for ten days or so before finally reaching the consumer, it is

Peach Pickers Using Bushel Baskets.

impossible to let them reach their full maturity before picking. It is always best to leave them on the tree just as long as possible and still get them to the consumer without their being injured or overripe. This means that for nearby markets they can be allowed to become riper than where they are sent to far distant markets. However, the fruit

should not be either too ripe or too green. It is easy to err on either side.

Peaches vary considerably with the different varieties as to the stage of maturity they must reach before picking. Firm varieties like Elberta can be allowed to reach a riper condition before picking than with the soft fleshed kinds like Carman. In cool dry weather the fruit can become riper than when it is hot and muggy. In wet weather there is always much loss from the fruit rotting.

A half-bushel wooden basket is the best thing to use for picking peaches. The fruit should be picked from the trees carefully, and just at the time when it has reached its full size and developed a good blush on the sunny side. When ready to pick the fruit must be solid, with no indication of a soft spot, and must be handled carefully so as to not bruise it by dropping it into the basket or in hauling it to the packing shed. If a soft spot can be felt when the fruit is held in the hand and squeezed gently, it is too ripe to ship far.

It pays to go over the trees several times, as the fruit will not all reach the same stage of ripeness at the same time and the smaller fruits that may be left for several days on the trees will increase greatly in size and pack into a much larger grade than if the tree is stripped at one picking.

Picking Pears

It is necessary in putting out a first-class grade of pears to go over the trees not less than three times, taking at each picking only those pears which are ready to pick. To know when to pick a pear can be learned only by experience. When left on the trees until they have begun to color pears will become granular in the center, and in storage they will break down at the core and become soft and mushy. A pear for market needs to be picked when it has reached its full size but is still green in color. In some varieties, such as Bartlett and Comice, the usual method of knowing when a pear is ready to pick is when the pear will snap off the stem when the fruit is lifted and

bent upwards at a sharp angle to the fruit spur. When such is the case the fruit needs to be picked and placed in storage to ripen. The yellow coloring of pears is developed in storage, although the crimson blush which appears on some kinds must be formed while still hanging on the tree. Not many varieties of pears will take on a red cheek, although it is common to some kinds.

Pears need to be handled with as much care as the apple, and extra care must be taken that the stems are not broken off or pulled out. On account of their extending out of the fruit, and being quite rigid, they are easily broken, and the way opened for the entrance of germs that will cause the fruit to rot.

CHAPTER IV

Packing

Packing in its broadest application consists of the operation of placing articles, goods, products or merchandise into suitable parcels, baskets, boxes, cans, barrels or other packages for safe transportation. In horticultural work it applies especially to the preparation of fruits and vegetables for shipment.

The approved method of packing fruits and vegetables necessarily differs widely with the nature of the article to be packed, and for the same product custom has established different practices in different parts of the country. Formerly it was the habit in many markets to return the empty packages to the shipper so that they could be used over and over again. With the vast increase in distant shipments, due to improved transportation facilities, this became impossible, and now cheap gift packages intended to be used but once, are coming into favor, and in some regions are used exclusively. This is by far the best practice, as it is a sanitary method, and assures a clean, neat package for the product.

While the shape, size and form of the package varies widely for the same kind of product in different parts of the country, some form of crate, barrel, box or basket constitutes the commonest package for the ordinary fruits or vegetables. These are modified to suit the particular purpose.

Modern Packages

Modern packages are characterized by lightness, neatness, cheapness and uniformity, and are of such shape as

will best accommodate the kind of product for which they are designed. Most packages are intended to contain some certain standard quantity, as pint, quart, bushel or multiple thereof, yet every market is more or less full of packages which contain "short" measure. Legal actions and regulations have been somewhat ineffectual in enforcing the adoption of packages containing quantities of certain volume, yet they should be observed by all growers, especially when the package is expected to contain a specific volume of standard measurement.

The sale of any product largely depends on the appearance of the packages in which they are contained, and packages which attract the eye of the buyer are most easily sold. It is always advisable to have a sufficient supply of the desired packages on hand at the beginning of the shipping season, as it is often difficult to get the right kinds of packages at the height of the season for that particular kind of product. Packages which have been once used for the shipment of fruit or vegetables should not be used for the purpose a second time. The general appearance of such packages are not only against them, but it frequently happens that the wood is filled with the spores of organisms which cause decomposition of the product from the produce which was formerly packed in them. These will then hasten the decomposition of the fresh produce which may be packed therein.

Any unused packages at the end of the season should be carefully gathered together and stored where they will be kept perfectly dry and clean and where their general attractiveness will be retained until they are to be put into use at a subsequent season.

Grading of the product before packing is very essential, and consists in selecting specimens of uniform size and condition for each grade used. There is a variety of names applied to the grades of any sort of produce, depending largely on the locality and kind. Each package should contain only one grade and be honestly packed all the way through.

As a general rule packages for soft and perishable

produce is packed in small parcels. Red raspberries, for example, are packed in small cups or boxes holding approximately a pint. On the other hand, winter potatoes, a product that does not require such careful handling, are packed in bags containing about 150 pounds. In the Southern states where the trucking industry has reached its highest development, there is much care given to packing vegetables, so as to have them reach the markets in the finest possible condition as there is in the Western orcharding sections to have the highly perishable fruits, such as peaches, cherries and apples, to reach the markets in the best condition.

Potatoes

While the potato is one product which can be handled with the minimum of care, yet for the early potato it is necessary to observe certain precautions against bruising and breaking the tender and immature skin, and in getting them properly packed so as to reach their distant market with the least amount of loss from bruising. Early potatoes need to be handled carefully from the time they are taken from the soil until in the hands of the consumer. They are sometimes dug with a machine made for digging potatoes, and sometimes with an ordinary "potato hook." They should be gathered from the field as soon as possible after digging to prevent their wilting and becoming sunburned or turned green through the development of chlorophyll. Grading and packing may be done in the field or they may be taken to the storage house and there prepared for market. The crop requires as careful and uniform grading as any other farm product. The tubers should be sorted according to size into first and second grades. All scabby, second growth and injured specimens should be rejected, and the different varieties kept separate.

Early potatoes are generally packed in ventilated barrels with a burlap cover, although in some sections the barrels are double headed in the same manner as apples. The potatoes are not "faced," but poured in carefully from a small basket that can be lowered into the barrel. During

the process of packing the barrel should be shaken or "racked" several times so as to cause the potatoes to settle and arrange themselves into the spaces between the tubers, and make the pack firm and snug so that it will be well filled at the time it reaches the market.

Sweet potatoes are packed in the same manner, and fully as much care is necessary in the grading of them as very small string-like potatoes are not desirable and tubers which are considerably over size add nothing to the appearance of the package. Potatoes of medium size are the most satisfactory for the Northern markets and usually bring the best price.

Some of the Southern sweet potato growers are of the opinion that the use of double headed barrels add materially to the marketing of the tubers in the North, as a double headed barrel insures the potatoes reaching the market in a better condition than is usually the case with the burlapped barrel.

Cabbage

In the Southern states where cabbage is grown for the Northern markets the usual package for marketing is a slat-crate holding about 100 pounds. The heads are graded according to size and packed as carefully as any other perishable product. The slat crate or ventilated barrel is preferred to the ordinary barrel because of the better ventilation that is obtained. Cabbage wilts considerably after being cut, and unless there is abundant ventilation for this moisture, the air in the package becomes saturated and moisture frequently condenses on the sides of the barrel. In a tight package rot will quickly develop, and the product be spoiled.

Late cabbage is most often packed in a square crate holding about a barrel, and in either sort of package it is important to pack heads of uniform size in each package, and to fill the package very full and solid, as cabbage wilts and shrinks considerably during transportation so that it is important to guard against having it reach the buyer in a slack condition.

Lettuce

The packages for head and leaf lettuce are somewhat different. In the Southern states where head lettuce is grown in the open field for the Northern markets, the lettuce is generally marketed in half-barrel baskets, while in the North where leaf lettuce is grown in greenhouses, the products are packed in half-bushel veneer market baskets, and in one-third and one-bushel boxes.

All of the heads of lettuce will not reach the same stage of development at the same time so that the field, frame or house must be gone over several times, selecting each time only those plants which have reached the proper development. The plants are sorted and graded as they are packed. In the Southern lettuce fields the plants are cut and trimmed in the field and packed there or taken to the packing house and packed. In the bottom layer of the basket the heads are placed stem end down and the remainder of the basket filled with stem end up, placing the heads in the basket as neatly as possible, and in uniform layers.

With leaf lettuce the packing is done either flat or stem end down, packing the basket or box as tight and firm as possible without crushing the leaves. The leaves will wilt and shrink somewhat after being cut, and for that reason the packages need to be well filled, but not so tightly as to heat, otherwise they will become slack before reaching the market, and not bring as good a price as might otherwise be had.

Beans and Peas

Beans and peas from the Southern trucking districts are marketed in the same sort of half-barrel basket as is used for lettuce. The packing is mostly done in the field, each picker putting the produce directly into the package without any additional sorting at the packing house. In some sections these packages are covered with burlap and in others a wooden lid is placed on each basket, thus mak-

ing it possible to put the product on the Northern market in somewhat better shape than when burlap covers are used.

Cucumbers

This crop is grown in the open in the Southern states and in greenhouses in the north, for the winter and early spring trade. In the Southern states the customary package is a one-third barrel veneer basket. The cucumbers are cut from the vines and carried to the packing house where they are sorted over and graded, so that each basket contains specimens of uniform shape and size. The most desirable market size during the early spring is for fruits six to eight inches long. These are placed in the baskets so as to lay flat, and packed in as firmly as possible. The baskets are covered with a wooden lid made for the purpose.

Cucumbers grown under glass are generally packed in boxes which are about eight inches deep and twenty-four inches square, and are either stood on end in the box or laid flat, according to the size and grade that is being packed.

Tomatoes

When tomatoes are grown as a truck crop in the South to be shipped to some distant market it is important to pick the fruit as soon as the first coloring appears. The fruit needs to be picked carefully, without the stem, and taken to the packing shed in small baskets or boxes, handled at all times in such manner as to prevent any possible bruises or injury to the skin.

In packing, only sound, perfect fruits should be used and each package should contain as nearly as possible fruits of the same shape, size and color. For fancy markets, or for long distance shipments, it is advisable to wrap each fruit in a sheet of soft, white paper, upon which the name of the grower should be neatly printed.

The usual package in the South is the six-basket carrier similar to the one that is used in some sections for packing

peaches. In packing such a package, the fruit should be arranged neatly in rows in each little basket.

Where the fruits are placed on local or nearby markets they are packed in the Michigan or Delaware type of baskets.

Beets

For distant shipment beets are pulled when about two and a half inches in diameter, and are tied in bunches of from about four to six, with the tops cut back about one-half. There is no standard sort of package for this root crop, the kind used depending largely on the market to which the crop is sent. Some markets prefer the ventilated barrels, while others want a bushel slat-crate and still others want either the half-bushel or half-barrel veneer hamper. No matter what sort of package is used, the beets should be well graded and neatly packed.

Celery

This crop is quite uniformly marketed in crates by the growers in all of the important celery producing regions. The plants are dug from the field and the roots cut off and then tied into bundles of from four to a dozen plants in a bundle and packed root end down in open crates. In some of the Northern markets, where celery is marketed locally, the plants do not have the roots cut off, but are packed in crates which have a water tight bottom in which a little water is placed. In such crates the plants will keep fresh much longer than where the roots are cut off; however, such packages are expensive and do not permit of as rapid handling as do the standard crates.

Radishes

Radishes intended for long distance shipments are pulled and tied into bundles of about a dozen roots each and packed in half-barrels or hampers. It is considered advisable in warm weather to pack some two or three

layers of crushed ice in each package of radishes, especially when shipping over long distances. This will assist in preventing the decay of the tops and roots, and keep the plants crisp and fresh.

Small Fruits

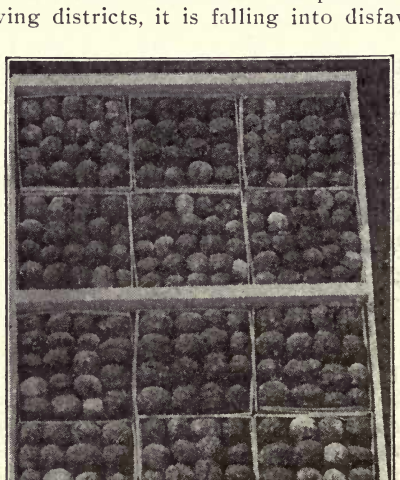
The packages used for berries of all kinds are pint or quart "cups" or boxes made of cardboard or thin veneer and fastened together with wire staples or tacks. The shape of the boxes varies somewhat with the market to which the fruit goes, although in a general way square boxes, which are a little larger at the top than bottom are preferred on the Eastern markets, while in the Middle Western states the "Hallock" or "Leslie" boxes are used. Whatever shape box is used, they are packed in crates holding from 16 to 24 or 32, 48 or 60 boxes.

As a rule the softer the berry the smaller the box should be, or at least the more shallow it should be in order to prevent the berries from being crushed by their own weight. For this reason the package most popular for the fruits of the brambles, such as red raspberries, black raspberries, blackberries and dewberries, are cups which are about five inches square and two inches deep. These cups hold approximately a pint, and in them the berries are not piled so deep that the bottom ones are crushed by the weight of those above. Packages of this size are so satisfactory for small fruits that blackberries have been harvested in the Puget Sound country of Washington and shipped to Chicago, where they arrived practically in as good condition as the day they were picked from the bushes.

Strawberries

The system of packing strawberries is undergoing a gradual transformation, taking the country as a whole. This is on account of the great extension of the commercial strawberry growing country, and the increasing demands for fancy fruits in neat and attractive packages.

Cups or boxes holding not over a quart are the accepted standard as packages for strawberries. In most sections of the country these boxes are arranged in little trays holding from four to a dozen boxes, which the packers take to the field. The berries are picked directly into the boxes, without any additional sorting or grading. While this practice is common and used in all parts of the strawberry growing districts, it is falling into disfavor for the



A carefully packed crate of strawberries. This style of packing adds materially to the attractiveness and helps in bringing a better price.

reason that the pickers are not always as careful as they should be about grading the fruit as it is picked. Children do most of the work of picking strawberries, and they become careless about grading unless they are more carefully watched than most growers are able to do.

Because of this there is an increasing tendency among growers who are packing fancy and extra fancy fruit to have the picking done in the usual way, and then repack the fruit at the packing shed. In this repacking the fruit is poured out onto a tray having a bottom made of mosquito bar or soft cotton cloth. All of the bruised, overripe or dirty berries are thrown out. The berries suitable for packing are arranged in two grades, and are placed in the boxes in rows and layers, much after the fashion of boxed apples. Berries which are of irregular shape, such as Bubach or Aroma, do not pack into boxes as smoothly and evenly as do such varieties as Senator Dunlap, Klondike or Clark's Seedling. But whatever the size or shape of the berry, the boxes should be graded honestly with the fruit in the top layer turned with the same side up, thus "facing" the box. Fruit which runs under three-quarters of an inch in diameter should not be marketed as first-class berries, as they are too small, and should be sent to the canning factory.

In those parts of the country where fruit growers' associations have control of the harvesting and packing the better methods are in use, and the growers receive more careful instruction about picking and packing their fruit. The association at Ashland, Oregon, issued the following instructions in 1910 for its berry growers: "Strawberries are graded 'A' and 'B.' The 'A' grade berries must be nice in appearance, firm and clean; smallest berry for 'A' grade should be of such size that four berries will form one row along the side of the cup; face the 'A' grade with medium size berries; do not put the extra large berries on top. The 'B' grade, firm and clean, no culls, and need not be faced. Stems on all strawberries should be about half an inch long. Pick in the mornings only, and keep dry and cool; do not let crates or picking crates set in sun. Deliver to warehouse before 10:30 a. m. Use wagon with springs and cover fruit. Make rule for pickers that berries must not be carried in hand but must be transferred to cup at once after picking. Berries should be handled as little as possible. Fill cups about half an inch above the rim; fill corners; pack firmly, but do not press. In

picking blackberries, raspberries and logans, remove all stems and pick as soon as berries come off readily. Be careful to not put overripe or crushed fruit in cups, as it will cause the entire lot to mould. Use no small or dried berries. Especial care is required to fill the corners; if not done, shipping causes berries to sink in cup. Currants and gooseberries are shipped in crates and cups, same as strawberries. Get instructions from manager as to time and condition of picking. Mark grower's name in upper left hand corner of crate. Attention to details gives satisfaction to customers and keeps up the price."

"Shed packing," as it is called, has found favor with the strawberry growers at Pierce City, Mo., where the association has made a fine reputation for its pack and has been able to realize from 15 to 35 cents per crate above the average market price. To accomplish this the berries are culled at the packing shed. There the force of help is divided into cullers, graders and packers, over whom is the shed inspector. About two-thirds of the force cull and grade; the other one-third being divided up into packers and finishers. To facilitate the work of packing, trays or pans have been contrived in the shape of a flat, shallow tin scoop tapering from 8 to 10 inches in width at the handle to about 4½ inches at the other end, and from about 12 to 14 inches long. These trays expose the surface of all the berries in such a way that the faulty ones may be quickly culled out. The good fruit remaining is then emptied into the box from which it originally came, and additional berries are added to make it nicely rounded. Every box and crate prepared for shipment must be examined by the inspector and receive his stamp of approval before being shipped.

Grapes

There are a great many different kinds of grapes grown in this country, yet there are but two styles or type of packages in general use. One of these is the "Climax" basket that is used for the Concord class of grapes, and finds its most extensive use in the central and eastern

portions of the country, while on the Pacific coast, where the Vinifera type, such as Cornichon, Tokay, etc., are most extensively grown, the four-basket crates are mostly used. There are various sizes of Climax baskets, holding 3, 5, 8 and 10 pounds of grapes, and are sold intact to the consumer. With the grapes from the Pacific coast they are usually sold by the pound on the retail stands, the average consumer rarely buying so much as one basket, which may weigh as much as five pounds. The Malaga grapes, that reach the Eastern markets in midwinter, are packed in half barrels with the spaces filled with cork dust. In such packages the grapes will carry better and keep for a longer time than when packed in baskets as other varieties.

In some of the large grape growing districts of the East the grapes are cut from the vines in the field and laid into lug boxes that will hold about fifty pounds. These are taken to the packing house immediately, where they are allowed to stand for at least twenty-four hours to wilt. They may stand for several days if the weather is cool, and will pack into the baskets very much more firmly after wilting than when cut from the vines.

Growers in some of the smaller sections do not repack their grapes in the packing house, but pick directly into the shipping baskets. When filled the baskets are set under the vines where they will be out of the sun. In picking, the grapes are carefully arranged in the baskets and well heaped up. After standing for a day or so they will have wilted sufficiently so that the lid can be placed on the basket.

Peaches

The packages for this fruit as it is packed in each of the many states where it is grown commercially are as variable as for any other kind of fruit. The most important of these are the Climax basket used in Michigan, the half-bushel and bushel basket, and the Delaware or Jersey basket, the 4 and 6-basket carrier and the flat box of the Pacific coast states. Of all of these the last named is the

only one which requires any especial skill in packing. The 6-basket carriers require that the peaches be graded into fruits of uniform size and placed in the little baskets in such manner as to make a good appearance. Some skill is required to do this in the best manner, but it is easily learned, and after a day or so any one who is careful can pack such baskets perfectly.

As a general rule the peach growers in all parts of the country pack their peaches in especially arranged packing houses. These houses are arranged so that the wagons delivering the fruit from the pickers in the field can drive up to one end or side of the house and unload directly on the floor of the house. The house is provided with long tables usually having a canvas bottom, and at convenient distances apart on each side of the table are brackets or racks of such size as to hold the baskets of the packers. The packers grade and pack at the same time. Culls are dropped through a chute in the table to baskets on the floor, and the packers put fruits of uniform size into each basket.

The bushel baskets are usually packed in the field unless the crop is very defective, necessitating the sorting out of rotten or overripe stock at the house. The Climax and Delaware baskets are sometimes packed in the field, although the growers who make the better packs work the fruit over in the packing house and sort into two or three grades.

In the great peach growing sections of the far Western states the packing of fruit has been reduced to a fine art and it is in these sections that one finds the greatest uniformity in the styles of packages and packing. About the only package that finds commercial use in the West is the light pine box having dimensions of about 11½ by 18 inches and 4, 4½ and 5 inches deep inside. The ends are made of 3-4 inch or 11-16 material and sides of 1-4 inch wood. In these boxes the peaches are packed only two deep, so that the lower layer is not bruised by the weight of the fruit above, and the contents cool very quickly when put in an iced refrigerator car or cold storage.

The majority of the associations in the West make three grades, and while they are known by different names in different parts of the West, they are practically uniform in size of fruit. These grades are known by the name of "extra," "90s" and "108s;" "extra fancy," "fancy," "choice," "F," "A," "B," etc.

The "extras" or "extra fancy" is applied to peaches that will pack not more than 80 to the box; "90s" should run from 81 to 94 to a box, and the "108s" from 95 to 108. In the peach growing section of Oregon the "F" grade is applied to peaches running not more than 66 to the box; "A" to 76 and "B" to 88. In this district a fourth grade running to 100 per box has been packed, but has not been a profitable size, and peaches running less than 88 are used up locally or canned.

Handling the Fruit

The first essential in packing peaches for the commercial market and especially where they are to be shipped for some distance, is to have the fruit picked in the right way and at the right time. Peaches which are picked too green or too ripe will not prove satisfactory on the market. In picking pick with the hand and not the fingers. Reach over the peach so that the fruit rests in the palm of the hand and separate the fruit from the stem by a twist from the wrist and not by a pull. Peaches picked in this manner will not show the least mark, even on the ripest fruit, and the fruit should be laid in the basket and not dropped. The fruit must be handled as carefully as eggs.

Grading of the peaches is done as the fruit is packed, as it is the general opinion among experienced packers that the fruit can be handled in that manner with the least amount of damage. Grading machines have been in use to some extent, but they have not proven altogether satisfactory as yet on account of the bruising which is caused. Yet there is every reason to believe that satisfactory machines will be developed within the next few years that will handle peaches with but little more bruising than they receive at the hands of careful pickers.

Upon being delivered from the field the peaches are carefully emptied out upon tables having well padded or canvas bottoms. At the sides of the tables are racks holding two or three boxes slightly inclined, one box for each grade, and the fruit is packed from the lower end up. Peaches packed in these Western sections are each wrap-

Interior of a peach-packing shed at Koshkonong, Mo., showing the packing table, bushel baskets in which the fruit is delivered from the field, and a six-basket crate.

ped in paper. This operation is easily learned with a little experience, although it will go rather slowly at first. The papers used for wrapping are cut 7x7 or 8x8 and kept in suitable trays at the side of the boxes and within easy reach for the packers.

The packers stand with one side to the table. A peach is picked up in one hand and a paper in the other, the paper being caught about the center between the thumb and first finger in such a manner that the paper lays flat on the palm of the hand. The peach is then quickly placed in the center of the paper, and the paper closed over the fruit by closing the fingers and finally finished by a deft little twist into the box so that the corners close over the fruit and serve as a pad between the box and fruit. After the first layer has been completed the second layer is put in in the same manner, and the box is ready for the nailing press.

There are many styles of arranging peaches in the boxes, depending largely on the size and shape of the fruit. It is of great assistance to the inexperienced packers to have a "size board" or specimen peaches of the different grades continually before them, so that by comparing these frequently the grades can be kept quite constant. The "straight" pack in which the fruit is arranged in straight rows up and down and across the box is the simplest style of packing and one that has been extensively used, but is being displaced by the "diamond" or "diagonal" pack, since in the straight pack each fruit rests directly on top of others and is thus more easily bruised. In the diamond pack the fruits are placed so that each specimen is in the hollow between several others, and long experience has shown that this style of packing causes less damage than the straight pack.

The diamond packs are arranged so that the peaches come in double rows across the box containing 2-2, 3-2, 3-3, 4-3, 4-4, 4-5, etc., corresponding to the "half tiers" in the boxed apple package. In this style of packing, the "3-2" for example, three peaches are placed in the lower end of the box, one in each corner, and the third exactly in the middle. In the second row there are only two peaches which are placed in the spaces between those in the first row. In the third row three peaches are placed in the spaces left by the fruit in the second row, and come directly above the fruit in the first row. In the fourth

row there will be two fruits again, and be directly above the ones in the second row. After the first layer is about half filled in the fruit needs to be "drawn down" snugly so as to give the box a little bulge at the side, but must be done without bruising the fruit. The layer is then completed. In placing the second layer in the box the first row at the lower end will contain two fruits placed over the spaces between the fruit in the lower layer. The second row contains three fruits, and so on alternately 3 and 2 until the box is filled.

Apples

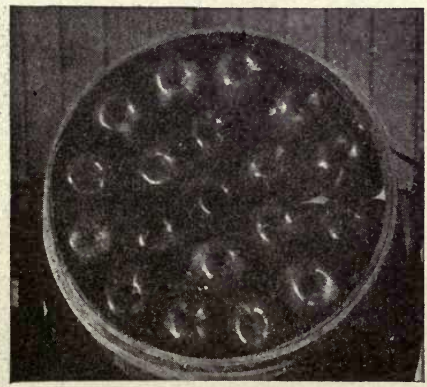
Apples for the commercial market are packed in fewer styles of packages than any other kind of fruit. Barrels holding approximately 100 quarts, and boxes holding a bushel are the packages most extensively used. Some trifling differences are made in the sizes of barrels by the laws of the different states, but they are approximately 28½ inches long, with heads 17½ inches in diameter, and 64 inches in circumference at the bulge on the outside. There is a slight difference made in the exact dimensions of the bushel boxes, on account of the adaptability of certain sizes to some sizes and shapes of apples.

It takes but little skill to pack a barrel of apples. A little experience, combined with the careful sorting of the fruit will enable any good workman to pack a barrel of apples, for the reason that the fruit is not arranged in the barrel in layers or rows, but the apples poured in and allowed to lay in whatever position they will.

In putting up the most fancy package of apples in barrels it is best to line the barrel with white or manilla paper, with a piece of lace paper over the face and a thick pad between the fruit and the head to prevent the apples from being bruised.

A barrel ready for packing is placed in front of the packer with the bottom end out and the head, or top end down. A few well sorted apples are then arranged with the stem ends down, so as to completely cover the head.

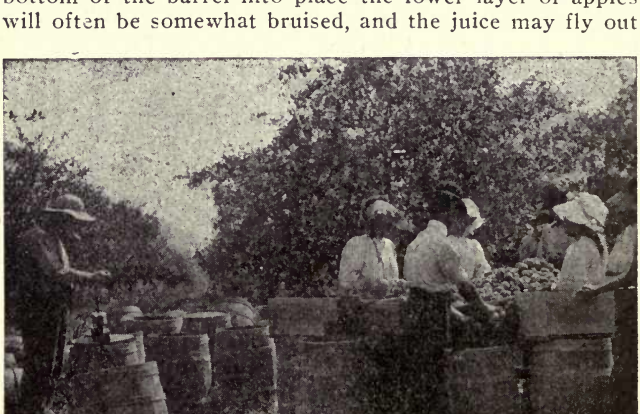
A second row may be placed in a similar manner if the barrel is to be packed nicely, otherwise the barrel is filled with apples of the same size and grade as the face layer, by lowering into the barrel a basket that can be emptied with the least liability of damaging the fruit by bruising. The barrel is shaken frequently while it is being filled to cause the apples to settle, but must not be done so vigorously as to bruise the fruit. When the barrel is full a layer of apples is then placed on top, all with the stems up, and should stand up above the top of the barrel for a couple of inches.



A Nicely Faced Barrel of Apples.

The chime hoops are then loosened up a little and the top one removed. The barrel-press and head are then put in place and the head forced into position. While the pressure is being applied a few strokes with a hammer directs the head into place, when the chime hoops are driven down and nailed; the lining hoops are then nailed fast and the press removed. The barrel is then turned over and the name of the variety and name of the grower are stenciled on the end that was downward, and which now becomes the "face."

A barrel thus packed opens up with a nice show of evenly packed apples on the face and makes a good appearance. The necessity of filling the apples above the chime and then forcing them down into the barrel must be done to get the fruit in tight enough to prevent it from shaking around and bruising. Apples packed firmly will bruise much less easily than those packed less firmly. In forcing the bottom of the barrel into place the lower layer of apples will often be somewhat bruised, and the juice may fly out



Apples are usually barreled in the orchard, thereby doing away with the necessity of hauling the fruit to and from the packing house.

of some of them, but this rarely causes any damage, as the juice is quickly absorbed by the wood and the slight breaks in the skin dry up and but little rot will result.

Packing apples in boxes is a fine art, requiring more skill to do properly, than almost any other single operation in the fruit business. The box as a package for apples is comparatively new and has reached its most extensive

application in the irrigated sections of the West, although on account of its adaptability, and the fact that it has great advantages as the package for fancy fruit it is being adopted in all of the Eastern fruit-growing sections.

In the Western fruit-growing sections it is the only commercial package for apples, and possibly always will be, but in the East it is hardly possible that it will displace the barrel as an exclusive apple package. This is for the reason that in the Eastern states barrels can be had at a price proportionately less than boxes. The barrel is a hardwood package, while the box is of soft wood and is cheaper in the West on account of being closer to the great forests of white pine and spruce. The box has been adopted in the West, not only because it was the cheaper package, but because it reduced the amount of damage to the fruit in transit to the minimum, and also because it was the only package that enabled the growers to put up a uniform and a fancy pack.

The sizes of these Western boxes have been varied from time to time in an attempt to get the box to fit the apple. But after a number of years experimenting, boxes of only two sizes have been adopted. One of these is known as the "standard," and is 10½x11½x18 inside measurement, and contains 2,176 cubic inches without the bulge. The "special" box is 10x11x20 inside measurement, containing 2,200 cubic inches without bulge, and is used for varieties which run too long to pack in the standard box.

The first essential in packing apples in boxes is to have perfect fruit. Nothing but the very finest apples should go into boxes in the Eastern states, and nothing grading lower than "choice" is packed in the Western sections. Packing tables having well-padded or canvas bottoms are next in importance, and are so arranged that the packers will have a rack sufficiently large to hold two boxes at a convenient height in front of them for easy packing. A cull box should be on the floor behind the packer, into which the culls can be dropped as the fruit is sorted on the tables.

The fruit as it is brought from the field in lug-boxes is carefully emptied out on the tables and sorted into the various sizes or grades to be packed. Each size is determined by the diameter of the apple from cheek to cheek. For the smallest size packed the diameter is 2½ inches. In some sections it is the custom to have sorters or graders who have that particular bit of the work to do, and in other sections the packers must sort their fruit as they pack. In other sections again the graders must wipe the dust and spray from each fruit as it is passed to the packers. Cotton flannel mitts, with the fleecy side turned out, makes the most satisfactory material. The apples are given a twist between the gloves, just enough to remove any spray that may be sticking to the fruit, but not hard enough to polish. Polishing is detrimental, as it reduces the keeping qualities.

Grading machines for sizing apples have, up to the present time, not been altogether satisfactory, as they bruised the apples to such an extent as to make them unfit for packing under the Western standard. A machine built on altogether new principles has recently been patented by Mr. James M. Hamilton, of Grand Junction, Colo., and gives promise of proving very satisfactory. This machine is described in The Fruit-Grower of December, 1910, from which the following quotation is taken:

Hamilton Grading Machine

"No packer, no matter how expert he may be, can put up a first-class pack from ungraded fruit. Some growers object to the grading of fruit, believing the packers should be able to grade as they pack, but when a packer is putting up forty or more boxes of apples a day, the fruit is being handled so rapidly that small defects, such as punctures in the skin, will be passed unnoticed and result in defective packing. Grading ahead of the packers makes it possible for the packers to work more rapidly, as by having the fruit sized, they do not have to "paw" over the fruit on the table in order to get the size needed to fill the box.

"The grading is usually done in the Northwestern fruit sections by persons who desire to learn packing. The new person is started into grading with a grading board having circular holes bored through it the size of the apples in each grade. One of these holes is 3½ inches in diameter, one 3 inches and one 2¾ inches. All apples that will not go through the 3½-inch hole are placed in a bin by themselves, and are packed as three and one-half tier. The 3 inch, and up to 3½, are placed by themselves, and are packed as four-tier, while those between 3 and 2¾ inches are packed as four and one-half tier, and those smaller than 2¾ are packed five tier.

"Some growers who do not put up the very fancy packs make but two sizes, 3½ and 4½ tiers. The graders size the fruit so as to go into these two packs. A grader after using a sizing board for half a day or so, will become so accustomed to the sizes of the apples in the different grades that the grading board will not be needed for every apple, but it is always a good plan to keep the grading board or ring within convenient reach, and occasionally try the apples to see that the proper sizes are being kept. A person's eyes quickly become fatigued, and it is easy to let the fruit increase so gradually in size as to be unnoticed by the grader, unless tried several times a day with a sizing board.

"The essential features of the Hamilton grader are two long parallel troughs, each about six inches wide, slightly inclined; each trough, or chute, is divided into three sections, or compartments, the bottom of each of these sections being formed by a heavy rubber belt. Thus there are really three of these rubber belts for each trough, and each belt has a succession of holes; the holes of each section are one-fourth inch larger in diameter than the preceding section, to accommodate apples of different sizes.

"Our illustrations show the general appearance of the grader. One of the troughs is for apples of 'fancy' grade, the other for 'choice' grade. The troughs have padded sides, and as the bottom is rubber the apples are not

bruised at all. Most graders which have been made heretofore have rolled the apples down an inclined chute and as they pass down this chute they drop through holes which are graduated in size from the smallest to the largest. These graders are bound to bruise the fruit more or less, and have not been satisfactory.

"The Hamilton grader does not roll the apples; instead, they are carried along on moving belts and pass from one section to the next, with a corresponding larger hole, without any bruising. If an apple does not drop through a hole in the first belt, it is carried to the next section, with a larger hole; it may drop through there into a bin with a canvas bottom, or it may be carried to the next section, with a still larger opening.

Fruit Is Sorted by Hand

"The apples are dumped from the picking boxes into the two bins at the head of the grader. Since the machine grades only as to size, men or women stand at each side of these bins to sort the fruit as to color, freedom from blemishes, etc. Two sorters can work at each of these bins. They simply sort the apples as to color, worm injury, etc., placing the perfect, well colored apples in the chute marked 'Fancy' and the apples which are a litle off color into the chute marked 'Choice.' Culls are dropped into a box at their feet.

"The belt forming the first division of the 'Fancy' chute is perforated with holes two and one-half inches in diameter; apples of less diameter fall through and are packed in the lower grades. It will be noted in the illustrations that curtains hang down at intervals in the troughs; these are made of heavy ducking and are merely to prevent apples riding the belt between the holes, and they drag every apple into an opening.

"Now, it frequently happens that apples are of smaller diameter one way than another, and may fail to go through the opening in the belt in one way, whereas if turned they would go through all right. To insure that all apples have

General appearance of Hamilton Apple Grading Machine. Sorters at the back with packers on each side.

abundant opportunity to go through, Mr. Hamilton has arranged a series of 'joggers' which are below the belts and which catch the apples partly through the holes and turn them over slightly as they pass along. These 'joggers' are set at an angle, slanting with the direction the belt travels; they are held by slight springs so that if an apple were firmly caught in one of the openings it could not be bruised in the slightest in passing these 'joggers;' the springs would simply permit the latter to drop back

Upper end of the machine with bins of apples on each side. The sorters work at these bins.

and allow the apples to pass. As there are about three of these 'joggers' on each division of the belt, every apple is given three slight turns as it passes, and if it has a smaller diameter which will permit its passage through the hole, it is pretty sure to fall through before it passes to the belt with the larger openings.

"The openings in the belt of the second section are two and three-quarters inches in diameter. We will assume

that the apple we have started on its journey through the grader has persistently declined to pass through the openings in the first belt; but if it is less than two and three-quarter inches in diameter it will drop through the openings in the second section into a bin at one side having a canvas bottom. If this apple should be more than two and three-quarter inches in diameter, and less than three inches, it will drop through the third section, for the holes in this belt are three inches in diameter. If it is larger than three inches then it passes on out at the end of the chute.

In sorting, "fancy" apples are placed in one chute and "choice" in the other. The machine does the rest.

"The chute for the 'choice' grade is arranged exactly the same, except that the openings in the first belt are two and a quarter inches in diameter, the next section has holes two and a half inches, and the third section has openings two and three-fourths inches in diameter.

Packers Each Handle One Size Apples

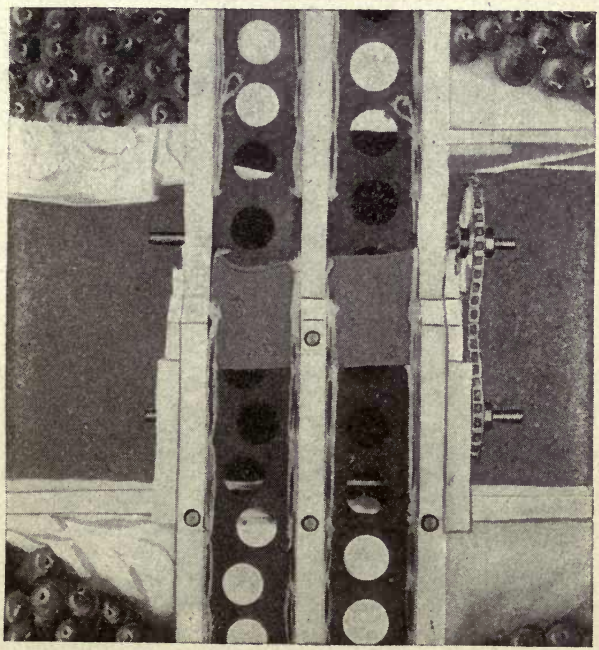
"It will be noted there are three bins on each side of the grader. On the 'Fancy' side the first bin contains only perfect apples which are two inches and a half in diameter and less than two and three-quarters; the next bin contains perfect apples two and three-fourths inches in diameter, and less than three inches; the last bin contains perfect apples three inches or more in diameter. On the 'Choice' side the same is true, except that the apples are one-fourth inch less in diameter, and of course they are off color in some way, and therefore are of second grade.

"The work of this machine is absolute so far as grading the apples as to size is concerned; if the sorters at the head of the machine have done their work well and have culled out all defective fruit, packers can work from these bins with their eyes shut. Of course the sorters will occasionally make mistakes, and a bad apple will get by them. There is this advantage, however, in this method of sorting: Their work can be inspected in the bins before the apples are packed, whereas under ordinary conditions, where the packer does both grading and sorting, the fruit can be inspected only after it is packed, and then it is frequently too late to catch the bad ones.

"The packers working for Mr. Hamilton have never had any previous experience in packing apples in layers, but they soon became so expert that they were packing 100 boxes a day apiece, and the work was well done, too. In fact the packers, with the aid of the machine, were so speedy with their work they were working only every other day to give the picking force opportunity to catch up with them. Ordinarily packers are paid by the box, but since perfecting his grading machine Mr. Hamilton pays his packers by the day. The usual rate was 5 cents per box; now the packers are paid $2 per day, and if they pack 100 boxes—and they are doing that right along—the cost of packing was reduced to 2 cents per box, with an additional charge for the sorting.

"Scores of experienced fruit men have seen the Hamil-

ton grader at work this season, and all pronounce it a success. Mr. John F. Moore, manager of the Grand Junction Fruit Growers' Association, believes that the use of this machine will solve the problem of the Grand Valley growers in getting packers who can put up the tier pack. Mr. Hamilton's experience has been satisfactory, and he be-

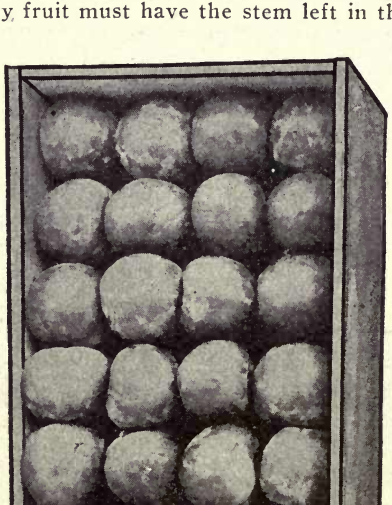


Looking down on the belts. The holes in the upper portion are one-fourth inch larger than in the lower.

lieves that he can layer his apples as cheaply now as he formerly could pack them with the old "jumble" pack. The machine certainly looks like a winner, and we believe it will help to solve the problem of better grading and packing everywhere."

Packing the Boxes

Fruit that has the skin punctured should not be packed. Apples that have lost their stems, provided the skin is not broken where a stem is pulled out, may be packed, although too many such should not be put in any one box. First quality fruit must have the stem left in the apple.



Four tier apples in a box packed "straight."

There are three styles of packs used in the apple sections of the Western states. One of these, the "jumble" pack, is confined to Colorado and portions of Utah, but will possibly be displaced in a few years by the tier pack of the Northwest. In the far Northwest, two other styles, known as "straight" and "diagonal" tier packs are in use.

The straight pack includes the three, four and five tier apples, and the rows of fruit run parallel to the sides of the box.

In the "straight" pack the apples are placed side by side in rows, so that each apple rests directly on top of another. In the "jumble" pack the first layer is faced, either straight or diagonal, and the box then filled with apples in any position they happen to lay. It is a rapid method of filling boxes, but does not make a fancy package.

The chief advantage of the diagonal pack is that it accommodates the half tiers, such as the 3½ and 4½ tier apples, the rows of which seem to run diagonally to the sides of the box. The "tier" in each instance not depending so much on the number of layers deep as the number of layers wide. The 4 tier running 125 to the box, the 4½ and 5 tier have five layers. The 3½ and 4 tier have four layers. The 4½ tier apple is a good example of half-tier sizes, and consists of a size such that four apples will not fit tightly in one row, and there is not room in the row for five apples. So, to make it 4½, three apples are placed in one row and two in the spaces between, so that in the two rows there are five apples, and in the diagonal rows there are five apples.

This diagonal pack is meeting with much favor in the sections where it is being used, as it is not so hard on the apples as the straight pack. In the straight pack each fruit rests directly upon one below it, while in the diagonal it rests in the space between three or four.

For fancy fruit it is the general custom to line the box with white paper. The size of it being 18x24, so that two sheets will line the box. It will be necessary to make a double fold in the paper at the corner of box, in order to prevent its being torn as the pressure causes the bottom to bulge outward. The object in having this paper is to protect the fruit from dust and odors that may come through the cracks in the bottoms and along the sides, and to add to the appearance of the package.

In some sections it is the custom to wrap each apple with paper as it is being placed in the box, and to put a

layer of paper between each layer of apples to prevent bruising as much as possible. The paper for wrapping apples should be kept in a little tray at the side of the box, and the paper placed in the tray with the smooth side up, in order that it will slip through the hands the more easily. It is most convenient to wear a rubber thumbstall to aid in picking up the paper, otherwise the packer must moisten his thumb on his tongue each time he wraps an apple.

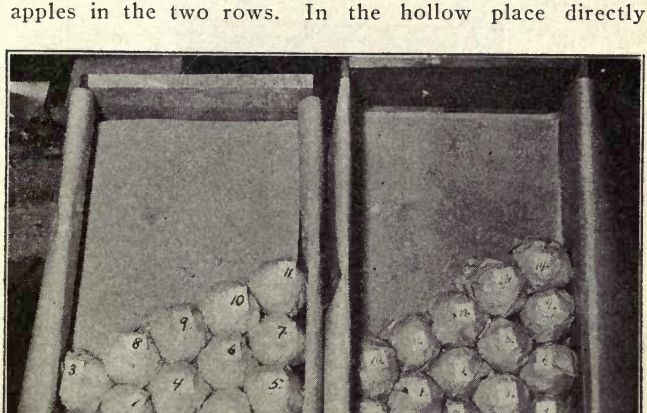
In some sections where the layer pack is in use, each layer is separated by a sheet of heavy paper or cardboard, and each apple wrapped in tissue paper. This wrapping paper is so arranged about the fruit that the corners of the paper fold over the stem of each apple and serves as a cushion. But since the wrapping of each individual apple is, at the present time, believed to add nothing to the keeping quality of the fruit, some of the leading districts of the West do not wrap.

Just how to put up each style of pack is a difficult matter to describe, although it is easily learned from experience. In the fruit districts of the Northwest there are between thirty and forty different styles of packing in use, no two of which are exactly alike. These are due entirely to the variations in the size and shape of the different varieties of fruit that are grown. Of these numerous styles of packing, few persons ever use more than two styles in their own packing house, and these are the less complicated ones.

Packing apples "straight" is comparatively simple, as it is merely the selection and arrangement of the fruit in straight rows parallel to the sides of the box. The rows will be three, four or five apples wide across the end of the box; from five to nine apples long and from three to five layers deep. And while this is the easiest system of packing apples, it is less flexible, accommodating fruits of fewer shapes, and is by far the hardest on the apples, as each apple rests directly on the apple beneath it.

The diagonal style of packing is somewhat less easily learned, but it accommodates a greater variety of sizes and

shapes, and is not so hard on the fruit. Taking the 4½ tier pack as an example, three apples are placed in the lower end of the box, one being in each corner and the third exactly half way between. Into each of the hollows made by these apples other apples are placed, making five apples in the two rows. In the hollow place directly

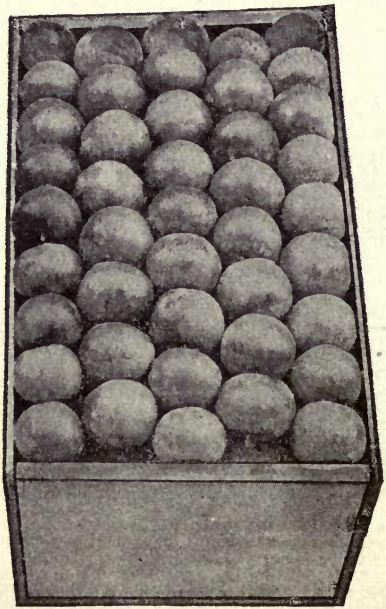


The box on the left shows the beginning of the first layer of a 4½-tier pack, the one on the left is the second layer in the same pack.

over the apple in the left-hand corner another apple is placed, and likewise in the middle space. The fourth row is then started by putting an apple between these two and the fifth row begun with an apple in the space against the side of the box. This process is repeated until the first layer is about half in, when the fingers of both hands are placed against the fruit and drawn down and towards the packer in such a way as to pull the fruit down snug. Complete the layer and repeat until the box is filled.

One important thing to observe in putting the fruit in

the box is to so arrange the fruit in each layer that the layer will be a little higher in the middle than at the ends in order to make the bulge to the sides and hold the fruit in tightly to prevent bruising by shaking about. The matter of obtaining just the right kind of a bulge is one that

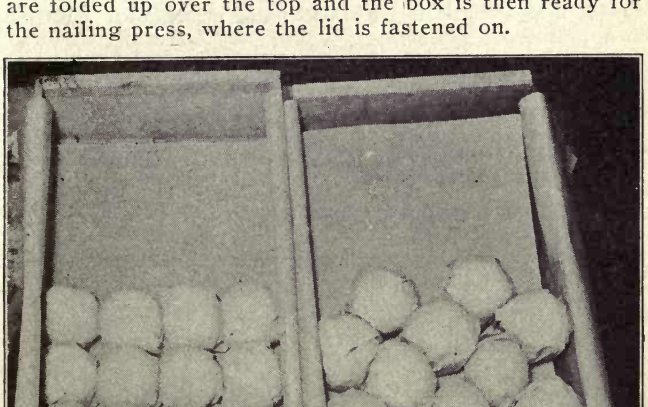


The finished box of 4½-tier apples.

must be learned by experience. It is obtained by using a slightly larger apple in the middle than at the ends. It is a common practice among professional packers to work those apples which are slightly irregular in shape at the ends of the boxes, turning each apple so that its shortest diameter is up and down. Those fruits which are most nearly circular will then be put in the middle of the box,

and when the pack is finally finished the box will have a nice bulge of about half or three-quarters of an inch on each side. The apples for the bulge need to be started with the first layer, as they cannot be held until the last layer is in and then get a satisfactory bulge.

As each layer in the box is completed a sheet of layer paper is put in, and when the box is filled the lining papers are folded up over the top and the box is then ready for the nailing press, where the lid is fastened on.



The box on the left shows the beginning of a 4-tier "straight" pack, and on the right is the same size apples packed "special diagonal."

A special form of press is in use for this operation, and consists of an arrangement of clamps which draw down the ends of the lid boards, leaving space for the cleat to be nailed on top of the lid, thereby holding them more firmly and preventing their splitting or pulling loose from the strain of the bulge.

After the box is nailed up, stamp the name of the va-

riety on the end just under the lid and mark just under it the number of apples in the box. The fruit buyers want to know how many apples are in a box, and with the tier pack it is an easy matter to tell exactly how many apples are in each box. After the number of apples has been marked, put on the number of tiers and the number given to the grower by the association to which he may belong. If a lithographed label is used, paste it on the other end of the box and mark it with the name of the variety, tier and number of apples.

When this has been done place the box on its side and thereafter handle it on the side, as if it is placed so that the weight comes on the bulge the fruit will be bruised.

The following table gives the size of the apple and the number in a standard box when packed diagonally in layers:

Table of Apples in Box

Tier	Pack	No. Apples in Row	No. Rows in Width	No. Layers in Depth	No. Apples in Box
STANDARD BOX:					
3	Straight 3	5-5	3	3	45
3½	Diagonal 2-2	4-4	3½	4	64
3½	" 2-2	4-5	3½	4	72
3½	" 2-2	5-5	3½	4	80
3½	" 2-2	5-6	3½	4	88
4½	" 3-2	6-6	4½	5	150
4½	" 3-2	6-7	4½	5	163
4½	" 3-2	7-7	4½	5	175
SPECIAL BOX:					
3	Straight 3	6-6	3	3	54
3	" 3	7-7	3	3	63
3½	Diagonal 2-2	6-6	3½	4	96
3½	" 2-2	6-7	3½	4	104
3½	" 2-2	7-7	3½	4	112
3½	" 2-2	7-8	3½	4	120
3	Straight 4	8-8	4	4	128
4	" 4	9-9	4	4	144
4½	Diagonal 3-2	7-8	4½	5	185
4½	" 3-2	8-8	4½-5	5	200

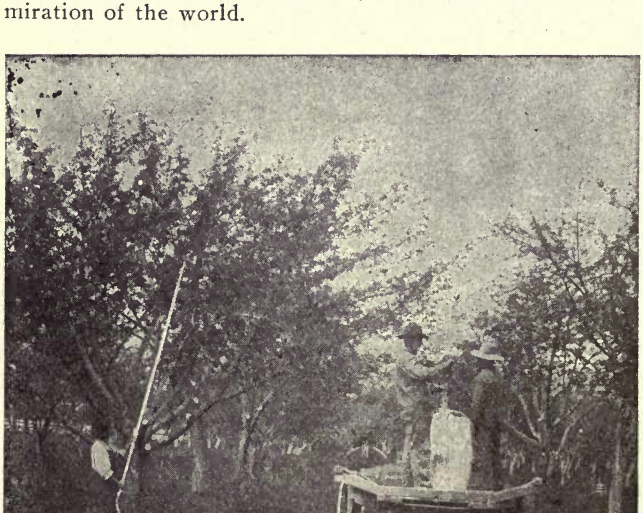
CHAPTER V

Spraying

Fruit growing as a commercial proposition met with its greatest boom with the discovery of effective means of controlling the insect pests and diseases which affected the various orchard crops. It was about the year 1876 that effective insecticides were discovered, this being through the discovery of the value of Paris green in controlling the potato beetle. Le Baron, the state entomologist of Illinois, made the discovery and suggested at the time that such means would also prove effective in controlling the damages of the canker worm. This suggestion was followed by an orchardist in New York state, who applied Paris green to his apple trees in the spring of 1878, and at the harvest of that crop he found that the damage from codling moth had also been very materially reduced. In the same year Prof. J. L. Budd used London purple for the same purpose in an orchard in Iowa, finding, as did the New York state orchardist, that there were fewer wormy apples where the spray had been applied than in other parts of the orchard. At first the fruit growers were skeptical of the value of the means of preventing worminess, so that up to 1885 the practice had been in a purely experimental stage, but thereafter became accepted as the only effective means of preventing the damages of the codling moth.

The practice of spraying to control fungi had a separate origin. It was discovered by the vineyardists of Bordeaux, France, in an attempt to protect their vines from downy

mildew, a disease which had been introduced from America. The effectiveness of this means of preventing fungous troubles was quickly taken up by the United States Department of Agriculture and the state experiment stations and these have prosecuted the work up to the present time with a persistency and efficiency which has won the admiration of the world.



A Barrel Outfit is Suitable for Small Orchards.

The operation of spraying has come to be regarded as of vital importance to the horticulturist, taking rank along with each of the other important cultural practices. Professor L. H. Bailey says that "Spraying is only one of the several practices which are of fundamental importance in the care of fruit plantations. Tillage, fertilizing, pruning

and other cardinal methods in pomology and their importance is none the less because spraying has proved to be so essential. Spraying is wholly a secondary operation, and its importance is the greater as the other care of the plantation is efficient, for the value of the product is thereby heightened. Many old and neglected orchards are scarcely worth the trouble and cost of spraying. The operation of spraying is not always necessary, and it does not, therefore, always give beneficial results. Unless insect or fungus troubles are present, there is no occasion for the operation; but inasmuch as these enemies are nearly always troublesome, and as no one can definitely prognosticate their absence, spraying comes to be an insurance. The risk is too great to allow the practice to be omitted in any year in apple and some other orchards, and the practice is efficient only when it anticipates trouble."

On this account and on account of the fact that so many fruit growers have refused to spray, or spray in an inefficient manner, the plant diseases have been increasing in numbers each year in all fruit sections so that it is highly important that every fruit grower realize the real insurance value of spraying and prepare to do thorough and effective work. In fact in some of the more progressive Western states where the fruit growers strive to put out nothing but the highest class of products, state laws have been enacted which make it imperative that an orchardist spray his orchard for the control of insect diseases, whether such pests are actually present in the orchard or not.

Hand and Power Pumps

In commercial orchard practice there are only two types of spraying machines that need to be considered, one of these is the pumps that are operated by hand and the other the pumps which are operated by power derived from gas, compressed air, gasoline engine or traction power. There are many different makes of each of these machines and there are especially desirable features connected with most all of them. However, it is the universal statement

of all practical orchardists who are making a success of their spraying work, that the hand power outfits are not suited to an orchard covering more than four or five acres. This is because the necessary pressure and speed cannot be obtained in hand power machines to cover the larger acreage in the limited amount of time that is available.

In point of time, any application of spray mixture must be applied when it will do the most good, and with insects this limits the number of working days to just a few, possibly ten days, when the insects can be most effectively reached. The spraying must be done during that time, as either before or after that period the spray mixture will not be so effective as the insects will have passed out of reach. The same thing is true of fungous diseases and the grower must know something of the life and habits of the pests he is combatting.

The time has long since passed when it is reasonable for any orchardist to ask if it pays to spray. That problem has been so thoroughly proven and so widely advertised that anyone who asks such a question, especially if he has been anyway concerned in fruit growing or has read, even casually, any publication treating on the subject of fruit growing, cannot help being convinced that spraying does pay, and pay well, when properly done.

But to make it pay the best the spraying equipment must be suited to the conditions under which it must be used. The chief points to be considered in this respect are the kind of plants to be sprayed—that is, whether they are strawberries, grapes or tree fruits; the acreage to be covered, for if there are more than five, or at the most ten acres, hand power outfits will not prove as effective as power machines. Then in the make or style of machine one needs to consider the general construction and arrangement of the outfit; the ease and convenience of handling under actual working conditions; the probable ability of the machine to handle the required work; the efficiency and suitability of the accessories.

In localities where spraying has not become established as one of the important practices in connection with or-

charding the growers are likely to expect too much service from a single machine, whether it be a hand or power outfit. Instances in the Middle West are very common where the growers will try to cover 200 or 300 acres with a single power machine.

A Power Sprayer in Operation.

There are several different makes of power machines on the market, such as those deriving their power from steam, gasoline, compressed air or gas, but up to the pres-

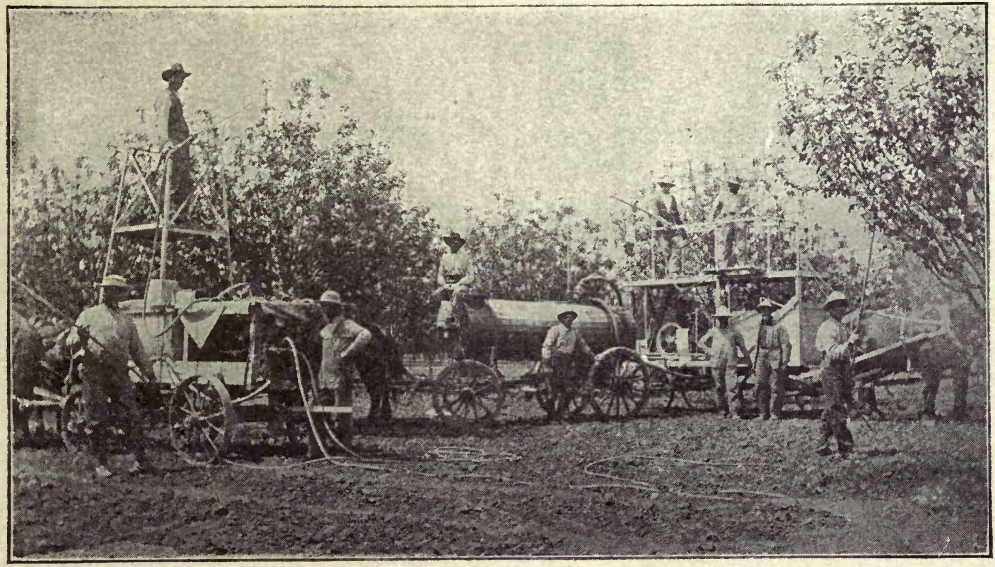
ent time the gasoline power machines have proven themselves the most effective, economical and convenient for use under all ordinary conditions. On steep hillsides, however, the gas machine possesses decided advantages on account of its light weight and the nearness to the ground at which the load can be carried. But such machines are objectionable on account of the expense of the gas used for power, and the usual lack of facilities for keeping the spraying mixture thoroughly agitated while being applied. With some kinds of spray mixtures, too, the gas possibly causes some undesirable chemical changes.

In the selection of a gasoline power outfit one must be governed to a large extent by the amount of work that is to be done with the machine and the conditions under which it is performed. Where the orchard is small and the interests diversified, it may be easily detached and used for other purposes than that of spraying.

The height of the wheels of the wagon carrying the spraying machine needs to be considered in the selection of a power machine, as well as the width of the tires. High wheels reduce draft on the team, but increase the danger of upsetting on steep hillsides. On plowed ground, especially in the spring when it is more or less muddy, wide tires are an advantage, but in rocky land the narrow tired wheels are much more serviceable. In this connection, no matter which is the height of the wheels, or the width of the tires, it is highly important that there be no waste space between the frame and the engines and that the frame be constructed so as to permit of the shortest possible turns without cramping or binding the wheels.

The hand pumps are very much more diversified in shape and construction than the engine power machines, as they are adapted to a far greater variety of uses. These will vary from the hand pumps which can be mounted on the spraying tank, or in a barrel, or attached to a knapsack and carried on one's back.

All of the working parts should be of hard brass or iron, as aluminum, which has been used in a small way,



High pressure power sprayers and refilling tank in orchard of Dr. A. E. Miller, Austin, Colo.

wears too fast. The nozzles especially need to be of brass, and their weight, especially for power machines, is of no serious consequence, as the back pressure from the pump more than balances the weight. For general orchard spraying the types of nozzles are limited to two. These are the "bordeaux" and the large chambered nozzle. The bordeaux is the nozzle which is most desired for the first spraying for codling moth, as practiced in the Western states. The other is the best for use when a mist-like spray is wanted, as is the case in the Middle Western and Eastern states for applying bordeaux mixture.

In sections where bordeaux mixture is most extensively used it will be an advantage to have all of the working parts of the machinery of brass, which comes in contact with the liquid, as this metal is not corroded by the spray mixture, as is iron. But where lime-sulphur is used most, then the working parts need to be of iron or steel, as this mixture corrodes brass. On this account steel tanks are coming into use in districts where lime-sulphur is used. Such tanks are especially desirable, as they are lighter and not liable to dry out, do not become waterlogged and are far more convenient to handle in the field.

In all machines it is important that there be an effective agitator for keeping the liquids stirred constantly while being applied to prevent the heavier part of the material from settling to the bottom and causing irregularity in the strength of the material that is applied. The most satisfactory agitators for power machines are those which are built on the propeller type, with blades sufficiently long to cause vigorous circulation throughout the entire tank of mixture when revolved at the usual rate of 120 revolutions per minute.

One of the greatest sources of lost time in a large orchard is reloading after the load is sprayed out, but this loss of time can largely be eliminated if there are suitable conveniences for reloading. This should consist of a reloading pump, unless the mixing station is on an elevated platform above the level of the spray tank. There are two types of reloading pumps that are available, one being the rotary

and the other a plunger pump, either of which is capable of handling 30 to 40 gallons of spray mixture per minute. Where bordeaux mixture is used, however, there is some danger from the rotary pump becoming more or less worn by the friction with the gritty particles in the lime, and priming will be necessary in order to get the pump to working satisfactorily. For use with supply tanks, plunger pumps are probably the most effective and satisfactory, since it is necessary in this case, to pump the prepared mixture with them.

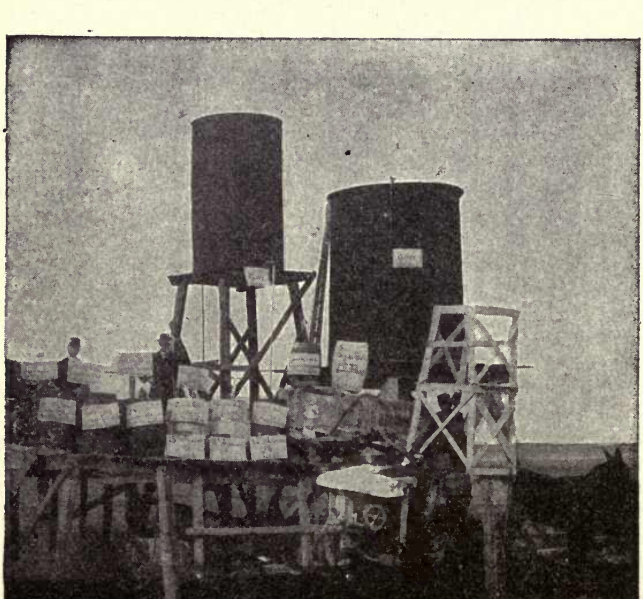
Spraying Materials

Since the discovery of effective means of controlling insect and fungous diseases of plants a great number of preparations have been devised for the control of special diseases on certain crops. Such a formidable list of these preparations have been published that it would seem at first glance that one would need an elaborate chemical laboratory in order to prepare the materials. However, the years of scientific and practical experimentation along this line have eliminated many of these spraying materials so that the plantsman of today needs know how to prepare less than a dozen different sprays in order to control any of the diseases for which a remedy is known.

There are two distinct groups of these spraying materials, one of them, called insecticides, is for the control of insect diseases, and the other, called fungicides, for the control of fungous diseases. Of these materials there are three groups of insecticides, such as (1) food poisons, (2) contact poisons, and (3) suffocating poisons. Which of these poisons to use will depend altogether on the kind of insect and the plant upon which it is feeding, so that for effective use of any insecticide, it is important that the plantsman know something of the habit of the insect, and just in what stage of its life it is most easily reached with the poison.

(1) Food Poisons. These materials are composed of substances which must be eaten by the insect as it chews

the foliage or fruits of the plants to be protected, and for this reason kill the insect by actual poisoning. Of these materials compounds containing arsenic, such as Paris



A convenient method of making spray mixture. Every barrel is plainly labeled so no mistakes can be made in mixing.

green and lead arsenate, are the most common, and are applied for such insects as the codling moth, canker worm or curculio, and applied either in water, as a dry powder or mixed with some substance which is to serve as a bait.

(2) Contact Sprays. These materials are applied for the purpose of destroying those insects which get their nourishment by inserting the beak into the plants and sucking the sap, rather than by chewing the flesh of the fruit or the leaves. Plant lice and scales belong to this group of insects, and since they suck their food, they cannot be reached by those poisons which are to be chewed up and swallowed. These sprays are more or less caustic and penetrating, and kill by coming in contact with the bodies of the insects.

(3) Suffocation Methods. It frequently happens that in some places, such as greenhouses and hotbeds, destructive insects get on plants which cannot be sprayed with either contact or food poisons, and the insects must be disposed of by some means that suffocate them by filling up their breathing pores, or cause their death by irritation. Such means as these are useful only in the greenhouse, and for insects that may work in the soil, in seeds, or on fruits or vegetables that are about ready for the market. Of chief importance among these suffocating poisons are tobacco, carbon bisulphide, pyrethrum and hydrocyanic acid gas.

Insecticides

Resin-Lime Mixture

Stock Solution.
Pulverized resin, 5 pounds.
Concentrated lye, 1 pound.
Fish oil, 1 pint.
Water, 5 gallons.

Dissolve the resin and oil together in a kettle over a warm fire, and when it has become well dissolved and somewhat cooled off, add slowly the lye and stir hard. To the mixture add about two gallons of water and boil it hard for about an hour, or until the mixture will dissolve in cold water. When it has reached this condition add enough water to make five gallons, and use this as the stock solution for use in the following:

Stock solution, 1 gallon.
Water, 16 gallons.
Milk of lime whitewash, 3 gallons.
Paris green, 4 ounces.

The object of this preparation is to obtain an adhesive material which will cause the poison to stick to smooth leaves. It may also be used with bordeaux mixture in the proportion of 2 parts of the stock solution to 48 parts of the bordeaux mixture.

Kerosene Emulsion

Hard soap, ½ pound.
Hot water (soft), 1 gallon.
Kerosene, 2 gallons.

Cut the soap into small pieces and dissolve it in the hot water. Add the kerosene immediately and churn it violently at the same time. Pumping the mixture back into itself for five or ten minutes with a hand force pump or syringe is an excellent method of mixing, as the materials must be mixed until they form a thick creamy combination in which no free oil shows on the surface.

This is a concentrated mixture and must be diluted before using. For use on apple and pear foliage, one gallon of the emulsion should be diluted with nine gallons of water. For cherry, peach or plum foliage, dilute with twelve gallons, and for house plants dilute with fifteen gallons.

Tobacco

Tobacco is used extensively in several forms for the control of insect troubles. It can be obtained in the market in several forms, either as a liquid, powder or stems, to be used according to conditions. The fine powder is used extensively about greenhouses and hotbeds for green aphis, and in nurseries and orchards for woolly aphis. It is scattered over the infested parts undiluted.

The essential poison of tobacco is extracted and appears on the market in several forms, as "black leaf," "nicofume," "tobacine," etc., and are used either as fumigants for greenhouses and hotbeds or as sprays for orchard insects such as woolly aphis, green aphis and some other sucking insects.

Miscible or Soluble Oils

Several brands of soluble oils can be had on the market. These are mostly petroleum products, so treated that they mix quite freely with water, and can be used for such insects as scale and aphis. These materials are efficient and useful, but must be used with caution, as when too strong they may cause serious injury to the plants. They should be used at strengths of not less than one part of oil to fifteen parts of water.

Lime-Sulphur

Stone lime, 15 pounds.
Sulphur, flour or flowers, 15 pounds.
Water, 50 gallons.

Slake the lime with some water in a large iron kettle. As it is slaking add the sulphur gradually and mix it with the slaking lime. Add ten or fifteen gallons of water to the mass and boil for about one hour, or until the mixture becomes an orange red or greenish color. Then add the remainder of the water to bring it up to a volume of 50 gallons, when it is ready for use.

Instead of boiling this mixture over a fire, it may be cooked by turning a jet of live steam from an engine boiler into the liquid, proceeding in the same manner as when the cooking is done in a kettle, except that the cooking with steam can be done in a barrel or wooden tank.

This mixture should be used only on dormant trees, as it is liable to cause serious scalding if used at this strength on foliage.

This material is put up commercially in concentrated form by a number of firms, directions for the use of which

vary with the brand, and they need to be used according to the directions which accompany each brand. Where small quantities are needed there is a distinct advantage in using the commercial brands, but where large quantities are needed, and especially if a steam boiler is available, the home mixture may be the cheapest.

Carbon Bisulphide

This is a heavy, volatile liquid used largely for the destruction of insects in stored grain. The fumes are very inflammable and caution must be taken to keep the liquid away from a flame, or even a lighted pipe. It has a very unpleasant odor and comes in large tin cans holding various quantities as desired. It needs to be used at the rate of 1 pound to every 1,000 cubic feet of space. The fumes of this liquid are heavier than air, so the liquid should be placed in shallow pans on the top of the bin of grain, and the bin should be as tight as possible. It is best to cover the bin with a canvas to keep the fumes in, and should not be uncovered or air admitted for 24 hours.

Hydrocyanic Acid Gas

Sulphuric acid, commercial, 1.83 sp. gr., 2 fluid ozs.
Potassium cyanide, 98 to 100 per cent, 1 ounce.
Water, 4 ounces.

Pour the water into an earthen dish and add to it the sulphuric acid. Do not pour the water into the acid, as it will spatter and burn the hands or clothing. Weigh out the cyanide and put it into a paper sack, being careful to not inhale any of the fumes that come from it, as they are highly poisonous. Place the vessel in the position desired, then drop in the paper sack of cyanide and leave the room immediately. The gas is liberated very quickly and is deadly poisonous.

For nursery stock in the dormant condition use the above quantity for every 100 cubic feet of space. The house or fumigating box should be as tight as possible, and the

fumes need to be confined for one hour, after which it should be thoroughly ventilated. If the fumes are confined in a tight room, means for opening the ventilators should be provided from the outside, and one should not attempt to enter until after the place has been well ventilated.

In fumigating the greenhouse the above quantities are sufficient for 1,000 cubic feet of space where plants are growing. Greenhouse plants vary greatly in their ability to withstand the effects of hydrocyanic acid gas, and plants such as tomatoes, roses and ferns are easily injured. In the greenhouse the fumigation should be done at night when there is no wind, and the house should be as dry as possible, and at 60 degrees temperature.

Pyrethrum

This is a very fine, light brown powder made from the flower heads of a certain species of Pyrethrum. It is practically harmless to man, but the fumes which it liberates on exposure to air are suffocating to insects. It appears on the market in three commercial forms:

Persian insect powder, made from the heads of pyrethrum roseum, a plant native to the Caucasus region and found under cultivation in America. Dalmatian insect powder, and Buhach, made from Pyrethrum cinerariaefolium. This is grown in California for this special purpose.

Any of these insect powders, when fresh and pure, are effective for their purpose, but they quickly lose their effectiveness on exposure to air. These powders are usually used by being sprinkled around over the insects, or in places frequented by insects, such as house flies and mosquitoes. They may be mixed with water and sprinkled over the plants.

Tanglefoot

This is the material from which sticky fly paper is made, and is useful for painting a ring around the base of

tree trunks to keep insects from crawling up from the soil. This is especially the case with woolly aphis. These insects when born are inclined to travel, and since the first brood in spring come from the old ones which have hibernated on the roots, they climb the trees and live on the branches during the summer. They can be prevented by tying a ring of paper, underlaid with cotton, around the trunk and applying the tanglefoot to the paper. If applied directly to the bark it may cause injury.

Paris Green

This insecticide has been used for a greater number of years than any other now in use, and when perfectly pure it is very reliable, but as it is a rather coarse crystaline material, it settles rapidly to the bottom of the spray tank unless the contents are kept thoroughly stirred. It is applied in connection with quick lime, the lime being added to prevent the Paris green from burning the foliage.

It is prepared for use as follows:

Paris green, 1 pound.
Quick lime, 4 to 5 pounds.
Water, 160-200 gallons.

Mix the Paris green with a little water and stir it to a thin paste; meanwhile slake the lime to a thin paste and then add the paste of Paris green and mix the two thoroughly, after which strain the mixture through a fine seive into the spray tank containing the requisite amount of water. If it is desired to use the poison in connection with a fungicide, bordeaux mixture can take the place of the water in diluting the above mixture. In applying this mixture to the trees or plants it is necessary to keep it well stirred all of the time, as the Paris green will settle to the bottom of the vessel, thereby giving irregular distribution.

Arsenate of Lead

Arsenate of lead is now the leading insecticide, having taken the place of Paris green for all orchard purposes.

There are many brands of this article upon the market and all are fairly pure and equally effective in controlling insect pests. The ready made arsenate of lead is all ready to use by diluting one to three pounds of the paste with fifty gallons of water.

As the commercial brands of arsenate of lead come in cans or kegs and in the form of a stiff white paste quite like white lead paint, it is made more difficult to handle by the paste drying out. For this reason many persons who have only a small amount of spraying to do prefer to make up their own arsenate, as it is easily made and is slightly cheaper than the commercial brands. Arsenate of lead can be made by the following formula:

Arsenate of soda, 4 ounces.
Acetate of lead, 11 ounces.
Water, 15-20 gallons.

Dissolve the arsenate of soda in two quarts of water and the acetate of lead in four quarts of water in wooden vessels. When dissolved pour them into the required amount of water. A milk white material will result, and it is ready to use. This material can be used at a greater strength without injuring the foliage of plants than can any of the other spray poisons. It can be added to bordeaux mixture or to lime-sulphur in the same proportion as when water is used.

Poisoned Baits

Sow-bugs, grasshoppers, cut worms and some other insects can be destroyed by poisoned baits. There are various forms of this method of destroying insects. Grass leaves dipped in Paris green or arsenate of lead is often an effective means of getting rid of cut worms. As a means of destroying grasshoppers a bran-arsenic mash is very successful and is made as follows:

White arsenic, 1 pound.
Brown sugar, 1 to 2 pounds.
Bran, 6 pounds.

Mix these materials together and then add enough water to make a thick mash and then scatter around the plants that are attacked, placing a spoonful in a place.

For cut worms in onion fields a dry bait has been found very effective when made as follows:

Paris green, 1 pound.
Middlings, 15 pounds.
Bran, 15 pounds.

Mix these materials thoroughly and scatter broadcast about the borders of the garden or the plants that are attacked. It may be easily scattered along the rows by the use of the seed drill.

Hellebore

Powdered fresh hellebore is of value in destroying insects on small fruits which are nearly ready to market and on which it is undesirable to use arsenical poisons. It must be used while fresh, as it loses its poisonous properties when exposed to the air, and it can be dusted over the plants or applied as a spray made thus:

Hellebore, 1 ounce.
Water, 2 gallons.

Resin Wash

Resin wash is used in California for several of the scales which infest the citrus fruits. It can be used as a summer spray for San Jose scale, but is not as effective as winter applications of lime-sulphur. It is made as follows:

Resin, 20 pounds.
Concentrated lye, 4 pounds.
Fish oil, 2½ pounds.
Water, 100 gallons.

Place the lye, resin and oil in a kettle and cover well with water and boil for about two hours, adding water as needed. Boil for about two hours or until the compound resembles strong black coffee. Dilute to one-third of the

final bulk with hot water, or with cold water added slowly over the fire, thus making a stock mixture. Dilute to 100 gallons when ready for use.

Fungicides

Fungi constitute a group of plants of a very low order in which the green coloring matter common in all cultivated plants is not developed. For this reason these plants are unable to digest for themselves the crude food materials available in the soil and air, and must get their food from the bodies of other plants which may be either dead or living. When these fungi are found on dead and decaying plants, such as rotting wood, they are called saprophites, but where they are found on the bodies of living plants, either on the root, leaves or fruits, they are called parasites. On account of this tendency for some of them to live on living green plants, they cause serious trouble oftentimes, known as "fungous diseases." Without proper protection the host plant is often entirely destroyed, or is unable to mature a satisfactory crop of fruit or seed.

The most common fungous diseases are known as mildews, leaf spots, cankers, fruit rots, scabs, rusts, etc., and since the most of these fungi live within the host, it is impossible to reach them after the host has become infected. For this reason preventive measures must be undertaken to keep the plants in a sanitary condition and reduce the possibility of their becoming infected with the fungus parasite. This can be done by spraying the plant with some fungicide which will prevent the fungus from gaining entrance either by killing the spores or preventing their germination.

For the most effective and positive results to be obtained from thorough spraying, it is best to keep the plantation in as clean and sanitary a condition as possible, through the removal of rubbish which may serve as the hiding place over winter of numerous insects, and fungus spores; to keep the ground cleared of objectionable weeds and grass; to keep dead limbs out of the trees, and dis-

cased leaves and fruit disposed of either by gathering and burning or turning them under by plowing and cultivating.

Bordeaux Mixture

Copper sulphate (blue-stone or blue vitriol), 4 pounds.
Fresh lump lime, 4 pounds.
Water, 50 gallons.

Dissolve the copper sulphate and slake the lime in a part of the water. When the lime has all slaked to a fine powder and the copper sulphate thoroughly dissolved, dilute each of them with half of the remaining volume of water, then pour them together, stirring constantly. A more convenient method is to dilute the materials in suitable tanks and run them together and at the same time into the spray tank.

Stock solutions of either copper sulphate or lime may be made up in the proportions of one pound of each to a gallon of water. To make up the spraying mixtures, four gallons of each can be measured out, diluted and mixed as before. The solutions of copper sulphate and lime should never be brought together in strong solutions as they do not make a satisfactory spraying material when thus treated.

Soda Bordeaux Mixture

Copper sulphate, 4 pounds.
Caustic soda (soda lye), 1 to 1½ pounds.
Water, 50 gallons.

Dissolve the copper sulphate in water as for the regular bordeaux mixture, and then add just enough of the soda lye dissolved in water to neutralize the mixture. There should be no more nor less of the soda lye used than is necessary to neutralize the mixture, and one will need a strip of blue and red litmus paper to do the testing. When neutral neither of the papers will change color, while if the mixture is acid the blue paper will turn red, and if too much of the soda has been used, the red paper will turn

blue. Some persons prefer to add about a pound of the soda and then neutralize with lime water, as there is not so much danger of getting it too strongly alkaline and burning the fruit.

This spraying material is not so easily made up as bordeaux mixture, but it has the added advantage of not soiling maturing fruits and ornamental plants. When carefully made good results can be expected, but on account of its scalding the plants unless carefully neutralized, it is not generally recommended.

Ammoniacal Copper Carbonate

Copper carbonate, 5 ounces.
Ammonia, 26 degrees Baume, 3 pints.
Water, 50 gallons.

Dilute the ammonia with five or six quarts of water and make a paste of the copper carbonate in water. Pour the ammonia over the paste, using just enough to dissolve it Do not apply more than is necessary. If any copper carbonate remains undissolved after standing in the ammonia for some few minutes, add a little more ammonia. Then dilute to fifty gallons.

This makes a deep blue solution that is not as effective a fungicide as either bordeaux mixture or the soda bordeaux, but it has the advantage of containing no sediment and can be used on ripening fruits and ornamental plants. It deteriorates after standing exposed to the air for some time.

Potassium Sulphide

Potassim sulphide, 3 ounces.
Water, 10 gallons.

This material should be dissolved and it is ready for use. Chiefly used for the control of powdery mildew on gooseberries.

Sulphur

Dry sulphur is used in a small way for the prevention of some of the mildews which attack plants in the field,

and can be mixed dry and sprinkled along the drills with onion seed for the prevention of onion smut. In greenhouse it is mixed with equal parts of lime and painted on the heating pipes, where it is slowly evaporated for the control of rose mildew.

Formalin

Formalin (40%), 1 pint.
Water, 30 to 50 gallons.

For the treatment of potato scab the seed potatoes are soaked for half an hour in the stronger solution. For oat and wheat smut the weaker solution should be used at the rate of about one gallon to each bushel of seed. The grain for treatment should be poured out on a tight floor and sprinkled with the solution. It should then be shoveled over into a pile and thoroughly mixed up so that each grain is coated with the solution. Then cover it with a canvas and allow to stand for a couple of hours before spreading out to dry.

Self-Boiled Lime-Sulphur

This spray mixture is one of the newest fungicides, and has proven especially effective in the control of peach scab and brown rot. Prof. W. M. Scott of the United States Department of Agriculture prepares this mixture as follows:

Fresh stone lime, 8 pounds.
Sulphur (either flowers or flour), 8 pounds.
Water, 50 gallons.

"In mild cases of peach scab and brown rot a weaker mixture, containing 6 pounds of each ingredient to 50 gallons of water, may be used with satisfactory results. The mixture can best be prepared in rather large quantities—say, enough for 200 gallons at a time, making the formula 32 pounds of lime and 32 pounds of sulphur, to be cooked with a small quantity of water (8 or 10 gallons) and then diluted to 200 gallons.

"The lime should be placed in a barrel and enough water poured on to almost cover it. As soon as the lime begins to slake the sulphur should be added after first running it through a sieve to break up the lumps. The mixture should be constantly stirred and more water added as needed to form a thick paste at first and then gradually a thin paste. The lime will supply enough heat to boil the mixture several minutes. As soon as it is well slaked, water should be added to cool the mixture and prevent further cooking. It is then ready to be strained into the spray tank, diluted and applied.

"The stage at which the cold water should be poured in varies with different limes. Some limes are so sluggish in slaking that it is difficult to obtain enough heat from them to cook the mixture at all, while other limes become intensely hot on slaking and care must be taken not to allow the boiling to proceed too far. If the mixture is allowed to remain hot fifteen or twenty minutes after the slaking is completed, the sulphur gradually goes into solution, combining with the lime to form sulphids, which are injurious to peach foliage. It is therefore very important, especially with hot limes, to cool the mixture quickly by adding a few buckets of water as soon as the lumps of lime have slaked down. The intense heat, violent boiling and constant stirring result in a uniform mixture of finely divided sulphur and lime, with only a very small percentage of the sulphur in solution. The mixture should be strained to take out the coarse particles of lime, but the sulphur should be carefully worked through the strainer."

CHAPTER VI

Orchard Pests and Diseases

Green Aphis of the Apple

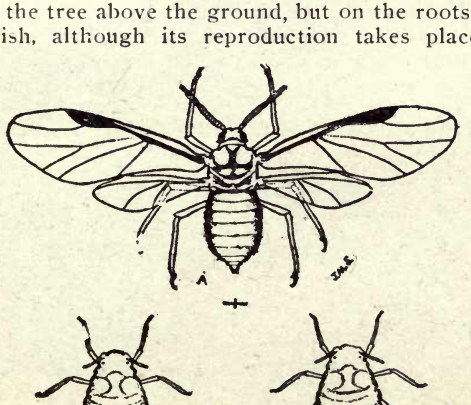
This is one of the common green lice that curls the leaves of the apple tree. It is an extremely common and troublesome insect in some parts of the country and is essentially one which feeds on the leaves by sucking the juice. The female lays eggs on the twigs of the new shoots in the fall, and these hatch just at the time the buds are beginning to open in the spring, and are ready to insert their beaks into the tissues of the unfolding leaves. These insects that hatch in the spring are all females, and in about two or three weeks they begin giving birth to living young, and the numbers then increase very rapidly. Early in the summer a generation of winged individuals appears, and fly from tree to tree and from orchard to orchard with the prevailing winds. In the latter part of summer a generation of winged males and wingless, egg-laying females appears and a little later the females begin laying the greenish black eggs which are to carry through the winter.

Remedy: It is quite difficult to kill the eggs of this insect. Strong applications of lime-sulphur have been helpful, but the best methods are with tobacco sprays, such as "black leaf" or "black leaf 40" at about the time the eggs have hatched and the insects are working themselves into the opening buds. Kerosene emulsion is also effective.

Woolly Aphis.

In many places this insect is more troublesome than the green aphis. It is readily recognized by its reddish

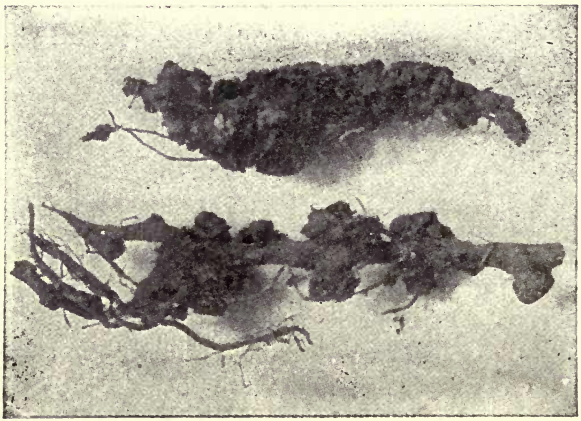
purple color and the white, woolly secretions which appear on the upper surface of its body, and from which it derives its name. It lives on the roots and on the tops of apple trees, usually on the smaller roots, and in the forks, and on the smaller branches of the tops. In winter it may entirely disappear from sight on the infested portions of the tree above the ground, but on the roots it does not perish, although its reproduction takes place more



Woolly aphis of the apple. A, winged female; b, wingless female, and c, a wingless female bearing the peculiar "woolly" secretion characteristic of this insect.

slowly. A winged brood appears late in the fall, but it has not been determined with certainty whether the females of this brood lay their eggs on the branches or on the soil. The infestation in the spring comes from the fact that the newly born young travel up the trunk to where they find suitable place for lodgment. They cause large smooth knots to form on both the root and branches wherever a colony of them may form, and in cases of severe infestation may so seriously injure the roots as to cause them to rot off.

When once established it is practically impossible to rid an orchard of this pest, and the best means is to guard against its getting a start in the orchard. One method is to have the apple trees worked on Northern Spy roots, as this variety seems to be quite immune from serious attacks. Nursery stock that has been puddled should have all of the mud washed off the roots and then be thoroughly examined for signs of infestation. Fumigation with hydrocyanic acid gas will eliminate the insects which may be



Characteristic galls produced on tree roots by the woolly aphis.

present. Where present on the tops of trees, they can be disposed of with kerosene emulsion or black leaf sprays applied with sufficient force to wash off or penetrate the woolly covering. Black leaf is considered the most effective when used in the proportion of one gallon to 65 or 70. When trees are sprayed with lime-sulphur for the eggs of green aphis, the woolly aphis is kept in check. A band of sticky fly-paper or "Tanglefoot" wrapped around the base of the trees will prevent the migrating young from ascending the tree from the roots.

Bark Louse.

This is a minute insect which is more active in the spring, feeding on the tender shoots. Later in the season it secretes a scale under which it lives. It can be controlled with sprays of kerosene emulsion or lime-sulphur applied while the trees are dormant.

Bud Moth.

This is a small insect, the larvae of which destroy the flower buds of apples, pears, plums, etc. It can be controlled with arsenical sprays applied when the buds are beginning to open and again ten days later.

Apple Magot or Railroad Worm

Troublesome in some places where it spoils or destroys apples by tunneling through the apples, causing the fruit to fall. Destruction of the infested fruit, together with keeping the orchard in thoroughly sanitary condition are the best means of eliminating this pest.

Brown Mite

In some sections of the West this insect has caused considerable trouble to the foliage of all kinds of fruit trees, causing the trees to take on the appearance of being in need of water. The mites feed on the leaves, but deposit their eggs on the branches and limbs. When very abundant they give a reddish color to the bark, quite noticeable in the winter. The eggs are deposited in late summer and do not hatch until after growth has begun in the spring. Weldon of the Colorado Experiment Station reports that this insect can be most effectively controlled with sulphur used in water as a spray. Flowers of sulphur, one pound to three gallons of water and enough soap so that the sulphur will mix freely with the water, is perfectly effective as a summer spray. Tobacco preparations will kill the mites, but not the eggs, and are effective only when repeated applications are made. Oil sprays seem to pene-

trate the eggs and destroy them better than the tobacco extracts, but are unsafe to use with water strongly impregnated with alkali.

Brown Tail Moth

This insect is found at the present time only in the region of the New England states, but at the rate it is spreading it may easily occupy the entire country in a short length of time. The adults, moths, of this insect expand 1¼ to 1¾ inches and are white except on the abdomen, which is brownish and tipped with a tuft of brown hairs. This tuft is small and dark in the male, but in the female is large and of a golden brown color, and on account of its prominence has won for the insect its name. They may be found on the wing in July. Both sexes are strong flyers and are attracted by artificial lights.

Eggs are laid in August on the leaves at the end of a shoot, and are covered with a few hairs from the body of the female. The young larvae appear in the course of a few days and feed on the leaves, spinning a web as they feed. In the winter this web is thickened and the colony passes the winter in the nest. These nests are very conspicuous, as they are so very different from any other wintering places for a colony of insects. Early in the spring they emerge from the nest and feed on the young leaves of the trees, and when the insects are numerous they will completely strip the foliage in a short time. When full grown they are about 1½ inches long, of a dark brown color with a sprinkling of orange, with the body covered with long fine reddish brown hairs and a row of conspicuous white hairs along each side of the body. There is a conspicuous red tubercle on the top of the sixth and seventh abdominal segments.

The unpleasant and dangerous character of these insects lays not alone in the harm they do to trees by eating the foliage, but also to the discomfort they cause to man when coming in contact with the hairs which cover the bodies of these caterpillars. These hairs are brittle, very

sharp pointed and barbed, so that they enter the skin easily where they set up a painful irritation.

On account of its leaf eating habit it can be controlled with any of the arsenical sprays which are applied as soon after the leaves open in spring as possible. As many of the over-winter nests as can be collected should be burned. Clearing out thickets of plants that are infested and putting old, neglected orchards in sanitary condition will keep the pest in control.

Canker Worm

These worms appear early in the summer in great numbers and are quite commonly known as "loopers" or "measuring worms." They are voracious feeders, and will quickly strip the foliage from the infested trees. The female moths are wingless and late in the fall they climb up on the trunks and branches of the trees where the eggs are deposited. Spray with arsenate of lead as soon as the insects appear, and repeat if necessary.

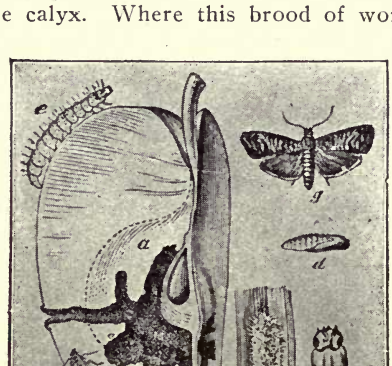
Cigar Case Bearer

The caterpillars of this moth infest the leaves and in the spring may be on the buds and young fruits. The mature caterpillars are about one-fifth of an inch long and a reddish orange color. They build around themselves a cigar shaped case from the lower surface of the leaf fastened together with silk. These cases are started in the fall and are increased considerably in the spring as the insect develops into maturity. The adults emerge in midsummer as a steel grey moth about one-half inch across the wings. It can be kept in check by applications of arsenical sprays, although on badly infested trees two or three applications may be needed at intervals of three days to a week apart.

Codling Moth

This insect causes a greater annual loss to fruit growers than any other single insect except San Jose scale and

plum curculio. It does this because it is the insect which causes the worm in the apple. It can be very effectively controlled by spraying with lead arsenate or Paris green. During the past half dozen years this insect has received a great amount of attention from orchardists and entomologists and very effecient means for its control have been perfected. There are two broods of this worm in each season, and the eggs of the first brood are laid on the leaves or young fruit and the worm enters the apple through the calyx. Where this brood of worms can be



Codling moth: A, portion of an apple showing tunnels made by the worm; b, calyx at which the worm entered; d, pupa; e, larva or worm; f and g, adults.

controlled there will be but little trouble from the second brood. On account of this habit of entering at the calyx it is apparent that the calyx should be filled with the poison. The second brood appears about mid-summer and enters the apple through the side. It usually selects a place where two apples touch or where a leaf covers the side of a fruit.

In the Western sections an attempt has been made, and with more or less success, to do this first spraying so effectually as to make subsequent spraying unnecessary. It must be done at a pressure of 150 to 200 pounds, with a coarse nozzle, the bordeaux type being preferred, and the spray applied just at the time the last petals are falling from the flowers. Better results can be had by making two other sprays at intervals of a month apart. The doors and windows of cellars or houses in which apples are stored over winter should be screened so as to keep the moths which may hatch out from the infested fruit from reaching the orchard.

Clean cultivation and the removal of scales of bark on the trunks and large limbs of the trees will prevent the worms from finding suitable places in which to pupate.

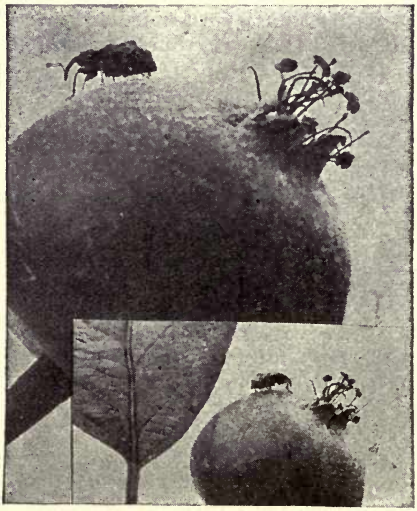
Curculio

There are three species of this insect which may do serious damage to the apple. These are the plum curculio, apple curculio and apple weevil. Of these the plum curculio causes the greater amount of damage. This insect is a beetle, the adult of which is about an eighth of an inch long, and which hibernates over winter in the rubbish, weeds, under clods or other convenient places in the orchard. On the apple this insect causes serious damage by puncturing the developing fruits for the purpose of feeding and to deposit eggs. These punctures differ somewhat from each other but either of them causes a dwarfing and stunting of that portion of the fruit, so that by the time the fruit reaches maturity it is very much misshapen.

The egg puncture made by this beetle is quite easily seen on fruits that have been stung. The female makes a little pocket in the flesh of the apple, and into this she deposits one egg. Then, beginning at the puncture thus made, she cuts a crescent shaped mark through the skin partly surrounding the puncture. These crescent shaped marks are very conspicuous on smooth skinned fruits such as the plum and apple, and in regions where the curculio

abounds may be found usually in great abundance in the early part of the summer.

These eggs hatch in from three to seven days into a small grub that feeds on the flesh of the fruit. For some reason, at present unexplained, if the fruit which is attacked continues to grow and enlarge rapidly, the grub will work its way toward the core, but usually dies be-



Plum curculio; enlarged in the upper figure and natural size in the lower.

fore the larval stage is completed. If, however, the fruit falls to the ground, then the larva reaches maturity. When full grown they come out of the fruit and enter the ground, where they form a little cell a couple of inches beneath the surface in which they pupate. Towards the latter part of the summer, sometimes extending over quite a long period, adults emerge from their pupal cells and

feed on the leaves and maturing fruits, sometimes making quite large holes in the fruit where they make frequent visits to feed. With the coming of cold weather these adults hide under bits of rubbish or in the grass, where they find protection during their period of hibernation.

This insect is one of the most difficult to combat of the many that attack fruit. This is so because of its feeding habits and general life history. One means which is quite often advised as a means of control is to jar the infested trees. The insects drop from the trees when disturbed, and may be caught on sheets and destroyed.

Cultivation during mid-summer is a method of disposing of large numbers, as when done while the larvae are in the pupal stage their pupal cells will be destroyed and the larvae killed by the exposure to the light and attacks of predaceous insects.

Recent experiments have shown that spraying trees with arsenate of lead is a very effective means of controlling this insect. The methods used in combatting the codling moth are such as to keep the curculio in check, and it has been the universal experience that sprays applied at high pressure are much more efficient than those applied as a mist at low pressure. Even when controlled in the most efficient manner now known it is not possible to destroy as great a percentage of these insects as it is of codling moth.

Apple Curculio

The habits of this insect are quite similar to those of the plum curculio, and means of controlling the latter will prove quite as effective.

Borers

Flat headed and round headed borers are both found in the trunks of apple trees, working under the bark and into the wood of the trees, usually near the ground. They cannot be controlled by spraying, although lime-sulphur solution at high pressure to the trunks will aid in reducing

the damage. Various washes containing soap and carbolic acid have been advised to drive or keep the insects from the trees, but none have proved to be of much value. The best and safest treatment is to dig the borers out with a sharp knife, or to run a wire into the burrow until the insects are reached.

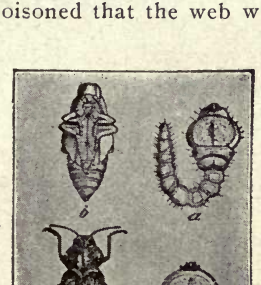
Apple curculio, natural size in the small figure.

Fall Web Worm

This worm is the larva of a moth of pure white color, with an expanse of wings of about one and one-fourth inches. The worms attack a great number of different kinds of plants, usually in mid-summer. The full grown larvae are about an inch long, with varied markings. They are thickly covered with hairs of various shades of yellow, being longer at the extremities of the body, and a dark

stripe extends along the back. They spin a web over the foliage and confine their operations inside the web. As fast as all of the enclosed foliage is eaten the tent-like web is extended, so that it may become of very large size if the insects are left undisturbed.

On account of its foliage eating habits it can be controlled by any of the arsenical sprays which may be applied. Usually it does not trouble orchards which have been thoroughly sprayed with lead arsenate, as this spray sticks, and when applied for the codling moth the foliage will be so well poisoned that the web worm cannot exist.



Flat headed apple tree borer:
A, adult; b, pupa; c and d, larvae.

Gypsy Moth

This insect at the present time is confined to a territory quite the same as the brown tail moth, but differs from that insect in that it passes the winter in the egg stage. The female does not fly, although provided with wings. She crawls into any convenient hiding place, whether it be under a bit of rubbish, under a stone, old can, fence or fence rail, building or what-not, and deposits her eggs. These are deposited in July or August and are covered with the tan colored hairs from the body of the

female. They do not hatch until the following May. The full grown larvae are dark in color and covered with dark hairs. The mature larvae have two rows of red spots and two rows of blue spots along the back with a yellowish but dim stripe between them. They usually reach their full size about the 1st of July, and then transform to pupae. These pupae are found in locations similar to the egg masses, but occur in the foliage of trees and shrubs as well. The male moth is brownish yellow in color, about an inch and a half across the wings. The female moth is nearly white, with a body so heavy as to prevent flight.

The most effective means of controlling this insect is to destroy the egg masses. There is an abundance of time for this as the eggs laid in mid-summer do not hatch until late next spring, a period of possibly eight months. The egg masses can be destroyed when found by soaking them with creosote mixture applied with a small swab or paint brush. This material can be obtained from dealers in farm supplies.

Scale Insects

Oyster Shell Scale. This insect is much larger than the San Jose scale, and resembles an oyster shell in shape. On account of there being only one brood in a season, it is easily controlled. Spraying for the San Jose scale will also destroy this insect. It may be held in check by spraying about the second week in June, while the young are hatching, with kerosene emulsion or self-boiled lime-sulphur. When numerous, growers should determine when the eggs are hatching by watching the trees carefully after the latter part of March, in order to apply the remedy before the young insects become protected by their hard scale covering. In general practice it is found best to prune off the badly infested branches during the fall or winter.

Scurfy Scale. This insect is a native of America found on the bark of the native crab trees. The scales are somewhat pear shaped in outline with a prominent nipple at the pointed end. Its color is grayish or whitish, and even when numerous, it does not cause the trouble that can be

expected from San Jose scale. Treatment for Oyster Shell or San Jose will keep this scale in check.

San Jose Scale. This is the most destructive scale insect that affects deciduous orchard trees. It lives on nearly all kinds of woody plants, and when left alone is capable of killing a tree in the course of a very few years. The scales are very small, seldom larger than the head of a pin, and with a conspicuous nipple in the center. Eggs are never deposited, but the females give birth to living young, after reaching maturity at about five weeks of age. Each female is capable of producing about 400 offspring. The characteristic thing about San Jose scale is that it causes the bark to turn red, especially the inner bark and the shoots of some species of plants. Other kinds of scales will cause a reddish appearance, especially on the fruit, but when the reddish color of the inner bark is pronounced, and the scales are circular in outline, it may quite likely be San Jose. For certain identification it should be referred to an experiment station entomologist.

The most effective remedy for this insect is spraying with full strength lime-sulphur solution during the dormant period, using either the commercial brands or home-made mixtures. Miscible oils are also effective, and when the commercial brands of these are used, the directions accompanying them should be followed, as serious injury to the trees can come from using these in too strong solutions. During the summer an application of self-boiled lime-sulphur has proven itself to be very effective in destroying all of the young insects with which it comes in contact, and in coating the branches so as to make it difficult for the young to find a place to settle.

Other Scale Insects. There are a number of other scale insects which attack orchard trees and shrubs, some of which closely resemble the San Jose scale in appearance. All of them are less destructive than the San Jose, and are easily controlled when precautionary measures are taken such as for the control of San Jose scale.

Tent Caterpillar. The eggs of this insect are deposited in masses in rows around the smaller twigs in mid-summer,

and do not hatch until the following spring. The caterpillars feed on the leaves spinning a web as they go. This soon becomes of considerable size and makes an unsightly appearance on the trees. When full grown the caterpillars are about two inches long, somewhat hairy and have a white streak running along the back. On their sides are yellowish markings and underneath they are quite black. The worms mature in about six weeks, and make cocoons in sheltered places, issuing as moths in about three weeks. The moths are about three-fourths of an inch long, with a spread of wings covering about one and three-fourths inches. It can be controlled by any of the usual arsenical sprays that are applied for insects, such as the codling moth.

Insects That Attack the Pear

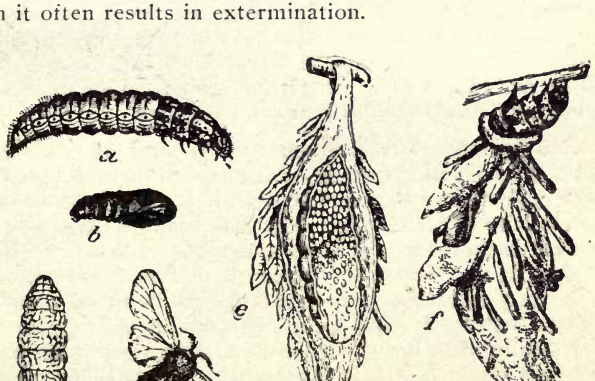
Pear Leaf Blister Mite. This insect attacks both pear and apple, although usually more common on the pear, from which it gets its name. It appears on the leaves in the spring at about the time they reach their full size, and cause reddish blisters to appear on the under side of the leaves.

The eggs are deposited under the outer scales of the buds and hatch as growth begins in the spring. The little mites burrow into the leaves, where they cause the characteristic swellings. These swellings in spring are reddish, in summer they turn green and by the latter part of summer have become a dark brown.

This insect is not at all difficult to control, as any of the mixtures used for controlling scale will keep it in check. Lime-sulphur, kerosene emulsion and miscible oils have all been effective in preventing injury from this insect on both apples and pears.

Pear Slug. Pear trees are attacked by this insect in the summer and again in the late summer or fall. It feeds on the upper surface of the leaves, leaving only the veins. Foliage thus eaten falls from the tree and leaves the trees bare. This insect during its early stages is a slimy slug,

but after its last moult the slimy covering is thrown off and the skin becomes a light orange color and clean and dry. It then goes into the ground, and emerges again in twelve or fifteen days as a fly. It spends the winter in the pupal stage just under the surface of the soil. Arsenical poisons, either dusted or sprayed on the foliage will control it. Because of its slimy nature, even road dust thrown on it often results in extermination.



The bag-worm: A, caterpillar removed from the bag; b, male chrysalis; c, wingless and legless female moth; d, winged male; e, bag cut open showing female chrysalis and eggs; f, caterpillar in the bag; g, cones made by the little caterpillars as they are beginning to spin their bags.

Black Peach Aphis. These plant lice are shining black in color, one form having wings and the other possessing none. They feed upon the juices of the peach, cherry and plum trees, working upon the leaves, stem and roots. They can be controlled on the leaves and twigs by spraying with the tobacco preparations as for green aphis. If very numerous on roots, scrape the soil away and apply pulverized tobacco.

Bagworm. These insects infest nearly all kinds of trees and shrubs, and will consume a large quantity of foliage during the summer, frequently defoliating the trees completely. It is the larva of a moth, that over-winters in the egg stage within the old female bags. In the late spring the young hatch from the eggs and crawl out on the twigs to the nearest leaf, where they begin to feed and begin the work of spinning the bags for themselves. This is a curious and interesting process. Into the construction of the bags the larvae add fragments of the foliage and leaf stems, securely fastened together with silk. It is easily controlled with arsenical sprays.

Red Spiders. These are extremely small insects which work on the under surface of the leaves of many plants. They are common in greenhouses, and in the semi-arid sections of the West they are becoming quite destructive to orchard and ornamental trees and shrubs. When present they cause the leaves to become yellowish in spots, and upon examination the under surfaces will be found covered with an extremely fine web. The adults will appear as very small red or brownish specks crawling under the web, and their eggs as minute glistening beads attached to the leaf in the meshes of the web. The adults are just large enough to be seen with the naked eye.

In the greenhouse they can be kept in control by daily syringing with cold water. In the field such means are impracticable, but the Colorado experiment station reports that they were able to keep red spiders controlled by spraying their plants with sulphur and soapy water as used for the brown mite.

Strawberry Insects

Leaf Roller. This insect appears early in the spring as a small brown moth, measuring about half an inch across the wings. It deposits its eggs on the leaves of the strawberry. The larvae are greenish brown, and when full grown, nearly half an inch in length, but rather slender. They mature in June, after having spun a web which

causes the familiar rolling upward of the leaflets. The soft tissue of the leaf is eaten and what remains turns reddish brown, giving the plant a burned appearance. There are two broods, and the winter is passed in the pupal condition. Spray the plants in August with an arsenical spray at the time the second brood appears. On account of the first brood of the insects pupating in the rolled leaves, the foliage may be mowed off and burned, thereby practically exterminating them from the plantation.

Sawfly; Slug. The adult of this insect appears in spring and deposits its eggs in the tissues of the stem or leaf. The larvae hatch in a short time and gnaw holes in the leaf, developing in the course of five or six weeks into pale green worms about three-fourths of an inch long. The larvae burrow slightly beneath the surface to pupate, emerging later as flies. There are two broods in the Southern states and one in the North. Spray the foliage with lead arsenate before the plants bloom, and again after the fruit has been harvested, if necessary.

Strawberry Weevil. This beetle deposits its eggs in the developing flower bud of a pollen-producing strawberry. The insect punctures a bud and turns and deposits its eggs into the puncture, then shoves it down into the bud with its beak. It then passes down the stem of the developing flower, where it punctures the stem, shutting off the supply of sap, and the bud shrivels and drops to the ground. There the larva develops to maturity and emerges as an adult beetle in about a month from the time the egg was deposited.

Spraying with arsenicals is recommended, although, from the feeding habits of the beetle it will hardly get enough poison to destroy it. Mulch the field with straw and burn it as soon as the fruit is off. The least amount of damage will come by planting pistillate varieties, setting four rows pistillate with one row of some variety of staminate berry, capable of producing an abundance of pollen. The weevil attacks only the staminate flowers, and lives on the pollen cells.

Root Louse. The life of this aphis is similar in general

to other plant lice. They appear first on the foliage and tender young leaves in the crown of the plant, and colonies of them may even be found on the roots of the strawberry, where they have been carried by a species of ant, which places them in specially prepared galleries.

The most effective remedy, perhaps, is to plant the berries in new ground every third year. Fumigation of the plants before planting will free them of any living insects, and spraying with black leaf when the lice are first noticed in the spring will keep them well in check.

Crown Borer. This is a white grub which works in the crown of the plants along in mid-summer. This grub is about one-fifth of an inch long, and develops into a curculio or weevil. To control this insect by spraying is rather difficult on account of its habits. The best means of control is to burn over the fields immediately after the fruit has been picked. Any plants remaining which are infested should be dug up and burned.

Grape Insects

Leaf Folder. This is the larva of a moth having wings of black, bordered with white, and with white spots on the upper sides. The adult lays its eggs on the upper side of the leaves. As soon as hatched the larvae begin to feed on the tissue of the upper side of the leaves, leaving only the hard veins and skin of the lower side. As it feeds it spins a web over itself in such a manner as to bring the sides of the leaf together, forming a fold in the leaf. It pupates within the folded leaf. Because of its leaf-eating habit it can be controlled with any of the usual arsenical sprays.

Flea Beetle. This is a small steel-blue beetle about an eighth of an inch long, which is readily disturbed on the vines, and has the habit of dropping to the ground. It passes the winter in the adult condition, and in early spring attacks the opening buds and tender young leaves. Soon after the leaves appear the female commences laying eggs, which are orange colored, on the under side of the

leaves. These quickly hatch and the larvae feed on the tissues of the leaves, puncturing them full of holes. There is a second brood of the beetles which appears about the middle of July. Spraying with arsenical materials will destroy this troublesome little pest.

Rose Chafer. This is a long-legged, awkward-looking beetle which attacks a great many different kinds of plants during the summer. It responds very slowly to any poisons, so that in small areas hand picking of the insects is probably the best treatment. In commercial plantations spraying with arsenate of lead will keep the insect under control.

Berry Worm. There are two kinds of insects which cause worms in the berries of grapes. One of these is the larva of a moth. This worm is about half an inch long, of a bluish black color, that spins a web and lets itself to the ground. The other is the grub of the curculio. Some seasons either or both of these insects may be very numerous, while in others they will be of no consequence. Thorough spraying with arsenate of lead will give quite effective control of both insects, although the curculio can be more effectively controlled if the vineyard is kept in clean cultivation, and the soil stirred quite frequently during the middle and latter portions of the summer. This will bring to the surface of the soil the pupal cells of the insect, which will perish upon exposure to the light. Spraying with arsenate after the fruit sets and again when the berries are about half grown will help in controlling these insects.

Leaf Hopper. This is a very small, inconspicuous insect that jumps from the leaves of the vine when disturbed. It comes in great swarms and does great damage to the vines by sucking the juice of the foliage from the under side. Thorough spraying with kerosene emulsion at the rate of one to ten, is the most effective means of controlling it. In applying the spray it needs to be done with good pressure and through a fine nozzle so as to fill the air with a mist. Those insects which are not hit while on the vine will get more or less upon themselves as they hop through the mist, and be destroyed.

Grape-Cane Gall Maker. This is a little beetle of the curculio family, which is very closely related to the grape-cane girdler, except that the gall maker is of dark brown color and the girdler is shining black. Thus far its injuries have not been of great seriousness, although present to a greater or less extent over quite a large area of the eastern portion of the United States. The female makes a series of holes in the grape canes, usually beyond the terminal cluster of fruit, in which she deposits her eggs. These hatch into a small larva which feeds on the tissue of the cane and causes the formation of a gall of considerable size. It can be controlled by removing these canes having galls, and arsenical sprays may keep the insects under control.

Grape-Cane Girdler. This insect, instead of making a line of holes up and down the canes, makes a ring of holes, in only one of which an egg is deposited. Then above this place where the egg is deposited she girdles the cane so that it breaks off. The larva lives in the stub. Removing the affected canes and spraying with arsenical sprays, together with keeping the vineyard in clean cultivation will keep this insect controlled.

Raspberry Cane Borer. This is the larva of a small black beetle, which makes two rows of holes about an inch apart near the tips of the canes in June, and deposits an egg just above the lower girdle. The larva attains a length of nearly an inch and bores down into the cane, causing it to wilt. Cut off the wilted canes below the lower girdle and burn them.

Vegetable Insects

Asparagus Beetle. There are two kinds of beetles known by this name, one of them is blue in color, and the other a dark red, with twelve black spots on its wing covers. Both of them attack asparagus as it is starting into growth and eat holes in the young tips, also eating the foliage and seed capsules. Allow a few hills to remain uncut, and keep them sprayed with arsenical poisons. These hills will

serve as trap plants, drawing the insects away from the ones that are to be used for cutting.

Bean Weevil. This insect deposits its eggs on the young pods and the larvae bore into the developing seeds, where they do not reach maturity until fall. Then they emerge if the season is warm, otherwise remaining in the seed until spring. When present the beans should be fumigated immediately after harvest, using one ounce of carbon bisulphide for every hundred pounds of beans, and leaving the bin closed for forty-eight hours.

Fungous Diseases

Apples

Bitter Rot. The conditions most favorable to the development of this disease are hot weather, accompanied by frequent rains and heavy dews at the period when the fruit is approaching maturity. Dry weather at that time will not cause a serious outbreak of the disease.

This is the most destructive fungous disease of the apple, causing a greater actual loss than does apple scab. But its virulence varies greatly with local conditions, and it may not cause serious trouble every year. It occurs throughout the entire eastern part of the United States. It appears on the fruit, causing it to rot, and is also found on the branches in the form of cankers. On the fruit it first appears as a small brown speck at about the time the fruit is beginning to ripen. As soon as this spot attains a size slightly smaller than a dime it becomes sunken in the middle and produces numerous small pustules in concentric rings, giving rise to the summer spores. The tissue of the fruit near the rotting areas is decidedly bitter, from which fact this fungus gets its name. The rotting areas continue to increase in size until the entire fruit decays. Many of these decayed fruits do not drop from the trees, but remain hanging to the branches throughout the winter. In the spring these "mummied" fruits, as they are called, give

rise to a new crop of spores that infect the new crop of fruit.

On the branches this fungus causes the formation of cankers, or areas of dead bark. The fungus is believed to live in these cankered areas for two years, giving rise to a crop of spores which falls onto the fruit, causing the characteristic black, decaying areas.

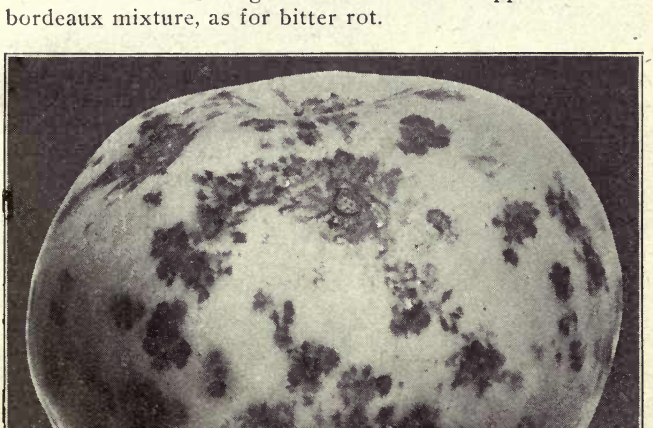
As a means of preventing damage from bitter rot, one of the first preventive measures should be a thorough examination of the trees while in a dormant condition, and removing all of the branches and limbs which show signs of infestation. All of the mummied fruit which remains on the branches should be removed and burned. Then the trees should be given a thorough spraying with bordeaux mixture. As many as six applications of this mixture will be needed, beginning in the spring, and applying the spray at intervals of two or three weeks until July, and even after that date if bitter rot should appear. Experiments carried on by the Illinois Experiment Station go to show that the early sprayings are more effective in controlling this disease than if the spraying is not done until after the disease appears. The work of spraying should be done thoroughly, so as to coat every fruit and leaf.

Blotch. This disease occurs through the southern and eastern part of the United States where it causes serious damage to the fruit on several different varieties of apples. On the fruits these blotches appear as dark colored, star-shaped areas, often being so numerous on an apple as to cover the entire fruit. It attacks only the skin of the fruit, so that the continued growth of the underlying tissue frequently causes the fruit to crack. The fungus does not rot the fruit as in the case of bitter rot, but mars the appearance so as to make it unsalable.

The fungus also attacks the twigs and branches on which it causes the formation of small and rather inconspicuous cankers. On the rapidly growing shoots and watersprouts these cankers have the same general appearance as on the fruit. The fungus lives in the cankers for

a number of years. On the leaves it appears as minute specks, scarcely one-sixteenth of an inch in diameter, of irregular shape, and usually yellowish or whitish, with one or more small black specks in the center. When very numerous, they may cause the foliage to fall.

To control this fungus make five or six applications of bordeaux mixture, as for bitter rot.



Apple blotch on a Maiden Blush apple, natural size.

Brown Spot, Baldwin Fruit Spot. This disease is caused by a fungus which finds entrance into the apple during mid-summer, and causes the fruit to deepen in color wherever the fungus may have found entrance. At the time the fruit is ripening it causes small brownish areas to form, which become somewhat sunken, and the flesh to become dry, brown and quite bitterish to the taste. It can be controlled by spraying with bordeaux mixture or even weaker fungicides.

Twig Blight. (See under Pear.)

Black Rot. This is a fungus causing the decay of apples, quinces and pears, and has become well known, although it is not a serious disease. Its most objectionable and serious character is that it causes large cankers to form on the limbs of the affected trees. The fruits that are attacked rot quickly, but do not show the shrinking of the tissues as in the case of bitter rot. After the rotting has become quite well advanced the diseased area will become quite spotted with small black specks from which the spores issue. It occurs most commonly on neglected and fallen fruit, and upon fruit in the storage cellar. The cankers appear as deadened areas of the bark, somewhat shrunken and producing many little pustules from which the spores arise. Removal of the cankers and thorough spraying with bordeaux mixture gives the most complete satisfaction, although preventive measures have not been well worked out. Clean orchards are affected the least.

Crown Gall. This disease is due to an organism that attacks a number of different kinds of plants, mostly of the family Rosaceae, causing large swellings to form on the roots or at the crown of the plant. It is exceedingly troublesome in nurseries, and appears as large soft galls, and may also be present as a mass of fine hairy roots. In the Western states it is very troublesome as the organism seems to find congenial conditions for its development and distribution. The galls increase in size rapidly and usually last for only one season, after which they decay, only to reappear again the next season. Trees are frequently so badly affected as to either die or be of little value.

No means is known of preventing the spread of the disease or of destroying it after it has once entered a tree. Careful inspection of nursery stock and burning all of the infested trees is all that can be suggested at the present time.

Fly Speck, Sooty Blotch. These diseases ordinarily appear on the fruit from unsprayed trees, in low ground,

and upon the lower limbs of trees in dryer locations. It is purely a skin disease and causes no injury aside from disfiguring the appearance of the fruit. Can be easily controlled with bordeaux mixture or any of the ordinary fungicides.

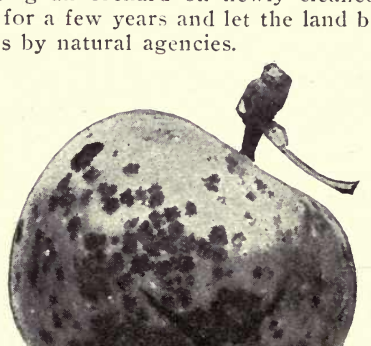
Mildew. The powdery mildew often occurs on the young shoots of nursery stock, making a dense felt-like growth over the leaves and twigs. It can be controlled with any of the usual fungicides.

Apple blossoms. On the left, just right for the first application of spray to control scab and codling moth. Cluster on the right is too late for the codling moth.

Rust. The bright orange colored patches of rust that are to be found on the leaves and fruit of apples, pear and quince, as well as upon the wild thorn and crab trees, are caused by the same fungus which makes the "cedar apples" on cedar trees. It spends a part of its existence on the apple trees and the other part on the cedar, so that the most effective means of controlling this fungus is to

get rid of the cedar trees. Spraying with bordeaux mixture or self-boiled lime-sulphur aids in checking the disease, but does not give perfect control.

Root Rot. This trouble is of common occurrence in several parts of the country. In the Middle West it occurs more frequently on trees which have been planted on land newly cleared from oak timber. In such cases it seems to be caused by a fungus which is found on the oak. Before planting an orchard on newly cleaned land, it is best to wait for a few years and let the land become freed of the fungus by natural agencies.

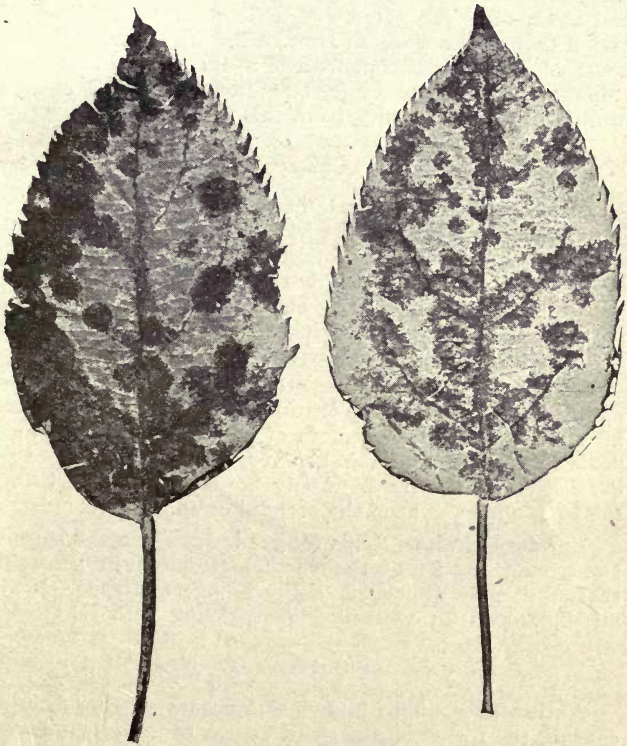


Apple affected by scab.

In the Western states a condition resulting in the death of the roots and portions of the bark of the trunk has been laid to poisoning from excessive use of arsenical sprays. This belief is doubted on good authority, however, as in some of the Western sections, in orchards which have never been sprayed, and in soils entirely free from arsenic, the same trouble is said to exist.

Scab. Apple scab is common to all orchards, except in some portions of the semi-arid sections of the West. It attacks the fruit and leaves, on which it causes large black

velvety patches. It not only injures the appearance of the fruit, but by its attacks on the foliage, it may prevent the formation of a crop of fruit.



Apple leaves covered with the fungus that causes scab.

It is most serious when the weather is cold and wet early in the season. Because of this the dropping of apples, which is often attributed to improper pollination

during such season, is directly due to the ravages of scab on the young fruits. All varieties of apples are attacked by scab, but some varieties more so than others. Thorough spraying with bordeaux mixture just before the buds open and again after the petals fall, followed by a third application two or three weeks later, will keep it under perfect control. Recent experiments lead to the opinion that lime-sulphur and arsenate of lead applied as for the codling moth will give immunity from this disease.

Cherry

Black Knot. This disease occurs on the cherry, apricot, plum and prune, causing the formation of large black galls or knots on the limbs and branches. These are frequently infested with insects which burrow within the galls. Removal of the galls by cutting out diseased limbs and spraying with any standard fungicide before growth begins in spring will eliminate the disease.

Leaf Spot. This disease attacks the cherry and plum upon the foliage of which it causes the formation of small brown spots, the dead centers of which fall out, causing a "shot-hole" appearance. When very prevalent it will cause defoliation of the trees. Apply bordeaux mixture before the buds open and keep the orchard clean.

Powdery Mildew. This fungus is found on the sprouts and young shoots of the cherry, although in favorable seasons it may attack all of the foliage and cause defoliation. It can be controlled by spraying with fungicides.

Currants

Anthracnose. This fungus also occurs on gooseberries, causing the formation of small brown spots on the leaves which turn yellow and drop when seriously attacked. On the stems the fungus makes small circular areas. Cutting out the affected canes and spraying with bordeaux mixture before the buds open will control the disease.

Cane Blight. This fungus causes serious trouble in some sections by killing the canes. Upon the dead canes

it will appear as a bright pink mass a short time after the cane dies. Spraying will help to keep the plantation in a sanitary condition, but plants which have been attacked seldom recover and should be dug up and burned.

Dropsy. This disease is possibly due to a physiological trouble. It causes a considerable enlargement of the stem. Cutting out the affected canes is most effective.

Blackberries and Raspberries

Anthracnose. This fungus causes small purplish spots to form on the canes. Later these spots become gray and sunken, giving somewhat the "bird's eye" effect. The stems and leaves may also become affected and result in severe injury to the entire plant. Control measures have not proven as satisfactory with this disease as with many others. Keeping the plantation in a thoroughly sanitary condition by cultivating and spraying, and removing the affected canes as fast as they show are about the best means of control.

Cane Blight. In the eastern part of the country this disease has caused considerable loss to small fruit growers. It is a wilt disease attacking the young canes and causing the affected portions to wilt and die. Planting healthy vines and removing the diseased portions when they appear are best means of control.

Crown Gall. (See Apple.)

Orange Rust. Among raspberries and blackberries there is a noticeable difference in different varieties in resisting this disease. Kittitinny blackberry is about the most susceptible, although some varieties of dewberries are easily affected. The fungus causing this disease appears on the foliage, the under surface of which turns a bright orange color, and the skin breaks open, liberating the brightly colored spores. Affected canes are usually much more spindling than those which are healthy. Spraying has not proved to be of much service in controlling this disease. Keeping the plantation clean and removing the

affected plants as they appear, and before they begin to shed their spores, is, perhaps, the best means of fighting the disease.

Grape

Anthracnose. Anthracnose or bird's eye disease of the grape is well distributed throughout the country. The fungus causing it may be found on the canes, leaves and fruit, although by far more commonly on the fruit. It causes the formation of grayish spots which are bordered with a purplish or reddish ring. It is difficult to control, although those vineyards which are thoroughly sprayed for black rot contain but little of the anthracnose.

Black Rot. The berries are most severely affected by this fungus, although the leaves are first attacked. On the berries a circular black spot first appears, gradually enlarging, and in the center of which small black pustules appear, from which the spores of the fungus are liberated It usually attacks the berries at about the time they are two-thirds grown and will destroy the entire crop before ripening time unless preventive measures are taken.

The most effective treatment consists in spraying the vines with bordeaux mixture at the time the buds are beginning to open, and then another application immediately after the new shoots appear, but before the flowers open. After blooming, the vines should have an application of bordeaux every two weeks until five or six applications have been made. If the disease appears at about the time the fruit is beginning to ripen, ammoniacal copper carbonate will be a better spray to use, as it will not soil the appearance of the fruit.

Downy Mildew. This disease is widely spread throughout all of the grape producing sections of America and Europe. The first indication of the disease is the formation of yellowish spots of irregular shape and size on the upper surface of the leaf. On the under surface these spots will be covered with a white downy growth on which the spores of the fungus are produced. The fungus attacks

the berries when young, causing a mouldy growth to cover the entire fruit and even an entire bunch of fruit.

This fungus is of distinct historic importance, since it was the disease which was introduced into Europe and which later led to the discovery of bordeaux mixture. This spray, applied before the buds open, and again at intervals of two weeks until the flowers open, then another application immediately after the flowers fall, will hold the disease under control.

Powdery Mildew. In moist seasons, and in low ground, this fungus frequently causes trouble by its attacks upon the foliage, and to a small extent the berries of the grape. It appears as a powdery, mouldy growth on both the upper and under surface of the leaves, causing them to arch more or less when the disease is very bad. It can be controlled by any of the usual spraying operations.

Peach Diseases

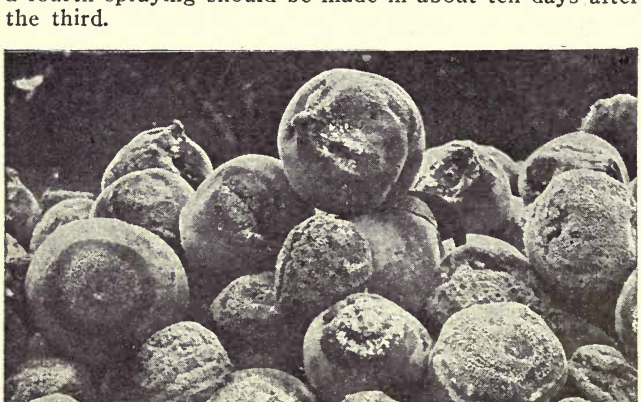
Peach Blight

This disease occurs at the present time in the Western states, where it has become quite common from Colorado westward to the Pacific coast.

The disease makes its first appearance in the fall and during the winter, in which the buds are killed and growth consequently prevented for the next spring. It attacks the fruit early in the season, on which it produces small circular spots, some of which may be covered with a drop of gum. On the twigs it produces spots, which may be more or less gummy, and some of which may encircle the twig, causing it to die.

It attacks both the peach and the apricot, and causes a greater loss to the Western fruit men than any other one fungous disease. It can be very easily controlled with either bordeaux mixture or lime-sulphur. Fall applications are most effective and should be made as soon after the late fruit is gathered as possible. If San Jose scale it pres-

ent, lime-sulphur—1 to 10 or 12—should be used, otherwise bordeaux will be best. A second application should be made in the spring at about the first of May and a third application in about three weeks, and if the disease is especially troublesome, or if the weather should be rainy, a fourth spraying should be made in about ten days after the third.



Brown rot, altogether too familiar to most peach growers.

Brown Rot

This disease is capable of the most extensive damage to the peach crop in the states east of the Rocky Mountains, since it attacks the fruit at ripening time, causing it to rot within a very few hours. It attacks all kinds of stone fruits, but causes the greatest amount of loss to peaches and plums. The disease makes itself evident by the small dark brown decayed spots, which rapidly enlarge and produce on its surface small tufts of brown spores. It may attack the flowers, twigs and leaves, but usually confines its operations to the fruit.

The spread of the disease is materially assisted by the plum curculio, which punctures the skin of the fruit and admits the fungus spores. Until recently this disease has been controlled only with difficulty, but investigations of the past three years demonstrate that by spraying with self-boiled lime-sulphur containing 2 pounds of lead arsenate to 50 gallons of the mixture, the disease can be held well in check. This spray should be applied about three times, first application at just about the time the "shucks" are falling from the newly set fruit; two other applications may be needed at intervals of about two weeks. It is important that the arsenate of lead be added, as it holds the curculio in check and seems also to add to the fungicidal value of the lime-sulphur.

Frosty Mildew

This disease causes a mouldy appearance on the under surface of the foliage of the peach. It is most common in the Atlantic Coast States, but is not a serious trouble and can be controlled by early spraying.

Leaf Curl

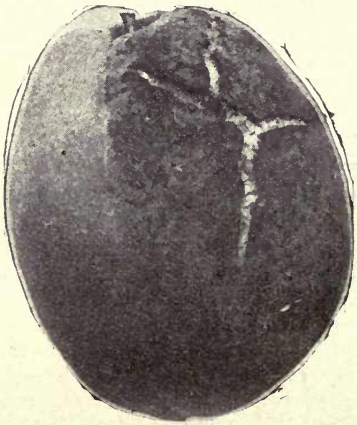
Leaf curl is a disease which is more or less common in all sections where peaches are grown. It is most troublesome in spring when the weather is cold and damp. It is due to a fungus which causes the leaves to curl and become badly deformed, finally dropping from the tree. The twigs and even the flowers may be attacked. Thorough spraying with bordeaux mixture in late winter or early spring, just before growth begins, will keep this disease in perfect control.

Peach Scab

This disease is widespread throughout the peach producing areas of the eastern portion of the country, where it occurs to a damaging extent on practically all varieties of peaches, and particularly those with white flesh. Its commonest appearance is a black velvety patch on one side of the peach, or it may occur in many small circular

patches, in which condition it is often known as "freckles." When very severe it will cause the fruit to be somewhat dwarfed in size, and make the flesh crack open, thereby exposing it to attacks of black rot.

It usually occurs along in the same orchards with brown rot, and has always been a troublesome disease to control, although it is well known now that it can be kept in perfect control by spraying during the summer season with self-boiled lime-sulphur. This material should be made and applied in the same manner as for the control of brown rot. In orchards that are sprayed for brown rot there will be but little trouble from scab.



A well developed case of peach scab. The skin cracked open, exposing the flesh to infection of brown rot.

Pear

Blight

This disease is very widespread in the United States, occurring in every pear growing section, and has practical-

ly driven the commercial production of pears out of a number of localities. It attacks not only the pear, but also the apple, quince, wild crabs and thorns, and has even been

Branch of pear infected with blight through the flower clusters.

known to attack the plum. It is known by a variety of names, such as twig blight, fire blight, blossom blight, etc. It is a bacterial disease, the organisms working entirely within the host, where it cannot be reached by any spray or wash that may be applied.

Body of pear tree infected with blight through the careless removal of a limb. Pruning tools should be sterilized, likewise the wounds, and then covered with paint, wax or tanglefoot.

The disease usually appears on trees at just the time they are in bloom, as the organisms causing the disease are carried from tree to tree by the bees and other insects which visit the flowers. They may also be transported by numerous kinds of leaf feeding insects and thus be carried to the twigs of many trees which are not in bloom. When

the leaves and blossoms are attacked by this blight they are turned a very dark or even black color very quickly. Where the disease has advanced far enough as to attack the limbs or even the trunks of the trees, it causes a water soaked appearance of the wood and bark, followed by shrinking and cracking of the bark from which drops of a sticky substance may exude. These drops are masses of the germs and may be carried by insects to other trees and the disease extended.

For many years after the cause of this trouble was known it was believed that it was impossible to stop it after it had once gained entrance to the tree. However, it has been found out that the disease can be kept in perfect control by pruning. It is highly important that the orchard be gone over several times during the winter and every twig and branch that shows signs of this disease be carefully cut out, the cut being made fully a foot, or in some instances more below the lowest sign of the disease. The wounds should then be sterilized with corrosive sublimate, and the tools also sterilized with the same fluid before touching them to any other branch. The germs can be carried on the pruning tools, and unless thorough sterilization is practiced, the pruning may result in more damage than good. The orchard should be gone over several times during the winter and a thorough search made for any sign of this disease.

Summer pruning may also be done to advantage, but will require even more care about sterilization of the wounds and tools, as the germs are then in their most active and virulent condition.

Plum Pockets

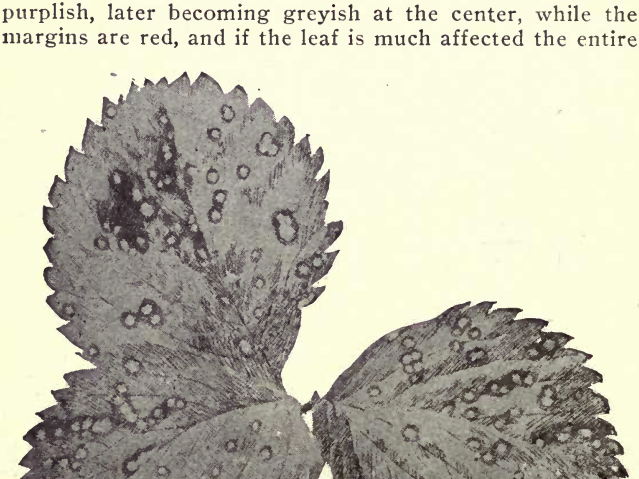
This fungus bears a very close relation to that causing leaf curl. It attacks the fruit of the domestic plums, causing abnormal deformities of the fruit, making them really become large bladder-like structures, in which the stone is rarely developed. It has been claimed that the fungus lives from year to year in the twigs of the trees, so that when once affected it cannot be very easily gotten rid of. However, this fact has not been entirely proven,

as trees which are well sprayed with fungicides, as for brown rot or black knot, are not attacked by the pocket fungus, or if they are, to only a slight and insignificant extent.

Strawberries

Strawberry Leaf Spot

This disease appears upon the leaves of the strawberry at about the time of flowering. At first these spots are purplish, later becoming greyish at the center, while the margins are red, and if the leaf is much affected the entire



Characteristic appearance of strawberry leaf spot.

leaf may become reddened. Control of this disease can be had by spraying the plants before flowering with bordeaux, and if the disease is troublesome later in the season it may be advisable to cut off the leaves and burn them.

CHAPTER VII

Principles of Pruning

Pruning is one of the most interesting and fascinating operations connected with horticultural work. A plant is a plastic, responding, changing organism which is affected by everything we do to it. We cannot remove a single branch without affecting the parts which remain. The shortening of any limb modifies to a greater or less extent the character which will be assumed by the parts which remain. A plant is capable of being shaped or moulded by pruning, and he who prunes will surely get results. However, as to whether these results are what are to be most desired will have to be learned by experience. One must prune and watch the results over a series of years to learn just what effects any particular treatment will give, as the plant grows.

Pruning cannot be learned from books. It must be learned by studying the habits of plants and the results of pruning. Books on pruning can, however, give one ideas which will enable one more readily to learn how to prune when he comes to do the work. The reading will be helpful only as it guides the operations in the field, and the horticulturist himself must learn directly from the plants themselves.

It is an easy matter to learn how to prune where one has the plants to work upon, and the time to watch their responses to the operations made upon them; but it is a difficult matter to tell others how to prune. No two plants

are alike. No two branches are alike. No definite rules can be formulated which will apply to every kind of plant in every locality in which it may be growing. It is a comparatively simple matter to prescribe formulae for the spraying of plants to govern the destruction of insects and control the damages done by fungi. With pruning, however, only systems can be defined which are broad enough to permit of wide modification according to the ideal and desire of the pruner and the habit and character of the plant. This means that the operation must be done in a rational, common sense way, rather than by following prescribed rules.

Since rules cannot be formulated for the pruning of plants, there are certain systems which can be designed that will enable the pruner to so modify his plants that they will all conform to certain well defined types. In grape pruning, for example, there are certain well defined types or systems in use, such as the spur system, the drooping system and the upright system, with several modifications or combinations of these. In ornamental plants there are natural forms and topiary forms which are made by training the plants into formal or fantastic shapes. In European countries fruit trees are trained into formal shapes, and they are a striking contrast to the shapes of pruning that are used in this country. Some of these differences are due primarily to a matter of taste, while others are employed to suit a certain definite purpose, or to adapt the plant to given surroundings or environment.

In the United States there is a great amount of difference in the style of pruning in the Atlantic coast states and in the Central and far Western states. In the Atlantic coast states the trees are given a high head, while in the Central and far Western states the head is placed closer to the ground. In the Eastern states the trees are trained with a more open head than in the Central or Western states. These styles are due mainly to an attempt to adapt the tree to the climatic conditions in which it is compelled to grow. In the rainy atmosphere of the coast region it is necessary to prune the trees with a high open head so as

to admit the sunlight and air, while in the brilliant sunlight and clear dry air of the West it is advisable to have the trees with a more dense head to prevent the tendency to sun-scald.

While there is more or less of difference in the style or system of pruning used in different sections of the country, there are certain well defined principles which will apply to all plants in any climate, or under any system of pruning. Pruning will modify the vigor of plants, and in some ways will cause them to produce larger and better fruits. It will keep the plants within bounds and may change the habit from wood producing to fruit producing. Pruning allows the removal of superfluous parts and of injured branches or roots. Intelligent pruning will facilitate the operations of spraying, harvesting and cultivating the orchard, and will enable the operator to train the plant in the form most fitting with his ideal.

In a plant growing normally there is a balance in the relation between the root and top, each supported and nourished by the other; and when either is mutilated the relation is upset and the balance disturbed. Heavy pruning of the top in the dormant season tends to increase the amount of wood growth that will be made the following season. In a contrary way, heavy pruning of the roots will result in reducing the amount of wood growth by shutting off the amount of crude food material that is gathered from the soil. Heavy pruning of the top, on the other hand, tends to develop weak portions of the plant by allowing those parts to receive more food. In heavy pruning it is always advisable to remove the weakest parts, as they are usually unable to thrive, even under better conditions. But since heavy pruning stimulates the production of wood, suckers will be formed, some of which may take the place of the weak parts, and develop into strong branches, restoring the plant to its normal shape and habit. The most rational system allows the plant to take its natural form, and this is especially the case with our fruit producing trees. This will vary somewhat with the age of a plant, as when trees are young they tend to a more up-

right habit than after they reach maturity and have produced several heavy crops of fruit.

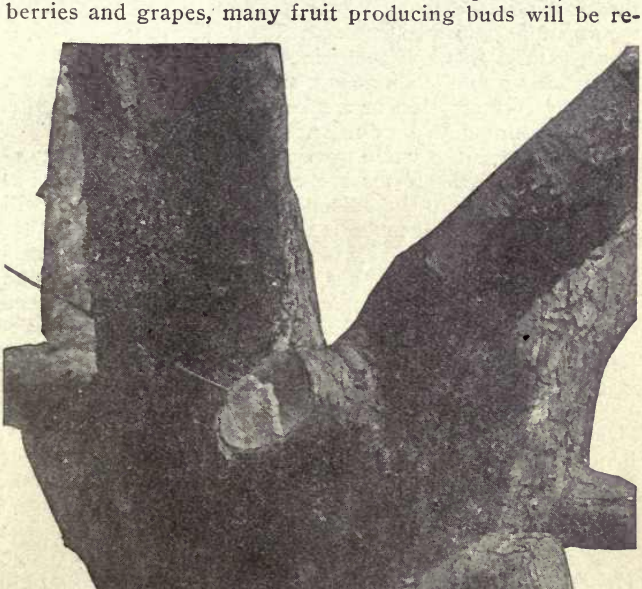
One part of a plant may live at the expense of another part. Very vigorous shoots will outgrow surrounding branches because they are better supplied with the crude food material collected by the root and appropriate the elaborated food formed in the leaves of their slower growing neighbors. In trees which have just been grafted the suckers which are formed below the graft will outgrow the branches which arise in the scion, and will outgrow the scion, and cause the starvation and death of the latter. The scion is, in a way, a parasite upon the branch, and the plant tends to throw it off.

The tendency of plants, and young plants especially, is to grow from the uppermost buds. By heading-in this tendency is overcome, and the plants stimulated into developing lateral buds. An obstruction just above a branch or bud tends to produce strong longitudinal growth in that particular branch, while an obstruction below a bud stops the downward flow of sap and causes a thickening of the parts above. This is often resorted to in the manner of notching or girdling for the purpose of causing the formation of fruit buds or the enlargement of particular specimens of fruit. But these factors are associated with modes of training rather than pruning proper.

When plants are making an excessive amount of wood growth they do not make fruit buds. Checking the growth of the top by pinching or summer pruning will tend to produce fruitfulness.

And while fruit bearing may be to a large extent governed by the methods of pruning, the habitual production of fruit is better regulated by small amounts of pruning regularly done, than by heavy pruning at infrequent intervals. In the case of old trees which have been neglected, it may take two or three years after severe pruning before the balance between top and roots can reach an equilibrium and the tree become fruitful. Light pruning every year is much better for the trees than heavy pruning done occasionally.

Pruning may be made a means of thinning the fruit by removing the fruit producing wood. In the case of plants which produce their fruit on the long growths of the season before, as in peaches, quinces, raspberries, blackberries and grapes, many fruit producing buds will be re-



Limbs cut off so as to leave long stubs like this will never heal. The stubs will rot and finally result in a hollow tree.

moved with each branch that is pruned off. In the case of trees that tend to an alternation in the years of fruitfulness, as in apples and pears, the tendency to alternation may be somewhat overcome through pruning.

Summer Pruning

All of the factors of pruning which have been mentioned are governed largely by the time of year at which the pruning is done. Winter pruning tends to produce wood, while summer pruning tends to fruitfulness. Summer pruning, through the removal of the leaves, reduces the working and elaborating surface, and a consequent tendency to starvation or weakening of the plant. If this summer pruning is done in such a manner, and at such a time as to stop the wood growth in the plant, it will generally promote the formation of numerous fruit buds, but if done too early in the season the growth of the tree will be upset, and it will make a second and late growth that summer. If done too late, after the tree has stopped making wood growth for that summer, it will have much the same effect as winter pruning. Summer pruning is more often done by pinching the tips from shoots that are making an excessive growth rather than by cutting out any large amount of wood.

The climate in which a tree is growing determines to a large extent what the manner of pruning shall be and when it need be done. In the colder parts of the country winter pruning, that is, cutting off large limbs during mid-winter, allows such a large amount of moisture to evaporate from the wood that the bark may be damaged for some distance around each wound from the effects of drying out. Under such circumstances the pruning is best done late in the spring, so that the wounds can be closed over most quickly. In the hot, dry sections of the country there may be a considerable amount of sun-scalding following severe pruning, and has given rise to the statements in the Central Western states that the trees should not be pruned. This, however, needs to be considered carefully, for, while it is true that in the states of bright sunshine and dry air the fruit will color up well even in trees with dense foliage, the trees will become more or less misshapen unless pruned. Under such conditions the pruning needs to be followed just as regularly as in the humid air of the coast states, but needs be done less severely.

In the Rocky Mountain region, where the rainfall is often less than eighteen inches annually, the trees have barely enough moisture to maintain themselves, and they have the habit of early fruiting. Cherry trees often produce a heavy crop at five years from the bud. Throughout all this region fruit trees have such a tendency to overbear that the system of pruning needs to be heavy every winter. On the western side of the Cascade Mountains, where the air is thick with humidity most of the year, the trees make an excessive amount of wood growth and grow so late into the fall that they are many times not sufficiently matured and suffer more or less from winter killing. Under such conditions the pruning should be done so as to prevent excessive wood growth, such as a generous amount of summer pruning. It frequently happens in the irrigated sections that where the trees are heavily watered, they will make unusually long shoots each season and set few fruit buds. This trouble can oftentimes be corrected without resorting to special pruning. By simply reducing the amount of water that is supplied to the trees, the vigorous wood growth can be stopped and the trees made to produce fruit buds.

In fact the styles of pruning that must be adopted by the irrigation fruit grower must of necessity be governed by local conditions, and will be to a greater or less extent different from that in use in the rainy districts.

The direction in which any given branch will grow will be governed by the position of the bud. In cutting off a branch it should be done just over a bud or branch that is on the side of the limb and pointing in the direction which the new limb is to take. With young trees especially the selection of a bud pointing in the direction the new limb is to take will enable the pruner to quickly and easily get the tree into the most desirable shape.

Healing of Wounds

The healing of large wounds is influenced by the position of the wound on the plant, the length of the stump,

the kind of plant and its vigor, the smoothness of the surface of the wound and the season at which it is made. Theoretically the best time to make a large wound is in the early part of the growing season, as at that time it can begin to heal over without delay. Such wounds should be made by making two cuts, the first one being made

In removing large branches, cut them close to the main limbs. the wounds will then heal quickly.

a foot or so from the junction of the branch to be removed with the limb to which it is attached. This will remove the strain of the heavy top and prevent the bark from peeling down on the limb that is to remain. After the weight of the branch has been removed, cut off the stump as nearly parallel with the main limb as possible and close up to it, so as to leave no stub whatever. The

callus which will close over the wound cannot extend out on a stub, but will quickly close over a wound that is smoothly cut and parallel with the limb.

On large wounds the wood should be coated with some waterproof covering, such as white lead paint, grafting wax or tanglefoot. This dressing is not for the purpose of hastening the healing, as it will not do so, but it will close up the pores of the wood against the entry of water and fungi that cause the wood to rot.

Pruning the Apple

The work of pruning should start at the time the tree is planted in the orchard. This is a critical time in the life of the tree and neglect of pruning at that time influences the tree during its remaining years.

It needs to be borne in mind that there is a physiological reason for this early pruning, although it is frequently neglected or overlooked by the planter, who may later wonder why his trees died or made such a weak growth. The roots serve the tree to collect water and mineral elements from the soil, which is carried through the sap wood to the leaves, and there elaborated and made over into the form in which it can be used by the tree in extending its branches and developing its fruit.

When the tree is dug from the nursery most of its root system is left in the soil, and unless the top is reduced in proportion it will constitute too great a drain upon the small root system. This results in weakening the tree, frequently extending over a period of three years or more. It may even result in the death of the tree through its having used up all of the food material that is stored in the cells of its body before the roots can draw sufficient from the soil to supply the needs of the developing branches.

In preparing new trees for planting, all of the bruised and broken roots need to be cut off smoothly so as to leave no ragged ends. All of the main roots should be shortened in to six inches or less, with a proportionate reduction of the top.

In the Western states yearling trees are mostly used for planting and when such is the case the top consists of nothing more than a single whip. This is cut off to within twelve to twenty inches of the ground, depending on how tall it was before pruning. In the case of two-year-old trees, there will have been formed three or more side branches, each of which will be a foot or more long, and all of which need to be shortened in about one-half at the time the tree is planted.

The shape of the future tree is determined to some extent by the shape given to the tree during its first year, and more especially the height of the head above the ground. In the Western states the orchardists prefer a tree with a low head, while in the East the trees are generally allowed to make a high head. Where one-year-old trees are used there will be no side branches at the time the tree is set, and all of its branches will have to form during the first summer in the premanent plantation. This gives the orchard man an opportunity to place the head just where it is desired, but when the head has been formed in the nursery it frequently happens that it is far too high above the ground.

In selecting the branches to form the permanent head, from three to five should be taken that are well distributed around the stem of the tree, and at some distance apart up and down the trunk. Where the branches all come out at about the same height it will result in a head that is easily split when the tree is loaded with fruit, and unless the branches are well distributed around the tree it will make the tree more or less one-sided.

In removing the limbs of a young tree make the cuts slanting and just above a bud, leaving a stub not more than an eighth or quarter of an inch long. A stub of this length will not be so long as to decay before it can be healed over, and it is not so close to the bud as to cause injury through drying out. Heavy winter pruning should be the practice with apple trees during the first four or five years in order to stimulate them into making a strong growth and building up a large frame-

work for the future fruiting surface. In those regions where excessive wood growth is a normal or usual condition the winter pruning will not need to be as heavy as where the rainfall is light and trees do not make as vigorous growth without stimulation.

When planting one-year-old apple trees there is little likelihood of getting trees that are forked, but in older stock some of the trees will be forked, with the two leaders of nearly the same size. If trees of that sort are planted they will usually result in one of the limbs being split off when it is loaded with fruit. In planting forked trees the possibility of future breaking down of one side can be entirely done away with by cutting back one of the branches of the fork to a strong bud near the base, or by cutting the limb out entirely. In pruning off the other limbs, cut them back to a bud that points in the direction it is desired the new limb shall take.

The Second Year

During the first year in the orchard there is little pruning necessary aside from the shortening in of the tree at the time it is planted, but beginning with the second year some definite system needs to be adopted and followed out. In this respect there are two general systems or shapes for the commercial apple trees, one of them being the pyramidal and the other vase. The pyramidal tree means one in which the central branch or branches have not been removed, and which of necessity makes a tree that soon becomes very tall, and unless carefully tended and pruned in later years will carry the greatest portion of its crop high above the ground. To shape trees after this fashion, the main central branch of the young tree should be allowed to grow; the only pruning that should ever be given it being just enough to shorten it somewhat each year, and thin cut the side branches upon it so as to keep them well distributed.

The vase shaped tree seems to be of Western origin, and requires a low head. This shape may be better called

the "open center" tree, as it means a tree in which the central branches have been removed and the lateral branches so trained as to leave the center of the tree open to sunlight and air. It is a style of training that produces a larger percentage of highly colored fruit than is possible with pyramidal trees in the hands of the average man.

Well arranged branches in the head of an open-top apple tree. Trunk protected from rabbits by a wooden veneer wrapper.

This vase shape must be started at the begining of the second year in the orchard by cutting out the central leader in the little trees, allowing nothing to remain but from

three to five side branches that are distributed some inches apart up and down the stem of the tree. Unless these branches are distributed several inches apart they are liable to make a fork that will be easily split, and as this style of pruning makes trees that are more or less weak in the fork, all possible care needs to be observed in getting the crown as strong as possible.

Subsequent pruning will be for the purpose of maintaining the shape of the tree, thinning the fruiting wood, promoting wood growth, promoting fruitfulness, removing unnecessary or injured parts and facilitating harvesting and spraying.

No formal rules can be laid down as to how an apple tree should be pruned after it has passed its second year in the orchard, as it depends to a large extent upon the variety, the locality, the age and climate. It needs to be borne in mind, however, that summer pruning tends to fruitfulness, while winter pruning tends to the production of wood growth, and in the Western states where trees have the tendency to overbear, winter pruning is by far more important than summer pruning.

The tops of the trees need to be pruned every year. If it is not done they soon become a mass of tangled branches, many of which are long and slender, and when heavily laden with fruit are easily broken down. When cutting off a branch or twig, make the cut close to a lateral branch, so as to not leave a stub. The sap in passing up the branch will be directed into the lateral, and in its downward course it will close over the wound made close to a lateral branch, whereas if a stub is left the healing callus cannot close over it.

Pruning the Peach

The peach is a fruit that responds very quickly to the amount of pruning done upon the trees, and in a commercial orchard pruning is one of the most important operations. Thorough pruning tends toward regular fruitfulness. It influences the size of the crop, and the size of the fruit,

as well as the period of starting into growth in the spring, the color of the fruit, time of ripening and longevity of the tree.

Unlike the apple, the peach produces its fruit upon wood produced during the preceding summer, and since the tendency is to excessive wood growth, unless the trees are regularly pruned, they soon become long branched and high topped, and make it difficult to harvest the fruit.

The foundation of a good framework in a peach tree lays entirely in the proper arrangement of the limbs during the first year in the orchard. This tree has its limbs well arranged.

One-year-old trees direct from the nursery are most desired for orchard planting and will consist of a single long straight whip with many side branches. These side branches should be cut back so as to leave but one bud at their base, and the main stem cut off, leaving from three to five side branches. These should be so selected that they

are well distributed around the tree. This is for the purpose of making a strong fork at the head. It is always desirable to get these main limbs to come out as near to the surface of the soil as possible, at most not over a

Three branches at the head, each dividing into two, making a wide spreading tree of ideal shape.

foot from the soil for the lowest limb. This will give the tree a low head and facilitate all of the operations in connection with the subsequent orchard.

The tendency of the peach is to make a large amount of wood growth each year, and it is nothing uncommon to

see trees that have made branches six and seven feet long in a single summer. Such limbs generally continue growing until so late in the summer that they are not properly

The average type of round top found in the peach trees of the Middle West. The head is too high above the ground.

matured by autumn and go into winter in a soft and sappy condition and are easily winter injured. Excessive wood

growth is not desired, but a good vigorous amount is to be encouraged at all times.

The style of pruning that is most approved of for peaches is that which will allow of an open head. This will permit the sunlight to penetrate down into the center of the head and cause the branches to set more fruit buds and to reduce the amount of rot in the fruit. Trees so pruned will usually make a large number of small twigs on the bases of the larger branches and increase the number of buds on the tree. These small branches are usually the most hardy, and carry through the winter in better shape.

Pruning in peaches is not done as a rule until rather late in winter or early in spring, for the reason that it is best to wait until it can be determined with some certainty whether there will be a crop of fruit that season or not. If the fruit should have all been killed by a severe winter or a late freeze, then the pruning will have to be done differently than if there is good prospects for a full crop. Where the fruit has not been damaged by the cold weather, then the amount of wood to remove will be only about half of the longest branches, cutting in all cases so as to maintain the shape of the tree and to keep the center open. Any large limbs that have a tendency to crowd up the center of the tree should be either cut out entirely or so shortened back that they will not shut out the sunlight from the middle.

When the fruit has all been killed by the severity of the weather, advantage can be taken of the circumstance to cut back more or less severely and renew the top of the tree. This will have the advantage of lowering the top and reshaping the tree. It is a method that has its limitations, but is very useful where the fruit buds have all been killed.

In cases where the injury from the winter has damaged the wood of the tree to such an extent that it has a brown color, it is advisable to head-back the tree, cutting oftentimes into wood that may be as much as four years old. This will so reduce the size of the top that the roots can

force out a large amount of new wood, and trees so treated will make a very vigorous growth during the summer following, although they may be somewhat late in starting. On such wood the growing period will usually be continued late into the fall, and the wood will not always be well matured by the time cold weather arrives, and under such conditions the buds will not be as hardy as the buds on slower growing and well matured

The head of this tree is too high above the ground. It is pruned so as to open it, and let the sunlight down into the center.

trees. But these buds have an advantage in that they are slower in starting into growth in the spring and oftentimes will escape late frosts that might otherwise damage the fruit. The hardiest buds are always at the base of the new wood, and especially of the well matured, plump wood on the slower growing branches.

Aside from determining the shape of the tree pruning has

another influence in that it results in a thinning of the fruit by removing some of the fruit buds. The peach always sets many times more buds than it can possibly mature into fruit, and there is a distinct necessity for the removal of some of the fruit by thinning. When this thinning can be done through the removal of the wood it is a saving of labor, and results in fruit of a larger size, better shape and higher color.

Peach tree with open top. Head starts near the ground, enabling pickers to reach most of the fruit without the use of ladders.

Pruning the Cherry

With cherry trees, both sweet and sour, most of the pruning the trees will need must be done during the first three or four years. This is necessary for the purpose of providing a large framework to furnish the fruiting wood in future years. In both kinds of cherries this framework needs to be made as broad as possible. Sweet cherries are inclined to be more upright in habit than sour va-

rieties, and will need to be opened out more by cutting to buds on the outer sides of the limbs. With sour kinds the trees will need little pruning after the third or fourth year. All that may be needed will be to cut out branches which cross or which are dead.

With sweet cherries there is a tendency to an excessive amount of wood growth, and it is not unusual for such kinds of trees to produce five feet of new wood in a season. This is especially true of young trees. For planting in the orchard one-year-old trees are most desirable, and they are cut off at about 24 to 36 inches of the ground. A number of side branches will be sent out, and only four or five of these should be retained, providing that many can be had properly distributed around the stem and widely separated from each other. Unless the branches forming the head of a cherry tree are well distributed it will result in a tree that is subject to gummosis. Sweet cherries are especially subject to this trouble and every care needs to be exercised to prevent it. Where the branches of the head come out too close together cracking and splitting will result, not only making them subject to gummosis, but possibly causing them to break off.

In case the sweet cherries are injured by the winter cold, let them stand unpruned until about time the buds start, then prune in the same manner as for peach trees which have been frozen.

The Bing cherry is especially liable to grow late in the summer and go into winter carrying its leaves, and possibly not having formed its terminal bud before frost. The cambium layer will be so soft and tender that it will be completely killed, yet the tree will start into growth only to die early in the summer. Do not permit the trees to grow late, but harden them up by a judicious amount of summer pruning, so that they will shed their leaves early. In the irrigated sections late growth is often caused by irrigating too late in the summer. Under irrigation it is quite easy to regulate the amount of wood that will be produced on trees by regulating the supply of water. Late applications will make the trees grow late, but by shutting

it off early the trees will stop growing and ripen their wood before the arrival of cold weather.

Pruning the Apricot

In the East the apricot is headed at a couple or three feet from the ground, while in the West the head is placed a little lower. One or two-year-old trees are the best for planting. Where yearling trees are used they should be cut off at about eighteen inches from the ground. This will start out several good strong branches. The lowest one to be retained should be about a foot from the ground, and three or four others selected which are well arranged around the stem, and at a distance of a few inches apart. This arrangement will make a strong head, and one which is not as apt to be broken down under a load of fruit as if the branches came out close together. It may be necessary to go over the trees a few times during the first summer and pinch out those shoots which are not desired so as to throw the strength of the plant into those branches that are to form the permanent framework of the tree.

Apricots come into bearing early, and by the third year in most places they will produce a crop. All of the pruning that will be needed after the trees come into bearing will be just enough to keep the tree in shape and growing thriftily.

Pruning the Pear

The habit of the pear tree is usually more upright and compact than with most varieties of apples. On account of this habit it needs to be pruned in such manner as to open the head and make it spread out. This can be done by starting the work early in the life of the tree, and prune in such way as to direct the new branch outward rather than upward. Select a bud that points in the desired direction and cut to it.

One or two-year-old pear trees are most desired for planting and they will have much the same appearance

and shape as have apples of the same age. The pruning at planting time is done in the same way as for apples. Start the head low and if the trees make a very strong growth during the first summer cut back some of the limbs that are the strongest, cutting to an outer bud always, so as to open out the head. The fruiting habit of the pear is quite the same as with apples and just here precaution needs to be taken in selecting the fruiting wood. The pear is very subject to attacks of the destructive bacillus causing "fire blight" and as this disease enters the trees most readily through the blossoms great precautions are needed to keep the fruit spurs clipped off the main branches.

These spurs will begin to form at from three to five years in most varieties of pears. During the first four or five years prune hard so as to encourage wood growth, but after the fifth year in the Central and Western states, and the seventh and eighth year in the East, where pears do not come into bearing so early, all of the winter pruning should be reduced or stopped, and more summer pruning done. This is necessary for the purpose of making the pear tree produce a hard wood which is resistant to fire blight. The best time to do this summer pruning is in August in the middle and northern sections of the country and later in the South, where late growth is made. By pruning late in the summer the trees will have made a good amount of wood, but the shock of pruning will take some weeks to overcome, and by that time the climatic conditions are such as normally stop wood formation in the tree. If the summer pruning is done too early the trees may be able to start into growth a second time and continue growing so late as to go into the winter with soft wood that is easily injured by the cold.

Pruning Brambles

Brambles are blackberries, raspberries and dewberries, and these constitute a group of plants that produce their fruit on the wood that grew the preceding year, and which

after having produced one crop of fruit dies. The pruning of these fruits consists in removing the old canes after they have ripened their crop and in heading back the young canes during the early growing period so as to make them branch out and increase their fruiting surface. The winter pruning consists in shortening in the laterals that were formed after the canes were pinched back during the summer.

With blackberries in all of the country east of the Cascade Mountains to the Atlantic Coast, the canes are headed back by pinching out a couple of inches of the tips after reaching a height of a couple of feet. This will make the canes throw out strong lateral branches that become the fruiting wood for the next year. In the winter these side branches are to be shortened in, and the amount of cutting that may be necessary will vary with the variety. Some kinds like Wilson produce their fruit mostly close to the cane, and consequently the branches can be shortened in quite close, but with kinds like the Snyder and Early Harvest, the fruiting portion is near the ends of the branches, and consequently not so much may be removed. It is always well to remove plenty of the wood in order to thin the fruit.

Blackberry bushes that are shaped in this manner and where the canes were pinched early, will be strong enough to stand alone, but in case of tall growing varieties like the Snyder it may be best to stretch a wire along both sides of the row to keep the canes from bending over when loaded with fruit.

Many experienced growers of blackberries prefer to train the canes on a trellis of some sort. In New York state, and some parts of the East, a two-wire trellis is arranged with the wires a couple of feet apart, and fastened to a strong post at the ends of the rows. The young canes are pinched just a little above the upper wire and tied to that wire until after the fruit has ripened. This will keep them out of the way of the fruit-producing canes, which are tied to the lower wire.

The canes may remain tied to the wires all winter, or

if winter killing is liable to happen, they may be laid down and covered. When they are lifted up they are tied to the lower wires and the upper wire left for the new canes as they appear. Where only a few hills are grown, as for home use, it is always best to tie them to single stakes. The only objection to this proceeding is that it is liable to bunch the canes too much and cause more or less loss from spotting of the leaves. Not more than three canes should be allowed in a hill, where tied to stakes, and only five or six in a hill where arranged on a trellis.

In the Northwest a two-wire trellis is used for blackberries, but the wires are placed at the same level, attached to a strong cross bar firmly nailed to the posts. If the rows are long, posts are set at intervals of twenty-five feet in the row. A double wire is run down each side of the cross arms, and the fruit producing canes are placed between these wires before growth begins in the spring. The canes are thus held firmly from bending over under their weight of fruit, and are out where the fruit can be most easily picked. The space between the wires is open and for the exclusive use of the new canes. As soon as the fruit is harvested the canes which have produced a crop of fruit are cut out, and any new canes over five in each hill. The most experienced growers prefer to have only five canes in a hill, and all others are removed as fast as they appear after the fruit is harvested.

The Evergreen and Loganberry need to be grown on trellis, as they make from twenty to forty feet of cane a season, and it is out of the question to handle them on the ground. When on trellises, the wires are arranged at levels of two and four feet, with the fruit bearing canes on the upper wires and the young canes on the lower. This keeps the canes where they can be reached, and as these kinds of berries have such villainous thorns, they must be trained so that they can be handled with the least amount of punishment from the thorns. As soon as the fruiting is over, the old canes are cut away and the young canes are placed on the upper trellis where they will receive the full sunlight and air.

Black raspberries, or back-caps as they are sometimes called, are pruned quite like the blackberry. The new canes are pinched at a couple of feet from the ground to make them branch out, and these laterals are cut back about half in late winter or before growth begins in the

Dewberry canes trained to a post. From three to five canes in a hill.

spring. Black-caps should be tied up to a trellis where the variety grows very vigorously and is liable to fall down under a load of fruit.

Red raspberries are pruned and trained in the same manner as black raspberries, except that it is not necessary to pinch the canes in the summer.

Dewberries are sometimes trained on stakes or trellises, as they make a great amount of wood and very long canes. A common method of handling dewberries is to grow them in hills fifteen feet apart. Let the canes remain on the ground without a trellis. Just as soon as the crop has all been harvested mow all of the canes off close to the ground, gather them up and haul out of the field. New ones will quickly appear and make a good growth during the remainder of the summer and be in good shape to produce a crop of fruit the next spring. This is rather vigorous treatment but it serves as a quick and easy means of getting rid of the tangle of old canes, which, unless removed will so choke up the hills in a few years that the plants are worthless. Growers who practice this method of pruning feel that the plantation will be short lived either way, and that it is an advantage to have the fields clean and free from dead wood rather than choked up with weeds and old canes.

CHAPTER VIII

Profits in Fruit Growing

There is such a gradually increasing amount of interest in the matter of fruit growing that thousands of persons are each year leaving their jobs in the offices, school rooms, shops and stores to undertake fruit growing for a livelihood. Some of them succeed in making a living, some make a failure and return to their former occupations, while others become wealthy. Many extravagant statements have been made by enthusiastic promoters of some certain sections concerning the unbelievable profits that it is possible to make from given areas of their land. In many instances these profits are purely visionary, while in many others they are entirely reliable.

From reliable data which has been collected in several states, it is apparent that sums ranging from $1,000 to $3,000 per year can be obtained from an acre of land under some conditions. Usually these conditions are beyond the reach of the amateur, and have been obtained by expert horticulturists, who have been several years in developing their product and their market. But it is also possible in many cases for inexperienced persons to make excellent incomes from fruit plantations, and it does not matter what state or section of the country one goes to, splendid returns can be obtained. There is this one fact to be learned from the data collected, and that is that some sections of the country are more favorable for the inexperienced to obtain large returns. These sections are generally in those regions where there is an abundance of fer-

Additional income from the orchard may be obtained by growing crops of beans, cabbage, onions, potatoes, small fruits or other produce between the trees.

tile, virgin soil, where the climate is mild and where the fruit or vegetable industry is more or less well developed. This is particularly true of the far Western and Southern states. It seems that where a number of persons in one locality are engaged in the same line of business there is a stronger spirit of optimism and mutual assistance, which work greatly to the advantage of the grower.

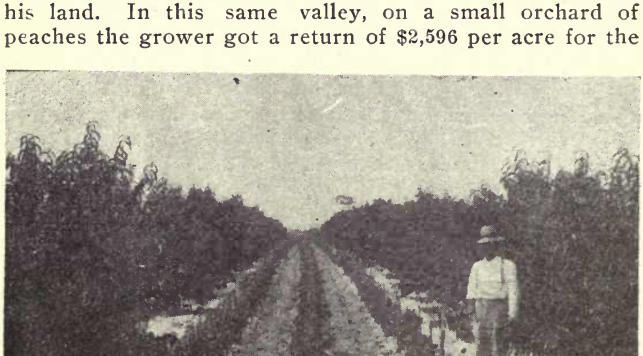
The following are representative samples of the letters which have come to the attention of the writer bearing on the matter of profits that are obtained in fruit growing.

Here is one from Bedford County, Virginia: "On 32 apple trees which are about 60 years old, and occupying about one acre, the crop in 1909 sold for an even $1,000. Its yield in some seasons past has brought a return of $1,500. The land near this orchard is valued at from $20 to $60 per acre. Near this orchard is another one which produced 240 barrels on one acre, and sold for $2 per barrel, or a valuation of 16 per cent on a valuation of $3,000 per acre."

The profits from growing fruit come not alone from the harvest of fruit each year, but also from the increased value of land, which brings good returns. A Virginian says: "When I came into possession of my property it sold for $7,500 and was not readily saleable at that figure. Through the planting of orchards I have been able to sell off land in this tract to the amount of between $25,000 and $30,000 and retain a property worth two or three times the original value."

Apples are the leading fruit crop in some sections of the far West and have been known to bring fabulous returns in some instances, but not every one can get such enormous profits. The average profits will run like this grower in the Yakima Valley of Washington got. He says that his three and one-half acres of apples have, in five years, brought a gross return of $20,000. In Parker Bottoms of this same valley a pear grower made a net profit of $26,616 from 618 pear trees planted in 1894. This is an average yearly net profit of over $1,100 per acre.

Growers near Wenatchee, Washington, have made good profits on their orchards, as is shown by the following: Four acres of six-year-old trees produced a crop in 1907 which sold for $4,451, and in the next year the crop on these same trees sold for $4,800, and in 1909, $5,400. A certain grower came to that valley in 1898 and paid $625 for five acres of raw land. In 1909 he sold his apple crop from this five acres for $3,250 and has refused $15,000 for his land. In this same valley, on a small orchard of peaches the grower got a return of $2,596 per acre for the



Tomatoes grown as a catch crop between the tree rows while the orchard is young.

fruit of one year. Fifty-four D'Anjou pear trees on two-thirds of an acre produced 952 boxes of pears that sold in the New York market for a price that would net the owner at the rate of $3,806 per acre. Another grower got $3,250 from five acres of apples planted in 1897. This is a return of 10 per cent on a valuation of $6,500 per acre.

D'Anjou pears from a single tree in an orchard near Central Point, Oregon, in 1907 sold for $204.75 net.

Near this same place another man harvested 3,020 boxes

of apples, the fruit from fifty-two trees, which netted $1,747.62.

This happened in a valley famous for its fruit crops and its enormous returns. In that valley one grower got $1,050 net from one acre of Spitzenburg apples, and $1,420 from an acre of Newtowns. Another got $1,620 from an acre of Spitzenburgs. In another orchard the crop of Bartlett pears from a single acre brought $1,244 after all expenses were paid.

Near Phoenix, Ariz., one man got $3,300 in net profit from the first crop of fruit produced on nineteen acres.

Not far from Mt. Selma, Texas, a fruit grower got a profit of $500 from five acres of peaches. Another man gets $2,800 from nineteen acres, ten of which are in peaches and the rest tomatoes.

In Michigan a fruit man got $900 from three acres of strawberries, and another man down in Mississippi got $450 from one acre of strawberries. A farmer in Marienette County, Wisconsin, sold $250 worth of strawberries from one-fourth acre of land. A neighbor of his got $922.54 after paying all expenses in harvesting and marketing the crop from two and one-fourth acres of strawberries. A man near Superior beat these men a little in getting $800 from one acre of strawberries.

From these figures it is evident that the fruit grower has abundant opportunity to obtain large returns from his efforts. These returns are not the maximum that is possible to obtain, but represent incomes received by the average intelligent grower.

CHAPTER IX

Small Fruits

Blackberries

The blackberry is a native American fruit, growing wild over a great portion of the eastern half of the country. Until about 1840 no attention was given to it under cultivation, as the wild patches were abundant and fruitful, but in 1841 the first cultivated form was introduced and was followed in a short time by the Lawton, Kittitinny and Snyder. These varieties are still the leading sorts under cultivation, and, while they have many desirable characters, they point to the neglect which horticulturists have given to the improvement of blackberries.

While the area of succcessful cultivation of the blackberry does not extend as far north as the raspberry, it reaches over a great portion of the South, in sections where the other kinds of bush fruits do not succeed. The kind of soil which is preferred by blackberry is indicated by the soil in which the wild sorts are found to do the best. This is a strong moist loam, in full sunlight. Where the soil becomes water logged for any portion of the year the berries do not thrive, and if the situation is one which becomes excessively dry during a considerable portion of the year, the plants do not do well. On this account, low ground or very sandy soil is not suitable for blackberries, although if given very good care in such locations they will produce some for home use. Where the plants are to be set in sandy soil they should be placed on a northern slope, as in such a position they will not be so liable to

suffer from lack of moisture; while in low ground a strong southern exposure will be better as it will be somewhat dryer than a similar position on a northern slope.

Soils which are very rich in nitrogen produce plants with very strong wood, but little fruit, as the energy is largely spent in making wood growth, at the expense of fruitfulness. On this account there will be more or less winter killing of the shoots in the Northern localities.

Preparing the Soil

The land which is to be planted to blackberries should be given very good preparation, especially if it is for a commercial or local market plantation. Plow it deeply in the fall and allow to lay rough all winter. The action of the frost will break up the lumps and liberate a large amount of the fertility. Then work it down smooth with a disk harrow as early in the spring as it is in condition to work, finishing up with a drag. Lay off the rows with a diamond plow, about eight feet apart and set the plants four feet apart in the row.

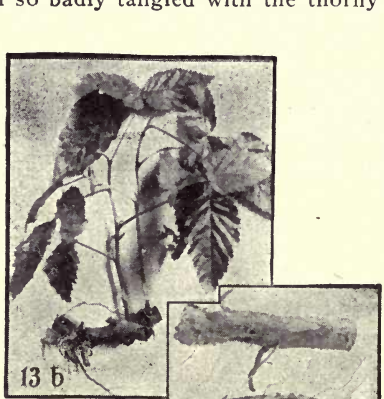
Propagation

Blackberries are propagated either from root cuttings or from suckers which come up around the parent plant. Either can be used with success in starting the new plantation, although if cuttings are to be used, they should be grown for one season in the nursery row in order to get established.

Planting

Spring planting is the best, as the plants start into growth immediately. The young plants are set in the furrow made by the diamond plow, and about four inches below the surface. During the first year or two the cultivation should be very thorough and frequent in order to induce the roots of the plants to penetrate into the deeper

soil, after which time the cultivation may be stopped, except for just enough to control the suckers which may appear in the middle of the rows. Sweeps or square pointed shovels on the cultivator make the best tools to keep the suckers cut out, and this work should not be neglected, for unless the suckers are cut out as fast as they appear the plantation will become a brier patch in a couple of seasons and so badly tangled with the thorny canes as to



At 13a is shown the usual method of making root cuttings of the blackberry; 13b shows one of the same cuttings after it has started to grow.

make it difficult to get through to harvest the fruit. In fact, the fruit from plantations which are not cultivated and pruned is smaller and more seedy than from those which are given good care.

Pruning

The canes of blackberries and other bramble fruits are biennial; that is, they live but two years. On this account it is necessary to cut out the old canes as soon as their

function has been completed and leave the room for the young canes. The first year after planting two or three canes will appear, which should have the growing tip pinched out when the cane becomes about eighteen inches or two feet high. This will cause the canes to send out several lateral branches and make stocky plants. This pinched out when they become about eighteen inches after for the purpose of inducing the plants to send out lateral branches, and thereby increasing the fruit producing area of each plant. After the second year the pinching should be done when the new canes become two or three feet high, depending on the vigor of the plants. Some growers practice cutting out the old canes just as soon as the fruit has been harvested, while others will allow them to remain until the following spring. Whether they are cut out in the summer or the following spring seems to make little difference, but in the spring the lateral branches should all be cut back about one-third. This will make the plants stockier and less liable to fall over when carrying their fruit, and it will also thin the fruit, by removing some of the fruit producing wood.

Harvesting and Marketing

For distant markets the blackberry should be picked at just the time that it begins to color nicely, and while the berry is still solid. But for local markets and home use the fruit should be allowed to become more nearly fully ripe. The fruit which is picked before it has reached full maturity will be quite acid, and just as it is picked from the plants it will not be suitable for use, although it will soften up and take on a very good flavor in the course of a few days, while it is going to market. Fruit which has ripened on the plants is by far the most delicious, but on account of the very thin and tender skin such fruit will not bear transportation, as it is very juicy and leaks badly when even slightly crushed.

Marketing is usually done in quart boxes, although when the fruit is to be shipped for a considerable distance the one pint cups will carry the fruit with less injury from

crushing. In such cups blackberries have been sent with complete satisfaction from the Puget Sound country of Washington to Chicago.

Winter Protection

In regions of severe winters, such as from northern Missouri northward, tender varieties, such as Early Harvest, will need to be protected to prevent winter killing. In northern Iowa and Minnesota it is advisable to protect all varieties of blackberries in the winter to keep the canes from being killed. This winter protection is usually done by bending the canes over and covering them with soil. Begin at one end of them and bend the canes over to the north or west, as they will then hold the snow better. Cover the tips with soil to hold them down. Bend the next hill over this, shingle fashion, and weight down the tips. Then when all are bent over, mulch them well with straw. For such practice better results can be obtained by growing the plants in hills rather than in solid rows.

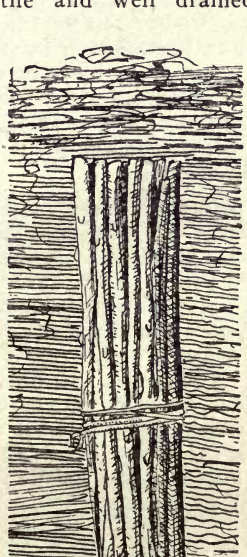
Currants

The currant is essentially a Northern fruit as in the Northern states, where the weather is cool during the summers, it reaches its best development. In the Middle and Southern states it produces fair crops of fruit when placed in a semi-shaded position, as on the northern side of a row of trees, or a fence. The currant enjoys a cool atmosphere and thrives in the climate of the northern portion of the Mississippi valley.

The cultivated varieties have come from a number of wild forms, mostly natives of Europe, and because of the diversity of the types from which these varieties have originated, we have in cultivation several kinds of different colors, such as black, red and white kinds. These all differ quite markedly in flavor, and the red and white varieties are most extensively grown. The black forms have a flavor which does not appeal to many persons and are grown but little outside of Canada.

Propagation and Planting

The currant may be propagated by division of the parent plant, by layers or by hard wood cuttings. Whichever is used, the plants should be set in well prepared soil, which is rich, fertile and well drained. Two-year-old



Currant cuttings tied in a bundle and buried upside down to callus.

plants from cuttings are better for setting in the field, as they are larger and can be handled more rapidly than the newly rooted cuttings.

The common distance for setting currants is five feet apart in the rows with the rows eight feet apart.

Pruning

The best fruit is produced on canes which are not over four or five years old. For this reason they will not need as much pruning as other kinds of bush fruit but will need to be gone over and have the oldest wood cut out, leaving the hills full of strong fruitful wood. By cutting out a few of the old canes each year a balance may be kept between the new and old canes, and the plant kept in a vigorous and fruitful condition.

On vigorous plants the shoots are inclined to make very strong growths, often reaching a height of six feet in a single season. When such is the case it is best to keep them pinched back to about three feet as in the case of the raspberry. It is also an advantage to cut out all but five or six of the strongest canes in each hill. Winter protection is not necessary with the currants and gooseberries. But on account of the long slender branches which they produce, in regions where there is a heavy snowfall, these branches may be bent over to the ground with the weight of the snow. On this account it is best to gather the canes into a bundle and tie them with a cord to prevent their being bent over.

Dewberry

This is a trailing form of the blackberry that has but recently come into cultivation. It grows in all parts of the country and its fruit cannot be distinguished by the general public from the ordinary varieties of blackberries. Its chief advantage is that it comes in some two or three weeks ahead of the ordinary kinds of blackberries, coming in after the raspberries have passed, and fills the gap when good prices can be had for the fruit. As a rule they are not sure croppers in most places, due perhaps to imperfect pollinization, and when such is the case it can be overcome by planting several varieties together.

Soils

The wild plants are found growing on sandy or otherwise well drained and rather impoverished soils. This may be because it is crowded out of the better locations by other kinds of plants, and can maintain its existence only on those soils which are too poor to support other kinds of vegetation. Under cultivation it does well on a great variety of soils, and locations which are suitable for blackberries do well for the dewberry.

Propagation and Training

Dewberries are propagated from rooted tips, as are the black raspberries, and also from root cuttings. The plants are set in rows 4 to 6 feet apart and 2 or 3 feet apart in the row. The best system of culture is to train the vines on a trellis or tie them to stakes. Some growers allow the vines to run over the surface, and are pruned just enough to keep them in hills.

Where the winters are so severe as to make it necessary to protect the plants during the winter, they can be most easily handled when placed on a trellis or tied to posts.

The trellises are made by running two wires along the row on posts about two feet high, bearing at the two ends a cross arm twenty inches wide. The wires are fastened to the ends of these cross arms and the canes drawn up over them. About a dozen canes can be allowed to form in each hill with this style of training. Where single posts are used there can be no more than half a dozen canes from each hill, and they are tied to the post and allowed to fall over the top.

The culture of the dewberry is similar in every detail to that of the blackberry. When given good care they are very productive but when neglected the fruitfulness is variable. Young plantations need to be kept in clean cultivation until the plants are well established. In cold climates the canes will need to be covered in the winter to

prevent their being frozen back. When trained to posts they can be laid down very easily and covered with soil. If the canes are pegged down and covered with leaves or straw, a plow furrow can be run on each side turning the soil over the plants, and an entire row covered very quickly.

Grapes

The grape is the most widely cultivated of all kinds of fruits. It is found growing wild on nearly every continent in the world, and cultivated forms have been in vineyards at almost every stage of the world's history. It is the fruit for the masses since varieties can be had which are adapted to almost any condition of soil or climate. Because of the ease with which it can be grown the grape is especially desirable for the home grounds, as it will flourish and produce acceptable crops under conditions where tree fruits could not find room. The grape is one of the most delicious of fruits, and because of the great number of varieties, obtained from an almost innumerable list of ancestors, it can be had in a good many flavors and shades of color, so that all persons can find among the varieties some kinds which are to their liking.

There are so many different varieties of grapes that kinds can be had which are adapted to almost any condition, and which will succeed in almost any climate where fruit can be grown. It is easily propagated, easily grown, bears early, lives much longer than the average bush or tree and gives a larger amount of fruit under average conditions of the home garden than any other kind of plant.

Soil and Location.

As a rule the grape is not particular as to the soil or location in which it is grown, although some kinds produce better when given special locations. But in general the grape will do well in soils that are rocky, sandy or heavy clay, rich or poor, and under conditions where other fruits would fail. For the commercial plantation, however, this

should not indicate that care need not be given to the selection of a site that is adapted to the growing of the grape, and especially the kinds which it is intended to plant. Grapes draw heavily on the available fertility in the soil, and the greater the care that is given to building up a good rich soil before planting grapes the better they will respond in fruitfulness. Under general conditions, a clay loam which is well drained will give the best results.

The best location is one which has a southern or eastern slope, as in such positions the land is not so likely to be overly wet, and the dews will pass off more quickly than on northern slopes. This is of importance in guarding from the attacks of numerous diseases to which the grapes are liable. Steep hillsides are often made into profitable vineyards, and likewise are many pieces of flat land in the river bottoms. But the proper precautions must be taken under each condition to protect from the troubles both situations will bring. Steep lands are hard to cultivate and to get over with the spraying machinery, while bottom lands are both frosty and disease producing.

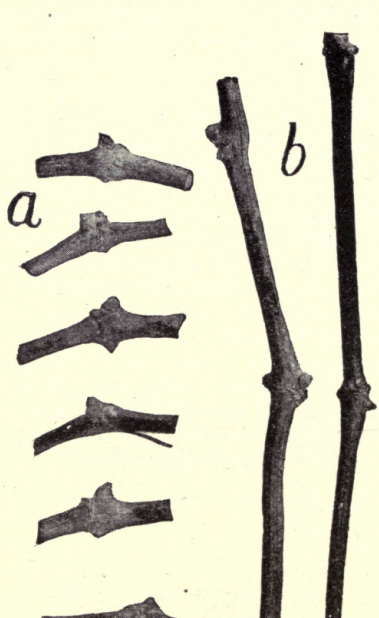
Preparation of Soil

As the grape is a strong feeder the soil should be well prepared before planting, especially if it is not naturally fertile. It is even best under average conditions to grow some leguminous crop for a couple of years before planting the vines in order to fill the soil with organic matter to improve the texture and nitrogen. When turning under a crop of green manure it should be turned under as deeply as possible and then work down smooth with a disk harrow. It should be remembered in setting a vineyard that it is to last a lifetime and more, and like building a house the more solid the foundation the better will be the super structure. A vineyard which is well planted will be more easily cared for in future years and be more profitable than one which is put in in a hurry.

Planting.

On this account the ground should be rich at the time the vines are planted in order to give the young plants a

good start. If manure is available, a generous amount of it should be worked into the soil a couple of years before setting the vines, as it will then become thoroughly



At a are shown several single-eye grape cuttings, and at b the ordinary three-eye grape cuttings as commonly made.

decomposed and be in better shape for the reception of the young plants. One-year-old vines are the most satisfactory, unless especially well grown two-year-old vines can be had. The objection that is made to two-year-old

vines by many experienced vineyardists, is that they are left-overs which the nurseryman has lined-out and grown a second, or even a third year before being able to dispose of them. The planting should be done as early in the spring as it is possible to work the soil into good condition.

The distance apart to set the vines varies to a great extent with the variety and local conditions, but for the Eastern and Middle Western conditions 6x8 feet apart is the usual distance. Where the soil is especially fertile, and the vines are of very strong growing varieties, the distance should be even farther apart than this. The operation of planting the vines goes a little slower than with planting tree fruits, for as a rule the roots are much longer and the holes must be made larger.

Before planting, the tops should be cut back so as to leave only about four buds on the new growth, and the roots so that they are about ten inches long. This may take off a very large portion of the root system, but many small rootlets will quickly be sent out to take their place, and the vine will start off more quickly than if the roots and tops are left unpruned. In setting these young vines in the ground they must be set deep. There is little trouble from getting them too deep, as with some other kinds of fruit, for if the roots should be at a greater depth than they can grow, new roots are sent out above them, and the vine goes along in fine shape.

Early spring is the best time to set the vines, although it is possible to set them at any time when the plants are dormant and the soil in good condition. In the far North it is generally best to plant the vines in the spring as they will then not be subjected to the long period of dormancy on account of the ground being frozen, and the plants prevented from becoming established. In the Gulf Coast country it is frequently best to plant the vines in the fall, for the weather will be sufficiently mild during the winter for them to make considerable root growth before spring comes, and will then be well established and ready to start off in fine shape.

During the first year the vines are in their permanent location they will not be in need of a trellis. With many varieties the only support that will be needed the second year will be just a post to which the vines can be tied to keep them off the ground. By the beginning of the third season there should be some sort of substantial support to which the vines can be tied. In the home grounds an arbor can be made which will be very serviceable in supporting the vines and also quite ornamental. In the commercial plantation a trellis of some sort should be constructed, as the vines can then be cared for in better shape, unless the variety is one which makes but a small amount of vine, as is the case with some of vinifera type. There are several styles of trellises used for grapes, depending on which of many styles of training are in use. One of the commonest is a two-wire trellis in which the top wire is about five feet from the ground, and the other at about three feet. For training on such a trellis only two canes are allowed to form and these are cut off at the top wire and spread out fan-shaped on the trellis wires.

What is known as the Kniffen system has a trellis constructed in about the same manner. One cane is drawn up to the topmost wire, where it is then cut off. At each of the wires two side branches are permitted to grow, and one is allowed to run in each direction on both wires to a distance about half way to the next vine. These are not cut off but allowed to remain as the stock from which the fruiting wood is to come. The fruiting wood is then formed on each one of these arms and drops down, so that tying is not a necessity.

In the Munson system of training three wires are used, one wire run through the posts at about six feet from the ground, and the other two placed at the ends of "T" shaped arms. The vines are trained up from the ground to this wire, and two arms allowed to form, one being in each direction. The new canes which form each season are then allowed to droop over the outer wires, while the permanent arms of the vine are fastened to the middle wire.

Cultivation

The grape responds to good cultivation, and it is important that the vines be given good cultivation during the first years in the vineyard, and enabled to become well established, after which time the land can be put into sod if so desired. However, the best practice is to keep the vineyard in cultivation for the early portion of the season at least, after which time it can be sowed down to a cover crop of some sort.

One of the great advantages of keeping the vineyard in cultivation is because this will bury many of the diseased berries which fall from the branches and also many of the leaves which contain the spores of the mildews and black rot that sometimes causes such havoc in vineyards. If the cultivation is continued during the summer it will also assist in keeping the curculio in check. This is one of the insects which cause the worms in the berries of the grape. Whatever cultivation is given, it should extend under the trellis, and work up all of the soil in the row. Sometimes it will necessitate a good thorough going over with a hand hoe to get this portion of the soil worked up as thoroughly as it needs to be.

Sex in Grapes

Like the strawberry in some ways, there is a great amount of difference in the different varieties of grapes as to their ability of setting fruit when planted by themselves. Nearly every one who has wandered through the woodland is familiar with wild grape vines which bloom abundantly each spring and fill the air with their delicious fragrance, but which fail to set a single fruit for the fall harvest. This is nearly always due to the fact that the vine produces nothing but stamen-bearing flowers, and is totally devoid of the ovary or fruit-producing portion, and hence unable to set fruit. Other vines will be found which produce an abundance of flowers, less conspicuous and fragrant than the staminate flowers, but which may or may not set fruit, depending on the proximity of other vines. If the flowers

of these are observed they will be found to have a conspicuous cone-shaped body in the center surrounding which is a row of small, withered anthers, usually bent down and under the cone-shaped portion. This central part of the flower is the pistil and ovary, from which the fruit is developed when the flower is properly pollinated. Still other wild vines will be found to have flowers which pro-

Grapes "bagged" to protect them from birds and insects and to keep them clean.

duce both ovaries and strong, erect stamens, and which are therefore called perfect flowers. These vines are able to set fruit without the intervention of the pollen from other vines.

In the cultivated varieties the same things are found, in that some vines are imperfect flowered and must have stamen-bearing vines planted near them in order to secure

proper fruiting of the vines. These facts are usually well known to the nurserymen and prominent vineyardists, from whom the amateur can obtain the desired information, in case it is not contained in the books or catalogues to which he has access. Likewise the information is obtainable from the experiment station authorities upon request.

Vines which bear the imperfect flowers need to have planted with them the vines of other varieties known to produce an abundance of pollen, and which bloom at about the same time.

Pruning

The grape responds to the style of pruning and the manner in which it is done more than any other cultivated fruit. Good grapes cannot be produced on vines which are not regularly and systematically pruned. Yet more vineyards are ruined through improper pruning than in any other way. Too many growers, especially those who do not observe the action of their vines closely enough, expect their vines to do too much. They leave too much fruit-producing wood. In this way the vines continually over-bear themselves, and are quickly exhausted.

The manner of pruning will differ with different varieties. Some need to be left with long canes of fruiting wood, while others need to be cut back to spurs on which there are only a couple of buds. Some kinds will need to have short but strong fruiting canes left, while others will do best when the small, short-jointed canes are used for fruiting wood.

One thing needs to be borne in mind with the usual kinds of grapes—that is, to keep the bearing wood close to the original trunk or head of the vine. The tendency is for the fruiting wood to get farther and farther away each year, and on account of this habit it is important that the fruit-producing canes be renewed from time to time, by being cut back to the stump. This will cause new shoots to form on the trunk, thereby renewing the fruiting wood. With vines which are trained on a trellis this renewal need not be done until the spurs or canes get out so far they

cannot be easily handled, then it will be necessary to head them back, and take a fresh start. The usual systems of training grapes provide for this condition, and, in fact, the usual systems are dependent on this one thing for their foundation.

Time to Prune

The grape can be pruned at any time during the dormant season, although it is important to do it sufficiently early in the spring to avoid the excessive bleeding which will sometimes occur. Tender varieties should be pruned in the fall in order that they can be bent over and covered with soil to prevent their becoming winter killed. Some definite system should be followed in the pruning, and if the grower is outside of a grape-growing community, it will be advisable to learn some system of pruning that is adapted to his conditions. This can be obtained from books treating of the subject of pruning or of grape growing.

In sections where the grape is a commercial crop the system of pruning which gives the best results will usually be pretty thoroughly worked out, and will be the best system to follow.

Raspberries

The raspberry is one of the most popular small fruits, although its area of successful commercial production is limited to the northern half of the United States and the Pacific Coast. Over this area, however, it is one of the most popular of the bush fruits, the blackcap being the most extensively grown for the commercial market. This is on account of the soft fruits which are produced by the red varieties, and the ease with which such kinds are damaged in transit.

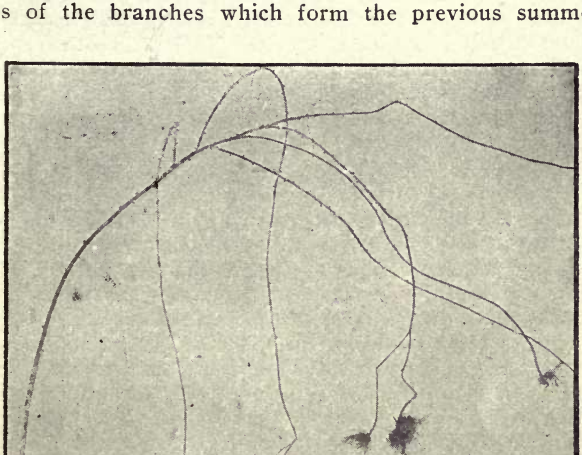
Soils

Soils such as are adapted to the blackberry are best for the raspberries. Red raspberries do better on a light soil than do the blackcap varieties. Soils which are very heavy,

or which contain large amounts of available nitrogen are not desirable. The latter kinds will produce an excessive amount of wood at the expense of the fruit. Good, strong loams are the most desirable.

Propagation and Planting

Blackcap raspberries are propagated from the rooted tips of the branches which form the previous summer.



A cane from a black raspberry showing how the lateral branches take root at the tips, where they touch the ground.

When these are well rooted they may be cut from the mother plant and used in setting the new plantation. Spring planting is most desirable, as the plants can start immediately into growth, attach their roots to the soil and not suffer from drying out as frequently happens when

they are set in the fall and must remain dormant throughout the winter.

Red varieties are usually propagated from suckers thrown up from the roots, but root cuttings may also be made the same as with blackberries and dewberries. Some varieties of the red raspberry do not make suckers very readily and so must be propagated from root cuttings.

The rows need to be about six feet apart and the plants set four or five feet apart in the rows, if they are to be grown in hills. If solid rows are to be made, then the plants can go as close as two feet in the rows. The hill system is the most desirable where the canes must be bent over for winter protection.

Pinching and Pruning

With the red varieties there will be no need of summer pinching after the first summer. The blackcaps will need to be pinched in the same manner as the blackberries. This will make them throw out strong side branches, which may grow out to a considerable length and take root at the tip. These tips can be used in enlarging the plantation, or may be dug out and thrown away as, if left, they will interfere with cultivation. The canes of both the red and black varieties are biennial, so that all old canes should be removed when done fruiting. It is best to remove them as soon as the fruit has all been harvested, as then the entire space can be given over to the new canes.

Winter Protection

In the Northern States, where the weather becomes severe during the winter, the canes of both kinds of raspberries are killed to the ground. On this account it is advisable to bend the canes over and cover them with soil as in the case of the blackberries. This work should be done at a time when the canes are not frozen, as when the wood is frozen it is very brittle, and the canes will break instead of bending.

Strawberries

The strawberry is the most important of all of the small fruits, and it readily finds a place in the garden of the farmer, in the dooryard of the city man and in great plantations of the specialist. It is the one fruit used more extensively than any other to plant among trees in the young orchards, and which the grower can depend on to make a profit while the young trees are coming into bearing.

The strawberry is a cosmopolitan fruit, and is found under cultivation in great plantations from the Gulf of Mexico to northern Canada and from the Atlantic ocean to the Pacific coast. So widely distributed, in fact, are the commercial plantations of this delicious fruit that it cannot be said to be confined to certain "belts" of profitable commercial production, as can the apple, peach or prune. This character, which permits this wide adaptation, comes possibly from the fact that its parentage is among almost a dozen wild species, coming from all parts of the world. This fact, too, has made it possible to have varieties which are adapted to widely differing conditions and filling a variety of needs. One may find varieties producing firm berries that will stand shipments of some thousands of miles; others will be sweet and melting, and suited only to home markets. Other varieties will come early, and still others that come late. New forms are being created at the present time which give good promise of producing fruit throughout the entire summer, while still other kinds are being developed for forcing in the greenhouse for the mid-winter markets.

As a commercial fruit the strawberry is rapidly growing in importance, and in practically every state there are now large districts where this fruit is the leading horticultural crop, and from which train loads of the fruit are shipped each season. This is a development of recent years, and has been increased by the perfection of methods of shipping fruits under refrigeration, and by the development of the large commercial orcharding operations. While many thousands of acres are now devoted to strawberry production the industry dates no farther back than about 1835,

when Hovey's Seedling was placed on the market as a variety that would thrive under cultivation. Up to that time the strawberry was known only as a wild fruit, and was considered to thrive only in its haunts in the woodland. But with the introduction of this cultivated form other varieties began to appear and each year now sees many new varieties placed on the market for the use and consideration of the cultivator.

Propagation

The strawberry reproduces itself with considerable vigor, in all but a few choice varieties. This manner of reproducing differs from the habit of most fruit producing plants, in that each vigorous plant sends out a number of

Diagram showing the manner in which a strawberry sends out runners to reproduce itself.

runners, which form new plants at intervals of a few inches. These new plants that form on the runners quickly attach themselves to the soil and develop root systems of their own. The slender straw-like runner which nurses them until their own roots are formed then dies, and the new plant in turn sends out other runners, so that from a small beginning a very large number of plants can be obtained in the course of one season.

In starting a new plantation the young plants give greater satisfaction than do those which have produced

a crop of fruit. It is easy to distinguish these young, virgin plants from old ones by the simple fact that their roots are numerous, come out from the crown and are pure white, or slightly tinged with yellow. After the plant has lived through one season and produced a crop of fruit these roots become dark brown or black, and underneath them a new set of roots is produced, which appear very early in the season as tender white roots, but which soon become wiry and yellowish.

In selecting plants for propagation, such as starting a new plantation, care must be exercised to secure only those plants with the light colored roots close to the crown and from which there are no tough, wiry, dark colored roots. In this connection it is a distinct advantage to secure plants from those which are known to produce good crops of fruits. There is strong tendency on the part of plants to inherit more or less of the fruiting habit of their ancestors, and plants secured from fields which have been given thorough care and which have produced large crops of fruit, are far better to use than those from plantations which have been neglected and which, as a consequence, have produced small crops of fruit.

In preparing to plant out a strawberry bed, it pays well to obtain the plants direct from the field of some grower who maintains a breeding bed, where the plants are grown primarily for the production of new plants, and from which the fruiting habit is well known. In case such cannot be done, it will pay to maintain such a patch in your own field where the plants can be given thorough care, and where each mother plant can be watched in its fruit production. There will be found a marked difference in the fruitfulness of each individual plant in a field. Some will make a large crop of large fruits, some will make a large crop of small fruits, and others may be entirely barren. Those plants which are least desirable in their fruiting habits should be chopped out of the propagation bed, so that their offspring will be eliminated in the future plantations.

Soils and Locations

The strawberry will thrive in almost any soil and in almost any location. It grows thriftily in the sandy loams of the South and extreme North, it grows equally well in the rocky clays of the Ozark Mountains, it thrives in the heavy clays of the Middle West, and equally as well in the volcanic ash of the inter-mountain valleys of the far West. It might be safe to say that the strawberry will thrive in any soil that is not a clean dry sand or water-logged peat or clay, and any soil that will produce good crops of any of the ordinary garden vegetables will be adapted to the strawberry. It is likewise adapted to any location as regards the exposure to the sun and prevailing winds. And there are varieties and strains of varieties which are adapted to locations in the Southern states or Northern states, and to the Atlantic coast sections as well as California and the Puget Sound country.

But whatever the soil or location the strawberry will do its best in proportion to the amount of available fertility in the soil upon which it is growing. The soil need not be especially deep, as the strawberry is a shallow rooting crop, but it does need to be abundantly fertile. Any additional care that is taken to enrich the soil before planting out a strawberry bed will be well repaid with the increased amount of fruit which it will produce. On this account it is frequently advised that the plants are most productive on new lands. Lands from which the native timber has just been removed, and in which there is an abundant supply of leaf mould to be turned under, is usually considered the best for strawberries. But this is no doubt only because the natural fertility of such soils has not been exhausted by over cropping. It is a well known fact that old fields which have been in cultivation for many years can, with proper care in fertilizing and preparing the ground, be made to produce as large and fine crops of berries as the virgin fields.

The choice of slope on which a plantation is to be made depends upon the objects to be sought. A southern slope is usually warmer and produces earlier berries, while one

sloping to the north will be later and the berries will be slightly less highly colored. In those sections where the summers are hot and dry it will be an advantage to use the northern slopes for the strawberry plantation, on account of the greater moisture which will be retained in the soils of such locations. But if means are at hand for irrigating the plantations such differences are of little value. The strawberry needs an abundant supply of moisture throughout the entire growing season. This is because of its shallow rooting habit. In dry summers it is not infrequent to find the strawberry plants in a dormant condition and most of the foliage dead by midsummer, only to revive and possibly produce a second crop of fruit after the late summer rains soak up the soil.

In the fall of 1910 this character prevailed over the greater portion of the country east of the Rocky Mountains. The early portion of the summer was dry and in August an abundance of rain came, soaking up the soil and putting new life into the strawberry fields, with the result that in September and October many persons were harvesting a second crop of berries, which were practically as good as the early spring crop. In the irrigated sections of the West many berry growers make a specialty of obtaining a second crop of berries, which they can do with ease when they understand how to handle the irrigation water and throw the plants into a dormant condition early in the summer. Then by applying the water again after the plants have had a short rest, they will immediately come into bloom and produce a second crop. In the mild climate of California, where strawberries can be kept in growing condition throughout the entire year, crops of fruit can be had almost every day.

Preparing the Land

Because of the adaptability of the strawberry to a variety of conditions it will grow and produce remarkably good crops in soils which have been given very poor preparation. But like every other cultivated crop it responds to good cultivation, and when the soil is put in the best pos-

sible condition the strawberry will produce its best and most profitable crops.

In the preparation of the land the drainage of the soil needs to be considered, for if not naturally well drained tile should be put in so as to prevent water standing on the land and to promote the aeration of the soil. But if draining is not a necessity, the question of fertility of the soil will be of first importance. Barnyard manure is by far the best fertilizer to apply to land which is to be planted to strawberries. This is so because it not only adds to the elements of fertility, but it also adds organic matter that will be converted into humus to improve the tilth of the soil, and promote a better general physical condition. This manure should be applied as fast as it is made, as then it contains the maximum of fertility and will be more nearly free from the white grub, which causes such serious damage to strawberry beds by eating off the roots of the plants.

The amount of manure which needs to be applied to the soil will depend on the general fertility, but ten or fifteen big wagon loads to each acre will not be too much for the average land. Distribute the manure with a manure spreader, as then it will be applied in a thin, even coat over the land, and can be applied more quickly than by any other means. But in cases where an abundance of stable manure is not available, soil improving crops handled in the best manner for improving the fertility and texture of soils will be most suitable, and in connection with them it may be necessary to add small amounts of potash and phosphorous as the local conditions may warrant.

The manure or cover crops should be plowed under as early in the spring as the soil can be worked, care being exercised to secure a uniform depth throughout. On this account a riding plow will serve a better purpose in most localities than the usual walking plow, and especially in the hands of an inexperienced plowman. The depth to which the land should be plowed will depend on the general nature of the soil. In soils which are naturally deep, the plowing can be done deeper than in shallow soils,

running as much as eight inches. But where the soils are shallow, it may be necessary to plow only half that deep. In this plowing, when manure has been added or crops turned under, the land needs to be turned completely over and then disced and harrowed so as to thoroughly incorporate the manure with the plowed ground. This will make the soil spongy, light and friable, so that the plant roots can penetrate to all parts of it and it will maintain a more even temperature around the roots than in a compact soil.

Rolling the land is sometimes a necessity and especially on soils which are naturally very heavy. On light soils such as sandy-loam clays, rolling may not be a necessity, although if it is lumpy rolling may be an advantage. The purpose of the rolling is to not only break the lumps, but to compact the soil so that the roots can quickly attach themselves. Rolling compacts the soil and prevents excessive aeration, which is possible in very light soils. Aeration not only dries out the roots, but it has a decided influence on the development and action of the soil bacteria and the liberation of fertility.

Time to Plant

The time to plant the berries depends a great deal on where one is located. In the South planting may be done to best advantage in the fall or early winter months. In the Middle West it can be done at any time when the soil is not too dry or frozen, while in the North spring planting will give the best results. The time to plant will depend on the season of the year at which the plants will most quickly take hold of the soil and become established. A strawberry plant is somewhat like a potato. In the fall it has stored up in its roots and crown a considerable quantity of food material that can be drawn upon to maintain itself when conditions otherwise may make it impossible to obtain such material from the soil.

Because of this one may ask why it is not just as well to set the plants as soon as they become dormant in the fall. As a matter of fact, plants do not become dormant

until the ground freezes so hard that it is impossible for the plant to obtain any nourishment on account of its having frozen solid. For this reason fall set plants in the North may not have time to form new roots before the ground freezes and may as a consequence dry out and perish during the winter.

A fine bunch of strawberry plants for setting out.

Planting

Just before one is ready to plant, the soil should be gone over and worked down as smooth as can be with a harrow and this, followed with a drag, that will leave it perfectly smooth. Across this then mark off the row either with a cord or by drawing a board having pegs driven through in the position each row is to occupy, and so as to

scratch lines across the field in which the berries are to be set.

Where transplanting machines, such as are used in some of the trucking districts, can be had, they may be used for transplanting strawberries and are a decided advantage in many respects. But the one great fault with the machines is that one cannot always set the plants at the proper depth. The strawberry needs to be set at the depth which will allow the crown of the plant to be flush with the surface of the land, neither too deep or too high. If set too deep, the crown will fill with soil and rot if the weather is wet. If set too high, the roots will be exposed to the sun and air, drying out or weakening the plant.

The best way to set strawberries is to get right down on one's hands and knees and "go to it." If one pads the knees with a good bunch of old sacking the work can be done with greater convenience. Where a machine carrying two men is used it is possible to set 8,000 plants in a day, and where setting by hand a good workman can set as many as 1,500 or even 2,000 plants in ten hours.

A dibble is necessary for making the holes in hand-setting, and one which is flat is better than a round one. With it a hole can be made that will allow the roots to be spread out flat, in a fan shape, and all of them come in contact with the soil. The dibble should be grasped in the right hand, thrust into the soil, and given an outward shove so as to make an opening behind it. The left hand then grasps the plant, shakes the roots out loosely and shoves them carefully into the hole so that the crown comes exactly at the surface. The dibble is then withdrawn and inserted again a couple of inches away from the plant and the soil pulled up against the roots. A little experience soon teaches one to know how to do the work quickly.

Systems in Planting

There are three systems of planting or training, the hill, hedge row and matted row. Each has its advantages and

disadvantages, and the method to adopt will depend on the conditions under which one must work.

The hill system consists in growing the plants in individual hills or stools, only one plant in a place. Such a practice makes a lot of hand work necessary and limits the size of the field. There are several ways of growing

Characteristic appearance of an old strawberry plant, not suitable for planting. Black, wiry roots at the bottom and new roots above them.

berries in hills, but they all resolve into the matter of keeping all of the runners off the plants and making all of the strength of the plant go into the development of one big fruit producing plant.

The hedge row is more popular than the hill system, as it entails a smaller amount of labor and enables one to set the rows closer together. In this system each mother plant is allowed to make two runners and these are trained in the row, one going on one side and the second on the other side. When the plants are set from three to three and one-half feet apart and two feet in the row, they should stand about six inches apart in the rows after the runners are layered.

This system can be elaborated upon a little by what is sometimes called the "double" hedge row. This is essentially the same as the hedge row except that the rows are wider, although there should be fully six inches of space around each plant in the rows. This system is believed by careful observers to produce the maximum amount of large fruit that it is possible to get from a field. But the system entails a great amount of hand work, a greater amount, in fact, than the average man can give his fields where a large area is in berries.

The matted rows are most popular among the general commercial producers. The plants are set in rows about three or three and one-half feet apart and about two and one-half feet apart in the row. The plants are then allowed to grow and make as many runners as they can to fill up a row about a foot and a half wide. Beyond this the runners are kept cut off by a little attachment that is placed on the sides of the cultivator.

Winter Protection

Whether winter protection, or mulching, is used will depend largely on one's location. When a mulch is applied it may be done for any one or all of three reasons; first, to keep the soil cool and moist during the season; second, to keep the berries free from dirt during the spring rains, and third, to afford winter protection. In the Northern

sections the mulch is applied in the fall as soon as the ground freezes, in which case it serves all three purposes, but in the South, where winter protection is not needed, it may not be applied until in the spring, for the purpose of keeping the berries clean. In the most of the Western sections a mulch is not used at all, as it is not needed during the winter. Since rains seldom interfere at the time the crop is ripening a straw mulch is not necessary to keep the berries from becoming spattered.

Where a mulch is needed, straw serves the best purpose, although it is open to the objection of introducing seeds of the grain and various kinds of weeds, which may cause serious trouble in the field.

Where the mulch is applied for a winter protection it need not go on until the ground has frozen, as it is not the object of the mulch to keep the ground from freezing but to prevent the alternation of freezing and thawing several times during the winter. The dressing should be applied at the rate of a couple or three tons of good straw spread evenly over the rows of plants. In the spring this mulch will be so well water soaked from the effects of the winter snows and rains that it will rest heavily on the plants. When the plants give signs of renewing their activities it is necessary to draw the mulch from over the berries, leaving it close up to the sides of the rows where it will keep the rains from spattering dirt on the ripening fruit.

Renewing

Strawberry fields will not be profitable producers after they have made two crops. This is because the land will be more or less choked with the plants and new plants cannot obtain a place to grow and develop, so that the field needs to be renewed. There are a number of ways in which this can be done but one of the simplest and most effective means is to plow out the spaces between the rows, leaving a strip in the middle about six inches wide. Turn the soil away from the rows, back-furrowing towards the middle. Then make a liberal application of manure, throwing the most of it into the fur-

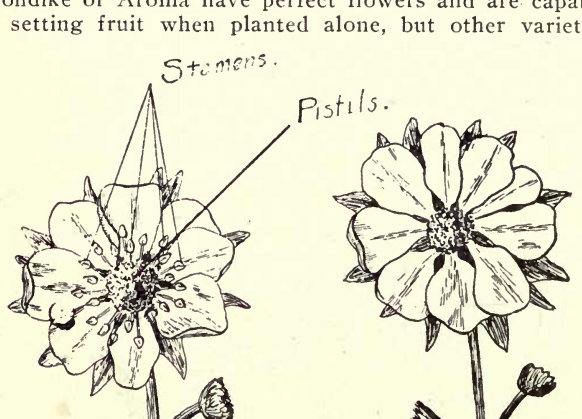
row on each side of the row of plants. Work the soil back into the furrow with a one-horse cultivator or with a disc from which the inner discs have been removed. Then go over the field with a hoe and cut out the old plants, work under the old foliage and leave the remaining plants standing about six inches apart. With such treatment as this the field will be in fair condition to produce at least one more profitable crop and possibly two crops. By the time the field has been in strawberries long enough to produce three or four crops of berries it will have exhausted the fertility of the soil or it will have become so toxic to the roots that the successful cultivation can not be continued without putting the land into other crops for at least two years. Should it be the intention of returning the same field to strawberry production, these crops should be of such kinds as will increase the fertility of the land rather than to produce a large immediate cash return. For this reason crops of some legume, such as clover, cow peas, vetch or crimson clover are the best, and the tops should not be mowed but turned under to add to the humus supply.

Another method is to plow a furrow down each side of the row turning the soil into the middle and then work it back with a spike tooth harrow with the teeth thrown slightly back. This will drag out some of the plants in the rows, pull out the old matted foliage and bury most of the crowns of the plants. The object of this is to encourage the plants to send out a new secondary crown and a new lot of roots all above the old crown. As soon as the new plants have begun to appear the field should be worked over with a hoe and the plants thinned out and culled, leaving only the most vigorous. This work is or should be done immediately after the fruit crop has been gathered, as the plants will then have the remainder of the summer to build up new plants to produce the crop of fruit for the next summer.

Sex in Strawberries

Many persons who are inexperienced in the growing of strawberries find that when their first planting comes into

producing age that it may blossom very freely but fail to produce a single fruit. The reason for it is that the flowers were not "fertilized" or pollinated. Some varieties of strawberries do not produce pollen; they are provided only with pistils, or the female organs of reproduction and must be pollinated by the pollen from varieties which have perfect or pollen-producing flowers. Varieties like Excelsior, Klondike or Aroma have perfect flowers and are capable of setting fruit when planted alone, but other varieties



Strawberry flowers; one on the left is "staminate" or pollen producing; one on the right is imperfect and bears no stamens. It must be planted with a staminate variety before it will be fruitful.

such as Warfield, Bubach, Haverland or Sample are pistillate, or have imperfect flowers and cannot set fruit themselves. If one obtains plants from any of the reliable dealers the sex of the plants will be marked in the catalogue, and one can thereby guard against getting all pistillate plants. Otherwise one will have to inquire from persons who know whether their plants produce perfect flowers.

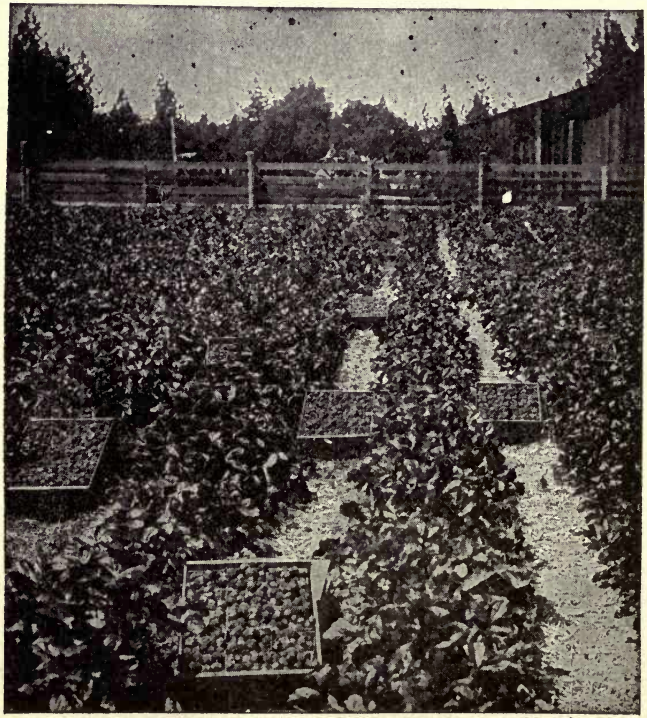
It is when the plants come into bloom that anyone can tell whether the flowers of a given variety of strawberry are perfect or imperfect. The "staminate," "male" or perfect flowered kinds will be found to have a number of yellow or greenish yellow bodies on little short stems surrounding a central green, cone-shaped body, which can be readily recognized as an immature strawberry. These yellow bodies are the "anthers" or pollen producing organs, and such flowers are able to produce fruit without the necessity of mating them with other kinds. But those flowers from which the anthers are missing must be planted close to pollen-producing kinds before there will be any fruit produced.

Many of the most desirable varieties of strawberries produce these imperfect flowers, so that to get a crop of fruit they must be mated with some kind which will produce an ample supply of pollen for itself and for the imperfect flowered kind. In setting out such a plantation it is found satisfactory to plant one row of the perfect flowered kind and two rows of the imperfect. In this way there will be one row of staminate plants between two rows of imperfect flowered varieties. The pollen which is produced by the stamen bearing flowers will be carried to the non-staminate kind by insects which visit the flowers. The common honey bee is the most industrious in performing this valuable work, although a number of flies and other kinds of insects no doubt help out. On warm days the wind may also help out in carrying the pollen, as some of it is undoubtedly blown from plant to plant and row to row, but in order to obtain the best results with pistillate varieties it is essential that the pollen-producing sort be one that blossoms at the same time as the staminate kind.

Varieties

The question as to what kind of strawberries to plant is not easily answered, so far as the home garden is concerned, although it is somewhat easier for the commercial plantation. In the catalogue of every dealer in strawberry plants there is a long list of varieties with tempting

descriptions of the delicious fruits that makes one want to plant every kind listed. In the home grounds it is well worth while having a list of several varieties, so selected that one can have strawberries from the beginning of the



Wide, matted rows, in a productive field.

season until its very close, and when the everbearing varieties have been well enough developed so that one can with certainty get a second crop each year, then those kinds should be included. It is well worth the while to

have several varieties in the home ground and to try some of the newer varieties which are being introduced from time to time, as they add to the interest of growing the fruit, even though that particular variety may not do so very well.

For the commercial grower, and particularly the grower in sections where there are successful strawberry plantations, it is best to adopt those kinds which are known to be a success in that particular section, and on the same kind of soil. In all of the large berry growing districts some one or two berries are grown more extensively than other kinds. For example, in the Southern states Klondike and Texas are the leading varieties. In the Ozark region of Missouri and Arkansas Aroma is most extensively used, while in the Pacific Northwest Clark's Seedling is the leading commercial variety. In every section, however, there are a great number of other kinds, although there will usually be one or possibly two leading sorts.

Every commercial berry grower should have a trial grounds on which he can test new varieties. Some kind quite different from what he is growing may produce greater quantities of fruit, or be otherwise more desirable. It is not necessary that such grounds be very large, for a little bed a rod or so square may be ample for trying out two or three new sorts each year, and once a start is obtained it is easily possible to increase the number of plants if one is so inclined.

Canning Fruits and Vegetables at Home

Saving a Waste

Canning fruits and vegetables on the farm is one way of saving what might otherwise be a large and extravagant waste. In nearly every fruit and truck growing section there is always some fruit or vegetable, in large or small amounts, which cannot be sold at a profit while fresh. When this is placed in cans and properly sterilized, sealed and labeled, it can be sold in the market at a profit above what it would have had it been sold fresh.

On the average farm an abundance of fruits and vegetables can be had during the summer season, but when winter comes these delicious and wholesome products are absent from the family table. If they are present it too often happens that they have been obtained from a store in the nearest town. These goods are often very poor substitutes for the products which can be canned at home, and especially when the cheaper grades are purchased. The average farmer frequently dries fruits, and possibly also some kinds of vegetables for winter use, but aside from these there is little for the home table and nothing for the market. This is largely for the reason that they believe it is impossible or difficult to can fruits and vegetables in such a way that they will keep in perfect condition without the use of mysterious chemicals or elaborate and expensive canning machinery. This is a mistake, for it is just as easy to can vegetables such as corn, peas and beans as it is to can peaches, plums or cherries.

Every fruit and vegetable grower has had the experience of trying to sell produce at a profit when the market was so glutted that a price sufficient to pay for hauling to town could hardly be obtained. This is especially the case when the produce was being placed on the local markets. It is under such conditions as this that it pays and pays well to have a little canning outfit and put up the produce in tin or glass cans to be sold during the winter months. Outfits can be had which will fit the needs of anyone who wants to can either vegetables or fruits, and in any capacity from a dozen cans to several hundred cans a day. The process is simple, and one which can be done by any farmer or farmer's wife.

There is only one secret to the commercial canning process. It is nothing mysterious or difficult, as so many persons believe. It is simply the careful observance of cleanliness and thorough sterilization of every can. Nothing more enters into the secret of canning. It takes no chemicals whatever, and the process is so simple that it can be done with success in any kitchen, or even out of doors under the shade of a tree. On account of the simplicity

of the process there is no reason for a farmer hauling his vegetables or fruit to the railroad and shipping to a distant canning factory, as then the farmer does most of the work and the cannery gets the money. By canning the vegetables at home the farmer can sell his finished product at the same price as the large canner and make a profit on his goods. If shipped to a cannery this profit would have been divided between the transportation company, the canner, the jobber and sometimes even the retailer.

A portable canning outfit is handy for home use.

Cleanliness is of first importance in canning, as filth of all kinds is full of germs of disease and organisms which render it difficult to make the product "keep" after it is canned. It is essential and almost indispensable that an abundance of clean, pure water be available in the kitchen or building in which the canning is being done, and so much more convenient if this water is under pressure and

obtained by simply opening a valve. All of the produce can then be washed free from any dust that may be clinging to it and can also be more readily cleaned of any spots of rot which may be on it. To have the fruit perfectly clean and to handle it with clean tools and put it in clean cans and sterilize in clean vessels makes the operation of canning very much easier and safer than if the cleanliness is neglected. Perfectly clean products will sell for a better price than that which is put up in a shiftless, "don't care" fashion.

Sterilization

The reason for so much fruit spoiling after it is canned is due entirely to the lack of perfect sterilization of the cans after being filled. Some products can be placed in cans and sterilized by cooking for just a few minutes while others may require prolonged cooking. This cooking is done for the purpose of destroying the organisms which cause the products to "spoil." These organisms are of various kinds. Some of them are the common moulds, some are yeasts quite similar to the yeast which causes bread to "rise," while still others are of the minute forms of life called "bacteria." All of these organisms are present everywhere all of the time, and when fruits and vegetables are harvested and prepared for market, or canning, they are completely covered with these extremely minute forms of life.

These organisms can be killed by heat. On this principle rests the foundation of the canning business. As soon as one learns how to cook their produce in air tight vessels so that all of these organisms are killed, then the contents of the can will keep in perfect condition until air containing the spores of these organisms is admitted. Perfect sterilization can be had by enclosing the produce in clean jars or cans and then submitting them to heat of sufficient temperature for a long enough time to destroy all of these organisms. Sterilization is readily accomplished by the use of boiling water. In localities where water boils at nearly 212 degrees Fahrenheit most of the

ordinary forms of ferment organisms are killed at the boiling point of water. But the spores or resting stage of these organisms will not be killed at that temperature, so that it is necessary to do one or all of three things: increase the length of time of the cooking process, increase the boiling point by increasing the steam pressure, or by repeated cooking and cooling. In the ordinary process of boiling some kinds of organisms may not be killed by being subjected to that temperature for just a few minutes, whereas if the temperature is maintained for some time they are killed.

Boiling Repeatedly

By boiling, all of the living organisms will be killed and then by allowing the product to cool, any of the spores which remain will germinate, so that a second boiling in the course of twenty-four hours will kill the second crop and leave the contents in practically a sterile condition, although a third boiling may be necessary to make absolutely certain. Repeated boilings in this manner are hardly necessary with the usual forms of garden produce when the boiling point of water is nearly 212 degrees. But when the boiling point falls as low as 205 degrees or less, as it does at high altitudes, then the repeated boiling is necessary unless the cooking can be done in a steam tight vessel where the steam pressure can be increased, or else by keeping the produce at the boiling point a number of hours.

Processing

This cooking through which the produce must go in order to make it keep is known among canners as "processing," although its only meaning is thorough cooking in order to destroy all germs of fermentation and decay.

This work can be very effectually done in open kettles in the home or small factory, although for rapid work and in large establishments it is an advantage for some kinds of produce to have steam tight compartments in which the sterilization can be done at a temperature higher than the boiling point of water in an open vessel.

Home Outfits Are Simple

The canning machinery which is on the market for the use of farmers and persons who expect to pack only a small amount of produce are very simple. They consist of a heating device, usually a sheet iron stove or furnace, on which is a tank of water. Into this tank is immersed a frame-like affair holding the filled cans during the cooking process. Such simple outfits as these can be purchased for amounts as low as $10, while twice that amount will buy a very good outfit for canning on a small commercial basis.

Accessories

In addition to a means of cooking, or processing the produce, there are a few small tools which will be needed, especially if the canning is done in ordinary tins. These are a capping iron, which is a curved piece of iron for soldering the cap on the cans; and a tipping copper for soldering up the hole in the cap which is left for the escape of the air while the cans are being exhausted. There will need to be a supply of sal amoniac and soldering fluid, to make it possible to solder the cans. The sal amoniac can be bought of the druggist, while the soldering fluid can be made at home by dissolving in muriatic acid all of the zinc it will take.

Definitions

Capping is a term applied to the operation of soldering the cap onto the can. The cap is a little circular piece of tin rimmed with solder which fits over the hole in the top of the can. In capping, the rim of the can into which the cap fits must be absolutely clean and dry. The contents of the can must not be closer than a quarter of an inch of the top, as the cap must not be soldered on if the contents touch the lid. Put the cap in place and brush a little of the soldering fluid around the edge. When the capping copper is passed around the cap the solder around its edge will be melted and secure it to the can.

Tipping consists in closing the little hole in the center of the cap. This is done with the tipping copper, and the

lid must be wiped perfectly dry and clean and then wet with a little of the acid flux. Touch the hot copper to a bit of solder and then place the melted drop over the hole and the job is done. Tipping is not done until after the air in the cans has been exhausted by a preliminary boiling.

As soon as the cans are filled with the produce they are to contain they are capped and placed in the upper part of the process tank submerged two-thirds their depth in water. Here they are maintained for a sufficient length of time to thoroughly heat the contents to near the boiling point and expel most of the air in the can. There should be an air space of a quarter or half an inch in each of the cans to allow for the expansion of the produce as it is being processed and to prevent the contents touching the top and making trouble with the soldering that must be done. As soon as the cans are removed from the exhaust they are tipped and are ready for the processing operation. In this the cans are immersed completely in the boiling water, and if the tipping or capping has not been thoroughly done, there will be a little stream of bubbles rise through the lid. Those cans which leak must be removed immediately and the hole effectually closed before the processing can be done satisfactorily. If the cans are perfectly air-tight the ends will be somewhat bulged after the processing is finished, on account of the expansion of the contents, but as soon as cooled down the ends will be flat.

Blanching is necessary in the canning of some kinds of vegetables and consists in doing what the housewife calls "par boiling." Where this is necessary the blanching should be done in a separate tank from that used for processing. In a small factory or the home canning plant a large new wash boiler makes the best sort of vessel for this purpose.

Directions for Processing Asparagus

This is the first vegetable of the season to be canned. Cut it as for the market, having the stalks just a little

shorter than will fill the cans. Wash it perfectly clean and pack firmly in the cans, placing the tips all one way. Asparagus cans are usually made square instead of round and open on the side. This is for convenience in filling. Exhaust 10 or 15 minutes and process for 20 or 30 minutes.

Beets

Small sized beets are the best. Young, tender ones an inch or less in diameter, with the tops removed, should be par boiled until the skin slips off. Remove all of the skin and pack firmly in cans. Cover with water, exhaust and process for an hour.

Lima Beans

These must be carefully hulled by hand and all damaged beans should be culled out. Pack only those which are perfect in shape and not too ripe. They loose their flavor quickly after being shelled and on that account need to be packed immediately after shelling. Pack the cans within a half or three-fourths of an inch of the top as the beans swell some; cover with water, exhaust ten minutes and process for forty-five minutes.

Green or Wax Beans

String beans will need to have the strings removed. All kinds must have the tips and stems cut off and the pods broken into halves or smaller pieces. Gather the beans while they are quite young so that they will be tender. String beans must be blanched for ten or fifteen minutes. Pack them tightly into the cans within half or three-fourths of an inch of the top, cover with water and exhaust. The processing will need to cover a period of an hour of hard boiling. It must be done very thoroughly as beans spoil very easily unless perfectly sterilized.

Corn

Most persons have difficulty in canning corn so that it will keep. When perfectly sterilized it keeps as well as

any vegetable. The most certain way to make a success of canning corn is to process three times, letting the cans stand and cool for twenty-four hours between each cooking. The corn must be in a milky stage. Cut the grains off the cob, scrape the cob lightly with the back of the knife so as to get all of the milky portion. Pack into cans within three-fourths of an inch of the top and fill nearly full of water. Exhaust for fifteen minutes. Let cool for twenty-four hours and process again. Let cool over night and give a third boiling of half an hour, and it will keep perfectly.

Blackberries

Fruit should be ripe, but not so soft that it will mash when handled. Remove all stems. Pack firmly without crushing. Cover the berries with water, add sugar if desired; exhaust for three minutes, process for ten minutes.

Cherries

These fruits can be quickly pitted with a machine. Pack solidly in syrup or water as desired, in two-pound cans. Exhaust seven minutes and process for twenty minutes.

Peas

Shell tender young peas and screen so as to grade into different sizes before packing. Blanch for five minutes, pouring them into boiling water. Remove and pack firmly into cans. Cover with water; exhaust for fifteen minutes and process for one hour. Greatest success may be had by allowing to cool for twenty-four hours and then repeat the processing.

Pumpkin and Squash

Prepare as for immediate use. Cook until nearly done in an open vessel, then pack in cans. Exhaust for ten minutes and process for forty minutes.

Peaches

Use firm, solid fruit that is not too ripe. Peel, cut into halves and remove the stones. Pack firmly in the cans and cover with syrup or water as desired. Exhaust for five minutes, process for fifteen minutes. The best grade of fruit must be unbroken halves. They may be packed in two, three or ten-pound cans. Pie peaches are usually packed in the larger sizes of cans.

Raspberries

These are handled in the same manner as blackberries.

Tomatoes

These have become the most popular of all kinds of canned vegetables and afford an excellent means of bringing in an income while the orchard is maturing. Stone is the best variety, as the fruit retains its deep red color during the processing better than most any other variety. The fruit needs to be clean, firm and well colored. Scald with boiling water until the skin will slip easily. Remove the skins and cut out the hard stem end, being careful to not mash the fruit in handling. Save all of the juice that runs out of the cans. Cover with juice or water if necessary. Exhaust eight minutes and sterilize for half an hour. Do not allow the fruit to stand after being scalded, as it spoils very quickly.

Varieties of Apples, Peaches, Pears, Grapes to Plant

The following list of varieties of fruits are from data collected by the horticulturists of the states named and are varieties which are considered as the best for commercial plantings in the states named:

Alabama

Apples—Red June, Red Astrachan, Early Harvest, Family, Winesap, Yellow Transparent, Horse, Yates, Terry.

Grapes—Bunch: Delaware, Niagara, Concord; Muscadine type: Eden, Memory, Scuppernong.

Peaches—Greensboro, Carman, Hiley, Family Favorite, Belle, Elberta, Salway, White Heath.

Pear—Kieffer.

Arkansas

Peaches—Sneed Triumph, Carman, Family Favorite, Early Crawford, Champion, Gen'l Lee, Elberta, Mixon, Late Crawford Emma, Matthews, Beauty, Picquet's Late, Heath Cling, Salway, Slappy, Early Elberta.

California

Apples—Newtown, Bellflower, Gravenstein, R. I. Greening, E. Spitzenburg, Mo. Pippin, Astrachan, Red June.

Grapes—Muscat, Tokay, Cornichon, Thompson, Emperor, Malaga, Rose of Peru, Zinfandel, Sweet Water, Verdal, Carignane, Black Prince, Alicante, Sultina.

Peaches—Muir, Phillips, Salway, Lovell, E. Crawford, Tuskena, Foster, Elberta, Nichols, Sellers, Lemon, St. Johns, Henrietta, Mary's Choice, Hale, Alexander.

Pears—Winter Nelis, Seckel, Easter, Du Comice, Doyenne, D'Ete, Clapp's Favorite, Glout Morceau, Barry Comet.

Colorado

Apples—Jonathan, Gano, Stayman, Winesap, Grimes, Colorado Orange, Wealthy, Duchess, Hass, Rome Beauty, Mamomth Black Twig, White Winter Pearmain, Black Ben.

Grapes—Concord, Moore's Early, Niagara.

Pears—Bartlett, Kieffer, Seckel.

Peaches—Crawford, Elberta.

Iowa

Apples — Yellow Transparent, Liveland Raspberry, Charlamoff, Wealthy, Anisim, Hutchins Red, Salome,

A fine young apple orchard in the irrigated country.

Windsor, Iowa Blush, Tolman Sweet, Allen Choice, Stayman, Delicious, Ben Davis, Gano, Grimes, Jonathan, Winesap, York Imperial.

Pears—Fluke, Bloodgood, Flemish Beauty, Seckel, Warner, Anjou, Kieffer, Longworth.

Peaches—Sneed, Champion, Crosby, Hill Chilli, Russel, Lone Tree, Greensboro.

Michigan

Apples—Red Astrachan, Duchess, Wealthy, Baldwin, Golden Russet, Red Canada, Wagener, Grimes, Hubbardston, Jonathan, Maiden's Blush.

Grapes—Brighton, Diamond, Niagara, Delaware, Worden, Concord, Moore.

Pears—Lawrence, Kieffer, Anjou, Seckel, Howell, Bartlet, Clapp's.

Peaches—Triumph, Kalamazoo, Elberta, Engle, Dewey.

Minnesota

Apples—Duchess, Hibernal, Charlamoff, Patten's Greening, Wealthy, Longfield, Tetofsky, Malinda, Okabena, Peerless, Wolf River, McMahon, Yellow Transparent.

Grapes—Beta, Janesville, Moore's Early, Brighton, Delaware, Worden, Agawam, Concord, Diamond.

Missouri

Apples—Ben Davis, Jonathan, Grimes, Huntsman, York, Winesap, Rome Beauty, Delicious, Wealthy, Early Harvest, Yellow Transparent, Ingram, Delicious, Black Ben, Gano, Stayman.

Peaches—Champion, Carman, Family Favorite, Elberta, Crosby, Salway.

Pears—Kieffer, Garber, Duchess, Anjou, Clapp's Favorite.

New York

Apples—Gravenstein, Oldenburg, McIntosh, Boiken, Northern Spy, Spitzenburg.

Pears—Washington, Lawrence, Anjou, Bartlett.

Peaches—Carman, Mountain Rose, Crawford, Mamie Ross, Elberta, Salway, Greensboro.

Northern New England

Apples—Oldenburg, Gravenstein, Baldwin Spy, Hubbardston, Stark, Tolman, Fameuse, Wealthy, Dudley.

Pears—Angouleme, Anjou, Bartlett, Clapp's, Lawrence, Sheldon, Vermont Beauty.

New Jersey

Apples—Early Harvest, Early Ripe, Red Astrachan, William's, Starr, Rambo, Wealthy, Maiden's Blush, Fall Pippin, Jonathan, Stayman, York Imperial, Northern Spy, Baldwin, McIntosh.

Grapes—Green Mountain, Niagara, Brighton, Worden, Diamond, Delaware.

Peaches—Greensboro, Hiley, Carman, Waddel, Mountain Rose, Early Crawford, Niagara, Elberta, Salway, Rare Ripe, Belle of Georgia.

Pears—Kieffer, La Conte, Bartlett, Clairgeau.

North Carolina

Apples—Red June, York, Stayman, Winesap, Grimes, Shockley, Ben Davis, Delicious, Newtown.

Grapes—Niagara, Concord, Delaware, Scuppernong, James.

Peaches—Greensboro, Carman, Salway.

Pears—Kieffer, Le Conte, Seckel, Early Harvest.

Ohio

Apples—Yellow Transparent, Oldenburg, Sweet Bough, Maiden's Blush, Grimes, Jonathan, Northern Spy, Rome Beauty, York, Hubbardston.

Grapes—Worden, Green Mountain, Niagara, Brighton.

Pears—Wilder, Bartlett, Angouleme, Seckel.

Peaches—Mountain Rose, Greensboro, Champion, Elberta, Smock.

Oregon

Apples—E. Spitzenburg, Yellow Newtown, Jonathan, Baldwin, Yellow Imperial, Gravenstein.

Grapes—Concord, Niagara, Tokay, Malaga, Muscat.

Peaches—Alexander, Crawford, Foster, Muir, Salway, Hales' Early, Cliny.

Pears—Bartlett, Anjou, Bosc, Howell, W. Nelis, Comice, E. Beurre.

Washington, Idaho and Montana

Apples—Spitzenburg, Jonathan, Baldwin, Wealthy, Wagener, Rome Beauty, Winesap, Delicious, King David, Winter Banana, Gravenstein, McIntosh, Grimes Golden, Arkansas Black, White Winter Pearmain, Stayman Winesap, Belleflower.

Plums—Bradshaw, Columbia, Prince de Agen, Italian Prince, Imperial Gage.

Peaches—Alexander, Mountain Rose, Foster, Muir, Susquehanna, Lemon Cling.

Cherries—(Sweet) Napoleon, Lambert, Black Republican; (sour) Late Duke, May Duke, Morello.

Rules for Naming Fruits

To avoid the confusion which arises in naming new varieties of fruits the American Pomological Society adopted the following rules, which are to be applied to all new varieties of fruits as they are introduced, and to the renaming of old varieties:

Rule I. No two varieties of the same kind of fruit shall bear the same name. The name first published shall be the accepted and recognized name, except in cases where it has been applied in violation of this code.

(a) The term "kind" as herein used shall be understood to apply to those general classes of fruits that are grouped together in common usage without regard to their exact botanical relationship; as apple, cherry, grape, peach, plum, raspberry, etc.

(b) The paramount right of the originator, discoverer or introducer of a new variety to name it, within the limitations of this code, is recognized and emphasized.

(c) Where a variety name, through long usage, has become thoroughly established in American pomological literature for two or more varieties, it should not be displaced nor radically modified for either sort, except in cases where a well known synonym can be advanced to the position of the leading name. The several varieties bearing identical names should soon be distinguished by adding the name of the author who first described each sort, or by adding some other suitable distinguishing term that will insure their identity in catalogues or discussions.

(d) Existing American names of varieties which conflict with earlier published foreign names of the same or other varieties, but which have become thoroughly established through long usage, shall not be displaced.

Rule II. The name of a variety shall consist of a single word.

(a) No variety shall be named unless distinctly superior to existing varieties in some important characteristic nor until it has become determined to perpetuate it by bud propagation.

(b) In selecting names for varieties the following points should be emphasized: Distinctiveness, simplicity, ease of pronunciation and spelling, indication of origin or parentage.

(c) The spelling and pronunciation of a varietal name derived from a personal or geographical name should be governed by the rules that control the spelling and pronunciation of the name from which it was derived.

(d) A variety imported from a foreign country should retain its foreign name subject only to such modification

as is necessary to conform to this code or to render it intelligible in English.

(e) The name of a person should not be applied to a variety during his life without his expressed consent. The name of a deceased horticulturist should not be so applied except through formal action by some competent horticultural body, preferably that with which he was most closely connected.

(f) The use of such general terms as seedling, hybrid, pippin, pearmain, beurre, rare-ripe, damson, etc., is not admissable.

(g) The use of a possessive noun as a name is not admissable.

(h) The use of a number, either singly or attached to a word, should be considered only as a temporary expedient while the variety is undergoing a preliminary test.

(i) In applying the provisions of this rule to an existing varietal name, that has, through long usage, become firmly imbedded in American pomological literature, no change shall be made which will involve loss of identity.

Rule III. In the full and formal citation of a variety name, the name of the author who first published it shall be given.

Publication

Rule IV. Publication consists (1) in the distribution of a printed description of the variety named, giving the distinguishing characters of fruit, tree, etc., or (2) in the publication of a new name for a variety that is properly described elsewhere; such publication to be made in any book, bulletin, report, trade catalogue or periodical, providing the issue bears the date of its publication and is generally distributed among nurserymen, fruit growers and horticulturists; or (3) in certain cases the general recognition of a name for a propagated variety in a community for a number of years shall constitute publication of that name.

(a) In determining the name of a variety to which two

or more names have been given in the same publication, that which stands first shall have precedence.

Revision

Rule V. No properly published variety name shall be changed for any reason, except conflict with this code, nor shall another variety be substituted for that originally described thereunder.

Grafting and Budding

Apples, pears and some other fruit and ornamental trees are propagated by means of grafting. This is done in many instances largely for the reason that the kind to be increased does not come true from seed; and when done on large trees, it is for the purpose of changing the kind of fruit produced by the top or to change the shape of the top. Where young stock is grafted, it is generally done by what is known as the "whip or tongue," and as this is the most common style of grafting and most applicable to the widest range of uses, it will be described. Where large trees are to be worked over, the work is done by what is known as "cleft grafting" and will be described under that head.

In grafting two things are necessary, first a lot of small roots of the apple. The roots most commonly used are from the one-year-old seedling trees. Next is a quantity of "scions" or twigs of the current year's growth from the trees that it is desired to increase. These scions should be free from the old wood and taken from the trees after the leaves have fallen, but before the wood freezes. They may be kept for any length of time till ready to use by packing them in damp sand or green sawdust in a cool cellar, or even packed in the soil out of doors and covered so as not to freeze.

The grafting is best done in a cool living room or in a cellar where the air is moist. It can be done at any time during the winter, but best at sometime after January and

at least a month before planting time. February is generally the most convenient time to do the work.

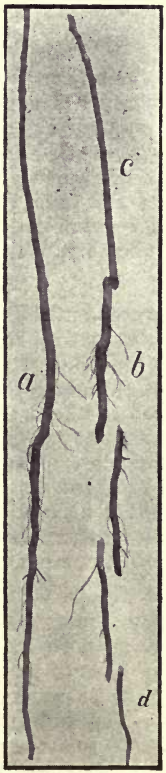
Making the Grafts

If the twigs are long enough make the scions about six inches long, but they may be made shorter if necessary. On the butt end of the scion make a sloping cut an inch or an inch and a half long. Use a sharp knife and make the cut smooth and uniform. On the cut surface, about one-third of the way from the end of the twig, make a slit or tongue by a downward cut, from one-half to an inch deep along the grain of the wood; then cut off at the desired length.

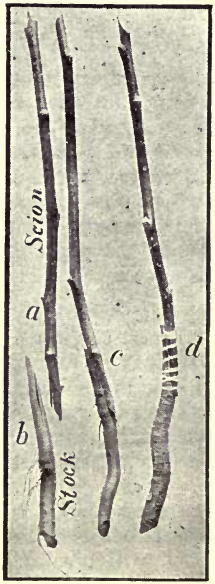
Next take one of the long seedling roots and follow the same process. Begin at the crown (the part of the root that was just at the surface of the ground) and form a sloping cut, being careful that it is of the same slope as that of the scion; and make the tongue in the same way the same distance from the end of the root as in the scion. This done, cut the root off, having the piece about three inches long and repeating the process until the entire root has been used. If the seedlings have made a good growth and the soil has been porous enough to let them go down, each root will usually make two and sometimes three pieces.

Join the root and scion by pressing the two sloping surfaces together and forcing the tongues to interlock. At this point the main thing to be observed is to watch one side and to see that the bark line of the scion comes in contact with the bark line of the root. This is highly important, for here is where the two are to grow together. The scion and root may not be of the same thickness; in fact, seldom are, but this makes no difference if the above instructions are followed. After pressing the two pieces together, it will be necessary to wrap the graft at the point of union with No. 18 or 20 knitting cotton. Lay the thread on the wood near the end of the cut, wind two or

three times around at this place, at the same time pressing the parts together with thumb and finger. Next, work the



No. 1



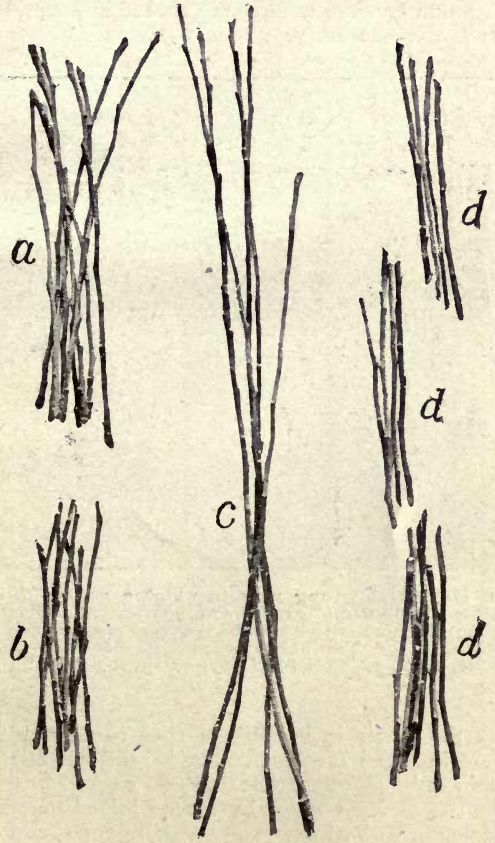
No. 2

No. 1. Apple stock for grafting; a is a No. 1 apple root of one season's growth from seed. This is cut into several sections as at b, c and d; c is the seedling top and d the tip of the root, both of which are to be discarded. The sections at b are the best for grafting.

No. 2. The apple graft; a is the scion; b is the stock; c shows how they are put together; d is the finished graft, ready for planting.

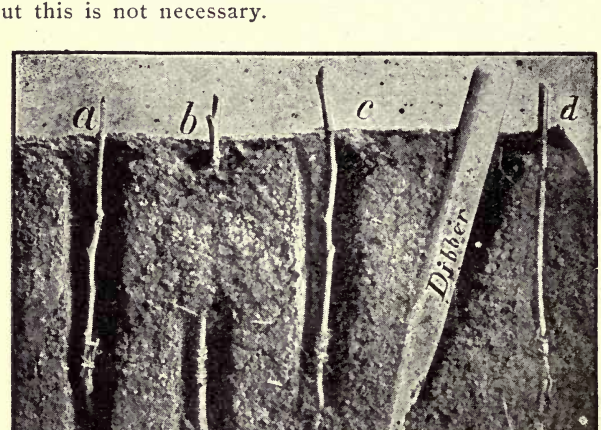
thread up to the other end of the cut by winding it two or three times around the graft during the distance, then two

or three times around the other end of the cut as in the beginning. Fasten the end of the thread by drawing it



Long and short twigs of apple before being made into scions; a, short twigs from an old tree will make only one scion each as at b; c, long twigs from thrifty trees; d, the same twigs made into scions.

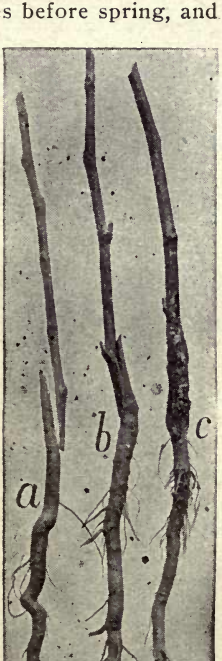
down in the cut and, by a sharp jerk, break it off. This completes the process. The finished graft should be from seven to nine inches long. The old way was to wax the point of union or wrap with waxed thread or strips of cloth but this is not necessary.



The right and wrong way to plant a graft. Holes are made with a dibber and grafts dropped in. If soil is packed down with the heel it is liable to leave an open space around the root, as at b. The better way is to close the hole with the dibber, as at c. Soil then packed tight against the root, as at d.

Pack the grafts in bundles of fifty to a hundred each and store in green sawdust or moist sand where they are to remain until planting time. While packed in the sawdust the cut surfaces which have been joined together will actually begin to heal over and partially unite, and on this account the grafts should not be disturbed until they are taken out to plant. Keep the box of grafts in a moderately cool room or a cellar, or bury them in the soil out of doors

where they will not freeze. If the grafts are buried in sand it may have to be sprinkled and moistened several times before spring, and will need to be watched.



No. 3

No. 4

No. 3. A pear graft; a shows the seedling root and scion; b is the two pieces fastened together, and c shows the waxed graft ready for planting.

No. 4. This figure shows the right way to shape the scions for cleft grafting.

Planting

As soon as the ground will do to work in the spring select a place where the soil is moderately rich, but not

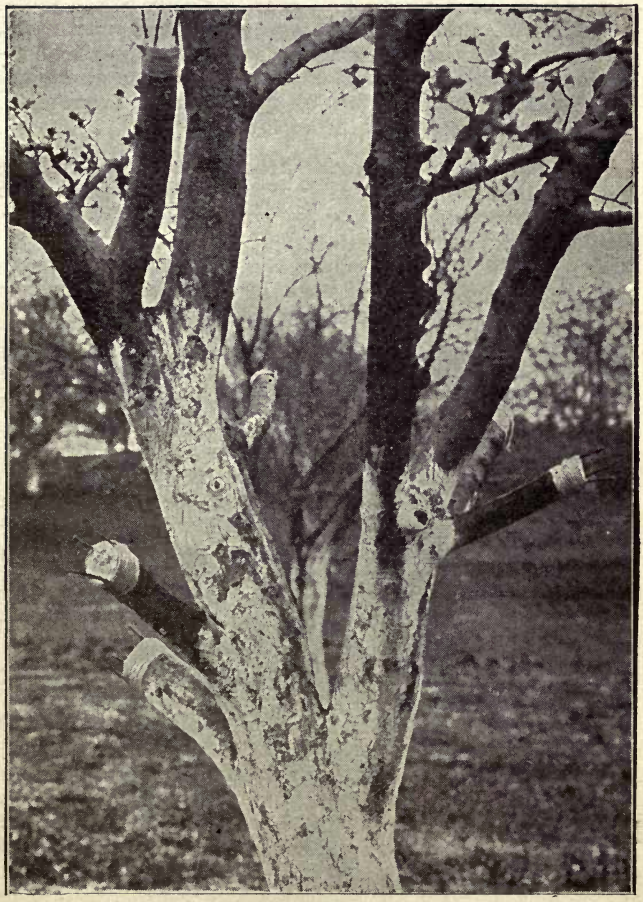
extremely so, on which to plant the grafts. Plow the land deeply and otherwise prepare as for a garden spot. The rows need not be long but should be perfectly straight. To get them straight stretch a string across the plot. The rows are to be four feet apart, laid off with a single shovel plow. With an old hoe handle which has been sharpened to a point, with a long slope, go along and punch holes in the ground about eight inches or a foot apart, withdrawing the pole carefully and with many side movements so the soil will not fall in. Plant the grafts deeply. After placing them in the holes, see that only one or two buds of the scion are left above the ground. This will make it necessary to have the ground plowed deeply. Be sure to press the soil up closely against the roots of the grafts. This is best done with a dibber or short stick which is forced into the soil beside the grafts and crowds the soil up against them. The grafts cannot grow if air spaces are left around the roots. Give the little trees good culture, including two or three hoeings during the summer, and they will reward their owner with a vigorous growth.

At the end of the summer the trees will be "one-year-old" trees of the nurseryman, and can be dug as soon as the leaves have fallen and ready to be transplanted to the orchard. If it is desired to use two-year-old trees, they can be left in the nursery for another summer.

There are special implements on the market for wrapping the grafts, planting the grafts and digging the trees. These are of great assistance in saving time and labor where large quantities of trees are grown.

Cleft Graft

Cleft grafting can be done on any sort of fruit tree and is used mostly for the purpose of working over old trees which are beyond the condition in which they can be worked by the ordinary whip or tongue graft. It is the style of grafting that is especially useful where one has a few trees that have reached the bearing age and are found to be unsatisfactory either in kind or in quality of fruit. It is the style of grafting that will allow one to work two



This shows a good way to top work a tree. Only about half the branches are grafted at one time.

or more varieties of apples on one tree. In fact as many varieties as there are branches may be top-grafted on a single tree. It is a matter of great curiosity to see apples of different colors and sizes growing on the same limbs, but it is easily done by grafting scions of the desired varieties on bearing trees. New varieties may be oftentimes hurried into bearing by working them on the branches of trees that have reached bearing age.

It will be necessary to collect the scions for top-grafting early in the winter before freezing weather and store them in the manner described above. The grafting is done early in the spring at the time the leaf buds are beginning to open. At this time the sap in the tree to be top-worked will be flowing freely, but the scion to be inserted upon it should be perfectly dormant in a cellar.

To do the work, saw off the old branch, if as much as an inch in diameter, or even the body of the tree if not over four inches thick, and split down through the center with a hatchet or knife. The scion (which is the same kind of wood as described for other scions) should be only four or five inches long, and at the butt end whittle on both sides to a wedge shape. In making the wedge the slope must be long and uniform, care being taken to whittle about the same amount of wood from each side. Pry open the split in the trunk or branch to be grafted and carefully insert the scion so that the bark on one side will be exactly in contact with the inner part of the growing bark of the old stub or stump. This is extremely important, for here is the place where they are to grow together, and they cannot do so if the bark of one piece is not in line with the bark of the other. If the old branch or trunk of the tree is large enough, that is, thick enough, it is advisable to use two scions, one on either side of the stump, as this will double the chances for success. If the grafted stump be as much as three inches thick, a wedge for the purpose should be made and driven down in the center of the cleft just far enough to prevent too great pressure on the scions and yet not far enough to cause them to be loose. After driving down to the proper point, the wedge

may be broken off. When the scions and wedges are in place it will be necessary to cover all of the cut surfaces with soft grafting wax.

The wax may be melted in a tin pan at the house and carried to the orchard if not too far away, or the pan may be set on a hot stone and will then stay melted for a considerable time. The melted wax can be most easily spread over the cut surfaces of the graft by means of a little paddle, and needs to be spread all over the cut surfaces of the scion and stub, although it is not necessary that the bark be also waxed. This waxing is done to prevent the cut surfaces from drying out and thereby preventing the scion and stub from uniting. The wax need not be disturbed at any time thereafter.

If both or all the scions inserted on a stub should grow, cut all of them off but one. Only one scion should be allowed to grow, as more than one at a place will cause a bad fork that will split easily.

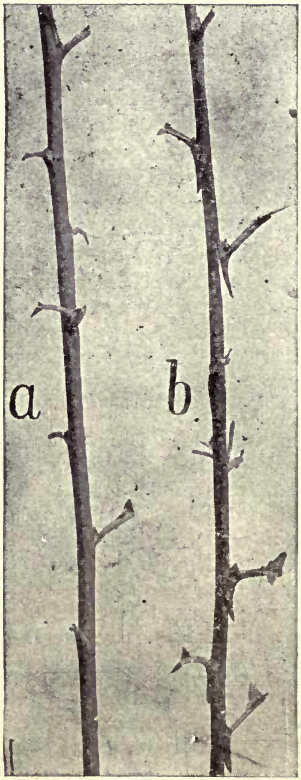
Budding

Budding is an operation done upon any woody plant for the purpose of increasing some desirable variety that cannot be obtained from seed. Its object is identical with grafting, and differs from it in that in grafting a scion bearing several buds is used, while in budding the scion consists of but one bud, with a small bit of the bark to which it is attached. All of our tree fruits can be reproduced with more or less ease by budding, while the peach is propagated in this manner exclusively, as it does not unite very readily when grafted.

This operation will be described as generally practiced on the peach, although the practice will differ not at all for propagating apples, pears, or any of the stone fruits.

Stock for budding is generally the one-year seedlings obtained by stratifying the seeds over winter and planting out the following spring. The seedlings will be large enough by June in the South for budding, and by August

in the Northern states. When budded in June, the tops of the seedlings are cut away as soon as the buds have united, and the growth from the buds is very rapid, so that by late autumn it is large enough for planting in the orchard.



Budding sticks. At a the leaf blades have been cut away, and at b the buds to be used are partially cut off and made ready to take to the field. Sticks prepared in this way must be wrapped in a wet cloth to keep the buds from drying out.

While June budded trees are usually smaller than those budded in late summer, one year's time has been saved, which is often a matter of great importance to the grower, whether he is growing them for his own use or to sell.

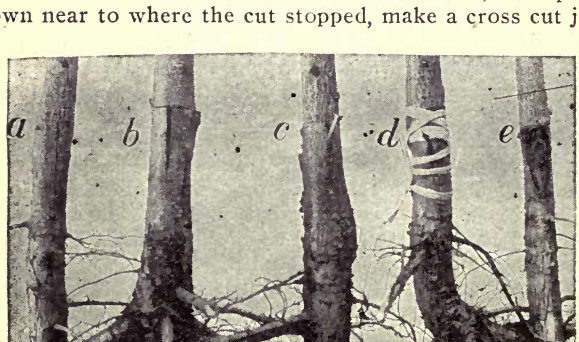
For summer budding, which is the most common practice, the buds should be inserted about the last week in August or first week in September. In general the budding should be done at the time when the bark will peel the best. When the work is ready to be done the buds are to be selected from the desired varieties. Buds are always procured from the young branches that have grown the same season the budding is done. On these young branches there will always be a few inches toward the tip which is soft and immature, and therefore this part should be cut away. Peach tree twigs contain both flower buds and leaf buds. If flower buds only were present and were used for budding, they would do nothing but blossom and die, while the leaf buds (also called wood buds) will grow and make a top to the tree. The best wood buds are found towards the middle of the twig.

The wood buds may be distinguished from the flower buds (also called fruit buds) by remembering that they are smaller, flatter and never so plump. A fruit bud can do no particular harm if there is also a wood bud. It is desirable to remember this as a wood bud will frequently have a fruit bud on either side of it. When this is the case the outside buds may be broken off, as they are of no use. Where there is only one bud at the base of the leaf, it is usually a wood bud, and where there are two or three in a row across the twig, it is almost certain that the middle one is a wood bud and the outside ones are fruit buds. After a little observation and practice it will not be hard to distinguish between the two kinds, and to select the proper one to use.

The weather is usually very warm at budding time, so it will be necessary to wrap the twigs from which the buds are to be taken in wet paper or a damp cloth to prevent their drying out. As soon as a twig is cut from the tree, trim off the leaves, leaving a piece of the stem about

half an inch long to hold to when the buds are being inserted.

The manner of cutting the bud from the twig, which is known as the budding stick, is to hold the stick in the left hand upside down and with the other hand force the knife blade down through the bark and into the wood, making a downward cut. Next withdraw the knife and, at a point down near to where the cut stopped, make a cross cut just



Budding peaches. A is a seedling showing the T-shaped cut; at b the flaps have been lifted, at c the bud has been inserted, and d shows how it is tied with raffia. At e the bud has united and the raffia removed.

through the bark and no deeper. If the bark peels easily, and it should at budding time, the bud may be lifted up and will part from the wood very readily. While many prefer to have no wood adhering to the bud, there are some others who slice the buds off from the twig, leaving a portion of the wood attached to them.

The little seedling peaches should be budded as near the ground as is convenient to work, which will be within two or three inches of the surface of the soil. The first step in preparing the seedling to receive the bud is to make a

slit in the bark lengthwise, and at the upper end of this slit a cross cut, thus forming a T-shaped figure on the bark of the seedling. The bark should peel readily and is gently raised and turned back. Now the bud should be cut from the budding stick as directed and inserted beneath the bark of the sprout by holding with thumb and finger the short stem left for the purpose and forcing it downward sharp end first, until the square end of the bud gets down to where it will fit against the cross cut in the bark itself. The bud is then ready for wrapping.

In order that the bud may form a union with the growing seedling it is necessary to press it closely against the tree by binding with some sort of string. Nurserymen commonly use a kind of material called "raffia," which is wet before applying and adjusts itself to the parts to be covered and makes an excellent wrapper. A good substitute for raffia easily obtained by everyone is strips a quarter or half an inch wide torn from old soft cotton cloths. Buds are sometimes tied with strips of wet corn shucks. Whatever is used is to be bound around newly inserted buds in such a manner as to leave only the stem of the leaf sticking out. This leaf stem will serve as an indicator to show whether the bud has united or not. If the stem remains green the bud is living; otherwise it will turn brown in a day or two. Do not wait longer than ten days before examining the buds to see if they are living. If they have united with the trees, release the bandage by cutting it on the opposite side from the bud in order to not disturb the healing wound. This early examination and cutting of the string must not be forgotten, as it is very important. At this time the tree will be making a very rapid growth in thickness and in a remarkably short time will grow over the string and choke the tree to death, or what is more to the point, will make a deep ring in the tree and cause it to break off where the bud is inserted. During the autumn in which the bud is inserted in the tree it will make no growth other than to make a firm union with the stock, the bud itself remaining dormant.

The following spring the bud will begin to grow along

with the other buds on the tree, and then the seedling top must be cut off at from one-half an inch to an inch above the bud. This will throw all of the growth into the new bud, which will shoot up rapidly. A large number of little sprouts will spring up around the stump, and it will be necessary to rub them off two or three times during the summer in order to keep the growth where it is wanted.

It is best to plant peach seeds in rows running north and south, which will make it possible to bud all of the trees on the north side. This is believed to be desirable, because it is thought that the sun may injure the buds when they are first inserted. One season's growth from the bud makes trees of the proper age for planting in the orchard.

"Springing the Bud"

In very early budding, or at any time during a dry season when it is difficult to obtain mature buds, pinching the little points of the shoots from which the buds are to be taken ten days or so before they are required will have the result of perfecting them. This is called "springing the bud" and is the proper practice when the embryonic twig seems to be loitering. We have a great deal to learn yet about budding and it is a science which every horticulturist should acquire for the time is coming when we will be producing the most of our planting and renewal stock in this way.

How to Make Grafting Wax

Gratfing waxes may be prepared in a great variety of ways, nearly all of them using resin and beeswax for the foundation. Some grafting waxes need to be melted over a fire and applied hot, others are soft and pliable when cold. The latter can be used in cool climates, but where the summers are very warm, the thin waxes when used on wounds or top-grafts are liable to melt and run.

The hard waxes can easily be kept in a working condition in the field by placing the vessel containing the wax

over a lighted kerosene lamp. If the lamp is placed inside a box that has a hole cut in the top large enough to let the wax pot set in, the lamp can then be protected from blowing out in the wind.

Common Grafting Waxes

1—4 pounds resin, 2 pounds beeswax, 1 pound tallow.
2—6 pounds resin, 2 pounds beeswax, 1 pound tallow.
3—6 pounds resin, 2 pounds beeswax, 1 pint linseed oil.
4—4 pounds resin, 1 pound beeswax, 1 pint raw linseed oil.

Waxed String for Grafting

Common knitting cotton, No. 18, dropped into any of the waxes made from beeswax and resin while the wax is melted. The ball should be turned over frequently and allowed to remain in the hot wax for several minutes to become thoroughly saturated.

This string is useful in wrapping grafts and does not need to be tied. Waxed cloth can be made in the same way, and is used in making top grafts.

Evaporating Apples

It frequently happens that a portion of the fruit crop cannot be profitably marketed at harvest time, and unless used in some other form it becomes waste on the hands of the grower. Such fruit may be dried or evaporated and be thus converted into a marketable or usable product.

There is a distinction between "dried" and "evaporated" fruit, the former term usually being applied to sun dried fruit and the latter to fruit that is dried in an evaporator. For home use, where only small quantities are needed, sun-drying is the easiest means of handling such fruit. The fruit to be sun-dried is first pared and quartered or sliced and placed on a suitable surface in the sunlight, where it will have the advantage of free circulation of air. It is

always advisable in sun-drying to have the fruit covered with a thin screen that is raised an inch or so above the fruit to protect it from being spoiled by insects. It is impossible, or at least difficult, to protect sun-dried fruit from dust. This is one of the most serious objections to this manner of drying fruit, as the dust is always full of germs of many kinds.

Artificial evaporators of convenient size may be had for home use, and are simple to construct and operate. A kitchen cook stove is serviceable for small quantities, and there are some evaporators on the market for use in this way. However, the principle of these evaporators is to support the fruit over a vessel containing hot water in such manner that the fruit will not be cooked nor bathed by the steam, but dried by a continuous flow of dry air. A wire screen supported over a bake pan that is covered will answer the purpose.

Portable evaporators for use in the orchard and capable of handling five or ten bushels of fruit a day are easily constructed, or may be bought ready for use. They consist of a sheet iron stove over which is a box holding several trays on which the sliced fruit is spread. These trays are made of slats of wood, or galvanized iron screens. The top and bottom of the box is provided with openings that will allow of free passage of air over the fruit.

For market it is often customary to bleach the fruit with the fumes of sulphur in order to keep it white and produce what is sometimes believed to be a more pleasing appearance. However, as the bleaching causes the fruit to absorb more or less of sulphurous acid, it is rendered deleterious to the health. For home use bleaching should not be done.

Where considerable quantities of fruit are to be evaporated some of the simple paring and slicing machines that are operated by hand will facilitate preparing the fruit. But where large quantities are to be handled a power machine will give better service. There are such machines on the market that are capable of paring as much as 400 bushels of apples a day.

After the fruit is pared it will have to be trimmed of any little scraps of skin or worm holes and other blemishes. This is possible only by hand work, and must be done with an ordinary paring knife. Where the fruit is to be bleached, it is treated as soon after the paring and trimming as possible. The fruit is enclosed in a tight box in shallow layers, over which the fumes of burning sulphur are passing. It will take an exposure of half an hour to an hour and a half to sufficiently bleach the fruit. If a long delay occurs between the paring and bleaching it is impossible to make the fruit regain its original whiteness.

The time required for drying will depend entirely on local conditions, and to a small extent on the weather, taking a longer time in rainy weather than in dry. To determine when the fruit is dry is dependent largely on the experience of the dryer. The fruit should be so dry that when a handful is pressed into a ball it will be "springy" enough to separate at once upon being released. It should not be possible to press any juice from any of the slices, and the fruit should have a soft, velvety, leathery texture.

In large fruit sections it is often a very remunerative business to operate a large evaporator which can use all of the unsaleable fruit from the vicinity, this being especially the case when the evaporator can be used in connection with a vinegar or canning plant.

By-Laws of Grand Junction Fruit-Growers' Ass'n.

I

The name of the said association shall be the Grand Junction Fruit Growers' Association.

II

The objects for which the said association is created are to buy and sell fruit, vegetables, hogs, meat stock, and all of the products of Mesa County, both fresh and manufactured; to erect, operate and maintain canning and packing factories and commission houses; to manufacture and

sell all products of Mesa County; to lease, mortgage and sell said business, and to borrow money for carrying on same, and to pledge their property and franchise for such purpose. To acquire by purchase and own real estate, buildings, machinery and all the necessary power and power plants for carrying on said premises, and to lease, mortgage and sell the same.

III

The term of existence of said association shall be twenty years.

IV

The capital stock of the said association shall be twenty-five thousand dollars, divided into five thousand shares of five dollars each.

V

The number of directors of said association shall be seven, and the names of those who shall manage the affairs of the association for the first year of its existence are C. W. Steele, A. A. Miller, J. W. Rose, R. W. Shropshire, J. H. Smith, P. A. Rice and A. B. Hoyt.

VI

The principal office of said association shall be kept at Grand Junction in the said county, and the principal business of said association shall be carried on in the county of Mesa.

VII

The stock of the association shall be non-assessable.

VIII

The directors shall have the power to make such prudential by-laws as they may deem proper for the management of the affairs of the association not inconsistent with the laws of this state, for the purpose of carrying on all kinds of business within the objects and purposes of the association.

BY-LAWS

Article I

Section 1. The board of directors provided for in the articles of incorporation of this association shall be elected annually at the regular annual meeting of the stockholders, as hereinafter provided, and shall hold their office until their successors are elected and qualified.

Section 2. Said directors shall be stockholders in said association and shall be fruit growers in Grand Valley and shall be residents of Mesa County, Colorado.

Section 3. Any vacancy occurring in the board of directors shall be filled by the remaining members of the board.

Article II

Section 1. The board of directors shall, as soon as may be after their election, elect a president and vice-president from among their number, who shall hold their offices for one year, and at said meeting the said board shall appoint a secretary-treasurer and manager, who shall be subject to removal at any time.

Section 2. The secretary, treasurer and manager shall each, when required by the board, give bond in such sum and with such security as the directors may require, conditioned on the faithful performance of their duties, and to turn over to their successors in office all books, papers, vouchers, money, funds and property of whatsoever kind or nature belonging to the association upon expiration of their respective terms of office, or upon their being removed therefrom, or with other conditions as may be proper.

Section 3. The president shall preside at all meetings of the directors or stockholders. He shall sign as president all certificates of stock and all other contracts and other instruments in writing, which may have been ordered by the board of directors.

Section 4. The vice-president shall in the absence of or disability of the president, perform his duties.

Section 5. The manager shall have full charge of the commercial and shipping department of the association. He shall receive all money arising from the sale of fruit and other commodities handled by the association, and pay the same to the parties entitled thereto, and render a true account thereof; and he shall also be the treasurer of the association and disburse same under the direction of the board of directors, except as hereinabove set forth.

Section 6. The secretary shall keep a record of the proceedings of the board of directors and also of the meetings of the stockholders. He shall also keep a book of blank certificates of stock, fill up and countersign all certificates issued, and make the corresponding entries upon the marginal stub of each certificate issued. He shall keep a stock ledger in due form, showing the number of shares issued to and transferred by any stockholder and date of issuance and transfer. He shall have charge of the corporate seal and affix the same to all instruments requiring a seal. He shall keep in the manner prescribed by the board of directors all accounts of the association with its stockholders, in books provided for such purpose. He shall discharge such other duties as pertain to his office and as may be prescribed by the board of directors.

Section 7. These by-laws may be amended by the board of directors at any special meeting thereof called for that purpose, a notice of such proposed amendment being given in the call for such special meeting.

Article III

Section 1. The regular meeting of the board of directors shall be held at the office of the company on the first (1st) day of each month, except when the first day comes on Sunday or legal holiday, then on the following day.

Special meetings of the board of directors may be called by the president when he may deem it expedient or necessary, or by the secretary upon the request of any three members of said board.

Section 2. A majority of the board of directors shall

Irrigating an apple orchard. Five furrows between the trees.

constitute a quorum for the transaction of business, but a less number may adjourn from day to day upon giving notice to absent members of the said board of said adjournment.

Section 3. The board of directors shall have power:

First. To call special meetings of the stockholders whenever they deem it necessary, by publishing a notice of such meeting once a week for two weeks preceding such meeting in some newspaper published in Grand Junction, Colorado.

Second. To appoint and remove at pleasure all employes and agents of the association, prescribe their duties, where the same have not been prescribed by the by-laws of the association, fix their compensation, and when they deem it necessary, to require security for the faithful performance of their duties.

Third. To make such rules and regulations not inconsistent with the laws of the state of Colorado, and articles of incorporation, or the by-laws of the association, for the guidance of the officers and the management of the affairs of the association.

Fourth. To incur such indebtedness as they may deem necessary for carrying out the objects and purposes of the association and to authorize the president and secretary to make the note of the association with which to raise money to pay such indebtedness.

Section 4. It shall be the duty of the board of directors:

First. To be caused to be kept a complete record of all of their meetings and acts, and also the proceedings of the stockholders, present full statements at the regular meetings of the stockholders, showing in detail the assets and liabilities of the association, and the condition of the affairs in general.

Second. To supervise all acts of the officers and employes, require the secretary, treasurer and manager to keep full and accurate books of account of their respective business.

Article IV

Section 1. At the regular meeting in the month of January of each year the directors shall declare such dividends upon the capital stock, to all the stockholders then appearing of record, as may be warranted by the net earnings of the association for the preceding year.

Article V

Section 1. The board of directors may, whenever they shall deem it necessary, place on sale so much of the capital stock of the association as may be necessary to raise funds for the purpose of carrying out the objects and purposes of the organization of the association, such stock to be sold only upon the following conditions:

First. That not more than three hundred (300) shares thereof be sold to any one person, firm or association of persons.

Second. That such stock be sold to fruit growers in Grand Valley.

Third. That such stock be sold at not less than par value of five dollars ($5) per share.

Article VI

Section 1. The annual meeting of the stockholders for the election of directors shall be held on the third (3rd) Saturday in January each year, but if, for any reason, it should not be held on such day, it may then be held on any day subsequent thereto as hereinafter provided.

Section 2. The board of directors shall be elected by the stockholders at the regular annual meeting. Public notice of the time and place of holding such meeting and election shall be published not less than ten (10) days prior thereto, in some newspaper of general circulation printed in Grand Junction and the said election shall be made by such of the stockholders as shall attend for that purpose, either in person or by proxy, providing the majority of the outstanding stock is represented. If a ma-

jority of the outstanding stock shall not be represented, such meeting may be adjourned by the stockholders present for a period not exceeding sixty (60) days. All elections shall be by ballot, and each stockholder shall be entitled to as many votes as he or she owns shares of stock in said association; provided, however, that no person who is not himself a stockholder shall be allowed to represent by proxy any stockholder in the said association.

The persons receiving the greatest number of votes shall be the directors for the ensuing year, and until their successors are elected and qualified.

Article VII

Section 1. Certificates of stock may be transferred at any time by the holders thereof, or by attorneys in fact or legal representatives. Such transfers shall be made by indorsement on the certificate of stock and surrender of same; provided, such transfer shall not be valid until same shall have been noted in the proper form on the books of the association. The surrendered certificates shall be canceled before a new certificate in lieu thereof shall be issued, and no transfer of any share of stock shall be valid or allowed upon the books of the association upon which any deferred payments are due and unpaid, or which has not been sold and transferred in accordance with the provisions of the by-laws of the association.

Section 2. Any stockholder desiring to dispose of his stock in the said association shall deposit the same with the secretary of the association, and the same shall be sold by the secretary at not less than par for the account of such stockholder within sixty (60) days from date of such deposit, under the restrictions of section 1, article V, of these by-laws: provided, that if the secretary shall not have sold such stock at the expiration of sixty days, then such stock may be returned to the stockholder and disposed of by him, without restriction or limitation by the association.

Article VIII

Section 1. All members of the association are required

to market all of their fruit through the association and bear their proportionate share of the expenses of handling same.

Section 2. Any member may have the privilege of selling his own fruit at the orchard, but no sales of fruit shall be made to a dealer in fruit, or to any person why buys to ship outside the county. In case of sale of the entire crop of any particular fruit or fruits, by reporting the same to the association, one-half (½) only of the regular commission will be charged.

Section 3. Any member having any grievance or cause for complaint as to treatment of his fruit by the association can appeal to the board of directors, whose decision shall be final.

Section 4. All members must pack their fruit for shipping in a neat and workman-like manner, and pack in standard sized packages, as adopted and in general use by the association, having placed their name thereon.

Article IX

Section 1. A purchaser of stock of this, the Grand Junction Fruit Growers' Association, shall hereafter receive of the profits of the association in proportion to the money he has invested.

INDEX

Books on Agriculture

GENERAL FARMING

American Farm Book	Allen	$2.00
Animal Breeding	Shaw	1.50
Book of Alfalfa	Coburn	2.00
Cereals in America	Hunt	1.75
Clovers, How to Grow Them	Shaw	1.00
Cyclopedia of Agriculture (4 vols.)	Bailey	20.00
Elements of Agriculture	Welborn	.75
Farm Appliances		.50
Farm Buildings		2.00
Farm Conveniences		1.00
Farm Grasses	Spillman	1.00
Farm Machinery and Farm Motors	Davidson-Chase	2.00
Forage Crops	Voorhees	1.50
Ginseng	Kains	.50
How Crops Feed	Johnson	1.50
How Crops Grow	Johnson	1.50
Principles of Agriculture	Bailey	1.25

SOIL

Fertilizers	Voorhees	$1.25
Fertility of the Land	Roberts	1.50
First Principle of Soil Fertility	Vivian	1.00
Irrigation Farming	Wilcox	2.00
Irrigation Institutions	Mead	1.25
Soil and Crops of the Farm	Morrow-Hunt	1.00
Soils	Hilgard	4.00
The Soil	King	1.50

FRUIT-GROWING

American Apple Orchard	Waugh	$1.00
American Fruit Culturist	Thomas	2.50
American Horticultural Manual (vol. 1)	Budd-Hansen	1.50
American Horticultural Manual (vol. 2)	Budd-Hansen	1.50
Citrus Fruits and Their Culture	Hume	2.50
Conquest of Arid America	Smythe	1.50
Dwarf Fruit Trees	Waugh	.50
Forcing Book	Bailey	1.25
Fruit Garden	Barry	1.50
Fruit-Growing in Arid Regions	Paddock-Whipple	1.50
Fruit Harvesting, Storing and Marketing	Waugh	1.00
Horticulturist's Rule Book	Bailey	.75

Books on Agriculture—Continued

Nursery Book	Bailey	$1 50
Nut Culturist	Fuller	1.50
Peach Culture	Fulton	1.00
Pear Culture for Profits	Quinn	1.00
Plums and Plum Culture	Waugh	1.50
Popular Fruit-Growing	Greene	1.00
Principles of Fruit-Growing	Bailey	1.50
Propagation of Plants	Fuller	1.50
Pruning Book	Bailey	1.50
Quince Culture	Meech	1.00
Successful Fruit Culture	Maynard	1.00
Systematic Pomology	Waugh	1.00

DISEASES OF PLANTS AND TREES

Bacteria in Relation to Country Life	Lipman	$1.50
Disease in Plants	Ward	1.60
Fumigation Methods	Johnson	1.00
Fungous Diseases of Plants	Duggar	2.50
Plant Diseases	Massee	1.60
Spraying of Plants	Lodeman	1.25
Text Book on Entomology	Packard	4.50
Insects and Insecticides	Weed	1.50

SMALL FRUITS

American Grape Growing and Wine Making	Husman	$1.50
Bush Fruits	Card	1.50
Cape Cod Cranberries	Webb	.40
Cranberry Culture	White	1.00
Grape Culturist	Fuller	1.50
Small Fruit Culturist	Fuller	1.00
Strawberry Culturist	Fuller	.25

GARDENING

Asparagus	Hexamer	$0.50
Bean Culture	Sevey	.50
Book of Vegetables	French	1.75
Cabbage-Cauliflower	Allen	.50
Celery Culture	Beattie	.50
Mushrooms, How to Grow Them	Falconer	1.00
New Onion Culture	Greiner	.50
New Rhubarb	Morse	50
Onions		.20
Potato, The	Fraser	.75
Practical Garden Book	Bailey	1.00
Sweet Potato Culture	Fitz	50
Tomato Culture	Tracy	.50
Truck Farming in South	Davis	1.00
Vegetable Gardening	Bailey	1.50

Books on Agriculture—Continued

POULTRY

Ducks and Geese		$0.75
Eggs and Egg Farms		.50
Plymouth Rocks		1.25
Poultry Doctor	Robinson	.50
Poultry Houses and Fixtures		.50
Reliable Poultry Remedies		.25
Turkeys	Myrick	1.00
Wyandottes		1.25

MISCELLANEOUS

A B C & X Y Z of Bee Culture	Root	$1.50
American Sugar Industry	Myrick	1.50
Cement Worker's Hand Book		.50
Chemistry of Plant and Animal Life	Snyder	1.25
Cider Maker's Hand Book	Trowbridge	1.00
Cyclopedia of American Horticulture (4 vols.)	Bailey	20.00
Evolution of Our Native Fruits	Bailey	2.00
Farmer's Business Hand Book	Roberts	1.25
How to Choose a Farm	Hunt	1.75
Landscape Gardening	Waugh	.50
New Creations In Plant Life	Harwood	1.75
Plant Breeding	Bailey	1.25
Rural Wealth and Welfare	Fairchild	1.25
Survival of the Unlike	Bailey	2.00
The Farmstead	Roberts	1.50

Any of the books listed on the preceding pages can be obtained at the price named, from

THE FRUIT-GROWER,
ST. JOSEPH, MISSOURI