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CORVALLIS, OREGON.

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## ORCHARD MANAGEMENT

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By C. I. LEWIS and W. H. WICKS.

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## INTRODUCTION.

This bulletin, entitled "Orchard Management," is not intended to put forth and explain some new and wonderful discovery or achievement in the domain of horticulture, but rather to thoroughly explain the management of important fruits and assist the large class of deserving people who are now beginning to realize and appreciate the value of fruit-growing as a sound lucrative occupation.

The fruit industry is rapidly enlarging and becoming of great importance throughout the Pacific Northwest and more particularly the fertile State of Oregon. Altho the price of our various fruits and particularly apples, is not as high as that which Mr. Leulling received for his first apples which he sold in Portland in the early fifties, yet nevertheless, there is a neat profit in raising fruit at the present prices.

Almost ninety-five per cent of those people who have just begun or intend to begin raising fruit in this state are those who are leaving their original profession. Consequently, we are receiving letters of inquiry at the experiment station from men who have not the first principles of fruit-growing, and those with the rest of the industrious people of the state are the ones this treatise is intended to assist. The questions asked are so various that it is thought best to answer them by printing a general simple bulletin that everyone can understand, and it is hoped will fulfill the apparent need.

The word orchard is very broad in its meaning and will admit of further explanation. By orchard we mean a group of trees planted and cultivated for their fruit. Thus, we have an apple, peach, plum and pear orchard and any other combination of fruit-producing trees that may be grown. This work will treat of pomaceous fruits such as the apple and pear.

The prospective fruit grower will appreciate a few remarks in regard to the price of fruit land, the prices of the various fruits, and the adaptability of our state to growing the different kinds. We think at the present time there is hardly five per cent of the suitable land in Oregon in use for raising fruit. The tabulation of the fruit districts and the fruits that do well in them will throw light on this subject, but the world must know that more fruit land is lying idle

in this state, particularly in the Willamette valley. Most all of our foothills could be successfully put in cultivation and upon a suitable subsoil, the apple, pear, peach, and grapes will grow to perfection. The Hood and Rogue river valleys have become famous, and the Willamette valley will be second to none when her people wake up and improve the splendid opportunities which lie before them.

The land here in large tracts, which is producing goat pasture and selling at the present time from twenty to fifty dollars per acre, should be put into suitable fruit and be worth from five to twelve hundred dollars per acre. There is nothing worth while in this world which does not cost an effort. There are difficulties incidental to all progress and the fruitgrower must be determined to meet and overcome them. The success of a man is usually determined by himself, and if the right spirited tiller takes charge of our soil, it will undoubtedly do its part in return.

We may here give to some advantage the profits and yields of some of our leading horticulturists of the state. In Southern Oregon there are thirty-five acres of Spitzenberg apple trees fifteen years of age which bore from thirty-seven to thirty-five boxes of three-and-one-half tier apples per tree. The net receipts of this crop was some better than \$8000.00. On another farm in the same vicinity, an acre and one half produced twelve hundred boxes of apples which sold for \$2.00 per box, making a profit of \$1,520. A carload of Southern Oregon pears sold last winter in the East as high as \$3.00. The Hood River Apple Growers' Union sold their apples this year a little better than \$3.00 per box. It must be well understood that the fruit is first-class and made so by proper management.

#### LOCATION AND SITE.

LOCATION.—The question of location is very difficult to answer satisfactorily, but a few remarks here will serve as a guide. The reader must always remember that the location must be chosen by himself. The location is the position of the place fixed by the surveyor. It may lie in any one of the various fruit regions, and is generally governed by the distance from shipping facilities, as the market may be reached no matter how far away. Bear in mind when choosing a location that the nearer the market the better, providing other things are equal, and secure several means of shipping if possible. If fruit is grown in small quantities and for fancy trade, it

is better to be close to the market, but if it is grown on a large scale for commercial purposes it may be grown further from the market, as our present day methods of transportation have overcome distance, but locate as near as possible to shipping points. The cost of land must not be too important in choosing a location if the desired location will produce your ideal crop. In order to grow the



Fig. 1.—Windbreak greatly needed. Only by the most judicious pruning can these trees be balanced, and then only with great difficulty. Staking would have helped many of these trees.

best fruits, you must choose those that will thrive best under the conditions of the locality. Facility of tillage and climatic conditions are very important in choosing your location, To sum up briefly the subject of location, choose a fertile soil which should be deep, well drained and good body or texture, near two or more shipping points, and a suitable climate.

#### SITE.

As to SOIL.—The site of the orchard is an important question and is governed by conditions that prevail in certain localities. The following points must be observed: Texture and kind of soil, supply of soil moisture or facility to irrigate, air and soil drainage,

wind-breaks, direction of slopes and distance from large woods.

The above terms will need more explanation before they are of any practical value to the man who is not acquainted with agriculture. There are many kinds of soil and our various fruits prefer their respective soils. We know that the apple likes a well-drained, deep rich soil, while the pear prefers a more heavy clay loam but likes to be well drained. The peach does best in a well-drained gravelly or decomposing rocky soil with a deep subsoil. In choosing land be sure not to have an ideal soil in one part of your orchard and a hardpan or impervious strata in another. If the soil is not rich, deep and satisfactory in every way, do not purchase it.

The soil moisture requires further explanation, but will receive more under the subject of "soil." The air drainage of an orchard is very important, as this is in relation to frost. The cold air settles in the valleys and low places and if the orchard is in the warmer and circulating strata of air it will often escape dangerous frosts. Water gives up its heat slower than the earth and orchards that are near it will be more or less protected from cold. The subject of soil drainage will be treated under its proper heading later.

The wind-break has proven itself exceedingly useful and there are many points in its favor, yet there are those who do not think favorably of it and will not tolerate one on their soil. Fig. 1 shows conclusively the need of an ordinary wind-break that can be obtained by planting any of our native conifers. Some very good reasons for a wind-break may be stated thus: It protects from cold, reduces evaporation of the soil, prevents breaking of trees by wind, lessens windfalls, protects blossoms, retains the loose surface soil and is a home for beneficial birds. There are some objections to the wind-break, which, however, need to be spoken of here in order to place your wind-break in its proper relation to the orchard. If the fruit trees are too near it, the fruit will be poor in color and generally covered with rust and more or less infected with insects. For warm, strong winds use poplar, maple, etc.; for cold winds the conifers, such as fir and spruce; seedling fruit trees, as Fig. 2, may be used, but must be kept sprayed. The alder and several other of our native trees furnish food for the tent caterpillar and several diseases. The more our natural forests are cleared away the more

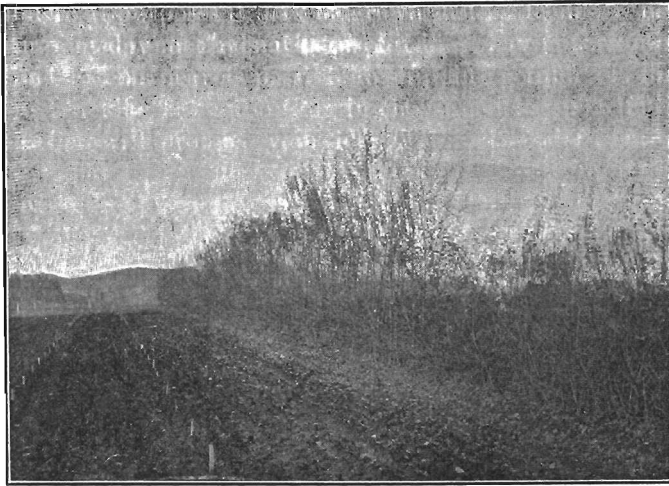


Fig. 2.—Effective economical wind-break. A wind-break may be grown with very little trouble and expense. This wind-break takes very little room and does not take much nourishment from the soil. ■



Fig. 3.—Permissible in a young orchard but the crop is somewhat too heavy. Never grow grains but garden truck may be grown if necessary.

wind-breaks will the horticulturists be compelled to plant. We cannot change and control atmospheric conditions, but we can moderate them to a certain degree. Fig 2 shows an effective economical wind-break of apple, plum and quince seedlings.

AS TO ASPECT.—The exposure or aspect is determined by the direction and slope of the land. The temperature of the soil and air is greatly influenced by the aspect and is a direct factor in growing the tender and early blooming varieties. If possible select a site that has a natural soil and air drainage. The excess of cold air and soil moisture must be carried from the orchard. The need of air drainage is apparent if we go from the top of a small hill to the valley and notice the difference in temperature. The colder air always settles to the low places, and consequently frost is more frequent. If you are to grow fruits that blossom early and must be protected from late frost, then a northern aspect is much to be preferred, but always remember a southern aspect is much better providing the late frosts will not bother in your locality. Those varieties that take on high color must be planted where they will receive the most sun. Always avoid small valleys with a creek running thru, as the cold air will accumulate in such places, and frost will do considerable injury, but large bodies of water are beneficial.

“Deep valleys with small streams of water are the worst situations for fruit trees, as the cold air settles down in these valleys on a calm frosty night, and buds and blossoms are very frequently destroyed. We know a rich and fertile valley of this kind in Connecticut where the cherry will scarcely grow and a crop of apple or pear is not obtained once in ten years, while the adjacent hilltops and high country a couple or three miles distant, yield abundant crops annually.”—*Downing's Fruits and Fruit Trees of America.*

#### SOIL.

The soil must have a good supply of humus and if possible some cover crop growing on it to be turned under. We must keep the land at work and not allow it to be idle, as was the general opinion a few years ago.

The amount of plant food which mature fruit trees in the full vigor of bearing use in one growing season has been reported by L. L. Van Slyke, O. M. Taylor and W. H. Andrews of the New York State Station. The apple trees in the experiment yielded during the season from twenty-three to nearly thirty bushels of fruit each, the pear trees, from one to five bushels each, the plum, from one to



one and three-fourth bushels each, and the quince trees about fifteen bushels.

Variety.	Lbs. Nitrogen.	Lbs. Phosphoric Acid.	Potash.	Lime.	Magnesia.
Apple.....	1.47	.39	1.57	1.62	.66
Peach.....	.62	.15	.66	.95	.29
Pear.....	.25	.06	.27	.32	.09
Plum.....	.25	.07	.32	.34	.11
Quince.....	.19	.06	.24	.27	.08

In our climate most all fruit trees will thrive and produce some fruit, but as before stated, each fruit prefers its own peculiar soil.

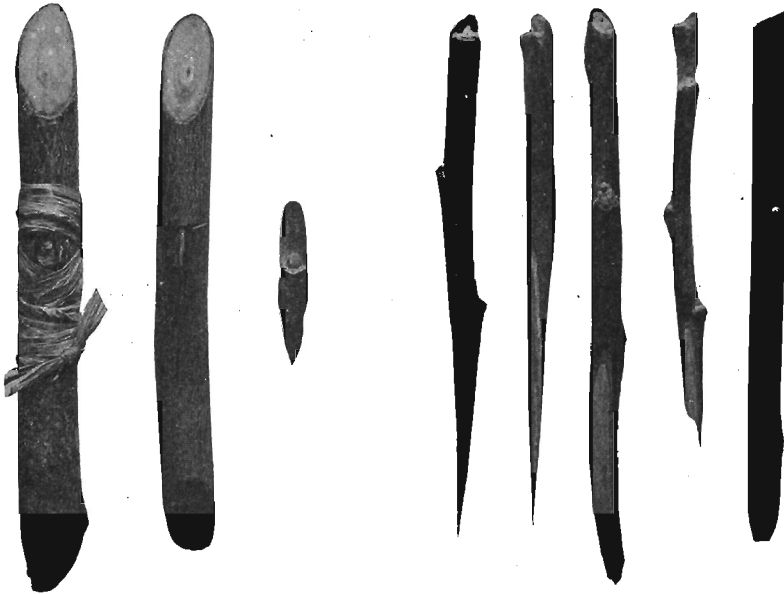


Fig. 4.—Common method of budding.

Fig. 5—1, 2, 3 desirable scions, 4 and 5 undesirable; 4 terminal growth, and 5 water sprout. The last two should never be used.

The soil best adapted to general fruit culture may be classed or divided into gravelly loam, sandy loam, strong black loam and clay loam. Very light sandy soil, wet swamp and peat soil or dry sand, are generally to be avoided, although there are exceptions. For instance, in the neighborhood of Grants Pass we find a large area of light sandy loam which the observer would not consider good apple land. This land has been filled in by previous overflows of the Rogue River, but this soil produces fruit of the finest qualities. Investigation shows the reason. The soil is deep and mellow, from

fifteen to twenty feet when the water table is reached, thus supplying abundance of water. This soil is unexcelled for cultivation purposes as it can be worked while other soils are sticky and heavy. The hardier fruits usually do best on a rich, moderately heavy clay loam, and experience has shown that the apple, pear, and plum do much better on such a soil and are much more immune from diseases of various kinds. Fruit on such a soil is large, of good keeping quality, and in our climate of fine color. Fruit on lighter soil is generally smaller, of higher color, poorer keeping quality, maturing sooner but producing fruit of fine flavor and aroma.

A gravelly loam is a soil that contains gravel but not in excess. A strong loam is a soil that is rich and contains just enough sand to make it loose and easily worked. Clay loam is usually a strong and deep soil and contains just enough clay to make it more or less difficult to work. It is best to choose a soil rich in calcareous substances if the texture is good. The small fruits require rich soil and will do well almost on any soil that will produce first-class farm crops.

**PREPARATION.**—The first thing to do is to have the soil in a good state of cultivation so that it can give up its plant food when applied or that which it already contains. The soil should be tile-drained, if not naturally, thoroly fertilized, properly subsoiled and put in the best shape possible before any trees are planted. If the soil is deep, the trees will go deep into it, and the root system will be out of the way of the plow. The manures should be incorporated in the soil immediately, and must be placed where the rootlets can use it and not piled high about the trunks of the trees after they are planted.

#### **DRAINAGE.**

**FUNCTION.**—The functions of drainage are many but the following will give some of the most important reasons why land should be drained. Drainage removes the injurious salts in the earth which would accumulate in a soil with no natural or artificial drain. It removes water at those times when a surplus would be very injurious to plant life by excluding sufficient air. In our rainy season the surplus water must be carried off. In contrast to this, drainage enables the soil to hold more moisture in those times when it is most needed by the plants. In soils poorly drained the water table is near the surface in the early part of the season, and hence the

plants make a lateral shallow root growth. Later, when rains become less frequent, the water table or level falls and the plants, owing to a poor root growth, suffer in time of drouth. It deepens the soil and makes the capillary action greater, while it increases the amount of plant food by causing a larger amount of soil to give up its food when penetrated by the roots of plants. The lower the water table the more surface will the plants be able to utilize, as nitrification and those changes which unlock stored plant food take place in well ventilated soil. The physical condition of the soil is greatly improved by aiding and facilitating chemical changes. The

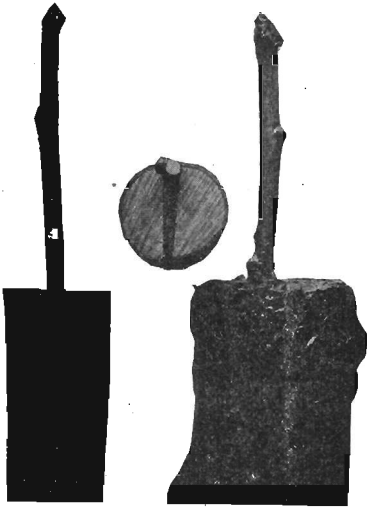


Fig. 6.—Cleft grafting. No. 1, scion inserted ready for waxing. No. 2, end view of No. 1 to show position of scion. No. 3, No. 1 waxed. Be sure to thoroughly cover the wound. All things considered, the best method of top working.

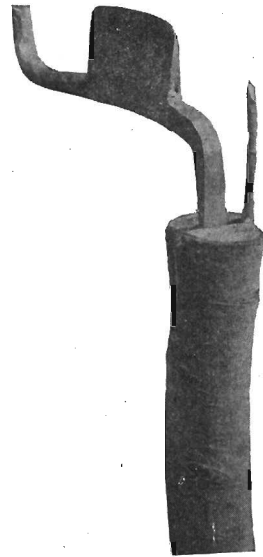


Fig. 7.—Grafting chisel. This can be made out of an old file. The blade must not be driven into the stock too far.

soil is made much warmer by the removal of surplus water, and the increased temperature has a beneficial influence on plant growth. Those small bacteria which are so important are able to do much more and faster work in soil which is well drained.

Wm. P. Brooks, in his book entitled "Soils and how to treat them," says:

"Among the principal benefits which follow the drainage of soils needing it may be mentioned the following: it deepens the soil, promotes aeration, makes manures more effective, warms the soil, lengthens the season both for plant growth and for work, makes all tillage operations easier and improves the

tilth, reduces the liability to injury of crops from drought, promotes the better germination of seeds, results in the production of larger crops of better quality and decreases the risk of failure of crops, reduces the amount of surface wash, makes it possible to haul heavy loads over the field, produces better sanitary conditions, and decreases the number of mosquitoes and malarial diseases. Thorough drainage and thorough tillage are the main points in land improvement."

**LAND THAT REQUIRES DRAINAGE.**—There are several kinds of land which need drainage, but it can safely be stated that a large percentage of land in Oregon would be benefited by a system of drainage, and much of our so-called white land could be reclaimed if the surplus water was carried off and the land cultivated properly.

Land that is overflowed frequently by our creeks and rivers need a thoro system of under-drainage; also flat land with a heavy subsoil. Most land at the foot of hills are subject to ooze water and the overflow of springs, etc., and hence will be much benefited by drainage. In the rainy season here may be seen land where the water table is visible above the surface, and it can be readily seen that such land needs drainage. Any land that will not shed its surplus water in forty-eight hours after heavy rains needs drainage badly.

**ITS EFFECT ON PLANTS.**—Seeds often decay in poorly drained soil, and those that do succeed in germination have very unfavorable conditions to contend with. A fair amount of moisture, air and favorable temperature are needed for plant growth. A certain amount of water is necessary in the soil, it must be understood, but the amount above what the plants require must be carried off. The food of plants is in solution and water is the medium in which it is carried from the crude state to the useful form.

The soil particles are made much smaller by drainage, and thus the small delicate root-hairs are enabled to pass among them and secure more food. The tips of roots and root-hairs are acid and have the power of unlocking plant food in the soil and oxygen in sufficient amount is required among the particles in order for the rootlets to carry on their work. Crops are also of better quality and the valuable constituents are increased. Among the most valuable ingredients may be mentioned starch, albuminoids and sugar. It must be remembered that all conditions support their respective plant life, i. e., water-logged soil will support water-loving plants, and a well drained soil will produce the more valuable ones.

**METHOD OF DRAINAGE.**—There are several ways of draining a field,

but the under-drain is the only method to use in soil used for horticultural purposes. The surface drains may serve temporarily in some conditions but they are inferior to the under-drains. All sorts of drains have been used in the past but experience has proven that the tile drain is the best. Some of the other kinds are brush, cement, wood, stone and brick.

The distance between drains is governed entirely by the kind of soil and the position of the same. If the soil is more or less loose and friable, the drains may be from twenty to forty feet apart and be quite satisfactory. They will do better work if placed much

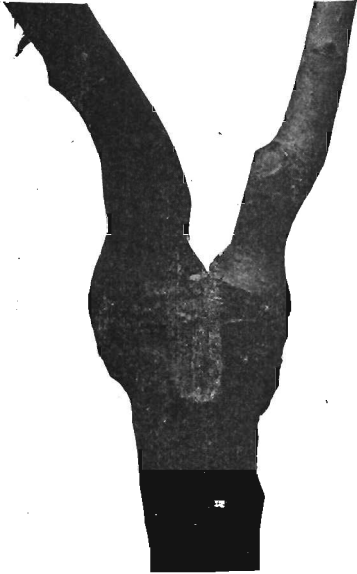


Fig. 8.—A stock of this size cannot support two scions. One would have made a strong union.



Fig. 9.—Result of two scions on a small stock. The stock is decayed in the center. Practically lost. One scion would have prevented this.

closer in heavy impervious soils. The depth to which they are placed depends upon the outlet, the slope of the land to be drained and the general conditions of the soil. The depth of the drains will govern the distance apart to which they are placed. The deeper the tile, the farther apart they may be placed, providing the soil is porous and will admit the water to the drain. From four to five and one-half feet is none too deep for best results, and the deeper the water table the better for the trees. The drains should be, in

all cases where possible, deep enough to escape being misplaced by tools, and in severe climates, by frosts.

The size of the tile is an important consideration in putting in a system of drain. Wheeler says:

"If the fall be six inches in one hundred feet, the two-inch main will carry water from three acres, and with a fall of twelve inches in one hundred feet, it will carry the water of double the above named area. Also for the more open soils, a four-inch main would carry the water from five acres, a six-inch main, the water from twelve acres and an eight-inch main the water from twenty acres, provided the fall is from three to four inches in every hundred feet. If the fall is six inches, the different sizes will carry the water from one and one-half times the above named areas. In clay soils the number of acres for the different sizes at different grades will be double those above named."

It is never wise to use larger tile than necessary. The outlet of the main drain is an important point. Much depends upon into what the main empties, but a solid substantial support is forcibly recommended. Otherwise, the terminal joints become misplaced and eventually the whole system is obstructed. If the outlet is in a stream where the water flows against it with any considerable force, build your bulkhead at such an angle so the water of the stream will not wash in back of it and eventually carry it out.

In conclusion, will say that the tile must be properly laid and all work done well.

#### CULTIVATION.

This is performed to better the mechanical condition and increase plant food. Tillage of the soil in the orchard is to increase chemical changes. Every orchardist has his method of cultivation. The most general practice is to plow about the time the blossoms fall, or as soon as the conditions are suitable, and then follow this with a clod crusher or disc harrow. The soil is afterwards kept with a very fine dust mulch of three or four inches deep all summer. This is very instrumental in saving soil moisture. The tools most commonly used by the best fruit growers are as follows: eighteen inch disc, smoothing harrow, leveler, clod smasher, spring tooth or acme harrow, Kimball orchard weeder, a home-made weeder to cultivate near the tree trunks, and a good plow.

It is far better to have a small piece of land and keep it under high cultivation than to poorly care for a larger area. The people in this state should dispose of a portion of their large farms and improve their method of cultivating the smaller amount. The value of cultivation thruout the dry season may be more appreciated if

explained more in detail. Suppose you place in a pan of water the end of a large glass tube and notice the rise of the water in the same. The operator will notice that the water does not rise to any



Fig. 10.—Correct planting. The properly planted orchard should look like this. These trees show beautiful symmetry and good care.

great extent. Then place in the same pan of water a very small tube in the same manner as the larger and notice the rise of water. This then is the same principle as that in the soil, that of capillary

action. The finer the ground is made, the smaller and more numerous are the capillary tubes, and thus the more moisture is carried upward from the water table. The cultivation should not be continued too late in the season, as it will induce a late growth of the trees. Cultivation should stop in late summer or early fall, and the land be sown with vetch, clover, rape, turnip or some such plants as a cover crop, to be turned under in the following spring.

#### COVER CROPS.

The cover crop is coming more into favor in this state. Most soils are losing their humus, through continued working and producing, and the cover crop is the ideal thing to restore them to their former condition. Before sowing a cover crop, determine what results certain plants will bring about. If your trees need nitrogen, they will show it by having light green small foliage and a small wood growth. The best cover crop in this case would be any one of the leguminous plants—preferably vetch. If your fruit lacks color add potash, sow turnips or rape, and if your soil needs some of the surplus water carried away, sow those plants that evaporate the greatest amount. The cover crop should be plowed in before it becomes too abundant as too much green vegetation does not decay rapidly and tends to dry out the soil.

**WHAT A COVER CROP WILL DO.**—A cover crop will catch in the fall the nitrates and other valuable plant food which would otherwise be lost in the drainage system and hold it over until the following spring for the use of the trees. It also catches the nitrates in the spring, which are apt to leach out, and takes up the excess water, and thereby put the ground in condition sooner for cultivation. The humus loosens the soil particles which in turn increases its water capacity. The humus is essential for the growth of the beneficial bacteria of the soil. One of the most important parts that a cover crop plays is its ability to change chemically the compounds in the soil and put them in an available form for the trees. The cover crop gathers, digests and turns over to the trees the plant food which it has stored.

The rotation of cover crops is earnestly advised. This is exceedingly important and must be practised in order to furnish the trees with a balanced ration. When to change the crop will depend upon what the trees lack, as some orchards need more potash than nitrogen and visa versa. Some orchards will need only the humus supplied and this is best furnished by rye. In all uses of a cover



crop make it do a definite work. Never pasture the cover crop in the orchard as the soil is usually too wet to allow stock upon it, and

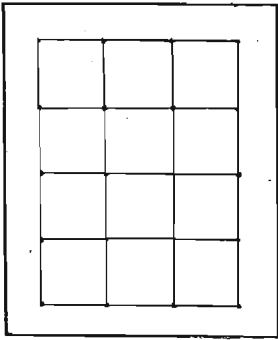


Fig. 11.—Square or opposite plan.  
Not so good as Fig. 12.

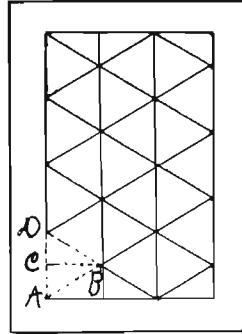
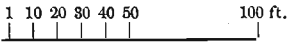


Fig. 12.—Hexagonal plan.  
More trees to the acre  
than by square plan.

the trees will gladly appreciate all the food they can obtain. Some argue that feeding the cover crop is profitable, but it is not half so valuable as the first-class apples at three to four dollars per box.



Fig. 13.—Close planting. Trees eight years old and too close to admit proper care. Thirty-six feet is none too far apart.

## FERTILIZATION.

The fertility of the soil depends upon so many things that it is very difficult to tell just what fertilizers to add, but it must be born in mind that poor crops in nine times out of ten are due to poor mech-



Fig. 14.—Never start the main limbs in this manner. They should issue in a whorl from eight to fourteen inches apart to prevent a bad crotch.

anical condition, instead of lack of plant food. Many of our valley soils are rich in plant food and it remains for the tiller to put it in an available form. If the soil is a heavy clay loam and allowed to become puddled and kept too wet, we can readily see that the mechanical condition is to blame, if the soil produces nothing, no matter how much plant food it contains. If the soil is deficient in any one plant food, it is almost sure to be nitrogen. This most valuable food can be added in several artificial ways—in the form of nitrates—but there are certain minute organisms that will use the free nitrogen of the air if

the condition of the soil is such that they can live. The salts of nitrogen are rapidly leached out of the soil in this climate due to a large annual rainfall. Plants use nitrogen in large quantities.

The fertilizers should be applied early or in time to help the natural growth of the orchard, and not applied so late as to cause the trees to make a late or second growth. Do not think that you must be always adding commercial fertilizers to your orchard land, but rather improve the mechanical condition, and unlock the stored up food already in the soil.

**SOD CULTURE.**—This treatment may be used to great advantage in some cases. Under certain conditions where the soil is exceed-

ingly rich, moist, and the trees are making too rampant a wood growth, the sod method may be used to great advantage for checking the same. Under very few conditions can sod culture be recommended for the permanent method. The orchardist must study his trees and determine what method of cultivation they require. If the sod method is chosen for a period of years, always mow the grass and leave it upon the soil, instead of putting it into the barn for hay. After the sod has served its purpose break it up and practice the most needed method. The sod method should never be used in a young orchard. The young trees need all the food possible and good care, during the first years of their existence, is absolutely essential. The growth of vegetables is permissible during the early life of the trees, but if the trees require all the food it is of course best not to use their supply by growing other plants (See fig. 3).



FIG. 15.—The result of a poorly formed head. Breaks when laden with fruit. Past redemption.

In conclusion, the orchardist cannot be too strongly impressed with the importance of cultivating his young trees in the most careful manner, and always give them the first choice and use of the food. It is observed that no orchard under good cultivation is abandoned, while those in sod are often uncared for.

#### IRRIGATION.

One of the most serious problems we have to solve at the present time in our semi-arid fruit districts is that of irrigation. At present many growers are meeting this problem blindly, and believe that irrigation is the only practice that can guarantee to them a full crop of large apples, the size being all gain, and nothing being sacrificed in return. They fail to make a close study of their conditions,

and because a certain fellow fruit grower who irrigates obtains wonderful results they immediately accept the general principles without realizing or studying their relation to their own conditions. Before irrigating on a large scale, be sure you need it. Many times more thoro cultivation is what is needed; and if you irrigate, remember that the problems concerned with irrigating our fruit are vastly different from those connected with cereals, forage crops, or garden truck. You must know how much water to apply, how and when to apply, and the action of the water on tree, fruit, and soil.

It takes less water if it is added in the form of one or two good applications thoroly wetting the soil, than if added a great number of times but in small amounts. Again, if applied, say mostly in July, better all around results are obtained. At times one would be justified in adding water in the fall but not as a general practice. Whenever irrigation is resorted to, it should soon be followed by thoro cultivation. In certain locations, like Rogue River and Hood River, we find just as fine fruit grown without irrigation as with it, altho certain areas doubtless would be benefitted by irrigation. The problem in these localities will be largely a financial one, whether one or two irrigations, with moderate amount of cultivation, is cheaper than very intense cultivation. In the Grand Ronde Valley young orchards up to the time of heavy bearing seem to do very well without any irrigation, but heavy bearing orchards seem to need several irrigations in order to mature a heavy crop of large apples. In the Willamette Valley cultivation is all that is needed.

There are a good many systems of irrigation in vogue. The one most commonly used is to plow ditches on each side of the rows of trees. But, whatever the system used, the aim should be to allow for as even a distribution of water as possible. In regard to the kind of water used, we find well, river, spring, and artesian water. Where the two latter are used it is a good plan to have the water analyzed to determine whether or not it contains injurious salts. One grower in southern Oregon collects the drainage water in a reservoir where it is pumped by a gasolene engine into a large tank and from that sent over the fields. The leakage from the tank is pumped by a ram to the farm buildings. Wherever land is irrigated it should be well under-drained, thus preventing the accumulation of injurious salts or acids.

Irrigation has a tendency to prolong the growing season, at times

producing a secondary growth. We have at this date, December 12th, two apple trees which still have nearly their full leafage. These were irrigated heavily, while the surrounding trees were not.



FIG. 16.—These trees have been started low and are easy to take care of. The proper height for this state. Soil mulch is ideal. Tow-headed trees and large financial returns are synonymous when given good care.

latter long ago entered the rest period. Whenever this practice of late irrigation is employed the twigs and buds do not seem to harden properly and in case of a hard freeze they are liable to be injured and the result will be a light apple crop. This very case hap-

pened the past season. It is sometimes given as an argument in favor of irrigation that in the mountainous states and in some of the states like Minnesota where the land has been heavily irrigated or where it is naturally moist and heavy; that apple trees do not suffer as much. Whereas, on dryer land, the trees are often killed. This doubtless is true. The presence of moisture in the soil tends to absorb much of the frost, while in dry soils the tree is obliged to receive it. But this has little to do with hardening buds in our climate. The very fact that the trees retain their leaves is in itself an indication of a forced soft growth and energy expended in these lines that would be better exerted in hardening wood and bud. Often where pears are irrigated it produces a very rapid soft growth and when the trees are attacked by the blight they succumb very rapidly. Especial care should be used also in irrigating the cherry and peach not to produce too rapid and soft growth. In short, you must study the action on the different fruits.

On moderate heavy loams we find we can grow apples that keep longer than on the light loams where apples naturally mature more rapidly and consequently have a shorter life. This fact has led some to conclude that the irrigated apple is a superior keeper. On the contrary, where fruit is heavily irrigated, we find that size is gained, but flavor, aroma, keeping and shipping qualities are sacrificed. Especially is this true with pears and peaches. Now, as a state, we have earned a reputation for producing fruit of quality, fruit of unrivalled flavor, of unsurpassed color and keeping and shipping qualities, and we should guard this reputation jealously.

The action of irrigation on the soil should be closely studied, from both the chemical and the physical standpoint. The nature of the soil must determine to a very large degree the methods to be employed. You must solve this problem largely to yourself. While the principles are the same, the application of them will be very different under the various conditions. If we can increase the net returns of our orchards and not sacrifice any of our reputation, then by all means irrigate; but be sure of your position.

### PROPAGATION.

The propagation of the pomaceous fruits must depend upon the development of seeds, buds or scions. Subjected to circumstances favorable for growth, the bud or graft will make as

sturdy a tree as the seedling. Budding and grafting are employed in all our propagation of the better class of fruit, as this method is the only way to multiply the variety true to type. It never pays to propagate by seeds unless you are looking for a new variety or wish stocks for budding. The common and best method for securing trees is budding in late summer while the sap is still active. These buds are inserted on well formed young stocks and are far superior to the root-grafted tree. (See fig. 4).

When it is thought desirable to grow apple stocks at home, the seed should be sown in the fall in strong land that has been very deeply cultivated. Seldom ever is it profitable to bother with apple seed, as nice young trees of any variety can be obtained from any of the various nurseries in the state at a very reasonable cost.

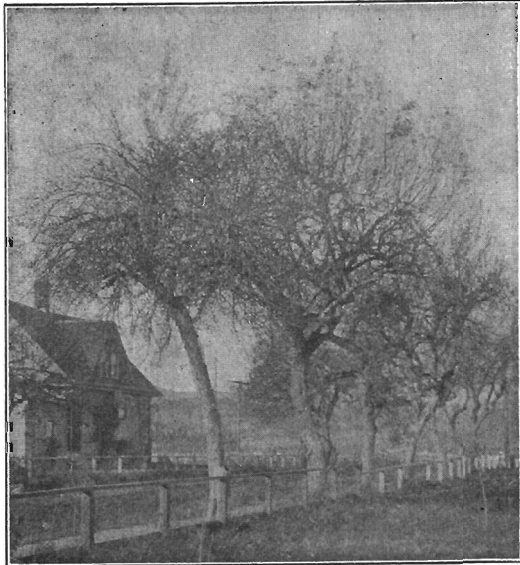


Fig. 17.—These trees are practically out of reach and valueless. Result of close planting and poor pruning.

Many of the difficulties met with in fruit culture, as maladies of various kinds, unfruitfulness, and so forth, are induced by a careless and indiscriminating method of propagation. The stock has a most important influence on the health and longevity of the tree and should therefore be propagated and selected with due regard to its soundness, vigor and hardiness of constitution. In all propagation use only the best material. The scions should be only from the ends of bearing branches and of the last year's growth. Do not use suckers or water sprouts of any kind. (See figs 5 and 6).

Select only that which shows vigor, constitution and that which meets your requirements.

The one essential thing in budding and grafting is to bring the

cambium layer or inner bark of the stock and scion in perfect contact. The whole process is very simple, but it is best to secure the services of an experienced workman if you do not understand the process. It is best to do grafting in the spring. There are many

methods of grafting but only a few are in common use or of any practical value. (See fig. 6). Grafting is employed for top working while budding is employed for multiplying the variety. (See figs 7, 8 and 9).



Fig. 18.—Usually the result of the open center tree. This may be prevented by artificial wiring or inarching, but expensive and unsatisfactory. This may partly be obviated by judicious training and pruning.

### TREES.

Under this head we will first take up the importance of care in selecting the stock. The nurserymen sow the apple seed in rows and when these have attained the proper size, desirable varieties are

worked on to the seedling stock. The best method of securing your trees is to take scions from trees of well known characteristics and habits in the vicinity in which you wish to plant and send them to the nurseryman for him to work the same on suitable stock for you. (See fig. 4).

The trees that are one year old from the bud or graft are the most desirable as they are then in a state to be properly trained. The



reasons for buying one-year old trees are this: the root system is not so badly damaged in transplanting, the tree has not grown crooked, they can be started to suit the grower and not so liable to die when transplanted as the older trees. Some nurserymen practice cutting off the tap root which makes the tree handle better and this is considered a good practice to a certain extent, but the tree needs the tap root to go deep into the soil and thereby avoid severe conditions. The root system must be judiciously formed. The tap root may be cut off to a certain degree, but cut back all the root system equally. All mangled and bruised roots must be removed, and remember where a smooth clean cut is made several new rootlets will issue. It is readily seen then that a moderate root pruning is beneficial. The top should be cut back in proportion to the roots. A yearling tree should be cut off about forty inches from the ground, and the lower limbs started from eighteen to twenty inches from the soil. A two-year old tree should have its branches cut back from one-half to one-third of their length and all cross limbs cut out. When a tree is taken out of the nursery row a large portion of its root system is left in the soil. The balance between the roots and the top is thus destroyed and pruning must be resorted to in order to reestablish the equilibrium. Nearly all of the elements which build up a tree are taken from the soil in a liquid form and carried to the leaves of the tree and worked into a suitable form for its use. This shows how important the roots are to the plant.

We find people who advocate the Stringfellow method of root pruning and planting, but there are very few places and conditions where it will be of value. In a long growing period and rich soil, the trees may adjust themselves, but who would ask better growth of an orchard when our present method of cultivation and handling are carried out properly. Trees in this state come into bearing plenty soon enough for their own good. Young trees should not be permitted to bear heavily until they're from six to eight years of age.

WHERE TO PURCHASE.—The buyer must secure his goods where the best can be obtained with honest dealing. We heartily advocate buying trees from our home nurseries; the trees are acclimated, the temperature is mild and the trees escape severe conditions. Always patronize home industry if possible. It should be remembered that nursery stock should never be purchased just because it is cheap. If possible go direct to the nursery and choose the trees for your-

self. The large sized trees are not always the most desirable, but rather choose a medium size, vigorous, straight, stocky tree of a firm, hard growth and free from disease. Crown-gall and woolly-aphis are the worst pests on young trees, also green aphis. An orchard planted with infected trees will never be of any value. The tendency is to buy trees too old rather than too young.

When the trees arrive they should be immediately unpacked and heeled in. The heeling-in process is very simple; a trench is dug deep enough to accommodate the roots nicely, and the trees are placed with their tops facing the south. The time to purchase your trees is in the fall for this climate. Assuming the time has arrived for you to buy, the next and exceedingly important subject is the kind to buy.

#### WHAT VARIETIES SHALL I PLANT?

There is no more important question connected with the industry and more often asked by fruit growers. The ordinary fruit grower has not time to test varieties and this should be done by our various experiment stations. It is also very difficult for an experiment station to tell what varieties will succeed best on every man's farm in the state, but the behavior of varieties on the station grounds will give sufficient knowledge to limit the varieties to certain localities.

The following list of fruits which are adapted to certain localities of the state will serve to answer "What varieties shall I plant?" and is intended to be of value to the prospective fruit grower in this state. The state is divided into five horticultural districts and each one supports a commissioner. The following is a complete list of the officers of the state board of horticulture, as well as the suitable varieties to plant; also the horticultural districts.

#### BOARD OF COMMISSIONERS.

State at Large and president	W. K. Newell; Gaston
First district	J. H. Reid, Milwaukee
Second district	Chas. A. Park, Salem
Third district	A. H. Carson, Grants Pass
Fourth district	R. H. Weber, The Dalles
Fifth district	Judd Geer, Cove
H. M. Williamson, Secretary	Portland

The district boundaries are as follows:

First district—Multnomah, Clackamas, Yamhill, Washington, Columbia, Clatsop and Tillamook counties.

Second district—Marion, Polk, Lincoln, Benton, Linn and Lane counties.

Third district—Douglas, Jackson, Klamath, Josephine, Coos, Curry and Lake counties.

Fourth district—Wasco, Morrow, Crook, Gilliam and Sherman counties.

Fifth district—Union, Baker, Umatilla, Wallowa, Grant, Malheur and Harney counties.

List of varieties well recommended for the several pomological districts of Oregon:

#### FIRST DISTRICT.

Apples—Red Astrachan, Early Harvest, Yellow Transparent, Dutchess, King, Gravenstein, Wealthy, Famuse, Spitzenburg, Yellow Newtown, Baldwin, Jonathan, Gano, Northern Spy, Red Cheek, Pippin, Winesap and Russet.

Pears—Bartlett, Bonne de Jersey, Angouleme, Fall Butter, Clairgeau, Seckel, Idaho and Winter Bartlett.

Cherries—Royal Anne, Bing, Lambert, Black Tartarian, Kentish, May Duke, Major Francis and Black Republican.

Plums—Green Gage, Reine Claude, Peach Plum, Yellow Egg, Blue Damson, Washington and Bradshaw.

Prunes—Italian, Petite, Silver and Hungarian.

Peaches—Alexander, Hale's Early, Early Crawford, Late Crawford, Salway and Elberta.

Grapes—Concord, Worden, Niagara, Moore's Early and Delaware.

Strawberries—Albany, Wilson, Clark's Seedling, Sharples, Magoon and Excelsior.

Raspberries—Cuthbert, Marlboro, Gregg and Cumberland.

Blackberries—Lawton, Taylor and Kittatinny.

Currants—Fay, Cherry and White Grape.

Gooseberries—Champion and Downing.

#### SECOND DISTRICT.

Apples—Yellow Transparent, Early Harvest, Red Astrachan, King, Gravenstein, Wealthy, Famuse, Dutchee, Yellow Newtown, Jonathan, Baldwin, Winesap and Babbitt.

Pears—Bartlett, Seckel, Clairgeau, Bosc, Comice, Winter Nelis and Idaho.

Cherries—Royal Anne, Lambert, Bing, May Duke, Black Republican, Black Tartarian, Waterhouse, Elton and Willamette.

Plums—Reine Claude, Willamette, Bradshaw, Peach Plum and Brignole.

Prunes—Italian, Petite, Silver, Hungarian.

Peaches—Early Crawford, Late Crawford and Foster.

Grapes—Concord, Delaware, Worden and Moore's Early.

Strawberries—Magoon, Clark's Seedling and Wilson.

Raspberries—Cuthbert and Marlboro.

Blackberries—Lawton and Kittatinny.  
 Currants—Cherry and Fay.  
 Gooseberries—Downing and others.

## THIRD DISTRICT.

Apples—Gravenstein, Spitzenburg, Yellow Newtown, Jonathan.\*  
 Pears—Partlett, Comice, Bosc, Anjou and Winter Nellis.  
 Cherries—Bing, Royal Anne and Black Republican.  
 Plums—Washington, Coe's Golden Drop and Yellow Egg.  
 Prunes—Italian and Petite.  
 Peaches—Alexander, Hale's Early, Early Crawford, Globe, Muir, Cling and Salway.  
 Grapes—Concord, Moore's Early, Moore's diamond, Worden and Eaton—American varieties; Tokay, Rose of Peru, Black Prince, Black Hamberg, Malago, White Muscat, Golden Queen, Thompson's Seedless.  
 Strawberries—Magoon, Brandywine, Haverland, Jessie, Sharpless and Marshall.  
 Raspberries—Cuthbert, Gregg and Mammoth Cluster.  
 Blackberries—Lawton, Kittatinny and Mammoth.  
 Currants—Cherry and Fay.  
 Gooseberries—Downing, Oregon Champion and Industry.

## FOURTH DISTRICT.

Apples—Red Astrachan, Gravenstein, Yellow Transparent, King, Dutchess, Yellow Newtown, Baldwin, Northern Spy, Wagener, Winter Banana, Hyde-King, Red Cheek Pippin, Jonathan, Winesap.  
 Pears—Bartlett, Anjou, Buerre Easter, Winter Nelis, Flemish Beauty and Comice.  
 Cherries—Black Tartarian, Lambert, Black Republican, Royal Anne, Bing and Early Richmond.  
 Plums—Abundance, Prunus Simoni, Peach, Columbia, Yellow Egg.  
 Prunes—Hungarian, Italian, Petite, Silver and Tragedy.  
 Peaches—Alexander, Elberta, Foster, Weber's Prize, Crawford's Early, Crawford's Late, Lemon Cling, Early Charlotte, Hale's Early and Salway.  
 Grapes—Black Hamberg, Muscat, Black July, Rose of Peru, White Sweetwater, Muscatella and Tokay.  
 Strawberries—Clark's Seedling.  
 Raspberries—Cuthbert and Gregg.  
 Blackberries—Kittatinny, Lawton, Snyder and Mammoth.  
 Currants—Cherry, Fay and White Grape.  
 Gooseberries—Champion and Red Jacket.

## FIFTH DISTRICT.

Apples—Rome Beauty, Jonathan, Gano, York Imperial, King and Spitzenburg.

\* None others should be considered.

Pears—Bartlett, Clapp's Favorite, Anjou and Beurre Easter.

Cherries—Bing, Royal Anne and Lambert.

Prunes—Italian, Hungarian.

Peaches—Early Crawford, Elberta, Globe and all early varieties.

Grapes—Concord, Worden and Sweetwater.

Strawberries—Clark's Seedling, Sharpless and Magoon.

Currants—Fay.

Gooseberries—Industry.

The Spitzenburg and Newtown varieties seem to do best in the lower valleys, while such varieties as Rome Beauty, King, York Imperial and Jonathan prefer the higher altitudes. It must be thoroly understood that certain parts of our state are more adapted to growing the different kinds of fruits, and do not try to grow those that are not adapted to your locality. There is always money in producing first-class fruit, no matter whether you are raising Newtowns or Baldwins.

In the eastern part of our state, where the altitude ranges from two thousand to four thousand feet, the fall varieties of apples may be successfully grown, but the fall varieties usually mature in high altitudes about the same time as the winter varieties in lower altitudes. The season is too short to grow winter varieties very successfully, while in the lower altitudes and valleys most any variety may be grown. Assuming the above list will enable one to choose judiciously his varieties, we will next take up the subject of

#### PLANTING.

WHEN TO PLANT.—The fall is without question the time to plant in Oregon. There are a few objections to this in the eastern part of the state. The soil is more fit to be handled in the fall, the farmer has more time and the trees become well established before the growing season the following spring. Only once in eight or ten years will damage be done to an orchard in eastern Oregon if set in the fall.

HOW TO PLANT.—The hole should be made to accommodate the root system without cramping it and deep enough so that the roots are not liable to dry out the following summer. The hole should be dug broad and plenty of pulverized soil at the bottom to furnish food for the tender feeding rootlets.

The thing to bear in mind is to plant your trees deep and allow the tap root to go straight down into the moist rich subsoil, and the other roots to make a lateral and downward growth. The only

guide as to depth is to place them a few inches deeper than they were in the nursery. The earth should be well packed about the tree when it is planted in order to withstand the pressure of the wind. While filling up the hole see that the fine soil is neatly packed among the fibrous roots and all roots are in their proper position. Trees should be planted only when the soil is in a friable loose condition, as handling while too wet will do serious injury. If the trees are planted according to the foregoing manner and the top cut back, there will be no need of tying or staking.

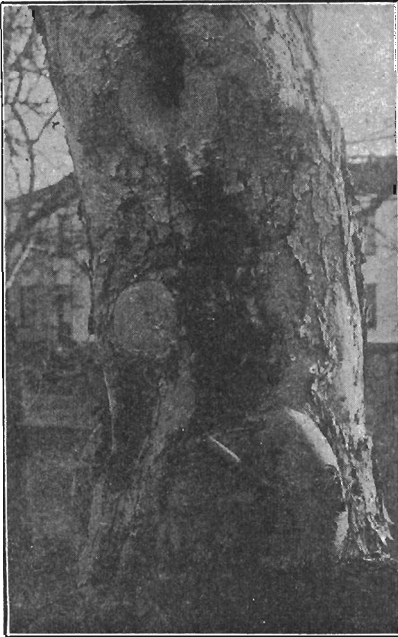


FIG. 19.—Result of removing limbs properly. No. 1 shows how a wound may be assisted to heal. No. 2 shows a wound perfectly healed. No. 3 shows wound almost closed.

The question of setting the trees straight is solved by every orchardist having his own plan, but the topography of the land figures quite extensively in the method. If the ground is level, have sticks about one foot long and secure a strong wire as long as the orchard if possible. Mark off the distance on this line for each tree and place a peg there. Then mark each side of the orchard in this way. To fill in the square draw the line from the end peg to the other, and then another row is put out. Thus the operation is carried to the other side. After the stakes are placed properly for the trees, secure a four-inch strip about four feet long with a hole in each end large enough to allow a stake

to be driven thru. Cut a notch in the middle of the stick; when you place the notch on the guide stake put a stake thru each hole on the end, and then lift the bar to allow the digging of the hole. Having the hole dug, put back on the two stakes the marking bar and place the tree in the notch, instead of the guide stake. If this work is done carefully every tree will be in its proper place (See Fig. 10).

The plan of planting is to be decided by the individual. The two

plans most used are the opposite or square (Fig. 11) and the alternate or hexagonal (Fig. 12). To set out the hexagonal, the following plan which is taken from "Barry's Fruit Garden" is thought quite simple and efficient:

"Suppose, for instance, we propose to plant a plot of ground one hundred feet square, and to have the trees twenty-five feet apart every way, we make a triangle of wood, A, B, D, (Fig. 12) each side of which is twenty-five feet; we then measure the distance from the angle, B, to the center of the opposite side, at C, and this gives us the distance between the rows, which will be about twenty-one feet. This will be called the small measure; and with this we measure off on two sides the distances for the rows, and put down a stake at each. We then commence on the first row, and with the long (twenty-five feet) measure mark off the places for the trees, and put down a stake to each. The measurements must be made with exactness, in order to have the plantation present a regular appearance, as in Fig. 12."



FIG. 20.—This kind of pruning is never permissible, always cut close to the trunk and make a smooth wound.

The hexagonal plan will accommodate more trees and all will be an equal distance apart. In this plan there is a larger clear area about each tree. Be sure to set your trees properly and a good distance from the fence. Properly set trees are much easier to take care of than those that are improperly set. The distance for plant-

ing is much disputed among horticulturists, but thirty-five to forty feet is the most desirable for apples. Never, under any conditions, plant these less than thirty feet apart. For planting table of fruits see appendix.

### CARE OF TREES.

**AT PLANTING TIME.**—Prune the roots as soon as they are dug and immediately pack them for shipment, or, best of all, put them in their permanent place if possible, always protect them from winds, freezing temperature and strong sun. Cut all damaged and bruised

roots off at planting time, and remember always to keep them covered with a wet cloth, straw, or moss while out of the ground.



FIG 21.—The result of leaving a stub. The heart of the tree is all decayed.

### PRUNING.

This is a broad subject and one that is not much understood by most people. Usually, when a man buys trees, he thinks he must be always pruning them, but such is not the case. Pruning is to assist nature and must be done with certain definite objects in view, namely, to promote growth, to produce fruit spurs, to retard excessive growth, and to form the tree in the desired shape.

There is a struggle for light, heat and air among the individual branches or twigs of a tree which is commonly termed "struggle for existence." Every twig requires air, heat and light, and as each has not the same position on the tree, some must die or be removed. Those near the centre must be watched more closely as those near the outside receive plenty of air and sun. Almost every variety of trees have their individual shape. If each is studied and pruned



according to their characteristic tendencies, the process of pruning will be very simple.

**AT PLANTING TIME.**—When the young trees have been root-pruned and planted, cut the top back so it will balance the root system, and, by all means, do not allow all the scaffold limbs to issue from or near the same place. A tree with limbs issuing from the same point is doomed when the fruiting period begins, and the danger increases as the tree grows older (See Figs. 14 and 15).

Some people prefer the high-headed trees, while others favor the low-head, and this is determined to a great extent by the conditions of the locality, but the ease of picking, spraying and pruning low-headed trees far outclass the disadvantage of cultivation, and for the above reasons the low-headed tree is always to be re-

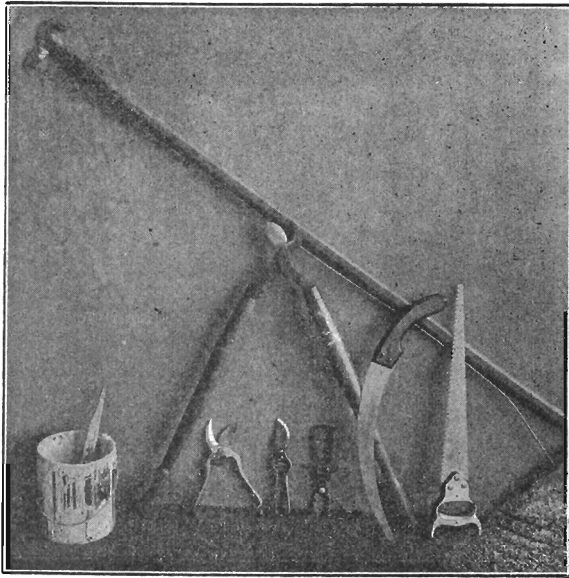


FIG. 22.—A group of satisfactory pruning tools. Every one necessary. Do not overlook the paint or wax can.

commended in this state (See Fig. 16). It is generally thought by fruit growers that the high-headed tree is better as it allows better and easier cultivation. This is the main point upon which the advocates of high-headed trees base their whole argument. A high-headed tree is generally the worst kind to cultivate under for usually the lowest limbs are permitted to make a decided lateral growth almost parallel to the soil, and when these limbs are laden with fruit they extend almost to the ground and it is readily seen that close cultivation is impossible.

The trees in the old orchards and yards all over Oregon show the evolution of the high-headed tree. It is simply this, when the

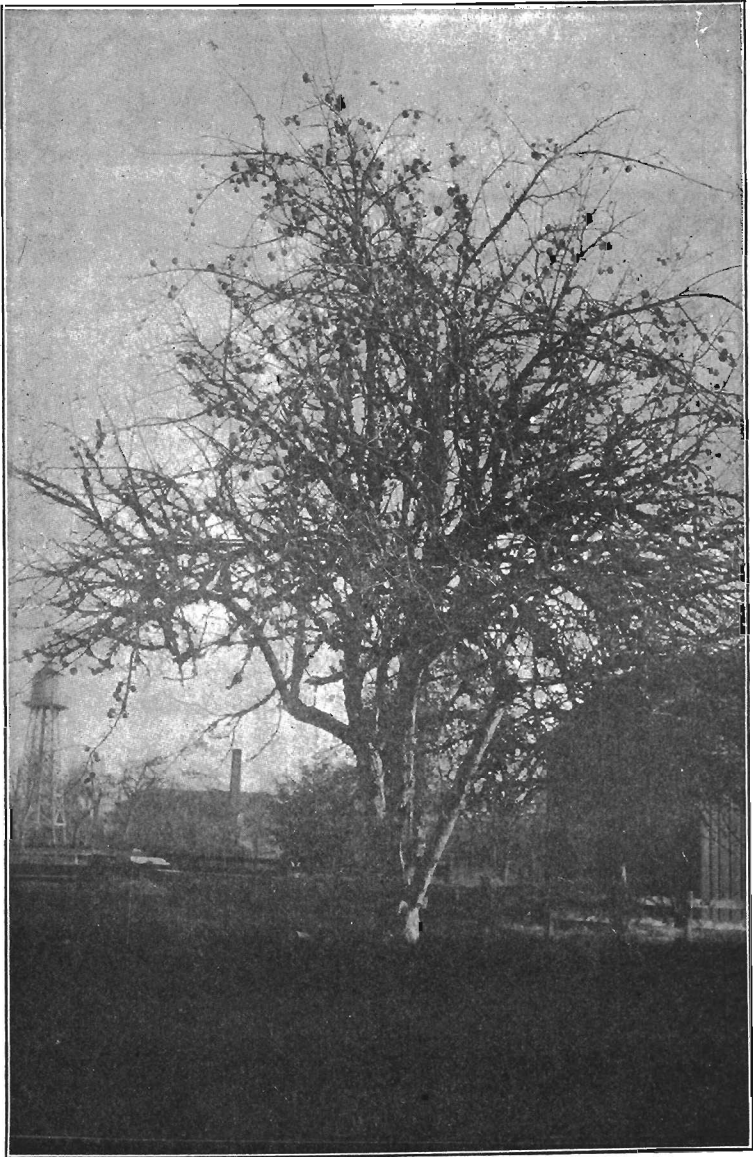


FIG. 23.—This tree has been neglected and unprofitable for years.

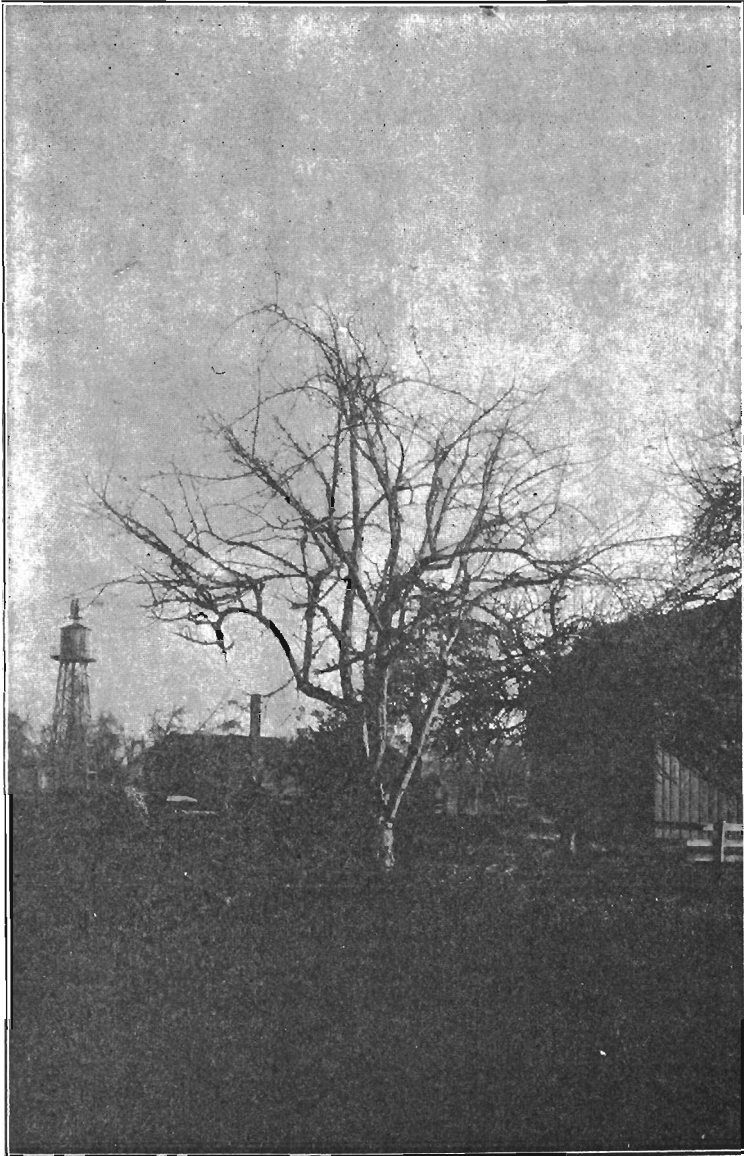


FIG. 24.—Same tree as shown in Fig. 23 after pruning. More than enough wood left. If pruned too severely the first year, a growth of water sprouts would be the result. It may be headed back and lightly pruned next year.

lowest limbs interfere with cultivation they are removed, the next set of limbs are permitted to make a lateral growth similar to the first, and eventually these are cut off. Thus it continues until the crown of the tree is ten to fifteen feet from the ground and the fruit is practically out of reach (See Fig. 17).

On the other hand the crown of the low-headed tree is started near the ground and the limbs make an upright slanting growth, which allows far closer cultivation. The limbs, by pruning, are caused to grow strong and able to support their fruit. As stated



FIG. 25.—The smooth twigs have been sprayed each year, while the moss-covered ones have been neglected. Lime and Sulphur sure death to moss.

before, the low-headed tree is much easier pruned, sprayed, picked, and the trunk protected from sun-scald. Cultivation can usually be easier done with low-headed trees than with high-headed ones, as they are usually grown. Ordinarily the trees are not kept pruned and the limbs droop, so as to hinder cultivation.

The choosing of low or high-headed trees usually determines the profit or loss to the grower. Therefore, summing up the advantages of the low-headed tree and comparing them with the advantages of

a high-headed one, it is readily seen why the latter is becoming very unpopular.

The yearling tree which is nothing larger than a good sized buggy whip, should be cut off about forty inches from the ground when planted and those buds eighteen to twenty inches from the soil should be encouraged to form the crown. All below should be removed.

**ANNUAL PRUNING.**—After the crown has been properly started the first year, the next great important step is to decide at the beginning of the second year whether you are going to grow trees with a



FIG. 26.—The only way to keep pace with the multitude of insects and fungi. There are now many different spraying machines on the market.

central leader or hollow centre. These methods of forming trees are much discussed by prominent orchardists thruout the state, and both methods are being used. The great advantage of both methods being used in the state is that they afford an object lesson, and hence we have but to compare results (See Fig. 18). The object of cutting out the centre of a tree is to give more light, more circulation of air and better color to the fruit. By this method, the life of the orchard is sacrificed for the above conditions, as the trees trained this way break down when they begin to bear, or necessitate continual wiring of the scaffold limbs. All of this is of course unnatural and expensive and can be overcome by proper pruning and permitting the central leader to remain.

When the leader is permitted to make a strong upright growth,

it acts as a balance to the whole tree and does away with inarching, wiring, and with judicious pruning the trees do not need propping. Generally the open centre tree is denser in the centre than the other for the scaffold limbs are pulled too close together.

Interlacing, crossing, rubbing and diseased branches must always be removed, no matter what the ideal form of the tree may be. If your trees are making too much wood growth, cut them back in the summer, which will cause them to produce fruit spurs and make a



FIG. 27.—A fair sized tree cut back for top-working. Be sure to leave some of the top to carry off the surplus sap.

stronger growth, but do not cut back too far as the fruit is liable to sun-scald, and if pruned too severely the tree will make a heavy sucker growth. It is best to prune moderately in winter for excessive and undesirable growth, and prune moderately the following summer, about July, to check the wood growth. If the trees are making a poor wood growth and more wood is desired in preference to the fruit, prune in the winter. This must be done in moderation to avoid a heavy sucker growth the following summer. It is always best to prune moderately every year both in winter and summer if

necessary. Pruning may be done in Oregon anytime while the trees are dormant, except where severe freezes are frequent.

In pruning the tree fruits, always make a clean smooth cut and have a bucket of good wax or paint handy and thoroly cover the wound. This prevents decay of the wood and allows the new tissue to grow over unmolested by fungi or the elements. The cambium or inner bark will begin to cover the wound as soon as the tree becomes active in the spring, but will form only over a limited portion of the cut surface. The growth of the cambium can be encouraged and made to completely cover the wound if cut along the inner side of the callus with a sharp knife. In all your pruning take the branch off just as close as possible to the limb where it issues and never leave a stub. (See Figs. 19, 20, 21, 22, 23 and 24.)

### SPRAYING.

This subject is becoming of greatest importance, as our orchards show, if we stop to examine them. Spraying is only one of the requisites to success in up-to-date fruit growing. It must be understood that

spraying cannot take the place of cultivation and is only an insurance to the grower. Trees grow by assimilating plant food and if scale and other diseases are at work the trees do not develop and the fruit is not allowed to go on the market. There are five essential operations upon which success in fruit raising depends. They may be given as follows: Tillage, fertilizing, pruning, spraying and thinning.

Spraying is becoming so thoroughly understood that most of the diseases can be held in check or entirely eradicated. Spraying

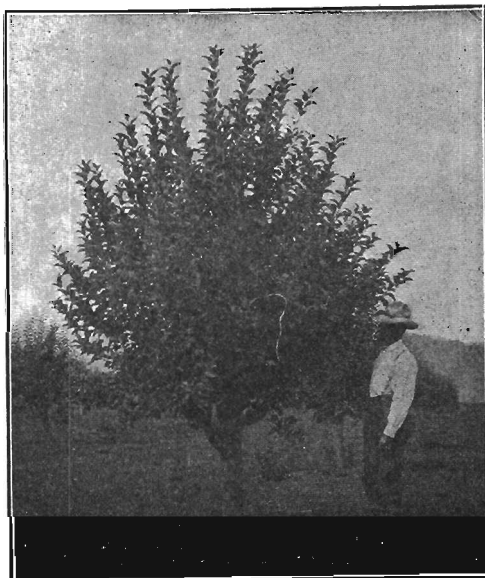


FIG. 28.—Young top-worked tree. The scions have grown rapidly and a well balanced tree is the result. This tree will need judicious pruning and care for several years. Photo taken year and half after grafting.

should be done every year to guard against any disease that the tree may become affected with, or to destroy what may be already established, and destroy those pest that are injurious to the fruit. Years ago horticulturists did not understand much about fruit diseases and the effects of spraying but the problems are being very rapidly solved (See Fig. 25). The kind of machine and apparatus to use depends upon the notion of the fruit grower. However, the pump should be strong and well fitted with hard brass working parts. The nozzle must be chosen in regard to its power to carry and deliver the material properly. There are now many different kinds of spray outfits, but the ones that are desirable are those that meet the above requirements and can be well operated under the existing conditions where they are to be used. (Fig. 26) When you spray, do it at the proper time and do it well. If you do not, it is a waste of time and material. The material must be properly mixed according to formulas given in the best spraying bulletins. For further knowledge of the pests and diseases and how to combat them, the reader is referred to bulletins on spraying by Prof. A. B. Cordley of this station. Also see appendix.

#### THINNING.

Thinning the fruit is a practice always advised and is exceedingly profitable. Some people think it does not pay but there is hardly today a successful fruit grower in the state who does not thin his fruit, and this thinning is the key to his success over those who have favorable conditions, but do not put out the firstclass product. The fancy fruit and price is obtained by proper thinning. It makes the fruit larger, better color, reserves the vitality of the tree, destroys disease infested and imperfect specimens, and tends to cause the tree to produce an annual crop.

All the fruit must be picked sooner or later and many more apples will be worth picking if encouraged by thinning. An orchardist in southern Oregon thinned his apples this year to one on a spur and the result was that ninety percent of the entire crop sold in the three and one-half tier class. Determine then for yourself if it pays.

Always thin to one fruit on a spur and where the spurs are close all the fruit should be removed on a few of the spurs. The best apple of the cluster is the one to leave. The earlier the thinning the better, as the remaining fruit receives all the energy from the very first of its growth. The thinning should be done when the fruit is about the size of a hazelnut. It sometimes requires more



judgment and discrimination to thin fruit properly than it does to gather it. The cost of thinning depends upon the price of labor, and the condition of the trees. Usually the price will range from fifteen to eighty cents per tree.

Do not let your trees bear heavily while young as every fruit they produce reduces their vitality and heavy yields ruins the form of the tree. There is plenty of time for trees to bear after they have received the proper training and preparation for future usefulness. Some men boast of the wonderful yield of their two and three year old apple trees, but they do not realize what that means to them in the future.

### POLLINATION.

There is no greater need of study of any one phase of pomology more than pollination. The present knowledge among horticulturists of this subject is quite limited, but we are rapidly securing more valuable facts along this line.

It is not safe to plant an orchard without knowing whether the varieties are self-fertile or self-sterile, and their ability to cross-fertilize with other varieties. Not all failure to set fruit is due to imperfect fertilization. The efficiency of pollen varies with the conditions of the tree and environment. Some of the main factors which govern pollination are vigor, variety, health, age, heredity and vitality of the tree. Most all varieties are improved by cross-fertilization, and a large orchard should be planted with one-third of the trees as pollen producers.

It is known that the same varieties do not blossom at the same time in different parts of the state, but like conditions will affect the same varieties alike. Varieties that are useful for producing pollen must blossom at the same time the desired varieties blossom and the pollen must be potent on that variety. Up to the present time all the work in pollination has shown the following varieties are more or less self-sterile and should not be planted alone: Northern Spy, Gravenstein, Grimes, Tompkin's King, Red Astrachan, Esopus Spitzenburg, York Imperial, Belleflower, Winesap and Willow Twig. The varieties that are found to be self fertile are: Rome Beauty, Jonathan, Ben Davis, Oldenburg, R. I. Greening, Fallawater, Baldwin and Yellow Transparent.

The pear varieties considered self-sterile are: Anjou, Bartlett, Bosc, Clairgeau, Clapp, Columbia, Gray Doyenne, Easter, Howell, Idaho, Jones' Seedling, Kieffer, Lawrence, Louise, Mt Vernon,

Pound, Sheldon, Superfine and Winter Nelis. Those considered self-fertile are: Buffum, Angouleme, Elizabeth, Flemish, Le Conte, Seckel, Tyson and White Doyenne.

"Some of the combinations that have been successful in many parts of the country for planting together are: Bartlett with Nelis, Flemish Beauty, Easter, White Doyenne; Idaho with Bartlett; Kieffer with Le Conte, Garber; Coe Golden Drop with French Prune, Green Gage, Italian Prune; Satsuma with Abundance, Burbank, Red June; Miner with De Soto, Forest Rose, Wildgoose; Wildgoose with De Soto, Newman, Miner."—How to make a Fruit Garden.

There are two main factors in selecting varieties for cross-pollination. The first requisite is that there must exist a mutual affinity between the two; the second, they must blossom about the same time.

The 1905 report of the State Board of Horticulture contains a very valuable chart on the blossoming of varieties. The chart, which is completed by Prof. E. R. Lake of this station may also be found in his Bulletin No. 82.

#### RENOVATING NEGLECTED ORCHARDS.

In almost any part of our state can be found orchards of advanced age which do not pay, and it is readily seen that something is wrong. The problem of renovating an orchard is sometimes a large one and often proves to be very expensive. The causes which are responsible for an unprofitable orchard are many and may be briefly stated thus: Unsuitable varieties, poor drainage, unfavorable site, poor soil, neglect, unfavorable climatic conditions and old age.

The first and most important point in rejuvenating an orchard is whether or not the trees are worth saving. The varieties may be not what you desire or too far gone to be responsive to treatment. If the trees are on wet land, cut them down or thoroly drain the soil, as a fruit tree will never thrive with wet feet. Apple trees over thirty-six or seven years old, which have long been neglected, are not worth saving; likewise the cherries over twenty, the pear over twenty-two or three, the plum over fifteen and the peach over twelve years of age. In fact, the trees which should not be worked with are those with a high head, partially decayed trunk and in a generally run-down condition. If nothing more serious than insects and fungus diseases are present, the orchard may be very eco-

nomically reclaimed, as, for example, the Eisman Brothers' orchard, which was saved from anthracnose by Prof. A. B. Cordley of this station.

The renovating of old trees requires practically the same treatment and methods as to properly care for the young orchard. The trees must have a general awakening and started into growth both in fruit and wood. They should make new twigs twelve or more inches long each year instead of the usual one inch growth. The first thing to be done then is to break up the sod and get the soil into cultivation and feed the trees by applying barnyard manure, wood ashes and any nitrate or phosphorus fertilizer. Especially add nitrogenous cover crops. This is essential for stimulating a good growth of the trees.

See that all surplus water is carried away and then begin war on the large army of insects and numerous diseases that have been at work for years. Buy a good spray outfit with plenty of material to spray with, and learn thoroly how and when to use them. Spraying calendars as well as information on diseases and insects may be had by applying to the station director for bulletins on the subject. Every other tree will probably have to be removed, as most of the older orchards were planted too close. Make a thoro study of your orchard before cutting out any trees and arrange if possible to cut out those that cannot be saved by the most skillful treatment.

Next comes the management of the individual tree. The chances are that the tree presents a hard appearance. In this climate the moss and lichens soon cover the bark and water sprouts become numerous. Various fungi and insects thrive unusually well here and at the expiration of twenty years or more the uncared-for orchard is quite a study. The first thing to do with the tree is to prune it properly if it is not to be top-worked. Do not prune the tree too severely the first year, as it will produce suckers and water sprouts in large numbers, but keep after it systematically each year until the tree is well thinned and properly balanced. (See fig. 24). If you do not wish to keep the original varieties, the trees may be top-worked or grafted. It is not advisable to graft trees that are too old, as usually their vitality is low, and better fruit can be obtained sooner from newly planted trees. (See figs 27, 28).

Do not graft limbs that are over three or four inches in diameter as young wood unites better and makes superior growth. It is

best to graft the smaller limbs of the tree in such a manner as to form a well balanced head and leave plenty of the original top to carry off the surplus energy until the grafts require the room, which is about the second year. Cleft-grafting is the best method for working over large trees. A top-grafted tree will usually come into bearing in three to six years. The old adage, "An ounce of prevention is better than a pound of cure," is quite true in regard to growing fruit trees.

#### APPENDIX I.

##### HORTICULTURAL SOCIETIES AND UNIONS IN OREGON.

1. Oregon State Horticultural Society—E. R. Lake, Secretary, Corvallis.
2. Forest Grove Horticultural Society, Forest Grove—Col. Harry Haynes, Secretary.
3. Clackamas Horticultural Society—J. C. Zinzer, Secretary, Oregon City.
4. Mosier Horticultural Society—A. P. Bateham, Secretary, Mosier.
5. Medford Horticultural Society—L. B. Brown, Secretary, Medford.
6. Medford Fruit Growers' Union, Medford.
7. Ashland Fruit and Produce Association.
8. Hood River Horticultural Society—J. L. Carter, Secretary, Hood River.
9. Marion County Horticultural Society—E. C. Armstrong, Secretary, Jefferson.
10. Linn County Horticultural Society—F. M. Mitchell, Secretary, Albany.
11. Polk County Horticultural Society—R. L. Chapman, Secretary, Dallas.
12. Grants Pass Fruit Growers' Union—Chas. Meserve, Secretary, Grants Pass.
13. Hood River Fruit Growers' Union—E. H. Shepard, Secretary and Manager, Hood River.
14. Hood River Apple Growers' Union—E. H. Shepard, Manager, Hood River.
15. Grande Ronde Valley Fruit Growers' Union—E. Z. Carbine, Secretary, La Grande.
16. Yamhill County Horticultural Association—W. H. Kingery, Secretary, McMinnville.

## APPENDIX II.

The following nurseries are doing business in this state and are submitted to the public, not to advertise the nurseries, but for the enlightenment of those interested in fruit culture. While we do not recommend any one of these in particular, the public is earnestly advised to patronize our home nurseries:

The Dalles Nurseries.....	The Dalles	Monte Vista Nurseries.....	Scappoose
Pacific Nursery Co.....	Tangent	J. B. Pilkington, Nurseryman.....	
The Woodburn Nurseries.....	Woodburn	.....	P. O. box 825, Portland
The Sibson Rose Nurseries.....		Thos. Prince (walnuts only).....	Dundee
.....	1180 Milwaukie Ave.	Quaker Nurseries.....	Salem
True to Name Nursery.....	Hood River	E. P. Smith.....	Gresham
Milwaukie Nurseries.....	Milwaukie	Brooks & Sons.....	Carlton
Albany Nurseries.....	Albany	Mt. Tabor Nurseries.....	Mt. Tabor
Oregon Nursery Co.....	Salem		

## APPENDIX III.

## LIST OF RELIABLE WORKS ON HORTICULTURE.

The Principles of Fruit Growing.....	Bailey
The Principles of Vegetable Gardening.....	Bailey
Plant Breeding.....	Bailey
The Horticulturist's Rule Book.....	Bailey
The Pruning Book.....	Bailey
The Nursery Book.....	Bailey
Cyclopedia of Horticulture.....	Bailey
Barry's Fruit Garden.....	Barry
Bush Fruits.....	Card
Irrigation Farming.....	Wilcox
How to Make a Fruit Garden.....	Fletcher
American Fruit Culturist.....	Thomas
Strawberry Culturist.....	Fuller
Nut Culturist.....	Fuller
Spraying of Plants.....	Lodeman
Irrigation and Drainage.....	King
The Soil.....	King
Fertility of the Land.....	Roberts
Hedges and Wind-breaks.....	Powell
Insects Injurious to Fruits.....	Saunders
Fungi and Fungicides.....	Weed
Insects and Insecticides.....	Weed
Plums and Plum Culture.....	Waugh
American Horticultural Manual (2 vols).....	Budd and Hansen
Successful Fruit Culture.....	Maynard
California Fruits.....	Wickson
Better Fruit.....	Hood River

Oregon Agriculturist and Rural Northwest.....	Portland
Northwest Horticulturist.....	Seattle
Pacific Homestead.....	Salem
Orchard and Farm.....	San Francisco
Western Fruit Grower.....	St. Joseph, Mo.
The Strawberry.....	Three Rivers, Mich.
Rural New Yorker.....	New York
Canadian Horticulturist.....	Toronto, Canada
Country Life in America.....	Doubleday, Page & Co., New York
Garden Magazine.....	Doubleday, Page & Co., New York
Suburban Life.....	Boston

## APPENDIX IV.

## FOOD POISONS—ARSENATE OF LEAD.

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

Dissolve the arsenate of soda in two quarts and the acetate of lead in four quarts of warm water; when dissolved add them to the required amount of water.

This formula is valuable for spraying very delicate foliage and is among the best, if not the best, of the remedies for the codling moth.

## CONTACT INSECTICIDES.

## Lime, Sulphur and Salt—Oregon Formula.

Quicklime.....	50 pounds
Sulphur.....	50 pounds
Water.....	150 gallons

Slake the lime thoroly, add the sulphur, cover with water, and boil briskly for at least an hour, until the mixture is of a deep blood red color with but little free sulphur on the surface. Add water to make 150 gallons.

This wash is the most satisfactory for San Jose scale and also a good fungicide.

## FUNGICIDES.

## Bordeaux Mixture for Dormant Plants—Bordeaux for Winter use.

Copper sulphate.....	6 pounds
Quicklime.....	6 pounds
Water.....	50 gallons

This formula should be used only upon dormant trees.

## Bordeaux Mixture when the trees are in leaf.

Copper sulphate.....	4 pounds
Quicklime.....	6 pounds
Water.....	50 gallons

Dissolve the copper sulphate in water in a wooden vessel. Slack the lime, using only sufficient water to insure slacking. Add water and stir until the "milk of lime" of the consistency of cream. Strain the lime thru a sieve to remove the larger particles. Dilute the milk of lime and the copper sulphate solution each to 25 gallons and pour these solutions together.

To see if the Bordeaux mixture is made properly, test it in the following manner: pour some of the Bordeaux into a small dish and add a few drops of the ferrocyanide solution. If enough lime has been used no change will be noticed; if a brownish-red discoloration takes place, more lime should be added.

The lime, sulphur wash may be used any time while the trees are dormant. The same may be said of the winter formula for the Bordeaux mixture.

Opinions vary in regard to the application of the lead arsenate for the codling moth, but it is safe to say that the first application should be made when the petals begin to fall, other applications will vary with season and development of the moth.

GRAFTING WAX FORMULA.

- |                      |                      |
|----------------------|----------------------|
| 1. Four pounds resin | 2. Four pounds resin |
| Two pounds beeswax   | One pound beeswax    |
| One pound tallow     | One pound tallow     |

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The horticultural law may be obtained by writing to the State Secretary.

## LIST OF BULLETINS

*(In print) published by the Oregon Agricultural Experiment Station to February, 1907.*

No. 6, 1890—Chemistry, Zoölogy .....	Washburn
No. 10, 1891—Entomology .....	Washburn
No. 28, 1894—Pig Feeding, continued .....	French
No. 32, 1894—Five Farmers' Foes .....	Craig
No. 33, 1894—Tent Caterpillar .....	Washburn
No. 34, 1895—Fruits and Vegetables .....	Coote
No. 35, 1895—Pig Feeding, continued .....	French
No. 36, 1895—Composition and Use of Fertilizers .....	Shaw
No. 37, 1895—Experiments in Cattle Feeding .....	French
No. 38, 1895—Fruit Pests .....	Washburn
No. 39, 1895—Grasses, Chemistry .....	Shaw
No. 40, 1896—Prunes, Apples and Pears .....	Hedrick
No. 42, 1896—Feeding Sheaf Wheat .....	French
No. 43, 1897—Flax Culture .....	French
No. 44, 1897—Review of Oregon Sugar Beets .....	Shaw
No. 47, 1897—Cheat and Clover .....	Shaw and French
No. 51, 1898—Marketing Fruit .....	Craig
No. 52, 1898—Nut Culture .....	Coote
No. 53, 1898—Sugar Beets .....	Shaw
No. 54, 1898—Flax, Hemp, Dairy, etc. ....	French and Kent
No. 55, 1898—Chemistry of Cherries .....	Shaw
No. 57, 1899—Brown Rot .....	Cordley
No. 59, 1899—Sugar Beet Experiments of 1898 .....	Shaw
No. 61, 1900—The Oregon Prune .....	Shaw
No. 62, 1900—Miscellaneous Investigations .....	Shaw
No. 63, 1900—Prevention of Smut on Oats—Preliminary Bulletin .....	Pernot
Circular Bulletin concerning Acid Soils in Oregon—1900 .....	Knisely
No. 68, 1902—Birds of Oregon .....	Woodcock
No. 75, 1903—Insecticides and Fungicides .....	Cordley
No. 76, 1903—Leguminous Forage Plants .....	Withycombe
No. 78, 1904—Canning Cheese .....	Pernot
No. 79, 1904—Plant-Food and Use of Fertilizers .....	Knisely
No. 86, 1905—Irrigation in Klamath County .....	Kent
No. 87, 1906—Canning Fruit and Vegetables. Preserving Fruit Juices .....	Pernot
No. 88, 1906—San Jose Scale .....	Cordley
No. 89, 1906—Part I. Efficiency of Cream Separators Under Farm Conditions. A Thesis by Ira P. Whitney. Part II. Dairy School Cream Separator Tests .....	Kent
No. 90, 1906—Acid Soils .....	Knisely
No. 91, 1906—Farm Practice with Forage Crops in Western Oregon and Western Wash- ton .....	Hunter
No. 92, 1906—The Walnut in Oregon .....	Lewis
No. 93, 1907—Orchard Management .....	Lewis and Wicks

Copies will be sent to applicants so long as the supply lasts.

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