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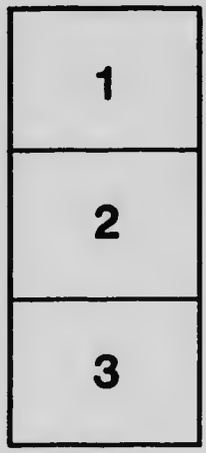
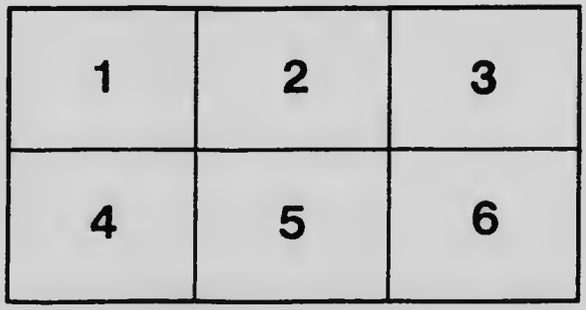




BULLETIN 144. June, 1903.

Ontario Agricultural College and Experimental Farm,

APPLE CULTURE.

By H. L. Hutt, Professor of Horticulture.

One of our leading nurserymen has observed that the demand for nursery stock of any particular kind of fruit depends largely upon the crop and the prices realized for that fruit the peceding season. If, for instance, apples are a good crop and bring good prices, the next year there will be a great demand for apple trees, but if the crop happens to be a failure or prices are unsatisfactory, many are then ready to tear out their newly planted apple trees and plant whatever fruit seems to be paying best at the time. The folly of such a shortsighted policy need hardly been commented upon. The planting of an apple orchard is an investment which lasts for more than a life time. It is wise, therefore, at the beginning to take a broad outlook and determine upon some definite line of work, and then adhere to it steadily. We can point to numerous apple growers throughout the Province who have made money out of their orchards, but these men did not lose faith, nor neglect their trees, when the crop was a failure or the prices low.

No doubt many growers have been discouraged by the low prices obtained for the fruit in some seasons, yet in most cases it might have been found that this was due largely to the unbusiness-like methods employed in handling and marketing the crop. The outlook for the apple grower never was brighter than at the present. With the reliable information we now have regarding varieties; more rational methods of caring for the trees; improved methods of handling the crop; and local and national co-operation in marketing it, there is no doubt that the apple crop will prove to be one of the paying crops of the future. There is a constant demand for first-class fruit in the best markets of Europe. Then if we realize for a moment the rapidity with which the great North-west is being settled, and consider that in all likelihood the apple will never be successfully grown in that latitude, we may safely count upon the North-west as one of the promising, and ever-increasing markets. In view of these facts, we believe that the Ontario farmer and fruit-grower, who is favorably located for the production of apples, can make no mistake in planting apple trees,—to what extent being determined mainly by the amount of care and attention he is certain of being able to give them.

Apart from the commercial side of apple culture, there is still need for the planting of small orchards on farms throughout the country for home use. It is surprising to find even in good fruit growing districts, such as we have in the greater part of Ontario, that there are yet thous-

NOTE. In the preparation of this bulletin Professor Hutt was assisted by Mr. H. S. Peart, B.B.A., Demonstrator in Horticulture. The section on "Insects Injurious to the Apple" was prepared by Professor W. Lochhead, Professor of Biology.

ands of farms upon which there is not an apple tree growing. The apple is certainly one of the most useful of all fruits, and no one who has a farm can afford to be without a small section devoted to apple trees for home supply.

Selection of Varieties.

One of the most important things to be considered in planting an orchard is the selection of varieties. Some of the most serious mistakes in the past have been made in this particular. In many cases worthless varieties have ben planted, which is hardly to be wondered at when planters had little more to rely upon regarding varieties than the exaggerated descriptions given by travelling tree agents. But in these days when we have reliable information about all classes of fruits for all sections of the Province published annually and distributed free, as is done in the report of the Ontario Fruit Experiment Stations, there is no excuse for planting anything but the very best varieties suited to each section.

One mistake to be avoided is that of planting too many varieties, particularly in commercial orchards. A half dozen good winter sorts has been found to be plenty. For home use, however, the list might be doubled, or at least lengthened, to suit the preferences of all members of the family. There should, in any case, be varieties enough to cover the season and give a bountiful supply from earliest to the latest. One or two summer varieties, three or four autumn, and half a dozen winter varieties would be about the right proportion of each to plant.

Another precaution which has to be taken in planning a commercial orchard, is that of planting too large a block of any one variety. For convenience in harvesting it is no doubt best to plant trees of the same variety near together, but on the other hand if these blocks of one variety are too large it may be the cause of poor crops, for there are many varieties which are self-sterile, that is, the pollen which they produce will not properly fertilize their own flowers, although it may be quite potent on the blossom of some other variety. This question has not been sufficiently studied to warrant us in saying definitely just which varieties are self-sterile and which are self-fertile, although from experiments which have been made, the following varieties appeared to be more or less self-sterile : Yellow Bellflower, Chenango, Gravenstein, King, Northern Spy, Primate, Rambo, Red Astrachan, Roxbury, Russett, Golden Russet, Spitzenburg, and Tolman Sweet. None of these should be planted in blocks of more than three or four rows, without some other variety intervening which blooms about the same time. In orchards where such a mistake has been made, it can be rectified most readily by grafting every third or fourth row with some variety which will insure cross-fertilization.

Both tree and fruit must be considered in the selection of varieties. The tree must have sufficient hardiness for the locality, and it is in this

particular that the Fruit Experiment Stations give valuable information to intending planters. Productiveness is also an important characteristic. Unfortunately some of the varieties of most excellent quality, such as the Blenheim and King are lacking in this respect, and, while it may be desirable to plant these for home use, still such a defect is a serious one in a commercial orchard. The age of bearing is another characteristic which varies greatly in different varieties. The Northern Spy, for instance, often requires ten to fifteen years before it comes in bearing, while Ontario, Wealthy, and many of the Russian varieties sometimes bear even in the nursery rows, or at least in a year or two after they are transplanted into the orchard. This is a difference which may well be taken advantage of in the arrangement of varieties in the orchard, for, as a rule, those which are slow in coming into bearing make larger trees and are longer lived, while those which begin early and bear heavily are more or less dwarfed in their growth and the trees are shorter lived. For this reason trees of the precocious varieties are often planted as fillers between rows of the later bearing and larger growing kinds.

The most desirable qualities in the fruit itself depend largely upon whether it is for the market or for home use. For home use, good quality is the first consideration. Usually those having a spicy or characteristic flavor, such as the Spy, King, or McIntosh, are most desirable. Apples with an acid or subacid flavor are most in demand on the market; nevertheless a good sweet apple is often much appreciated for home use. For the market, good appearance is the first consideration. No doubt in time buyers will be more discriminating and demand good quality rather than fine appearance, but at present the most saleable apples are those that keep well, are of fair size and an attractive color. Well colored red apples are those in the greatest demand in the Old Country market, a point which should be remembered in selecting varieties intended for export. Good shipping qualities have also to be considered in the selection of commercial varieties, although no doubt the improvement in methods of packing and shipping may render this of less importance in the future than it has been in the past. The Ben Davis apple has long been recognized as one of the best shipping varieties, on account of its firmness and good keeping qualities. On the other hand, the McIntosh is not a long keeper and is so easily bruised that it cannot be shipped satisfactorily in barrels. But with improved methods of packing and shipping, it may be shipped to any of the European markets and even placed on sale with the Ben Davis, and it is a question how long the Ben Davis, with its inferior quality, will be able in such competition to hold its place in the market. Those who champion the Ben Davis may take exception to the comparison just made because of the relative difference in season of the two varieties. Nevertheless, we believe that it will be safer in the future for growers to look more to the quality of the variety than has been done in the past, for in due time buyers will no doubt become more discriminating and demand apples of the very best quality.

Varieties Recommended to Ontario Planters.

The following list, prepared by the Board of Control of the Ontario Fruit Experiment Stations, contains only a few of the most valuable varieties recommended for planting in Ontario. These have been selected from about 800 that have already been tested in this Province. This list might well be doubled to include a number of valuable kinds for special localities.

In the following lists the varieties are mentioned in their order of ripening. The division into summer, autumn, and winter varieties is an indefinite classification because of the marked difference in the season of maturing in northern and southern sections of the Province, yet, it is valuable to some extent as a guide.

Varieties Valuable for Market.

Summer.

Red Astrachan : Adapted to all sections except the extreme north.
Duchess : Adapted to all sections.

Fall.

Gravenstein : Adapted to all sections except the St. Lawrence River district and the more northerly portions of the Province.

Wealthy : Particularly valuable for northern sections.

Alexander : For northern sections.

McIntosh : Adapted especially to the St. Lawrence River district but can be grown over a much wider area.

Fameuse : Adapted especially to the St. Lawrence River district, but succeeds well over a much wider area.

Blenheim : Adapted to all sections except the St. Lawrence River district and the more northerly portions of the Province.

Winter.

King : Adapted only to the best apple sections, and succeeds best when top grafted on hardy stocks.

Hubbardston : Adapted to the best apple sections.

Greening : Adapted to the best apple sections.

Cranberry : Requires good soil and is adapted to the best apple districts, but especially southern Ontario.

Baldwin : Succeeds best on clay land, and is adapted to the best apple districts.

Northern Spy : Adapted to the best apple districts, but can be grown with success further north by top grafting on hardy stocks. This is also a good method of bringing it into early bearing.

ONTARIO : An early and abundant bearer, but short lived. Recommended as a filler among longer lived trees. Adapted to same districts as Northern Spy, which it somewhat resembles.
STARK : Adapted to best apple districts.

VARIETIES VALUABLE FOR HOME USE.

Summer.

YELLOW TRANSPARENT : Adapted to all sections.
PRIMATE : Adapted to best apple sections.
SWEET BOUGH : Adapted to best apple sections.
DUCHESS : Adapted to all sections.

Fall.

CHENA..O : Adapted to be. apple sections.
GRAVENSTEIN : Adapted to best apple sections.
WEALTHY : Especially adapted to northerly sections.
McINTOSH : Especially adapted to northerly sections.
FAMEUSE : Especially adapted to northerly sections.
BLENHEIM : Adapted to best apple sections.

Winter.

KING : Adapted to best apple sections. Should be top grafted.
WAGENER : Adapted to best apple sections.
SWAYZIE POMME GRISE : Adapted to all sections except most northerly.
GREENING : Adapted to best apple sections.
TALMAN SWEET : Adapted to best apple districts.
NORTHERN SPY : Adapted to best apple districts, but will succeed farther north if top grafted.
MANN : Adapted to best apple districts, but will succeed farther north if top grafted.

HARDY VARIETIES RECOMMENDED FOR SECTIONS NORTH OF LATITUDE 46 DEGREES.

Summer : Yellow Transparent, Charlamoff.
Fall and Winter : Duchess, Wealthy, Hibernal, Longfield, Patten's Greening, Whitney Crab, H.. lop Crab.

LOCATION AND SITE.

The large inland lakes surrounding the southern portion of this Province have a wonderfully ameliorating effect upon the climate for ..me distance from their shores, and as a rule, our most extensive com.. rcial orchards are in proximity to these large bodies of water. There ar.. however, in the interior many localities quite as favorable for fruit gr.. ng, b.. in such locations the question of site and exposure

has to be more carefully considered. The site usually selected for the orchard is one near the buildings, which may be all right if these are on the highest ground, for such grounds are not only best drained but are least liable to untimely frosts. Good atmospheric drainage is often quite as important as good water drainage, and cold air like cold water runs down hill. Only a few feet of elevation above a wide adjoining area may be sufficient to enable trees in full bloom to escape a frost which destroys the crop on the lower level. On level lands there is practically no atmospheric drainage and the orchardist must take his chances and make the best of it.

Exposure.

Where the land is rolling, and there is a choice of exposure, the situation should be carefully considered, for in many cases this may be the difference between success and failure. As to which is the best exposure, depends largely upon the surroundings. In proximity to large bodies of water the best exposure is toward the water. In localities subject to late spring frost the safest exposure is toward the north, as this helps to retard the period of bloom till danger of frost is past. On a northern exposure trees are less likely to suffer in times of severe drouth, and there is also not so much injury from sun scald, a most serious trouble in northern localities. For the reasons given a northern or eastern aspect is, as a rule, preferable to a southern or western one, and also because there is less exposure to our strongest prevailing winds, which come from the south west.

Windbreaks.

Protection from the prevalling winds is another matter that requires due consideration. The shelter accorded by a high hill or natural belt of timber is perhaps the ideal one, but where these do not exist, the planting of a windbreak is necessary. Prof. L. H. Bailey in his excellent book "Principles of Fruit-growing," thoroughly discusses the advantages and disadvantages of windbreaks, and summarizes as follows :

"The benefits derived from windbreaks are the following : Protection from cold; lessening of evaporation from soil and plants; lessening of windfalls; lessening of liability to mechanical injury of trees; retention of snow and leaves; facilitating of labor; protection of blossoms from severe winds; enabling trees to grow more erect; lessening of injury from the drying up of small fruits; retention of sand in certain localities, hastening of maturity of fruits in some cases; encouragement of birds; ornamentation."

"The injuries sustained from wind-breaks are as follows : Preventing the free circulation of warm winds, and consequent exposure to cold; injuries from insects and fungous diseases; injuries from the encroachment of the wind-break itself; increased liability to late spring frosts in rare cases.

"The injury from cold, still air is usually confined to those localities which are directly influenced by large bodies of water, and which are protected by forest belts. It can be avoided by planting thin belts.

"The injury from insects can be averted by spraying with arsenical poisons.

"The injury from the encroachment of the wind-break may be averted, in part at least, by good cultivation, and by planting the fruit simultaneously with the belt. So far as practicable, the wind-break should be planted as a distance of six rods or more from the fruit plantation."

The best trees for wind-breaks are some of the evergreens, such as Norway and White Spruce, the Austrian and Native White Pines. The Norway Spruce is most used because it is a rapid grower, and the young trees may be obtained very cheaply. The wind-break should be planted at the same time as the orchard, it will then be effective by the time the trees come into bearing. A single row may be sufficient, although in very exposed places, a double row, with the trees set alternately, is preferable. The trees should be at least six or eight feet apart, and even ten or twelve feet is better when the trees grow up. The trees in the wind-break should be well cultivated, the same as the trees in the orchard, until they become well established. Neglect of this is the main cause of failure in setting out wind-breaks.

The Soil and its Preparation.

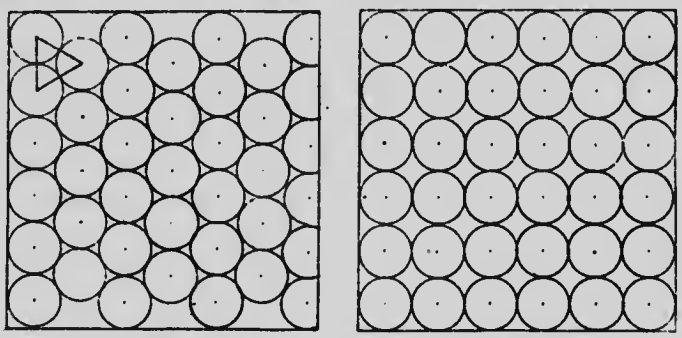
The apple tree readily adapts itself to a great variety of soils, yet there are certain kinds upon which it does much better than others. Light sandy soils are usually deficient in plant food, and are not retentive of it when fertilizers are applied to them. The trees upon such soils may do fairly well for a time, but as a rule they are less productive and shorter lived than on heavier soils. On the other hand, heavy clay soils may contain plenty of plant food, but they are difficult to work and unless very carefully managed bake so hard that the tree will not thrive upon them. The ideal soil is a happy mean between these extremes, a friable loam. It may be called a sandy or a clay loam, as either sand or clay predominates in its composition, and is all the better if of a limestone formation upon an open subsoil.

One of the first requisites in a good orchard soil is good drainage. Fruit trees will not thrive upon undrained soil. If the land is not naturally well drained, it should be thoroughly underdrained.

Good preparation of the soil previous to planting is very essential. Trees set on unprepared soil are seriously handicapped at an important stage of their life and often they never overcome it. Land which has been exhausted by grain growing is in poor condition for the growing of trees, although it may greatly improved by growing and plowing down two or three crops, such as rye, clover, or vetches, as a green manure. Probably no other crop leaves the ground in better mechanical condition for the growth of trees than clover. Its roots penetrate the soil deeply and leave it well filled with vegetable matter or humus.

There has been much diversity of opinion regarding the value of subsoiling in preparing the land for trees. But there is little room for doubt that it is of much benefit on land where the subsoil is hard and impervious to water. The subsoiler should follow in the furrow of the ordinary plow, loosening the subsoil as deeply as possible. Where this is not done, clover roots are the next best thing as subsoilers.

The preparation of the ground for planting should begin by a good deep plowing in the fall, and it would be all the better if it could be ribbed up as is now frequently done in preparing ground in the fall for spring seeding. This insures good surface drainage and quick drying of the ground in the spring. All that would then be required in the spring would be to harrow down the ridges and loosen up the ground as deeply as possible with a spring tooth cultivator.



Hexagonal. Square.

A comparison of the hexagonal and square systems of arranging trees in the orchard.

Arrangement of Trees in the Orchard.

There are several methods of arranging the trees in an orchard. The plan usualy adopted is that known as the square. By this arrangement the rows are planted the same distance apart each way, four adjoining trees forming a square. A more economical plan is what is known as the hexagonal arrangement, which admits of about fifteen per cent. more trees per acre without any more crowding. In the hexagonal arrangement the trees in one row are set alternately with those in the next, six adjacent tres forming a hexagon and enclosing a seventh in the centre.

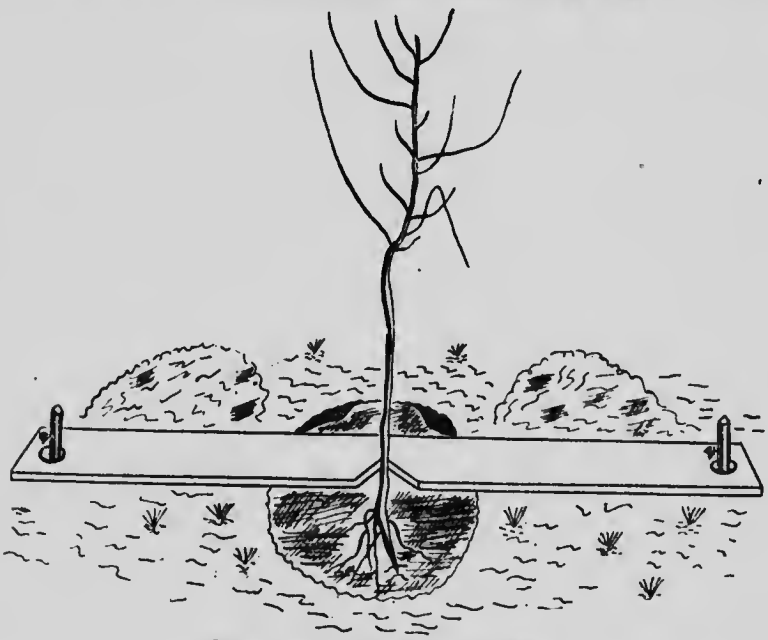
In laying out an orchard on the square, the first row is staked out at whatever distance the trees are to be apart, and at this same distance, the second and following rows may be staked out in the same manner.

In laying out an orchard on the hexagonal plan, after the first row has been staked at the desired distance, the position of the trees in the second row and also the distance apart of that and the following rows may be most easily found by taking two stout strings or wires, which after being fastened to any two adjacent stakes in the first row, are yet equal in length to the distance apart of these stakes, then drawing the free

ends out till they meet, forming an equilateral triangle. This being done at each end of the rows, the intervening trees may be located by measuring.

Whichever method of arrangement is adopted, the trees should be planted in rows as straight as it is possible to set them. Straight rows add not only to the appearance of the orchard, but to the convenience of cultivation. One of the best means of getting the rows straight is to stake out the position for each tree before beginning to plant. Laths are excellent for this purpose. Then when all has been properly staked out, a planting board should be used when planting to insure getting the tree in the exact position marked by the stakes.

A planting board is made of a light piece of board four or five feet long, with a hole bored through each end and a notch in the centre. It is well to have two or three of these made exactly alike, one for the planters and the others for those digging the holes. When a hole is dug, the notch in the planting board is placed around the stake, and wooden pegs are passed through the holes in the end of the board and left in the ground while the hole is dug and the board taken on to the next stake. The planters following place their board over the pegs and the tree in the notch in the centre. It will thus be in exactly the same position as the stake which previously marked the hole.



How the planting board is used.

Distance Apart for Planting.

The proper distance apart for planting depends altogether upon the ultimate size which the trees may attain, which in turn depends upon the

variety, the soil, and the locality. The varieties grown in our most northern orchards seldom spread more than twenty or twenty-five feet. While the kinds grown in the more favored apple sections of Southern Ontario often have a spread of forty feet. The best guides to intending planters is to observe carefully the distances required for full grown apple trees in the neighborhood. In southern Ontario this will be found to be from 35 to 40 feet, throughout central Ontario 30 to 35 feet, while in northern sections where only the hardiest kinds are grown 25 feet will be found quite sufficient. It is wise to allow plenty of space, so that there will be no crowding when the trees have reached their full size. Planting too close is a far more frequent and serious mistake than planting too far apart.

A plan quite frequently adopted, particularly in some of the large American orchards, is to use some of the small-growing early-bearing varieties, as fillers between the large-growing varieties. The Duchess, Ontario, and Ben Davis, for example, being planted alternately with large growing kinds, such as Baldwin, Greening, and Spy.

In such cases the large-growing kinds are set at the maximum distance apart, and the smaller kinds between them. By the time the larger kinds begin crowding, the smaller ones will have paid for their keep and that of the others and can be cut out to make room for the larger trees. The greatest objection to this plan is the danger that the fillers may be left so long before they are removed that the value of the whole orchard may be impaired.

Ordering and Obtaining Trees.

A complete list of the nurserymen of this Province is published each year in the Report of the Inspector of Fumigation, and most of our leading nurserymen advertise in the agricultural and horticultural papers. Upon application, any of these men are glad to quote prices at which they can supply stock.

It is well, when ordering nursery stock, to order early. Too many leave such a matter till planting time, when they might as well have had their order in several months sooner. By ordering early they are more likely to obtain just what is wanted, and if the nurseyman has not the desired varieties on hand, he can obtain them elsewhere by the time they are needed.

When the trees arrive from the nursery, it is best to unpack them as soon as possible, and, if it is not convenient to plant them at once, the roots should be spread out and buried in a deep trench till they can be permanently planted. The longer the trees are to remain in this position the more carefully they should be heeled in.

Transplanting.

There is a diversity of opinion as to the best time for transplanting. It may of course be done any time when the tree is dormant, either

in the spring or autumn. In favorable localities and with hardy varieties it may be done quite as well one season as another, but for general planting the spring is the safest time in our rigorous climate.

Great care should be taken to prevent the roots of the trees drying while they are out of the ground. If it happens to be hot and windy at the time of transplanting, it is a good plan to puddle the roots in soft mud as soon as they are taken from the packing box or trench, and in carrying the trees about the orchard, it is well to keep the roots covered with a wet blanket or piece of old carpet.

The hole for the tree should be wide enough to hold the roots without cramping or crowding, and should be deep enough to admit of a few inches of fine mellow surface soil being filled in the bottom, and still have the roots an inch or two deeper than they were in the nursery row. The roots should be spread out in their natural position and should be covered with moist mellow surface soil. It is well, in digging the holes, to have the surface soil placed at one side and the subsoil on the other, so that in refilling the surface earth may be placed next the roots and the subsoil left for the top. If the soil has been properly prepared it is seldom necessary to water the roots at the time of transplanting, but care must be taken to ensure the soil moisture from below coming up to the roots. This is insured by tramping the earth firmly as soon as the roots are well covered, and leaving only the top soil untramped to act as a mulch and retain the moisture below. The neglect of this firming of the soil around the roots is one of the most common causes of failure in the transplanting of trees. If watering is necessary, a small pailful poured in as soon as the roots are nearly covered, is of more use than a half dozen on the surface after the planting is done.

All torn, bruised, or injured roots should be cut back, with smooth cuts, to sound wood. Smooth cuts callous over quickly and new roots are the more readily sent out. Trees obtained from the nursery, no matter how carefully they may have taken up, have lost the greater part of their root system, and in order that they may make a satisfactory growth when transplanted the top must also be cut back to a similar extent to restore the balance. This cutting back, however, can be most satisfactorily done after the trees are planted, when they are held firmly by the soil and more careful attention can be given to shaping the head of the young tree.

Initial Pruning.

Closely associated with the heading back of the top at the initial pruning of the tree, is the question of determining the height at which the head should be formed. On this, as in many other points of orchard management, there is a variety of opinions. Some prefer high heads, because of the greater convenience for cultivation and working underneath; while others prefer them low, because of the greater convenience in pruning, spraying, and harvesting. There are other reasons, however, why low headed trees are preferable; in exposed locations the trees

and crop are less likely to suffer from violent winds, and in northern localities the trees with short trunks and low spreading branches are much less subject to injury from sunscald, the most serious tree trouble of the north. At the Algoma Fruit Experiment Station it has been found advisable to start the head not more than a couple of feet from the ground, while in the more favored sections the custom is to have at least four feet of trunk. This is the height at which the head is usually started on two or three year old trees as obtained from the nursery, and for this reason it is better for the northern planter to get two year old, rather than three or four year old, trees, so that he can start the head at whatever height he wishes. In this connection it may be stated that tree trunks do not lengthen, except by pruning off the lower branches, so that at whatever distance from the ground the lower branches are left, that will be the permanent length of the trunk.

Three branches are enough to leave to form the main limbs or framework of the tree top. These should be evenly spaced around the trunk to give a well balanced and symmetrical top, and they should also be placed on the trunk so as to distribute evenly the weight of the top and avoid bad crotches which are liable to split down with weight of crop. It is particularly important at this stage that great care should be taken to train the young tree in the way it should go, and much can be done in training and directing growth by heading back to buds pointing in the direction we wish the new branch to take.

Cropping and Interplanting.

In a newly-planted orchard the trees occupy but a small portion of the land, and they cannot be expected to give any returns for at least five or six years. It is advisable, therefore, that some other crop be grown in the orchard which will pay for the labor spent upon it till the apple trees come into bearing and require all the space. It is by injudicious cropping, however, that young orchards are often most seriously injured. It should not be forgotten that the apple trees are the first consideration, and that whatever cropping is done in the orchard must not interfere with them in the least.

In some cases the spaces between the trees may be planted with small fruits, such as raspberries, currants, or gooseberries, but these should not be planted within nine or ten feet of the trees nor should they occupy ground more than six or seven years.

Hoe crops, such as corn, roots, potatoes, etc., have generally been recommended as the best to grow in the orchard, because of the opportunity they afford for cultivation. This may be all right as far as it goes, but these crops draw heavily upon the plant food in the soil and return very little in the way of roots or plant residue. If such crops are successively grown for several years, they are almost sure to seriously deplete the soil of fertility, unless extra care is taken to maintain it by the application of manure or fertilizers. Probably on the whole the

least objectionable cropping is a well arranged rotation of crops, in which clover and hoed crops alternate frequently enough to keep the ground in good condition. Some of these crops harbor mice, and whenever such occur in the rotation precautions must be taken at the approach of winter to protect the trees from their ravages.

During all this intercropping a strip must be left in which the trees are growing for regular cultivation, and this strip should be widened each year as the trees increase in size. No cropping should be attempted under the head of the trees, and intercropping should be discontinued as soon as the trees require all the space.

Cultivation.

It is only during the last decade that the cultivation of the orchard has been considered a problem worthy of special attention by the great majority of Ontario fruit-growers. Even yet many have not abandoned the old practice of leaving the orchard in sod. At nearly every meeting of the farmers and fruit-growers someone asks the question : "Which is the best, sod or clean cultivation with cover crops ?

Cultivation improves the physical condition of the soil by breaking up the soil particles and presenting a greater feeding surface to the roots. By warming and deepening the soil, it permits of a greater depth of feeding area. Every soil particle is surrounded by a thin film of moisture, consequently the finer the soil particles the greater the surface area to hold moisture. A dry earth mulch or dust blanket on top checks the evaporation of moisture from below. Cultivation renders plant food more readily available by promoting nitrification and the decomposition of organic matter in the soil.

Knowing this to be the case, many growers have given the new system a fair trial, and have satisfied themselves that for most sections of Ontario clean cultivation with cover crops is more profitable than sod. There are indeed few cases where sod is more desirable than cultivation; these are where the soil is fertile and contains an abundant supply of moisture.

As soon as possible after the trees are set, a strip on each side should be cultivated to loosen up the soil which has been tramped down during planting. Each year this strip should be widened, so that no crop intended for harvesting is grown beneath the branches of the trees.

Cultivation should begin as early as the ground is dry enough in the spring. The first tool to be used in most cases is the plow. It is well to plow the land about five inches deep during the first few years after setting to encourage deep rooting. As the trees get older the depth of plowing should be gradually lessened, until by the time the orchard is in full bearing three to four inches is sufficient.

It is a good practice to roll each evening what has been plowed during the day, particularly if the ground is inclined to be lumpy. The soil is much more easily pulverized when freshly plowed than if allowed to lie exposed to the weather for several days.

Cultivate with the disc harrow or other cultivator after rolling to form a dry earth mulch, which prevents the loss of moisture by evaporation. Subsequently cultivation should be given as soon as possible after every rain, and about every two weeks in dry weather to maintain an effective dust mulch. These latter cultivations may usually be performed by means of light harrows. If weeds and grass get a start, the spring-toothed cultivator with the broad points should be used to cut them off. Cultivation should be continued until about the middle of July or the first of August, by which time the trees should have practically ceased growth. Cultivation after the first of August has a tendency to cause late growth of wood, which will not have time to properly mature and is liable to be killed back during the winter. If trees are making very rapid growth, it may be desirable to cease cultivation even earlier than the middle of July in order to check the growth. At the time of the last cultivation a cover crop should be sown.

Cover Crops.

What is an orchard cover crop? It is a crop sown on the ground at that season of the year when trees have ceased their growth. If man makes no effort to cover the ground, nature forms a cover of weeds and grass in her endeavor to protect the soil.

Cover crops may benefit in many ways, of which the following are some of the most important: (1) A cover crop, by adding a large amount of fibre to the land, prevents hard soils from cementing or puddling. (2) On bare and rolling land, where the rains quickly run off and snows blow off the high portions, a growing crop tends to hold these until they have time to soak into the soil. (3) Land covered by a growing crop dries out more quickly in the spring, owing to the transpiration of moisture through the leaves, and consequently may be plowed under earlier in the season than land which is bare. This is a very important point as it enables the orchardist to gain several days in the busy season of spring. (4) Ground covered with vegetation will hold the snows in winter and thus prevent deep freezing, therby avoiding the liability of root killing. (5) A cover crop affords the most economical means of furnishing a supply of humus in the soil. (6) The roots of a cover crop assist the tree roots in rendering available certain mineral plant food in the soil. (7) A large amount of plant food is liberated in the soil after the tree growth has ceased. This is taken up by the growing crop and held in a readily available form for the following season. (8) Leguminous crops, such as clover, vetch, alfalfa, peas, and beans, by virtue of certain bacteria which form nodules on the roots, are able to assimilate nitrogen from the air. As nitrogen is one of the most expensive fertilizing elements, the value of this class of plants cannot be too highly appreciated.

Cover crops should be sown about the middle of July so that they may make a good growth the same season. It is also wise to check the

growth of the trees about this time, so that they may mature their wood before winter sets in. The thorough tillage which should have been practised up to this season, leaves the ground in the best possible condition to give the young plants a start. The crop should be plowed under as early in the spring as possible, and cultivation should begin at once. If the crop is large and the soil rather dry, this is imperative, as the large amount of vegetable matter turned under seriously interferes with capillary action and leaves the surface soil unduly dry.

That a cover crop may be of the greatest value, it should be capable of withstanding the winter and continuing its growth next spring. This, however, is not a necessity, as many of the ordinary crops which will not live through the winter are valuable for this purpose.

Different soils require different kinds of crops. This has led to a division of cover crops under several classes. The most important are the nitrogen gatherers, which through the agency of the nodules on the roots can make use of the nitrogen of the air. Such plants as clover, vetches, alfalfa, peas, and beans, belong to this class, and should be used where the soil is deficient in nitrogen. Another class is known as the potash liberators, such as turnips and rape, which, although they do not add anything to the soil, as do the leguminous plants, yet change the form of the mineral potash so that it may be more readily acted upon by the roots of succeeding crops. Then there is a third class, commonly grown, such as rye, oats, and buckwheat, which are valuable chiefly on account of the humus formed by their development.

During the past two seasons, a number of the most common cover crops have been grown in the College orchard with a view to ascertaining their relative values. Among the most promising are the following:

Hairy Vetch, sown at the rate of thirty-five pounds per acre, forms a very close mat over the ground. This is a valuable crop owing to the fact that it collects nitrogen, lies close to the ground so that it does not inconvenience the pickers when gathering the fruit, and also withstands the cold winter and continues its growth early in the spring.

Red Clover and Mammoth Clover, sown at the rate of twenty pounds per acre, are about equal in value, make a fair growth, are low growing, and winter well on drained soil.

Crimson Clover has not made quite as good growth as the red or the mammoth, nor will it stand the winter here, which is a serious disadvantage.

Alfalfa, or lucerne, is one of the best leguminous crops for dry land. It makes a good growth and winters well. There is a mistaken impression that alfalfa will not make sufficient top the first season. Thirty pounds of seed per acre, sown in July, will give a good stand the same season.

Rape has given good results here. It makes a heavy growth of stiff stems, which, although nearly all killed in winter, stand up well

enough to hold the snows. Rape can scarcely be recommended for fruiting apple orchards, as it remains wet the greater part of the day, making the work of harvesting very unpleasant. It may be used to good advantage in the rotation, especially if few fruits are to be harvested.

Rye, the favorite crop of many growers, gives a fair amount of top and winters well. One advantage of rye is that it may often be grown on lands not in a physical condition for the growth of clover. In this way humus may be added to the soil, and conditions made more favorable for the growth of clover.

Maintaining Fertility.

The maintenance of fertility is more frequently neglected in the orchard than on any other part of the farm. Trees, even on poor land will produce fruit, but it is only on soils where fertility is maintained that paying crops are produced. Each year that fruit is harvested some plant food is removed. If profitable crops are to be expected the supply of plant food in the soil must be maintained.

The most essential elements for the production of fruit are nitrogen, potash, phosphoric acid, and lime. Nitrogen encourages leaf and wood growth, which are essential to the development of the tree and to the production of the best quality of fruit. Potash is an essential constituent in the growth of fruits. It constitutes a large proportion of the ash of the wood and more than 50 per cent. of the ash of the fruit, and is also associated with the development of flavor in the fruit. Phosphoric acid is essential to the development of the tree and the proper ripening of the fruit. Lime is not in itself an essential element, but assists in liberating plant food. On a soil deficient in lime, growth often continues so late that the wood does not mature nor the fruit ripen properly.

Barnyard manure supplies nitrogen, potash, and phosphoric acid, and improves the physical condition of the soil. Cover crops may take the place of barnyard manure to improve the physical condition of the soil, and the leguminous ones may add all the nitrogen required. Concentrated fertilizers or commercial plant foods may be used in conjunction with cover crops to supply all the plant food necessary for the growth of trees. In the use of commercial fertilizers it is well to proceed cautiously, and, by carefully conducted experiments, ascertain what elements of plant food the soil may be deficient in, and what amounts it may be necessary to apply to get the best results. Unleached wood ashes contain a small quantity of phosphoric acid, seldom exceeding 1½ per cent, a larger amount of potash, varying from 5 to 7 per cent., and also a certain amount of lime. Where pure wood ashes can be procured at a price not exceeding ten cents per bushel, they afford an economical source of

plant food. An application once in two or three years will usually give excellent results, especially on light soils which are most lacking in potash. Muriate of potash is another economical form in which to obtain potash. Phosphoric acid may be purchased in the form of superphosphate. Nitrogen may be procured in the form of sodium nitrate, but leguminous cover crops furnish a much cheaper source of this essential but costly element.

Pruning.

The object of pruning is to form a vigorous and evenly balanced tree, which will produce annually a paying crop of good sized, well-colored fruit. Unpruned trees produce many small-sized unsalable apples. Pruning lessens the number of apples per tree, but at the same time increases the size and improves the quality of those produced. A heavy crop of good-sized fruit is not so serious a drain on the vitality of the tree, nor the fertility of the soil, as the same weight of smaller apples would be, for it is the production of the seed which makes the greatest drain on the tree and soil.

Pruning should be practised every year without fail from the time the tree is planted. In this way the operation is never a severe one, and the removal of the large limbs becomes unnecessary. Limbs growing too strongly in any particular direction, which are liable to upset the balance of the tree, should be headed back. Where two limbs cross, one of them should be removed. Branches growing across, from one side to the other, should be cut out. Care should be taken to leave sufficient twigs in the centre to protect from sunscald. Much may be done in directing growth by heading back to a bud pointing in the desired direction. It is while the trees are young that the greatest care in training is required.

A properly pruned apple tree should be open enough to admit sunlight and permit of free circulation of air. Its lower branches should be trained high enough to admit of easy cultivation, yet the top should not be so high that spraying and harvesting are rendered difficult. Varieties differ more or less in their habit of growth, and, while it may be advisable to modify this to some extent, it is not well to attempt to change it unduly. Long bare branches should be avoided, and the formation of fruit spurs should be encouraged on all parts of the tree.

The best time for pruning is just before growth begins. Wounds made at that season soon heal over. It is not well to prune when there is frost in the wood. Pruning while the tree is dormant tends to increase the growth of wood. Summer pruning encourages the formation of fruit buds, but it is not advisable to do much of it, as the removal of any considerable amount of the leaf area tends to check the vigor of the tree. Pruning by the removal of buds may be practised at any season of the year.

The thumb and finger may be used for the removal of sprouts and buds during the summer. A pair of small pruning shears will remove all twigs less than half an inch in diameter. For larger limbs a sharp fine-tooth saw is needed. Make all cuts as smooth as possible and close to the main stem. When a large limb has to be removed, it may be advisable to cut twice, the first some inches out to avoid splitting, and the second to shorten the stub. A common mistake is the leaving of long stubs which cannot heal over before rot begins. Where it is necessary to remove large limbs, the wounds should be covered with grafting wax or thick lead paint to prevent the entrance of spores which cause decay.

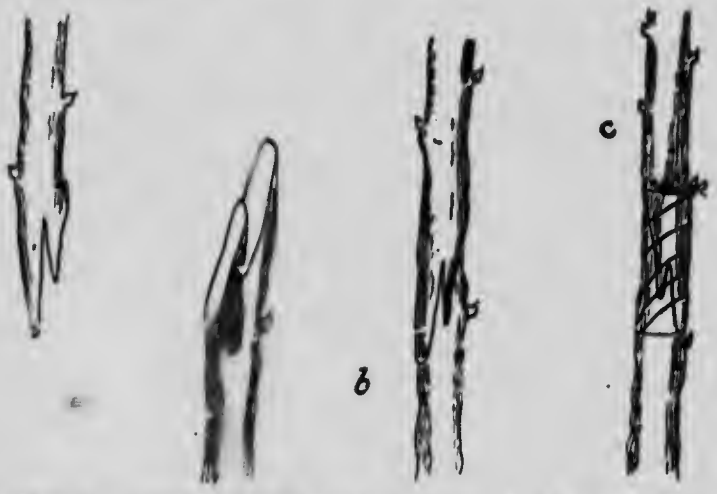
Grafting.

Grafting is the operation of inserting a scion into a stock, usually for the object of changing the variety of fruit produced. Trees bearing undesirable fruit may be top-grafted with some valuable variety. Many choice half-hardy varieties may be successfully grown by top-working on some hardy stock. Especially desirable characteristics in any variety may be perpetuated by grafting. Individuality is quite as marked in plants as in animals. A certain tree may possess some desirable quality, and this may be preserved and perhaps improved upon by selection. It is advisable when cutting scions to select from those trees which have the desirable characteristics most strongly marked. Nurserymen, as a rule, do not pay sufficient attention to the source from which they secure their scions. The individual orchardist may greatly improve his plantation by top-grafting with scions from a tree having the desired qualities most strongly marked.

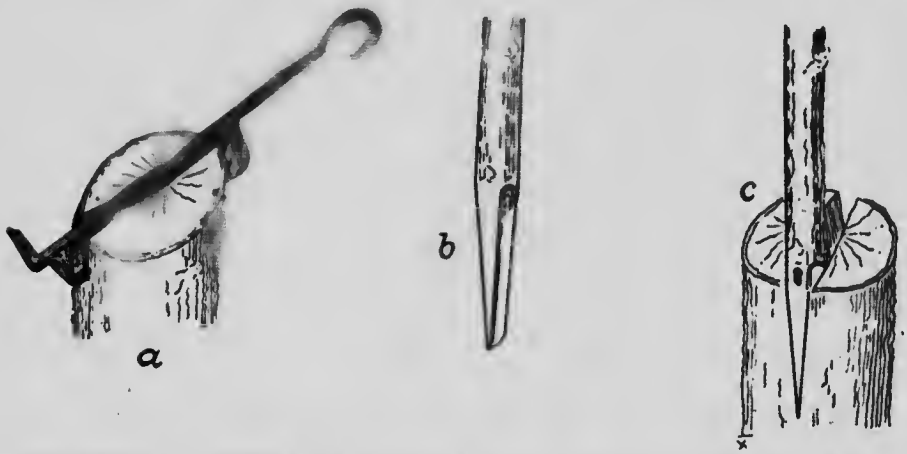
Grafting is usually performed in the spring. It is essential that the cambium layer of the scion and stock be in contact on at least one side. From this mucilaginous layer, lying between the wood and the bark, the new cells are formed which in time unite the parts and cover the wound. It is necessary to cover the wounds made in outdoor grafting to prevent the entrance of rot-producing spores. For this purpose wax is generally used.

A good grafting wax may be made by melting together four pounds resin, two pounds beeswax, and one pound tallow. Cool by pouring into a tub of water. Then work up into bars or balls which may be kept in any cool place until required. To economize wax, cloth is sometimes dipped into the hot wax, making wax-cloth. This is more difficult to use than pure wax. The wax may be melted and carried in a glue pot and applied with a brush, or as is more commonly done, it may be kept in water warm enough to keep the wax pliable so it may be readily applied by hand. It is well to keep the hands greased to prevent the wax from adhering to the fingers.

There are two common methods of top grafting. Whip or tongue grafting, which is practised upon small branches and young trees. Cleft grafting, which is usually performed on branches from one-half to two inches in diameter.



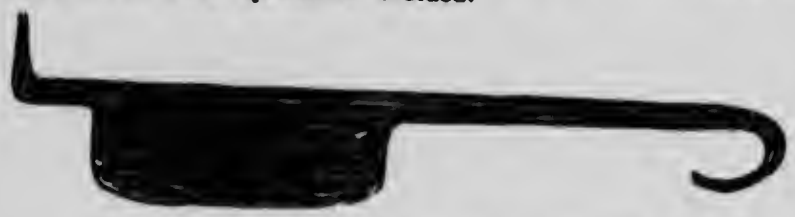
Whip grafting (a) scion and stock prepared, (b) same placed together, (c) tied.



Cleft grafting (a) splitting the stock (b) scion, (c) scion inserted in cleft of stock.

In whip grafting the stock is cut with a bevel about one-inch long, and the scion cut to fit that bevel. Both bevels are cut into slightly and the tongue of one fitted into the notch of the other. The cambium layers must be in contact on at least one side. After the scion is set the wound should be covered with wax or similar substance to exclude the air.

Large trees should not be entirely changed over in one year. The first year select the main branches; the second year part of the remainder, and finish the third year. In this way much of the annoyance caused by the growth of water sprouts is avoided.



A handy grafting iron made from a blacksmith's old file.

When cutting off large branches for cleft grafting it is wise to cut twice, making the first cut a few inches above the position chosen for the scion. Then cut off the stub at the desired point, and avoid the danger of tearing the bark. With a chisel or grafting iron split the branch just far enough to admit the scions. Too deep a split weakens the stock, and the scions will not be held sufficiently firm. It is well to avoid grafting two horizontal limbs, one directly above the other. The tendency of new growth is upward, and the growths from the lower one will interfere with the upper. In branches, other than those growing perfectly upright, the split should be made parallel to, rather than at right angles to the ground.

The scion should be made wedge-shaped, with bevel about one inch long, starting at each side just at the base of a bud. Make the scion three buds long, cutting off just above the third bud. It should be cut a little thicker on the side next to the bud, so that the stock may pinch tightly on that side to insure a close contact of the cambium layers.

Open the cleft with the wedge end of the grafting chisel and insert one or two scions, as may be thought necessary. Place the lower bud of the scion to the outside. Do not force the scion down, but open the cleft by enough leverage on the chisel to admit the scion freely. Setting the scion with the top pointing slightly outward insures contact in at least one point. After setting the scions, cover all wounds with wax.

It is sometimes necessary to remove part of the water-sprouts, which usually start during the summer, to give the scions room for proper development. By the following spring the scions should have made sufficient growth to require all space in that part of the tree, and all other growth should be removed.

Sunscald.

Sunscald is an injury to trees which occurs most frequently in the northern districts. It is most serious on young trees, but may also

affect the upper side of the large branches in older trees. It is caused by the action of the hot sun on the trunk and branches in the early spring. The first indication is an unhealthy appearance of the bark on the south and southwest sides of trunk and upper side of large branches, the affected parts soon turn brown, then black, and finally die.

In districts where sunscald is apt to occur, it is well to head the trees low and incline the stem slightly to the southwest. In this way the branches afford some shade to the trunk. Anything which will shade the trunk in early spring will prevent the injury. For this purpose the most convenient of the following materials may be used : cornstalks, birchbark, building paper, or a veneer of thin wood, such as is used in basket making. The large branches of old trees should receive natural protection from the small branches and twigs of the top. For this reason severe pruning of the top is not advisable in northern districts.

When trees are badly affected they usually die, but where the injury is slight, and is noticed soon after it occurs, treatment is practicable. Cut away the injured parts, and cover the wound with grafting wax or some material which will keep the wood from drying out. If the tree is healthy and vigorous, the annual growth spreading in from the sound parts soon repairs the injury.

Protection From Mice.

During the past two or three years, mice have become a serious menace to young orchards. The rapid increase in numbers may be largely accounted for by the indiscriminate destruction of the farmer's best friends, the hawks, that feed largely on mice by day, and the owls, which take up the work by night. By carefully protecting the hawks and owls for a few years, their numbers will again increase, so that the equilibrium of nature may be restored. In the meantime something must be done to protect the trees against the rodents.

Mice seldom harbor in a green crop, and on clean fields they find no protection. They are found chiefly along the fence lines and in old meadows. As there is usually some shelter afforded the mice near orchards, it is advisable to guard against their depredations. In localities where the snow falls early and remains on the ground all winter, the simplest means of protecting the trees is to tramp the snow firmly about the base of each tree early in the winter. Where the ground is not continuously covered with snow during the winter, a mound of earth about the tree is sometimes all that is required to divert the runways of the mice. Building paper cut into strips which will reach about one foot high when tied about the trunk of the tree in autumn has been found to be both a cheap and an effective preventive.

Treatment of Injuries Caused by Mice.

Bridge grafting.

Badly girdled trees usually die. When the part girdled is small and is covered before the wood dries out with grafting wax or other substance, which will protect the inner tissues the tree may be saved. If the girdled part extends entirely around the tree, it will be necessary to establish some connection between the cambium above and below the injury. This may be done by bridge-grafting. For this purpose use long scions cut to a bevel on each end. Insert one end above and the other end below the girdle, making sure that the cut surfaces are in contact with the cambium layer. A sufficient number of these scions should be put in to convey the cambium from the top to the roots and all cut surfaces exposed should be covered with wax.

Picking.

Apples should be carefully picked by hand, without breaking the skin or bruising the fruit in any way. Summer varieties for immediate home use or special local trade should be allowed to ripen on the tree; but if intended for distant markets or storage they should be picked

when fully mature, but before they have commenced to mellow. Winter varieties should hang on the tree until they have reached full size and have taken on good color. Apples picked while still immature as a rule keep longer than if allowed to fully ripen on the tree, but they do not develop the full color nor the best quality. No sharp distinction can be made between green and mature, or between fully mature and over ripe fruit; one blends imperceptibly into the other. Experience teaches at what stage to harvest the crop, in order to secure the highest quality and best keeping properties in the fruit. Sometimes, with summer varieties, it is necessary to go over a tree twice, picking the most mature specimens first and leaving the remainder for a week or two in order that it may more perfectly develop. Round bottom baskets or pails should be used for picking, and it is better to have them lined with cloth to prevent bruising the fruit. Fruit should not be piled on the ground, but should be placed at once on the sorting table or be placed in boxes or barrels for removal to the packing house. The apple should be picked with the stem on but without breaking off the fruit spur, as is likely to occur if the fruit is picked too green. Spring waggons should be used to convey the fruit to and from the packing house.

When the trees have been properly pruned the fruit may all be harvested from ladders. A short step ladder is convenient for the underside and low branches of the tree. For the upper branches light cedar ladders of suitable length will be found very convenient. Extension ladders have been praised very highly in the past, but as they are both awkward and cumbersome, practical growers are abandoning them. The practice of climbing through the tree to gather the fruit, and letting the baskets down to the ground by means of a rope, is out of date, and is not practised in commercial orchards. Inexperienced pickers often lose a great deal of time by not picking clean as they go, making it necessary to carry the ladder back and forth. Each time the ladder is moved all apples in each should be picked.

Packages.

A great deal of discussion has taken place during the past few years as to the best style and most suitable size of package. This depends somewhat upon the quality of the fruit and the requirements of the market. For summer varieties for local trade the ordinary eleven quart Climax basket is still the most popular package. For the export trade of XXX apples some prefer the box and others the barrel, depending on the market to be supplied and the relative cost of the two packages. Apples, other than early varieties intended for local markets, can usually be handled most cheaply in barrels.

The adoption of a standard size of box and barrel will have a tendency to establish confidence on the part of the buyer, and will eventually help the apple trade. The Standard barrel is defined in the Dominion Statute entitled Staple Commodities, I. Edward VII., Chap. 26, sec. 4:

"All apples packed in Canada for export for sale by the barrel in closed barrels, shall be packed in good strong barrels of seasoned wood, having dimensions of not less than the following, namely :—twenty-six inches and one-fourth between the heads, inside measure, and a head diameter of seventeen inches, and a middle diameter of eighteen inches and one-half, representing as nearly as possible ninety-six quarts."

The standard box has just been established by the Dominion Government, and its use comes into effect on July 1st, 1906. The inside measurements are: 10 inches deep by 11 inches wide by 20 inches long, having a capacity of 2,200 cubic inches, or very nearly one-third of the standard barrel.

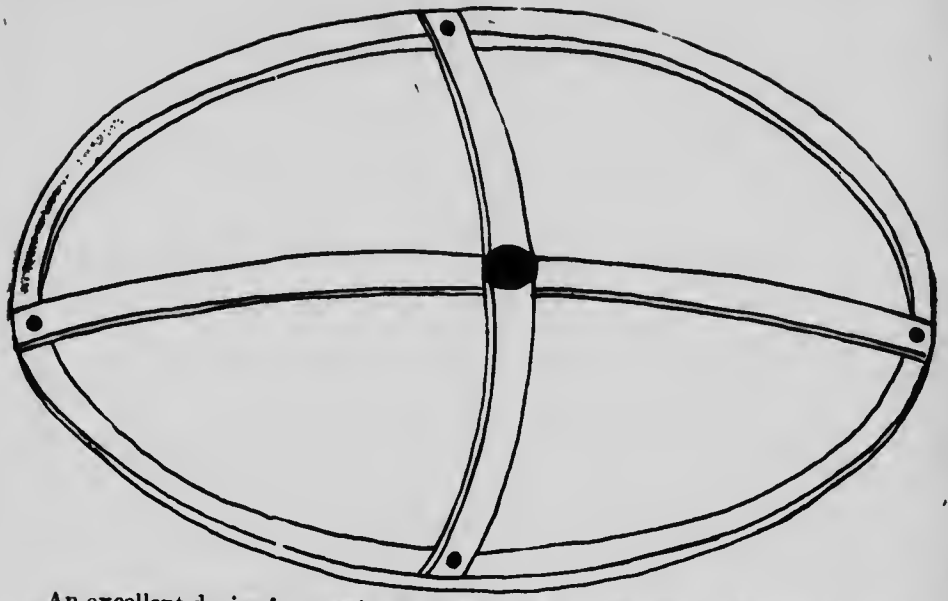
Grading.

Apples should be carefully graded. Wormy, spotted, bruised, and misshapen specimens should be removed. It is usually well to make two grades of good fruit, differing only in size and color. Each grade should possess uniformity of size and color, and be free from defects. All fruit of one grade cannot be of the same size, but all the fruit contained in one package should be uniform. It is seldom advisable to export anything but XXX fruit, the XX and X fruit may be sold on the local markets or to the evaporators.

Mechanical graders may sometimes be useful in grading to size, but their use is not generally recommended. With a little experience, hand grading soon becomes a very simple operation. A thin board with holes the size of the various grades in which to try an apple occasionally assists in fixing the size in the mind. A basket should be provided for each grade, so that no fruit need be handled the second time.

Packing.

Apples may be packed in boxes or barrels. If the barrel is used the hoops should be tightened and nailed, the head secured with liners and branded in accordance with the Fruit Marks Act, and the bottom end removed for filling. The first course of apples should be placed in concentric rows with the stems downward. Long stemmed varieties should have the stems clipped out. Some packers recommend placing the second course in by hand, but this is not necessary. The balance of the barrel may be filled by emptying direct from the basket. Be sure to let the basket well down to avoid bruising the fruit. After every two or three baskets the barrel should be racked to settle the fruit into place. To rack a barrel, place it on a plank and rock backward and forward once or twice. When one becomes accustomed to this work it is possible to settle the fruit quickly and effectively. With most varieties the barrel should be filled to about the top of the staves and levelled off evenly. At the last racking, in order to keep the apples from becoming displaced, it is a good practice to place on the top of the fruit, a false head covered with felt. Press the head carefully, tighten the hoops, nail on the liners, and the barrel is ready for market.



An excellent device for pressing the heads in apple barrels. The circle is a little smaller than the head of the barrel, and is made of iron, 1 in. wide and ¼ in. thick. The cross bars are made of heavy waggon spring steel. This enables the head to be put in place with the minimum amount of pressure on the head, and avoids bruising the fruit.

Packing in boxes requires more care than packing in barrels. For extra fancy fruit, it is well to line the inside of the box with fancy paper in order to present a better appearance when opened. Excelsior is often used in the top of the box, but it should be covered with paper to prevent the dust from settling among the apples. Place the first course by hand with stem end down. The remainder may be carefully poured in; but for the best results it is better to place all the fruit in layers, making sure that it is packed solidly. Place a piece of heavy paper on top of the fruit, press carefully, and nail the head on. If the fruit is properly packed it should require but little pressing to prevent the fruit from moving. The harder the fruit is pressed the greater the danger of bruising. Brand the box in accordance with the Fruit Marks Act. Always use stencils for branding. Pencil writing on a box is unsightly, and does not give the purchaser as good an impression as neat stenciling.

Some varieties, especially the softer ones, will bring better prices if each apple is wrapped in paper. The paper prevents the fruit from moving and becoming bruised and gives a finished appearance to the case. Only extra fancy fruit will pay for the additional cost of wrapping.

Marketing.

In so far as commercial fruit growing is concerned, the business end of the enterprise, that of marketing the crop to the best advantage, is second in importance only to that of producing fruit of the best quality.

It is in this particular that there is the greatest need for improvement at the present time; just how the improvement shall be effected is more or less of a vexed question. There are scores of apple growers who have the skill to produce first-class fruit, while there are comparatively few who have the business ability to place it on the market when and where it will bring the best price. This is no doubt an argument in favor of the division and specialization of labor, whereby the grower confines his attention to the production of the fruit and the dealer to the buying and selling of it. But it has been this division of the work among buyers and handlers and sellers that has so divided the proceeds that there has been little or no profit left for the producer. The growers who make the most out of their apples are those who keep in as close touch as possible with the best markets both at home and abroad. During the shipping season these men watch the market reports daily, and unless prices are satisfactory they hold their fruit until good prices prevail. The great majority, however, of those who have apples to sell wait for some local buyer to come along, and sell for whatever he chooses to offer, either so much per barrel or a lump sum for the crop on the trees. The latter plan is little better than gambling, and at best is a hap-hazard way of doing business.

The only apparent remedy for this state of affairs, and the most promising means of putting the appie trade on a proper business basis, is for the growers in each apple growing section to unite to form a strong co-operative association through which the grading, packing, and marketing may be accomplished.

An effective co-operative association for this purpose, involves the selection of an honest, wide-a-wake, business manager, and the erection of a central packing and storage house at the most convenient point for shipment. Through such an organization boxes and barrels could be purchased wholesale to much better advantage; the grower could devote his whole attention to gathering the crop at the proper season and delivering it in good condition at the central packing house; the association would relieve him of all care and responsibility in grading, packing, and marketing; and with this work in the hands of expert packers, the grade would be uniform and the packing properly done, which would in time inspire confidence in the purchasing public. A good business manager could keep in close touch with the best markets and make sales when and where the fruit was most in demand. In short, consumers would be assured of a better product and growers would realize a better profit.

Shipping.

Fom the time the fruit is picked, until it is placed on the market it should not be exposed to sun, rain, or frost, nor should it be subjected to rough or careless handling, which it too often receives when given over to the tender mercies of the transportation companies; and this is

another particular in which a strong co-operative association would be more likely to affect improvement than individual shippers.

During the late autumn or winter months when the late keeping varieties are shipped, well ventilated cars or compartments on ship board afford the best meass of transportation if precaution be taken against freezing. During the warm weather of the summer and early autumn when the early maturing varieties are sent to market, shipment in cold storage is advisable. Cold storage retards maturity and delays decay, but does not prevent it. Transportation in cold storage gives the best results when the fruit has been thoroughly cooled before being placed in the car or steamer for shipment. Herein, too, the cold storage at the central packing house provides this for every shipment which could not always be obtained by the independent shipper.

Storing.

The best keeping varieties of apples, when stored under proper conditions, may be kept the year round. The conditions necessary to the successful storage of apples are : a steady temperature, as near freezing as possible, without reaching that point; and an atmosphere moist enough to prevent wilting.

An ordinary house cellar usually furnishes the best place for the storage of the supply for domestic purposes. In such storage careful attention must be given to ventilation, as it is by this means principally that the temperature is regulated.

Before the fruit is stored it should be carefully picked over and all over-ripe, wormy, and bruised specimens should be culled from those intended for long keeping.

As there is always more or less risk in the storage of fruit, it is well for the grower who has apples to sell to hold the crop only so long as may be necessary to secure the best prices. For temporary storage in the fall a barn or other outbuilding may answer the purpose until severe freezing weather sets in. This is usually all the storing done by those who have but a small crop.

Where apples are grown or handled on a large scale, it pays to have a properly built fruit house, where the temperature and humidity inside can be controlled, and in which the crop may be held all winter if necessary. The walls of such a building are usually made of double thickness of matched lumber, with felt paper between and an air space between the studs. In such a house the crop may be packed and held for shipment as may be desirable any time during the fall or winter.

With the establishment of co-operative associations and central packing houses, the plan of the future will no doubt be central cold storage houses in connection with the packing houses, or at the points of shipment. In such houses the crop may be held under the most favorable conditions and put on the market whenever the demand warrants good prices.

Apple Orchard Calendar.

January : Read best available literature on fruit growing. Attend Farmers' Institutes and work up co-operative organization.
Make plans for new orchards.
Order nursery stock.

February : Order or make up supply of boxes and barrels for next season's crop.

March : Prepar. for spring work by getting in readiness plows, cultivators, spraying outfits and materials, pruning tools, etc.
Get pruning done at earliest opportunity.

April : Plant out young orchards as soon as ground is ready.
Do your grafting.
Apply first spray of Bordeaux and Paris Green before buds start.
Plow under cover crop as soon as ground is dry. Apply wood ashes or other fertilizers necessary.

May : Complete any of the above operations not finished last month.
Repeat spraying before blossoms open.
Follow plowing by surface cultivation.

June : Spray immediately after blossoms fall.
Apply carbolic wash to trunks of young trees to prevent borers laying eggs. Continue surface cultivation to conserve soil moisture.

July : Repeat spraying for the fourth or fifth time, as may be necessary.
Discontinue cultivation towards end of the month and sow cover crop as last cultivation.
Thin fruit on young trees which may be overloaded.

August : Pick early apples intended for the market as soon as fully matured and well colored.
Let hogs in the orchard occasionally to pick up early windfalls.

September : Begin harvesting autumn varieties as they mature.
Get in touch with the leading apple markets if you have no co-operative organization to depend upon.
Make an exhibit at your fall show, and study varieties there exhibited.

October : Continue harvesting of the winter varieties, taking them in the order of their maturity.

November : Watch market reports closely and ship promptly if quotations warrant good prices.
Pack and store apples for further shipment or winter use.
Protect trunks of young trees against mice, rabbits, or sunscald as may be necessary upon approach of winter.

December : Continue apple shipments as may be necessary or advisable.
Attend annual meetings of Fruitgrowers' Association and Provincial Fruit Show, and keep in touch with progressive fruit growers.
Balance accounts for the year and decide upon lines of improvement for the next.

INSECTS INJURIOUS TO THE APPLE.

By Wm. Lochhead, B.A., M.S.

1. Affecting the Roots.

The Woolly Aphis of the Apple (*Schizoneura lanigera.*) This insect is a small plant-louse with its body covered with a delicate, filmy cottony-like coat, which projects like a brush behind the body. It exists in two distinct forms, one inhabiting the roots and the other inhabiting the stems, the former being by far the more injurious. Throughout the summer the infested branches are very noticeable.

Galls and other enlargements arise on the affected roots, with the result that sooner or later death occurs. In the cracks which open up in the galls, the aphids live in clusters, and in a short time the vitality of the tree is very much reduced.

Treatment. Hot water, but little below the boiling point, when applied about the base of young trees in sufficient quantity to wet the soil to a depth of several inches, has been found to be effective and practicable. Tobacco stems, broken up finely and distributed about the base of the infested trees. The surface soil should be first removed, the tobacco applied, and the soil replaced. The roots of nursery stock suspected of bearing aphids should be dipped in a strong solution of tobacco stems, or in hot water (temp. 150 degrees F.) for a few seconds, or in hot soap solution, before the trees are planted.

III. Affecting the Trunk, Twigs or Branches.

1. The Round-Headed Borer (*Saperda candida*). This borer is the grub of a brown beetle with two white stripes. It makes a round, oval tunnel in the trunk between the bark and the sapwood. At the end of the third year it changes to a pupa, which later changes into a winged beetle when it emerges. The eggs are laid on the bark in June and early July. The presence of this borer is betrayed by the sawdust-like castings at the opening of the tunnel, and by discolored bark.

Treatment. Probe or cut out the borer in fall and spring; apply to the trunk a white wash or carbolic soap wash before the first of June.

2. The Flat-Headed Borer (*Chrysobothris femorata*). This borer has a large, flat thorax, and makes a wide oval tunnel. It is probable that the borer becomes mature in one year. The adult is a bronzy, greenish black beetle, about half an inch long.

Treatments. Same as for Round-Headed Borer.

3. The Buffalo Tree-Hopper (*Ceresa bubalus*). A greenish insect, somewhat triangular in form, with an enormously developed prothorax, which projects in front into two horns. This insect does much harm by making slits in the bark, which open and form large oval scars.

The twigs and branches readily break at injured parts. The eggs are laid in the slits in July and August, and hatch the following June.

Treatment. Prune out affected branches and twigs in fall and spring.

4. Oyster-Shell Scale (*Mytilaspis pomorum*). This brown scale insect infests the bark. It has a shape like a minute oyster shell. It passes the winter as an egg under the old scale. The egg hatches about the first of June, and there is but one brood each year.

Treatment. Spray trees with white wash, lime-sulphur wash, or whale oil soap solution in winter; spray with kerosene emulsion solution when the eggs hatch and the young are crawling.

5. San Jose Scale (*Aspidiotus perniciosus*). This insect is quite minute, is circular with a central nipple. It winters as a half grown scale and matures about end of June. There are three or four broods each season. It injures the tree by sucking the sap. If the presence of this insect is suspected, a repor should be made to the Department of Agriculture, Toronto.

Treatment. Spray in spring before buds open with lime-sulphur wash.

III. Attacking the Buds and Leaves.

1. The Bud Moth (*Tmetocera ocellana*). The Bud Moth is a small, grayish insect which lays her eggs in July on the leaves. The young caterpillars feed on the under surface of the leaves. They pass the winter in a half grown state in small scales near the buds or other protected places. In spring they attack the swelling buds, often riddling them, and later form silken nests about the young leaves. The caterpillar is almost naked, brown with black head, and about $\frac{3}{4}$ of an inch long when full grown.

Treatment. Spray thoroughly with arsenic solutions just as the buds open.

2. Fall Canker-Worm (*Anisopteryx pometaria* and the Spring Canker-Worm (*Paleacrita vernata*). The females of these moths are wingless, the former depositing her eggs on the twigs in the fall, the latter in the spring. The caterpillars of both species are loopers, which attain a length of an inch. They feed on the leaves. When full grown they descend to the ground and change to pupæ in earthen cells. The moth of the Fall Canker-Worm appears in the fall, while that of the Spring Canker-Worm appears in the spring.

Treatments. Band the trunks of the trees in early fall with burlap or cotton to prevent the wingless females from ascending to lay their eggs. Spray with arsenic solutions, usually just before or after blossoming, when the caterpillars are small.

3. The Tent Caterpillar (*Clisiocampa Americana*). The web tents of these insects are often conspicuous in May, as the leaves appear. The caterpillar is hairy, and has a white-stripe down the back. The oval co-

coons are formed in protected places, and the yellowish-brown moths appear a week or so later to deposit bracelets of varnished eggs on the twigs. There is but one brood each season.

Treatment. Collect egg clusters in fall and winter; spray the young caterpillars with arsenic solution; burn or otherwise destroy the tents.

4. The Cigar Case-Bearer (*Coleophora fletcherella*). Small cigar-shaped bodies may often be seen attached to the bark and leaves. These are the cases of tiny caterpillars which feed on the buds and leaves. In spring these caterpillars often do much harm. In late June or July the small moths appear to lay their eggs. When first hatched the caterpillars are leaf-miners, but later become case-bearers. They pass the winter in their cases, as half grown caterpillars.

Treatment. Spray thoroughly with arsenic solutions just as buds are opening and repeat if necessary a week later.

5. The Pistol Case-Bearer (*Coleophora malivorella*). This Case-bearer is readily recognized by the pistol-shaped case which is attached to the branches. The small dark-colored moths appear at the end of June and deposit egg. The caterpillars hatch from the eggs in July, and eat holes in the leaves. They make cases for themselves as they feed. They spend the winter in the cases attached to the twigs. In early spring they recommence feeding on the opening buds and flowers. About the first of June they change to pupae, and the moths emerge two or three weeks later.

Treatment. Spray with arsenic solution as the buds are opening, and again a week later.

6. The Apple Plant-Lice (*Aphis pomi et al*). These green plant-lice curl the leaves badly, and injure the buds. They are sucking insects and they secrete a sweet sticky liquid called honey-dew. They winter over as black, shining eggs on the branches of twigs. It is likely that there are more than one species. There are both winged and wingless forms during the summer.

Treatment. Spray when young plant-lice first appear with kerosene emulsion solution or any other good contact insecticide; spray with sulphur salt wash in early spring.

Several other insects are occasionally found injuring the leaves, viz., the Apple-Leaf Miner, which mines within the leaf, and forms its pupa within the folded leaf; the Apple-Leaf Bucculatrix, which forms white ribbed cocoons in clusters on the branches, while the caterpillars feed on the leaves; the Palmer Worm, a small yellowish green caterpillar, often numerous in June and July, when it injures the fruit as well as the leaves; the Apple-Leaf Tyer, which folds the leaf and lives within, feeding on the soft tissues; the Apple-Leaf Roller, which feeds within folded leaves; the Red-Humped Caterpillar and the Yellow-Necked Caterpillar, which cluster on limbs and eat the leaves.

Treatment. As a rule spraying with arsenic solution at intervals during the season will control these.

IV. Attacking the Fruit.

1. The Codling Worm (*Carpocapsa pomonella*). In the Eastern and Northern parts of Ontario there is but one brood, but in the South-western part there are two broods.

The small moths appear at the close of the blossoming period and deposit their eggs on the young fruit at the calyx end. The caterpillars bore into the fruit at the core, and when full grown, emerge and spin cocoons under the loose bark on the trunk in June and July, where they change into pupæ. Where there are two broods the moths appear in July and August to deposit eggs for a second generation. This brood of caterpillars may enter the half-grown apples at any point, but they emerge in the fall to form cocoons in which they remain hidden all winter. In spring they transform to pupæ, and later to moths just as the blossoms have fallen.

When there is but one brood the caterpillar after forming the cocoon remains in it until the following spring. The worms which fall to the ground with the apple make their way to some cover and form cocoons.

Treatments. Band the trunk with burlap or other suitable material about the tenth of June. Examine these bands every ten days or two weeks and destroy the cocoons which collect underneath; destroy the wormy and fallen apples; spray with arsenic solution soon after the blossoms have fallen; spray again in August to kill the young caterpillars of second brood.

2. The Apple Maggot (*Trypeta pomonella*). The adult of this Apple Maggot is a fly which deposits its eggs in the apple, and the maggots tunnel the fruit in every direction. They pupate in the ground or under any convenient cover.

Treatment. Prompt destruction of wind-falls. Spraying is not effective.

3. The Plum Curculio (*Conotrachelus nenuphar.*) This curculio does more harm in Ontario than the Apple Curculio. The fruit is often badly punctured and disfigured.

Treatment. Arsenical sprays will do much to control this insect, but so long as plum trees are uncared for, there will be much injury to apples.

4. Green Fruit Worms (*Xylina spp.*) There are several species of Green Fruit Worms. "There is but one brood in a year. They work mostly in May, pupate in the soil in June, live as pupæ during the summer and sometimes all winter, and most of the moths emerge in the fall and hibernate, laying their eggs in the spring." (Slingerland).

Treatment. Spray with arsenic solution before the blossoms open; cultivate ground in summer to kill the pupæ.

FUNGUS DISEASES OF THE APPLE.

I. Attacking the Fruit and Leaves.

1. The Apple Scab (*Fusicladium dendriticum, Venturia pomi*). This fungus first appears on the leaves in smoky greenish patches, upon which sooty pear-shaped summer spores are produced. Later it appears on the fruit, where it develops under the cuticle or outer layer of the skin, and forms dark brown, or blackish spots. It appears to thrive best in cool, moist weather, and on closely crowded trees. The scab passes the winter on infected fallen leaves, as black bodies imbedded in the leaf tissues.

Treatment. Plow under the dead leaves; spray with copper sulphate before the buds open, with Bordeaux soon after the leaves unfold and every two weeks thereafter until the danger is over; and prune so as to prevent overcrowding and shading.

2. The Ripe or Bitter Rot (*Glœosporium fructigenum, Glomerella rufomaculans*). This disease is very prevalent in Illinois and other Central States. Brown spots appear on the half-grown apple, these gradually enlarge and run together forming irregular patches. Black points often arranged in concentric circles form on the diseased areas. Spores ooze from the black points, and are carried to other apples by wind and rain. The fungus winters over in another form in diseased apples, but a stage of the fungus winters over on cankered limbs, which are the main sources of infection.

Treatments. Thorough spraying with Bordeaux; the destruction of old diseased fruit; the removal and burning of cankered limbs.

3. The Black Rot (*Sphæropsis malorum*). This fungus produces a characteristic disease. The early mature apples when affected first, become brown, with black discolored spots under the skin, later become black, and finally shrivelled, shrunken and wrinkled. The spores are formed in the small pustules readily seen in the dried up fruit and in the leaves. Paddock of Geneva has shown that this same fungus often produces cankers on the branches, which have open wounds made by sunscald, etc.

Treatment. Spray with Bordeaux four or five times during the season at regular intervals, burn or plow under the diseased fruit and leaves, scrape and coat with tar or paint the cankers on the larger limbs and cut off and burn those on the smaller.

4. Sooty or Fly-Speck Fungus (*Leptothyrium pomi*). This fungus injures mature apples under moist conditions, either in low moist ground or during a wet season. The popular names applied to this disease indicate quite accurately the character of the spotting of the fruit. Such varieties as Spy, Baldwin, and Greening are most susceptible to attack.

Treatment. Spray at regular intervals with Bordeaux, and select a high sunny position for orchard.

5. Fruit Spot (*Phyllachora pomigena*). This Fruit Spot has been quite common on Baldwins. It is recognized by sunken brown areas, which do not, however, sink very far into the flesh of the apple. The diseased spot has a bitter taste.

Treatment. Spray with Bordeaux.

The Powdery Mildew (*Podosphæra oxyacanthae*). This fungus sometimes injures apple leaves. White patches appear on both surfaces of the young leaves, run together, and form a white felt. There are both summer spores and winter spores, but the disease is not hard to control, as it lives almost entirely on the surface of its host.

Treatment. Spray with Bordeaux at regular intervals.

The Apple Rust (*Gymnosporangium macropus*). This rust is peculiar in that it requires the red-cedar, as a second host, to complete its development. The so-called "cedar-apples" contain spores which may infect the leaves of apples and cause orange-yellow spots on the upper surface and scurfy bunches on the lower. The spores from the apple leaves in turn infect the red-cedar..

Treatment. Remove red-cedars if practicable and feasible.

II. Attacking the Stem, Root, Trunk and Branches.

Apple Tree Cankers These cankers are irregular, sometimes concentric, open wounds on the trunk, branches, or twigs. The bark is first destroyed by bruises or by sun-scald, and injurious fungous spores affect an entrance. It has been proved that cankers may be produced by (1) the *Bitter Rot* fungus, (2) the *Black Rot* fungus, and (3) the *Nectria*. The Nectria is not common in Ontario but the first and second species of cankers are too common.

Treatment. Remove and burn cankers on smaller limbs and twigs, and scrape and coat with tar or paint those on the trunk and larger limbs; protect the trunks of trees subject to sun-scald; spray for Bitter Rot and Black Rot.

Crown Gall. (*Dendrophagus globosus*). This slime fungus produces enlargements or galls on the roots near the surface of the ground. Such galls have been observed mainly on nursery stock in the United States. The disease has not yet become either dangerous or injurious in Ontario.

Treatment. Remove affected tree and burn.

1. Twig, Fire, or Pear-Blight (*Bacillus amylovorus*). This bacterial disease, so destructive to the pear, is also prevalent in apple orchards. The bacterium enters through the blossoms, and perhaps through wounds and insect punctures. As a rule, the terminal flowers, leaves, and twigs are first killed, the diseased parts appearing as if scorched by fire. The bark becomes black or brown, and the inner bark and cambium are destroyed. The disease travels backward into the branches, so that in time the entire tree may be killed. The injury is most marked in rapidly growing trees. It is believed that bees are the unconscious agents of infection

of the blossoms, as they have been seen to feed on the drops of a gummy excretion, containing multitudes of bacteria, which ooze from ruptures in affected twigs, and then to visit soon afterwards the blossoms.

Treatment. Cut off and burn affected twigs and branches whenever they appear. The limbs should be cut off 4 to 6 inches below the diseased part.

PREPARATION OF THE BEST INSECTICIDES AND FUNGICIDES.

I. Bordeaux Mixture.

Copper sulphate (blue stone)	4 pounds.
Fresh stone lime	4 pounds.
Water	40 gallons.

(1) Make a stock solution of bluestone by dissolving 25 pounds in warm water in a barrel and add water to make up to 25 gallons. Every gallon of this solution in first barrel contains one pound of blue stone.

(2) Into a second barrel put 25 pounds of fresh stone lime, and add with stirring small quantities of water to slake it. When fully slaked make up to 25 gallons by adding water. Every gallon of milk of lime in this second barrel contains one pound of lime.

To prepare the Bordeaux, empty 4 gallons of blue stone solution into the spray tank or barrel, which already should have 25 or 30 gallons of water in it; stir the milk of lime thoroughly and empty 4 gallons of it through the strainer into the spray barrel with constant stirring; then add water to make up to 40 gallons.

Any one of several arsenical compounds may be used along with the Bordeaux to form a combination insecticide and fungicide. The following are among the best:

(a) *Paris Green.* Add 4 to 6 ounces to 40 gallons of Bordeaux.

(b) *Arsenite of Soda.* Boil together for 15 minutes one pound white arsenic, 4 pounds sal soda, and 2 gallons water, until a clear solution is obtained. Add 1 to 1½ quarts to 40 gallons of Bordeaux.

(c) *Arsenite of Lime.* Boil together for 45 minutes 1 pound arsenic, 2 pounds fresh lime, and 1 gallon of water. Add one quart of this solution to 40 gallons of Bordeaux.

II. The Lime-Sulphur Wash.

Fresh Stone Lime	20 pounds.
Sulphur (flowers)	15 pounds.
Water	40 gallons.

With warm water make the sulphur into a paste; put in the lime and add about 15 gallons warm water with stirring. The Sulphur made into

a paste may be added after the lime has been slaked. Boil for an hour and a half in a kettle or in a barrel with live steam. Make up to 40 gallons; strain into spray tank and apply while warm.

Other lime-sulphur washes, made without the addition of external heat, are being tested, but their effectiveness has not been definitely ascertained.

III. Kerosene Emulsion (For Bark-Lice and Plant Lice).

Hard soap ....½ pound, or soft soap 1 quart.
Boiling water (soft) ... . 1 gallon.
Coal oil .... 2 gallons.

After dissolving the soap in the water, add the coal oil and stir well for 5 to 10 minutes. When properly mixed, it will adhere to glass without oiliness. A syringe or pump will aid much in this work. In using, dilute with from 9 to 15 parts of water. Kerosene emulsion may be prepared with sour milk (1 gallon), and coal oil (2 gallons), no soap being required. This will not keep long.

IV. Tobacco Decoction.

Refuse tobacco ... ... 2 pounds.
Water .... 5 gallons.

Boil the mixture for 30 minutes or more, until a dark brown tea-colored solution is obtained. Keep it covered until cool. It may then be used undiluted for spraying infested plants.

V. Whale Oil Soap.

For Plant Lice.—1 pound in 7 gallons hot water.
For San Jose Scale in Winter.—2 pounds in 1 gallon hot water applied as the buds are swelling.

VI. Crude Petroleum.

Undiluted crude petroleum may be used in late winter on apple trees for the San Jose Scale, but the trees should be dry, and no part should be sprayed more than once.

VII. Wash for Borers.

First, add soft soap to a saturated solution of washing soda to make a thick paint, then add 1 pint crude carbolic acid, and ½ pound Paris Green to 10 gallons of wash.

To be applied to the trunks of apple trees in early June.

VIII. Lime Wash.

Slake 1½ pounds fresh lime in 1 gallon of water. Strain the wash before spraying. To be applied during winter to trees infested with Oyster-Shell Bark lice.

Orchard Spraying.

Spraying is now generally practised by our best apple growers and the most successful growers are the firmest believers in the value of, and necessity for, *thorough, intelligent spraying.*

Thorough, intelligent spraying means (1) the use of a good spray-pump and outfit, (2) a knowledge of the enemies to be treated, (3) a knowledge of the remedies which have been found most effective, and their preparation, and (4) the proper time for the application of the remedies. It should be remembered that prevention of fungous diseases is possible, but their cure is hardly practicable.

The following spray Calendar for an apple orchard will be found very helpful to the grower who makes an honest effort to spray successfully.

A Spray Calendar for an Apple Orchard.

Application.	When to Spray.	Insects and Fungi Controlled.
Lime-wash	In winter	Oyster-shell scale, scurfy scale.
Lime-sulphur wash or Crude Petroleum	In early spring while trees are still dormant	San Jose scale, oyster-shell scale, and aphids.
1. Bordeaux, and Paris Green or other arsenical compound	Just as leaf-buds are expanding	Bud moth, case-bearers, scab, bitter-rot, black rot.
2. Bordeaux, and Paris Green or other arsenical compound	Just before blossoms open	Canker-worms, tent-caterpillars, bud-moth, case-bearers, etc., scab, bitter-rot, black rot.
3. Bordeaux, and Paris Green or other arsenical compound	Just after blossoms fall	Codling moth, cankerworms, tent-caterpillars, etc., scab, bitter-rot, etc.
4. Bordeaux, and Paris Green or other arsenical compound	Ten days or two weeks later	Codling moth, palmer worm, apple bucculatrix, curculio, scab, bitter-rot, etc.
5. Bordeaux, and Paris Green or other arsenical compound	Two weeks later—in July	Scab, bitter-rot, etc.
6. Bordeaux, and Paris Green or other arsenical compound	When second brood of Codling moths appears in August	Codling moth, scab, bitter rot.