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RENOVATION OF AN OLD APPLE ORCHARD.

BY

RAYMOND S. WASHBURN. 1887

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RENOVATION OF AN OLD APPLE ORCHARD.

Introduction.

Throughout New York State there are many neglected orchards ranging in size from a few trees to several acres. These trees were planted in the early days mainly as a home source of supply and little thought and attention was given them as a commercial enterprise. They grew and produced an abundance of fruit and, since they were not a source of income, were naturally neglected. A majority of them were set too thick and formed tall high-headed trees which were hard to prune and spray. Later when the multitude of insect and fungous diseases became prevalent and scientists knew little of their control, the orchard owner became discouraged and allowed his once productive trees to deteriorate still further.

Now conditions have changed and there is a large and growing demand for choice fruit. To meet this demand thousands of acres of orchards have been planted but it will be some years before these young orchards will come into bearing.

The question is whether it will be profitable to renew these old orchards and make them a source of income while the new trees are growing and developing. The answer is that it will, as has been demonstrated in many neglected orchards of this state.

Cultivation.

There are many methods of apple orchard culture and individual growers, as well as scientific pomologists, have not yet decided on a universal standard of what the best orchard culture should be. Perhaps it would be well to briefly compare the different methods.

(1) The Continuous Clean Culture Method. By this method the land is plowed in the spring and cultivation continued throughout the growing season until late autumn when cultivation ceases and the soil is allowed to lie undisturbed and uncovered until the next spring when the process is repeated. This method is generally if not always found to be unsuccessful because of the severe washing and loss of soil due to rains.

(2) The Cover-Crop Method. This method consists in plowing and disking the ground as early in the spring as the soil will permit. Cultivation is continued until the middle of July, when some cover crop is sown and allowed to remain for the remainder of the season.

(3) The Sod Culture Method. This method consists in allowing the grass to grow and form a sod over the entire surface of the orchard, except a circular area of ground under each individual tree which is dug up and kept mellow during the growing season. The grass is mowed and allowed to remain where it falls.

(4) The Sod Mulch Method. By this method the grass is allowed to grow and form a sod over the entire surface of the orchard. Instead of spading and cultivating circular areas about each tree, these spaces are mulched with straw. The grass is also mowed at intervals and used to maintain the mulch about the trees. This method is well adapted to orchards on steep slopes where cultivation would result in severe loss through washing of the soil.

These last three methods of orchard culture were practiced at the Ohio Experiment Station with the result that the trees made a greater annual growth in the cover-crop plot than in the sod-culture plot, but not as great as in the sod-mulch plot.

On the sod-mulch plot there were produced 172 apples weighing 55.5 lbs; on the cover-crop plot, 70 apples, weighing 21 lbs; and on the sod-culture plot, 29 apples weighing 7 lbs. Thus showing a decided advantage in favor of the sod-mulch.

In two experiments conducted by the Geneva Experiment Station, as to whether the apple does better under tillage or in sod, the results were somewhat different from those found at the Ohio Station. This experiment was begun in 1903 in the orchard of Mr. W. D. Auchter, near Rochester, New York. The orchard consisted of nine and one-half acres of Baldwin trees, set 40 feet apart each way. On one-half of this orchard, or 118 trees, the sod-mulch treatment

was tried. On the remainder, or 121 trees, the tillage and annual cover-crop method was practiced. The trees in the two experiments received the same care and treatment as to spraying, pruning and all orchard operations except soil treatment.

Results of the two methods employed. The average yield on the sod-plot for five years was 72.9 barrels per acre, while that of the tilled plot was 109.2 barrels, or a difference of 36.3 bbls. in favor of the tilled plot. It is also interesting to note that the tilled trees yearly increased their bearing capacity; and that on the other hand the sod-mulch trees gradually decreased in yield of fruit.

During the entire experiment the fruit on the sod-mulch plot matured one to three weeks earlier than on the tilled plot.

The keeping quality of the tilled apples was much superior to that of the sod-mulched apples, those from the tilled plot keeping 4 weeks longer than from the sod-plot.

The fruit from the sod-mulch plot was more highly colored. However, in eating quality, the tilled apples were superior to the sod-mulched product. The tissues of fruit from the tilled plot was turgid and crisp while in the apples from the sod-mulch plat there was a tendency to dryness and meatiness.

Trees in sod showed abnormalities in foliage, branches and roots. The foliage on the tilled trees was a dark, rich green color while on sod it was a yellow color. The

leaves on the tilled trees were much larger, came out earlier and remained on the trees later than on sodded trees. The roots of sodded trees came to the surface of the ground; in tilled trees there were more roots and they grew deeper.

The average cost per acre, not including harvesting, was $17.92 for the sod; and $24.47 for tillage giving a difference of $6.55 in favor of the sod.

In summing up the results of this experiment, Professor Hedrick of the Geneva Station says that

Tillage is better than sod for the apple since there is a larger moisture supply in the tilled plot and therefore a greater food supply. There is more humus in the tilled plot and it is warmer and better aerated. Also there are more beneficial micro-organisms in tilled than in other soils.

From these results it would seem that tillage and cover-crops were best for the average orchard and especially so in case of old, neglected trees, since with neglected trees it is important that they should make a large and rapid growth of new wood.

Pruning.

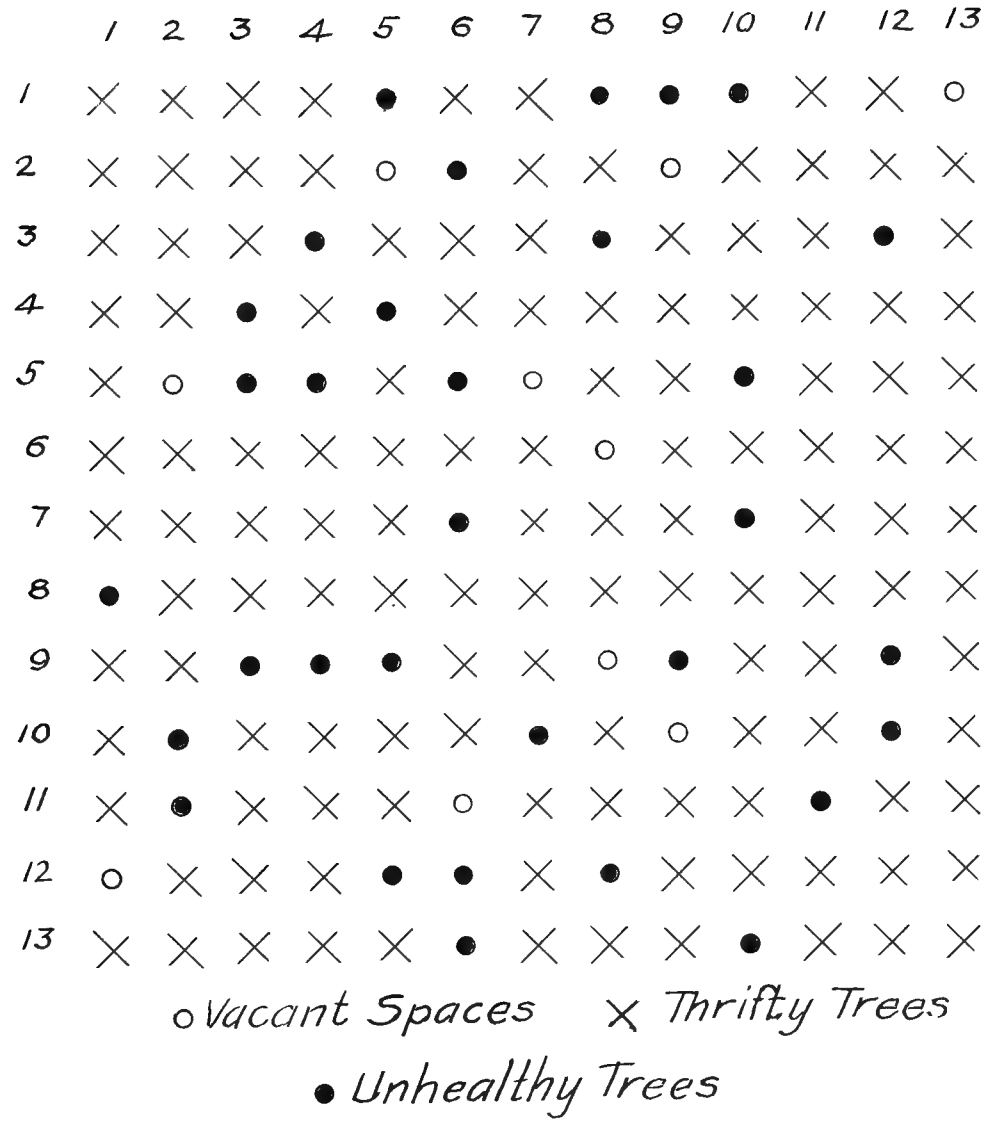
In a majority of neglected orchards the trees are too closely planted. The early growers failed to see the importance of plenty of room in which the trees could grow and develop, and as a result we of to-day see the effect of their failure to recognize this very important principle. When the greater part of the orchards in New York State were planted, about 40 years ago, there was a universal tendency to plant too closely. On 43 per cent of the area planted before 1880, the trees are 30 x 30 feet or less; 82 per cent are 35 x 35 feet or less. Only 18 per cent are over 35 x 35 feet. The larger growing varieties like Baldwin, Rhode Island, and Northern Spy will eventually require 40 feet between trees. With the smaller growing varieties, like Transparent, Oldenburg, Wealthy and McIntosh, 30 feet may be sufficient. If then the trees in these old orchards are too closely planted, the first and perhaps the most important factor in renovation is to remove the excess of trees.

The first step then is to determine if the trees are properly spaced. If they are too closely planted, the effect shows up in the healthfulness and productiveness of the tree. According to data taken from Cornell bulletin 226, the greater the number of trees per acre, the less the yield.

The average yield for four years of orchards where the trees were not over 30 x 30 feet apart was 186 bushels; for those between 30 x 30 and 35 x 35 feet, 222 bushels; for those over 35 x 35 feet, 229 bushels. Some of the more striking indications of close planting may be seen in the long armed upright growth with scarcely any foliage on the lower branches. As the trees gradually grow together at the top, the sunlight is shut off, the lower limbs begin to bear inferior, poorly colored fruit and finally die.

Now if it is true that only the upper branches bear good fruit, it can be readily seen that there is a great loss in bearing surface on these closely planted trees, only the top area bearing fruit, while in well-rounded, properly pruned trees, planted at the correct distance, the bearing surface would be at least three times as great.

If the trees are found to be too closely planted, and some must be removed, it is well to follow some regular plan, so as to retain the conformity of the orchard. When the trees are planted in squares, as is generally the case, in old orchards, every alternate tree in the row may be removed. This is accomplished by removing every second row diagonally. If the squares between the trees were originally 25 x 25 feet, they will, after removing every alternate tree in the row, then be 35.3 x 35.3 feet. If originally they were 30 x 30 feet, they will now be


1 2 3 4 5 6 7 8 9 10 11 12 13
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○ Vacant Spaces
× Thrifty Trees
● Unhealthy Trees

42.4 x 42.4 feet. So by removing one-half of the trees, it does not follow, as is commonly supposed, that the trees will be twice as far apart.

Before removing any trees, it is desirable to make a map of the orchard and locate upon it by a particular sign all inferior, weak trees, all vacant spaces by another sign, and all desirable trees by another. If this is done, one can determine at a glance whether to remove the first diagonal row or the second, starting with the diagonal row containing the greater number of vacancies and undesirable trees.

In the following diagram, the even rows show 20 poor trees and 7 vacant spaces, while the odd rows show 12 poor trees and 3 vacant spaces. In this case, it is advisable to remove the even diagonal rows, since they include 27 poor trees and vacant spaces out of a total of 42. The question often arises as to whether the trees adjacent to the vacancies should be removed. It is generally advisable to remove such trees, since each one so situated is likely to crowd one side of three other trees.

Shaping and Thinning the Individual Trees.

Old neglected trees are almost invariably unsymetrical and too high, making it almost impossible to spray properly and more expensive to gather fruit on these high branches. To be an intelligent pruner, one should know something of plant physiology, and the habit of growth of the apple tree. He should know the effects produced by pruning at different seasons of the year, how to make a cut that will heal most readily, and the influence of pruning on the fruit-bearing habit of the tree. Pruning during the dormant season incites wood growth, while pruning during the growing season promotes fruitfulness. The first thing to be done is to remove all dead and dying wood, then the pruner can see exactly what he has to work with. A tree that is over 30 feet in height may be shortened to 15 or 20 feet and one between 25 and 30 feet often may be cut back to about 15 or 18 feet. In heading back the upright branches, the cut is usually made just above a side branch that points outward. This tends to make the tree more spreading in habit.

The severity of heading in will depend largely upon the vigor of the tree. Nothing will start a tree into renewed vigor like severe pruning during the dormant season. The cutting-back, therefore, should be more severe with weakened trees. When a tree is severely headed back a rank growth in the form of water-sprouts spring out from the buds lower down on the trunk, and from these water-

sprouts an entirely new head may be formed. It is dangerous, however, to head back the entire tree the same season since the tree's source of carbohydrate food, sugars, starches, etc., is obtained through the action of sunlight on these substances which are stored in the leaves and therefore if the entire leaf surface is removed at one cutting the tree would probably die. For this reason, it is best to distribute the work of renewal over two or three seasons, removing only a portion of the top each year.

The character of the cut has a marked influence on the healing process. All food material capable of healing a wound is taking a downward course through the inner bark and to heal well a wound should be in a position to intercept this downward flow of sap from the foliage higher up. When a limb is to be removed, it should be cut close to the body of the tree and parallel with it. If this is done, the tree will be able to heal quite large wounds before decay sets in. All wounds over $1\frac{1}{2}$ inches in diameter should be painted with a good lead paint, to which has been added a little lamp black, so that the spots will be less conspicuous.

Improvement of the Sanitary Condition of the Orchard.

Much can be done to prevent the spread of fungous diseases by thoroughly cleaning up and burning old rubbish and dead limbs. It is also advisable to scrap down the bark with a scraper or dull hoe, removing all moss, rough

bark and lichens, thereby destroying insects and fungi. All cavities or hollows in body or branches gradually enlarging through decay should be carefully cleaned out, sprayed inside with Berdean mixture and filled with Portland cement.

Drainage.

Good drainage, natural or artificial, is fundamental to the best welfare of the orchard. The need of drainage may not be apparent while the trees are young, but as they get older and the roots penetrate into poorly drained and poorly aerated soil, the trees are damaged and in many cases killed.

In Walworth township, Wayne Co., 54 orchards, aggregating 232 acres are reported as in need of drainage. The average yield of these 54 orchards in 1902 was 203 bushels, 42 bushels below the average of the other orchards in the township.

Drainage is important for the following reasons:

(1) Drainage removes the excess of water, thus improving the physical condition of the soil, making it less compact and impervious, and improving its tilth which is important for proper and intensive cultivation.

(2) Drainage reduces winter injury, to the roots. The freezing of large amounts of water in the roots cause them to winter kill.

(3) Drainage promotes proper air circulation in the soil which is necessary to the proper growth of beneficial soil organisms and hinders the growth of many undesirable organisms. This growth of soil bacteria is very important since they are vitally related to the supply of plant food in the soil. It is through their action that the organic matter in the soil is decomposed.

(4) Drainage increases the amount of available moisture in the soil and allows the roots to distribute themselves over a greater area. When the soil is in good tilth, the total capillary capacity is increased. The soil is then in a condition to more easily absorb the rainfall and to retain a larger proportion of it than is the case in undrained soil. Also drainage lowers the water table which is important since the roots won't penetrate below the drainage table.

The depth to which the water level should be lowered seldom exceeds 4 feet. The distance between drains depends on the ease with which water will flow through the soil toward the drain. Generally speaking, drains should be placed between every second row on heavy soils and on medium soils about every 300 feet.

Fertilization.

According to the last census, $2,000,000 is being expended for orchard fertilization each year. Fruit farms expended 30 ¢ per acre for fertilizers as compared with 4 ¢ on hay and grain farms, and 2 ¢ per acre on stock farms.

It is the opinion of many scientists that in many cases the application of commercial fertilizers are made with negative results. It is difficult to determine the fertilizer needs of the apple, due to non-uniformity in soil and varieties over the large areas required, continuous cropping without chance for rotation and irregular bearing habit.

In 1894 experiment started on the Woburn Experimental Fruit in England showed at the close of the 14th season, that there had been almost total absence of effect from manure on clay soil. On poorer, sandy soil, manure gave a beneficial effect. The absence of effect on the clay soil was explained by the fact that trees draw their nourishment from a large area and from a considerable depth, and for that reason are very little affected by surface dressings of manure.

Another experiment made at the Geneva Experiment Station by Professor Hedrick, and reported in 1907, showed similar results. This experiment gave the results of twelve years of annual applications of potash and phosphate, in the form of wood ashes. During the last seven

years acid phosphate was added at the rate of 169 pounds K_2O and 129 pounds P_2O_5 per acre. The results of this experiment as a whole were considered negative, since the annual increase in combined yield of all varieties on the treated plots barely paid the cost of the fertilizers and their application.

These experiments do not prove that pertilization is always made with negative results, but simply show that the fruit grower should test for himself what plant food his soil needs.

Nitrogen fertilizers.

Sodium nitrate ($Na\ No_3$).

This salt is the principal source of inorganic nitrogen in commercial fertilizers. The chemically pure salt, nitrate of soda, contains 16.47 per cent of nitrogen and the commercial article, called "Chile Saltpeter" contains from 15.5 to 16 per cent. Nitrogen in the nitrate form is easily taken up by the plant and for this reason acts quickly in inducing growth.

Ammonium sulphate $(N\ H_3)_2\ S\ O_4$.

Sulphate of ammonia is a chemical salt which, when pure, contains 21.2 per cent of nitrogen. In commercial forms, however, it usually contains about 20 per cent of nitrogen. Sulphate of ammonia is obtained from the dry distillation of animal bone in the manufacture of bone-black, and also from the distillation of coal in

the manufacture of coke. Dried blood for fertilizing purposes is chiefly obtained from the large slaughtering establishments. Red blood contains from 13 to 14 per cent of nitrogen and is an excellent fertilizer since it decays very rapidly in the soil and is quickly available.

Fish Scrap. The waste parts, as heads, skin and bones. It contains from 7 to 8 per cent of nitrogen and from 6 to 8 per cent of phosphoric acid. It ranks with the high grade fertilizers.

Wool and hair waste. These materials are dissolved with acid in such a manner as to render them available and are quite rich in nitrogen.

Phosphate Fertilizers.

Bone phosphate in the form of raw bone contains about 22 per cent phosphoric acid and 4 per cent of nitrogen. It is a good source of phosphoric acid since it is in its original state and has not lost any of its original constituents through burning. Bone-black or animal-charcoal contains from 32 to 36 per cent of phosphoric acid, while bone ask contains from 27 to 37 per dent of phosphoric acid.

South Carolina Phosphate. This rock contains 26 to 28 per cent of phosphoric acid. It sometimes contains small percentages of compounds of iron and aluminum which interfere with the manufacture of the product and are undesirable.

Phosphate Slag. This is a by-product in the manufacture of steel from pig-iron rich in phosphorus. The ground slag is applied directly to the soil without treatment with

Potassium.

Kainit. This salt is the crude product of the mine and the potash contained in it is practically all in the form of a sulphate. It contains about 12.5 per cent of actual potash and 33 per cent of ordinary salt, and smaller percentages of magnesium chloride and magnesium sulphate.

Sylvinit. It is similar in composition to Kainit. The potash in Sylvinit, however, exists both in the form of a sulphate and of a chlorid. It contains on an average about 16 per cent of actual potash.

Muriate of Potash. This is a manufactured product and contains about 50 per cent of actual potash, equivalent to 80 per cent muriate. The chief impurities are common salt and insoluable matter.

High-grade Sulphate of Potash. The salt is usually sold on a purity basis of 98 per cent, or an equivalent of 53 per cent actual potash. It is usually considered superior to the muriate although more expensive.

Lime.

There are three forms: limestone, quicklime and slaked lime, each differing from the other in composition.

Quicklime absorbs moisture and slakes when exposed to the atmosphere. Lime thus slaked is called "air-slaked lime", and is usually less completely changed to a hydrate than when water is addsd.

Marble lime is made from pure limestone, and the burned limestone thus obtained is practically pure oxide of lime.

Burned limestone from the magnesium limestone contains from 50 to 60 per cent of calcium oxide, and 30 per cent or over of magnesium oxide.

The growth of the tree will generally indicate the need of fertilizers. When the tree looks scrawny and stunted and either no growth or but a few inches of annual growth are being made, fertilizers are needed. Nitrogen appears to a greater extent in the leaves and encourages strong wood growth which is desirable in old trees not growing vigorously. Potash is the basis of the fruit acids and is also a color factor. Phosphoric acid insures proper ripening of both fruit and tree. Lime strengthens the limbs, hastens the ripening of the fruit and has a tendency to give a steady growth to the tree.

Barnyard manure applied at the rate of 10 loads per acre supplies the necessary nitrogen, phosphoric acid, and potash, and will also add humus and improve the physical condition of the soil.

When manure is not available, and the trees are not making the proper growth, the following fertilizers per acre are recommended by the Geneva Station:

75 lbs. nitrate of soda
400 lbs. bone meal
150 lbs. sulphate of potash
1500 lbs. fresh-burned lime

Spraying.

An old orchard which has been neglected for many years is a source of infection, a breeding place for all the diseases to which the apple is heir. The environment has been such that the trees have been weakened and made susceptible to disease. Some of the things which aid disease in the orchard are: poor drainage, heavy, wet soil, poor cultivation and weeds which protect many diseases and pests during the winter. The owner of one of these orchards has a two-fold task on his hands. He must drive out the disease producing insects and fungi and after they are out he must keep them out by spraying.

In order to successfully combat a disease one should know something of its nature; how and when it attacks the tree. This is essential in order that the spraying may be done at exactly the correct time and the correct kind of poison used for the trouble. One disease requires one kind of spray and another disease requires another. There is no good in spraying with the wrong remedy. Some of the more important insect and fungous diseases I will describe together with control methods for the same.

Apple Scab. The apple scab, caused by Venturia inaequalis, is one of the most destructive fungous diseases of the apple and is found every where the apple is cultivated and the weather conditions are favorable.

On the leaves scab may be found as irregular rounded spots, somewhat swollen and with an indefinite margin, becoming brown as they grow older. The spots may be as large

as three-eights of an inch in diameter and later may die and leave the leaf ragged in appearance. On the apples the spots are very small at first and circular. They soon become brown in color, and as they grow may run together in patches.

The fungous also grows in the blossoms and twigs, but causes less damage to these and is often overlooked by the grower.

The damage from apple scab is caused in two ways. The apples are injured so as to be unfit for market, which often cuts down the price received per fruit one-fourth or a half. The most serious damage, however, is to the tree, in the injury to the leaves. The leaf surface is often so reduced that the tree has not enough vitality to ripen a crop of fruit, and the fruit is undersized and poor , besides being scabby. Also the tree cannot properly ripen its next season's fruit buds.

Scab grows best in cool, moist weather, and does not ordinarily spread at all in warm, dry weather. The scab spots are covered with very small spores which are blown about by the wind and spread the disease. The spores grow and germinate whenever they find water enough to wet them and if they happen to be on an apple or apple leaf they soon grow down into it and start a new scab spot. The fungous lives over winter chiefly on the fallen leaves, and along about March produces another kind of spores, winter spores, which are smaller and more easily blown about.

by the wind. These spores flying about in the orchard when the first leaves come out start the disease again for the next summer.

Control:

1. First scab spraying just before blossoms open.

Lime-Sulphur 1-40.

2. Second scab spraying just as petals fall.

Lime-Sulphur 1-40.

3. Third scab spraying three weeks after petals fall. Lime-Sulphur 1-40.

4. Fourth scab spraying nine to ten weeks after petals fall (about latter part of July or first of August).

Lime-Sulphur 1-40.

New York Apple-Tree Canker. This disease is caused by Sphaeropsis Malorum, and is found on the apple, pear, quince, hawthorn, plum, mulberry and elder. Epidemics occur more or less each year. The disease seems to be more severe on the Esopus Wagener and Greening.

On the trunk and limbs the fungous causes the bark to become much roughened as well as thickened, and in many instances a portion of the wood is laid bare. The area of bare wood is often small as compared to the extent of swollen bark; limbs are frequently seen that for six feet or more of their length are covered with rough bark.

The fungous is most often found on the larger limbs of mature trees. Old neglected trees, low in vitality, suffer more than young, thrifty ones. Sphaeropsis infects

trees in the spring, becoming evident as areas of discolored bark which spread until mid-summer and then produce pycnidia. In some cases the disease completely girdles the limb cutting off the flow of sap, which causes the leaves to shrivel up and die. The spores lodge in wounded places on the surface of the bark. A germ tube is sent out which under favorable conditions grows and produces a branched mycelium on which pycnidia are formed in about one month, and more produced as the mycelium grows and branches. These pycnidia contain thousands of spores imbedded in a gelatinous mass inside the pycnidium, and as water enters they sweel and the spores are shot out, blown about by the wind, and those that fall and germinate in a wound produce the cankers. The mycelium seem to be unable to penetrate to the cambium through living bark, which would suggest a means of control; namely, to avoid wounding the bark.

All wounds should be coated with thick paint or grafting wax. Cankered limbs should be cut out wherever practicable, and as a further precaution, thorough spraying with lime sulphur applying 6 to 8 gallons per tree as follows:

1. When the petals begin to separate and the first tinge of pink begins to show.

2. When about two-thirds of the petals have fallen.

3. As soon as all the blossoms have fallen.

4. Ten days or two weeks after No. 3.

These two fungous diseases are by no means the only ones which affect the apple, but perhaps they are the most important of any of them.

Insect Diseases of the Apple.

Codling Moth. The Codling-moth costs the fruit grower an annual tax of $3,000,000 in New York alone, and it is estimated that it would cost $8,000,000 to spray the apple trees in the United States for the Codling-moth at 4 ¢ a tree. The Codling-moth is the parent of the apple worm and is the cause of nearly all wormy apples. The apple worms pass the winter as full-grown larvae in rough, silken cocoons under the loose bark of the trees. In the spring they change to pupae and the eggs are laid on the fruit and leaves. The larvae begin hatching about 3 weeks after the blossoms fall, and continue hatching throughout May. On emerging from the eggs they do a little feeding, and at this time before they enter the young apple, will be killed if the trees have been properly sprayed. They live in the apple about 4 weeks and leave it through a hole in the side; they crawl to some crevice in the bark or elsewhere, spin a cocoon and change to pupae and come out as adults that year or remain until the next spring.

Control: Two applications of Paris green, 1 lb. to 100 gallons of water; or arsenate of lead, $2\frac{1}{2}$ lbs. to 50 gallons of water. One application within one week after blossoms fall, and a second application about a week or ten days later.

San Jose Scale. The San Jose Scale is a tiny insect first found in San Jose, California, from which it bears its name. The insect multiplies in such vast numbers on

the bark as to form a scaly crust, which can be rubbed off with the finger, It attacks nearly all varieties of fruit trees and is perhaps the only insect that is not controlled to any extent by clean culture and thorough tillage. The female insects deposit their young as early hatched larvae, which resemble tiny, yellow mites except that they have legs and atennae of true insects. They wander about for a few hours and then insert their sucking mouth parts into the bark and soon secrete over their backs a scaly covering. There are at least four generations each season, and it has been calculated that one pair of San Jose scale insects could give rise to over three billion descendants in a single season, if all lived out their lives without accident.

Control: This pest can be controlled on orchard trees by thoroughly spraying with lime-sulphur wash, diluted to $4\frac{1}{2}$ degrees Beaume, either in the fall, after the leaves are mostly off the trees, or in the spring from the time when the buds begin to swell until the flowers commence opening.

Round-headed Apple Tree Borer. The Apple tree borer is a dangerous insect enemy of the apple since it attacks perfectly healthy trees and its work is so concealed as to escape notice until the trees are past relief.

The borers are the larval stage of a long-horned beetle with two white stripes extending from the head the whole length of the body. The females lay their eggs during the warm season in small slits which they make in the bark. The ~~borers which~~ hatch from these eggs tunnel in the inner bark

and sapwood, making large tunnels filled with borer dust. Their presence can generally be detected by the dust which falls out of the tunnels when these are not entirely closed. Badly infected trees put out only sparse and small leaves in the spring and sometimes die completely later on.

Control: As a preventive, the orchard should be kept free from weeds and rubbish so as not to provide a hiding place for the beetles. Cut away the bark over the tunnels until the worm can be reached with a wire. When all have been removed, paint the wounds with white lead paint, diluted with raw linseed oil at the rate of 100 lbs. of paint to 3 to 4 gallons of oil. During the warm spring and summer keep the beetles from laying eggs in the bark by protecting the trees with brown wrapping paper.

The above insect and fungous pests are only a few of the many which attack the apple. For that reason I will give a general outline for spraying the orchard which will cover the needs of the grower in most cases. From this outline it will be seen that fungicides and insecticides may often be used together, controlling both a fungous and insect pest at one and the same time.

General Plan for Spraying the Apple Orchard, taken from Cornell Bulletin 283:

I. Dormant season before leaf buds open but just as they are swelling:

a. Lime-sulfur as a contact spray for

San Jose scale 32 to 33° Beaume 1-8
Blister mite 32 to 33: Beaume 1-11.

b. Add arsenate of lead, 2 pounds to 50 gallons, to the lime sulfur as a poison for

Bud-moth
Cigar-case-bearer

II. After leaf buds open but before blossoms open, i.e. when just beginning to show some pink. Watch weather and get spray on before rain, not after:

a. Lime-sulfur solution, 32° Beaume 1-40, or Bordeaux, 3-4-50, for apple scab (the fungus).

b. Arsenate of lead, 2-3 pounds to 50 gallons, added to lime-sulfur or Bordeaux as a poison for

Bud-moth
Cigar case-bearer
Canker-worm

(This application should never be omitted during cold, rainy seasons.)

III. After petals have fallen beginning when about two-thirds have fallen. Have spray on before rain comes. This is important.

a. Lime-sulfur, 32° Beaune 1-40, or Bordeaux 3-4-50, for

Apple scab
Leaf spot

b. Arsenate of lead, 2-3 lbs. to 50 gallons, used with lime-sulfur or Bordeaux for

Codling-moth
Canker-worm
Bud-moth

This is the most important of all the applications.

IV. Ten days to two weeks later. Before rain period:

a. Lime-sulfur, 32° Beaume 1-40, or Bordeaux, 3-4-50, for

Apple scab
Leaf spot

b. Arsenate of lead, 2-3 lbs. to 50 gallons, used with lime-sulfur or Bordeaux for

Codling-moth
Canker-worm

V. Eight to nine weeks after blossoms fall:

Same as IV for late scab infection and late attacks of codling moth. In most seasons this application is not necessary.

If aphis appears, spray before leaves curl with whale-oil soap, 1 lb. to 6 gallons, or kerosene emulsion diluted with six parts water, or use one of the tobacco extracts.

Cost of Renovation.

The usual cost of the first year's work will be from $30 to $57 per acre according to the condition of the orchard.

This table shows the minimum and maximum cost per acre compiled from records obtained from several farms in New York State.

Estimated Cost of First Year's Work in Renovating an Old Orchard.

Items.	Estimated cost per acre	
	Minimum	Maximum
Plowing	$2.00	3.00
Manure, 10 to 20 loads, at $1. or its equivalent in commercial fertilizer	10.00	20.00
Hauling manure, average at 50¢ a load	5.00	10.00
Pruning and hauling brush	5.00	10.00
Disking or harrowing twice	1.00	1.50
Disking or harrowing third or fourth time	.50	1.00
Cultivation, 2 to 4 times	.50	1.00
Spraying once:		
Material	2.00	4.00
Labor	1.00	1.50
Total	$27.00	$52.00

Profits from Renovated Orchards.

The following results are returns from an apple orchard of eleven acres in Orleans Co., N. Y., which was taken over in 1896. The gross returns from this orchard are:

1896	$250.00
1897	12.00
1898	800.00
1899	200.00
1900	1200.00
1901	300.00
1902	2000.00
1903	1400.00
1904	2722.50

Another farmer in Monroe County, N. Y., obtained the following results. The orchard consisted of 4 acres of Baldwins over 50 years old, which had had no care whatever for at least 20 years. This orchard was sold to a good orchardist, who began the work of renovation at once. Seventy-five loads of stable manure were applied and plowed under and the most thorough cultivation was practiced.

The first year not more than $25 worth of fruit was sold, but the second year, in response to more scientific management, $1,100 worth of fruit was sold. Pruning had cost about $50, plowing and cultivation $75, spraying, $60 and fertilization $100, a total of $285, leaving a net profit for the first two years of operating of $840 or $210 per acre.

Another 6.1 acre orchard in western New York gave the following results:

The orchard contained 243 mature trees, about one-half of which were 36 years of age and the remainder over 50 years old. The average yield during the eight years was 67 barrels per acre, which sold for an average price of $2.33 per barrel. The average cost of production was $1.16 per barrel.

Income, expense, and net profits on a 6.1 acre apple orchard in western New York.

Year	Income		Expense		Net profit	
	Total	Per acre	Total	per acre	Total	Per acre
1902	$913.87	$149.81	$519.39	$85.15	$394.48	$64.68
1903	969.89	159.00	482.56	79.11	487.33	79.89
1904	559.40	91.70	360.39	59.08	199.02	32.62
1905	792.25	129.87	324.31	53.16	467.94	76.71
1906	818.76	134.22	401.80	65.87	416.96	68.35
1907	861.45	141.22	364.40	59.74	497.05	81.48
1908	1362.97	223.44	583.55	95.67	779.42	127.77
1909	1896.79	310.95	591.93	97.03	1304.86	213.92
1910	1008.44	165.32	399.77	65.54	608.67	99.78
9-year average	1020.42	167.28	447.57	73.38	572.85	93.93

Summary.

1. Old trees can be renovated and made to produce a good income while the young trees are growing.

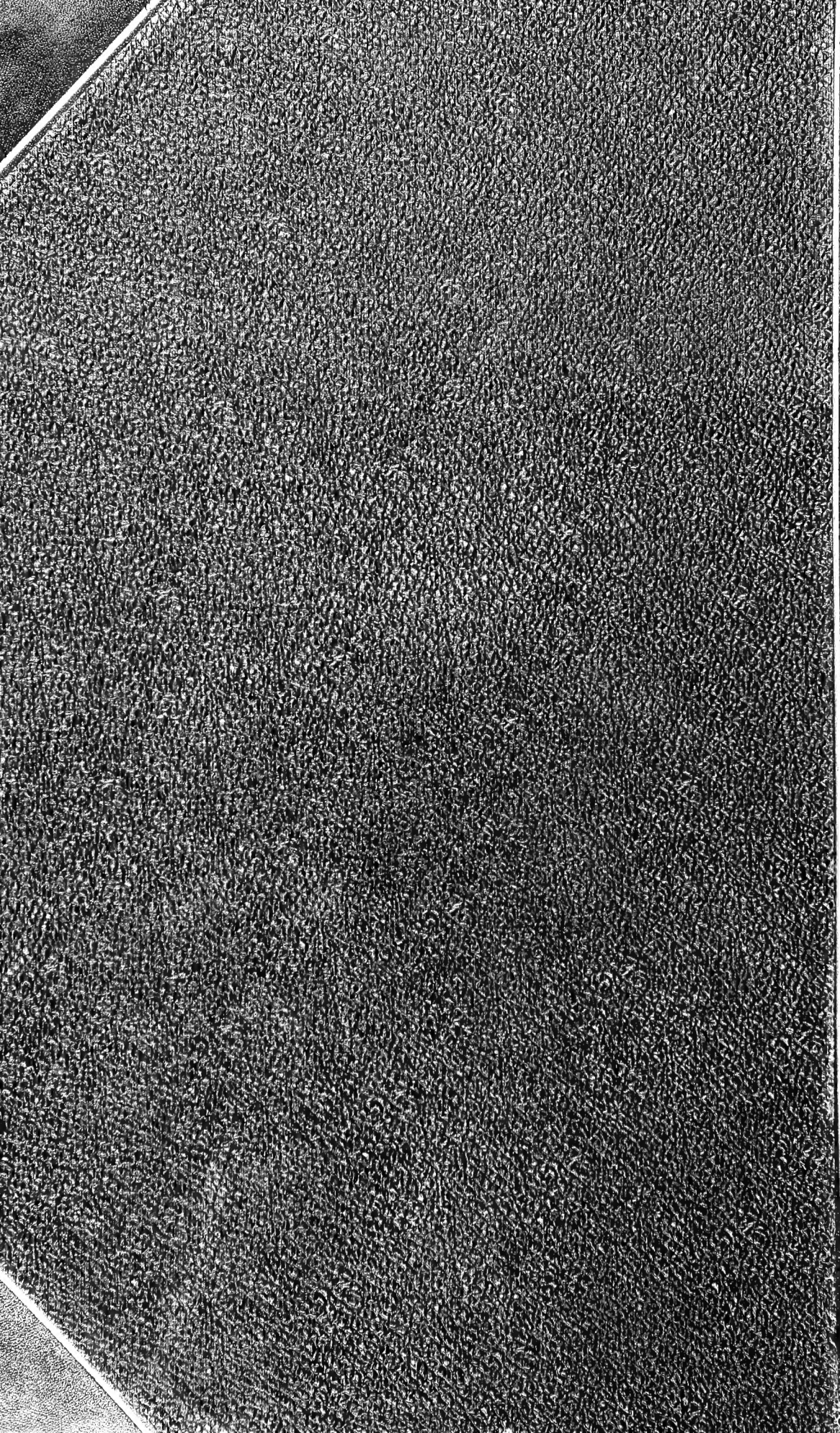
2. Clean culture and cover crop is the best system of cultivation. Cultivate until the middle of July and then sow a cover crop.

3. Drainage either natural or artificial necessary.

4. Prune thoroughly, remove excess of trees and prune individual trees annually.

5. Study the orchards fertilizer needs and if indications point toward a need of more plant food, supply it. Manure is the best fertilizer.

6. Spray for both insect and fungous diseases.

7. Renovation costs from $30 to $57 per acre.

8. The profits warrant the cost of renovation and will increase annually.