

SB
363
5 89

THESIS

THE RENEWAL OF NEGLECTED
APPLE ORCHARDS

J. L. STRAHAN

ALBERT R. MANN
LIBRARY

NEW YORK STATE COLLEGES
OF
AGRICULTURE AND HOME ECONOMICS



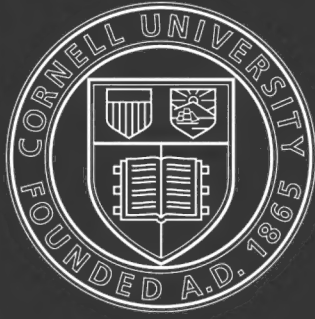
AT
CORNELL UNIVERSITY

Cornell University Library
SB 363.S89

The renewal of neglected apple orchards.



3 1924 003 408 600 mann



Cornell University Library

The original of this book is in
the Cornell University Library.

There are no known copyright restrictions in
the United States on the use of the text.

<http://www.archive.org/details/cu31924003408600>

State of New York } ss.
County of Sullivan }

Oct 16/12 Ithaca N.Y.

I, the undersigned do solemnly swear, that in the preparation of the accompanying thesis the composition is entirely my own, and that I have given full credit by quotation marks or references to authorities for any quoted matter.

J. L. Strahan.

Sworn to before me this
17th day of Oct. 1912

Wm. C. Baker
Notary Public

THESIS.

THE RENEWAL OF NEGLECTED APPLE ORCHARDS.

J. L. STRAHAN.

1911.

SB

363

589

327914

THE RENEWAL OF NEGLECTED APPLE ORCHARDS.

Scattered throughout the state are many apple orchards of from three or ~~four~~ four acres to thirty-five or forty acres in extent, which, from lack of proper care or at least from careless management, are going to wrack and ruin. This state of affairs is not only wasteful of the material bounties of the earth but results in an actual financial loss to the owner of such orchards. A few years of care and scientific treatment could bring an orchard that was costing its owner annually the rent of the land it was occupying, up to a condition where it would not only pay that rent but be a source of revenue considerably over and above it. This has been done by practical growers on a commercial scale so its validity is tested out. With these in view, it would seem advisable to study the matter in some detail, discovering, if possible, the most efficient methods of soil management, fertilization, pruning and spraying for old trees, from the experiences of men who have been successful in bringing their old orchards into profitable bearing. This paper, being as it is in a way, ^a ~~of~~ compilation of the results of many, cannot be accepted as final. Different methods of renewal may be equally efficient in different localities. The present study is therefore designed to be simply suggestive, and in no sense the last word on the subject.

For convenience, the subject has been divided into separate heads, which will be discussed in order, as follows;

1. Cultivation, including soil management, the use of cover crops, etc.

2. Fertilization, including the use of the different material available to the grower as fertilizers and their effects on the trees.
3. Pruning, including a discussion of the so called practice of "dehorning", scraping down the bark, etc.
4. Spraying, including life history and control of those pests and diseases which appear most likely to infest old trees, with a spray calendar^d for such.
5. Profits. Data for this is necessarily difficult to collect, and therefore this head will not be discussed as fully as the writer would like; but what is available may be suggestive.

CULTIVATION.

Most orchards which have been neglected for any length of time, have been in sod so long, and such a thick, tough mat has formed that the trees are starved for lack of the food which has gone to nourish the grass and weeds. besides this the soil itself is in poor physical condition owing to lack of aeration and proper drainage. Obviously the first thing to be done is to turn the sod over. It may be found difficult to do this as the sod is likely to be tough, the ground hard, and the tree roots near the surface. It has been found advisable, under such circumstances, to turn hogs in and let them root up the ground during the summer. The following spring, plowing will be found much easier and the root pruning which the trees will undergo be beneficial rather than detrimental. The actual feeding roots of a tree are renewed each year anyway, and pruning

the larger roots will have a tendency to make the feeders develop deeper in the soil during the following season. This is very desirable, as it allows of deeper plowing and enlarges the feeding zone of the roots. Following the plow should come a disk harrow, and the sod be thoroughly disked. This is essential, as it covers up any exposed roots and puts the sod in better condition to be decomposed and changed to humus. In plowing, it is well to annually reverse the order of breaking the ground, throwing soil toward the trees one year, and away the next. This tends to keep the surface from becoming irregular much longer than when the same order of plowing is followed year after year. As plowing close up to the bodies of the trees cannot be safely done through danger of injury by the traces bruising or mutilating them, it is almost necessary to have a one-horse breaking plow to finish up the rows.

Following ^{or} the plowing or disking, the surface should be kept clean and mellow with a spring tooth harrow, fine tooth cultivator or weeder. Cultivation of this kind is kept up until the middle of July or the first or middle of August, when some cover crop should be sown and allowed to take possession of the soil for the balance of the season.

There are two classes of suitable cover-crop plants, viz; legumes and non-legumes, which should be used alternately according to the needs of the trees. Legumes, like clover or vetch have the power, through the action of certain nitrogen fixing bacteria which live on their roots, of adding a very considerable amount of nitrogen to the soil which is available for the use of the trees when the plants are turned under. They

have therefore a fertilizer value above that of the *humus* which is a product of their decay. The other class of plants, the non-legumes, simply add humus to the soil together with what plant foods they used in their developement. The condition of the trees should determine which of these plants are to be used. The action of nitrogen is to stimulate the growth of wood at the expense of the fruit. If this is the result desired, then legumes should be used in conjunction with the regular fertilizing system. If, on the other hand, the wood growth is too abundant and should be checked, some one of the non-legumes should be used.

A number of different plants have been used successfully as cover crops. Mammoth and crimson clover have proven good for this purpose as have also winter vetch and cowpeas. These latter are usually sown in drills two feet apart and at the rate of $\frac{3}{4}$ to 1 bu. per acre. The young plants are then cultivated to give them a vigorous start. In order to secure uniform covering for the ground, a mixture of rye and vetch is sometimes broadcasted between the rows immediately preceding the last cultivation. This combination furnishes a dense carpeting during the winter and makes an early heavy growth the following spring by the time the ground should be plowed again.

In changing from old sod to cultivation the ground is very hard to work. One of the crops which has the best effects in loosening up the soil and getting it in friable condition is buckwheat. The roots of this plant are penetrating in their action and strike deep thereby helping to break up hard, unyielding soil. This should be used as a

cover crop the first year for this reason. Turning under a few such crops will make the soil spongy and friable, increase its moisture capacity and thereby render it more able to resist drought.

The cover crop plan is probably the nearest approach to the clean cultivation method of management which one can safely use and fulfill all the requirements of the trees. It combines a neat appearing orchard, which so many men delight in, with a thoroughly efficient one which, from a commercial standpoint is the desired end.

On some soils, where there is a decided tendency to wash, ~~it~~^{it} is not advisable to turn the ~~s~~^sod over at all. On steep hillsides this is likely to be the case. The soil from the top of the hill will gradually be transported through water action to the bottom, leaving the trees up above without any means of support. For such conditions as these, the sod mulch method of management has been devised and has proven quite successful, although it is doubtful whether such good results could be obtained from it as from the cover crop method on level or fairly level ground. It consists essentially of the following. The orchard is seeded down to some such grass as orchard grass or timothy and from these a sod is allowed to develop. Each year, instead of cultivating the ground the grass is allowed to grow until late in May or early in June when it is ~~down~~^{down} and left where it falls. If it grows rapidly it should be cut again in July or August. The grass which is cut forms a mulch and returns to the soil what plant food it utilized in developing.

There is a wide diversity of opinion among fruit growers as to which of the two methods is the better. According to an experiment conducted at the Woburn Experimental Fruit Farm in England with regard to the effect of grass on apple trees, it was found that the grass roots excreted a substance which was toxic to the tree roots and that the poor results usually obtained from the sod method of management was due to this toxic effect rather than to the fact that the grass robbed the trees of moisture and food when it is most needed. An experiment carried on at the Geneva Station in this state seems to favor the cover-crop method. An orchard was divided into two plats, one being left in sod and the other being cultivated according to the cover crop method. After running for six years, the following suggestive data was recorded.

	Sod	Tillage
Fruits per bbl.	434	309
Bbls. per tree,-	2.8	4.2
Net profit per acre,-	71.52	110.43
Gain in diameter of trunk,-	1.1 inch	2.1 inch.

These results are undoubtedly in favor of the tillage method of management.

One of the greatest arguments in favor of sod mulch is that it is less expensive and takes less time, thereby leaving the grower more time to engage in other farm operations. In the above quoted experiment exact cost accounts were kept and the sod method was less than one half as expensive to operate than the tillage method on an average; but the net gains were more than proportionally

less; so much so that tillage proved more profitable. The following figures for five years are suggestive.

	<u>S O D.</u>		Total	Net
	Cutting grass	Harvesting Crop	Expense	Income
1904-	19.99	219.25	327.14	325.76
1905-	7.46	82.89	166.47	330.28
1906-	3.36	104.30	186.29	154.96
1907-	3.67	138.07	239.28	487.16
1908-	6.14	173.43	246.88	353.86
Total	40.62	717.94	1166.06	1552.03

T I L L A G E.

	Culti- vation	Harvesting Crop	Total Expense	Net Income
1904-	33.75	210.90	332.55	185.34
1905-	48.71	96.85	221.68	355.60
1906-	30.30	231.80	340.73	392.42
1907-	46.63	224.20	371.35	800.31
1908-	36.67	338.59	447.82	723.41
Total	196.06	1102.34	1714.13	2457.08

Although the sod method cost only \$40.62 and the tillage cost \$196.06, yet the net gains of the sod were only \$1552.03 while those of the tillage were \$2457.08 or nearly twice as great. So in this case at least, the cultivation method proved financially to be the more desirable.

With regard to soil management, out of fifteen men who had been more or less successful in renovating old orchards, eight were decidedly in favor of tillage and seven favored sod in some degree or another. Of those who favored sod one simply delayed cultivation for three or four years until the other necessary operations such as pruning, spraying, etc. were well under way and beginning to show results.

Another gave as his reasons for not cultivating that his orchard was small and located near the house where cultivating would spoil the looks of his grounds. He would undoubtedly have obtained better results by cultivating. Still another left his orchard in sod for the main and dug up around each tree every summer applying stable manure and some form of commercial fertilizer. This in a measure combines both systems, getting some of the benefits of cultivation at small cost. Another found that after two or three years of cultivation his trees made too vigorous wood growth, so seeded his orchard down and left it in sod to check the rapid wood development. Thus his was also a combined system, receiving practically all the benefits of cultivation. It must be borne in mind, however, that not many old trees which require a system of renovating *are* strong and virile enough to allow of such a method of management, although there undoubtedly are conditions *where*, as this man states, "cultivation can be overdone". Another man got "very satisfactory results from the sod mulch method". It is evident, however, that he never tried the tillage method, and the chances are that, had he done so, his results would have been much more satisfactory. It is interesting to note that of the seven who used the sod mulch method only one was decidedly for it. He tried both systems and his results proved much more satisfactory in the case of the sod than in the case of tillage.

All eight of the men who favored tillage were emphatically in favor of it. There seemed to be no possible doubt in their minds as to which was the better system. One man writes,

"Our trees under cultivation both with and without cover crops have made a fine new growth yearly, have increased greatly in size, have healed over most of the damaged ^wback areas, and are to-day in a most healthy and robust condition. Another,-

"The effect as noticed from cultivation is slightly larger fruit but not such good color. Another writes, "Cultivation much better for all trees", meaning both young and old. A firm of landscape forresters and entomologists favors cultivation as evidenced by the following. "We generally recommend cultivation except on hillsides and even then in strips." This is evidently to get the benefits from cultivation and at the same ~~time~~ prevent rapid washing. Another grower writes, "Cultivation used, as secured thereby better annual growth and wounds heal more quickly; no injurious effects noted." All men quoted so far as favoring tillage had tried the sod method first as being cheaper, and had had poor, unsatisfactory results. Others of the eight tried the tillage method first and were well enough pleased with their results to continue with it and recommend it.

From the foregoing evidence it seems to be aparant that for average soil and topographic **conditions** cultivation and cover crops are the more desirable method and gives financially the better results. Yet there are conditions where , if apples are to be grown at all, the sod mulch method must be used; as for instance in the case where the trees are on a steep hillside and the danger of washing is great, or in the much more unusual case where the soil is so rich that the trees must be checked, rather than stimulated. It is only under such special conditions that, as far as the writer can see, sod mulch for any aged tree is to be recommended.

FERTILIZATION.

Of late years the question of fertilization has been studied to some extent by scientific men with the result that in their opinion, a great deal, infact most of the fertilizers applied to orchard soils in chemical form are wasted. This view is some what borne out by the United States Department of Agriculture, Bureau of Soils, in one of its bulletins concerning the soil solution, vis., that all soils contain sufficient plant food in solution to nourish an average crop every year providing good cultural methods are employed. Because of its extensive spread of roots and the consequent great intake of water from the soil, this theory would be especially applicable to the apple tree. Even if the solution were weak, the enormous amount of water taken in and required because of the extensive transpiring area of the leaves, would provide enough solid food to meet the requirements of the tree. It would seem unnecessary then to add any chemical fertilizer to a soil which is already plenty rich enough. A bulletin from the Geneva Station by Professor Hedrick entitled, "Does the Apple Orchard need Fertilizers", concludes thus (Bull. 339 Pop. edition) "The final conclusion must be that the trees in this orchard would be practically as well off in every respect had not an ounce of fertilizers been used about them. If fertilizers are not necessary for young trees in this orchard they have no value in innumerable other orchards in New York . One of the lessons the experiment should teach is that fertilizers are not necessary in the average soils if tillage and good care the rule,- the truth of the old adage 'tillage is manure'."

Although this experiment was run with young trees, there is little reason to believe that it would not apply equally well to old trees. Of course, large trees need more food than do small ones, but they are provided with a root system sufficiently large to meet their requirements. Another experiment carried on at the Geneva Station (Bull. 289 U.P. Hedrick) between the years of 1893 and 1904, would seem to bear out this idea. An orchard which had ^{been} in sod for forty three years was used for this experiment. It contained trees of the following varieties; Baldwin, Fall Pippin, Rhode Island, Roxbury and Northern Spy. In order to test out the effects of potash and phosphate on the yield and color of fruit, the following amounts of fertilizers were applied to four of the eight plats into which the orchard had been divided.

Wood ashes	per tree 100#	per acre 4800#
* Acid phosphate	8½#	408#
* The phosphate was applied only during the last seven years.		

According to calculations made the actual amounts of potash and phosphate applied were as follows:

P ₂ O ₅ per acre	72# from ashes	57# from phosphate
K ₂ O " "	169# " "	
Lime	1536# per acre	

After ten years of this treatment, the following results were noted.

Annual average increase in bu per tree.

Fall Pippin	1.05
Roxbury	2.65
Greening minus	0.34
Spy	2.55

Baldwin .28

From a financial standpoint, the results were practically negative. The estimated increase in value of the crop on the treated plats for a hypothetical five acres was \$74.50. The net gain was only \$24.50 or hardly enough to pay for hauling the fertilizers.

It is interesting to note that both treated and untreated plats increased markedly in yield from 1893 to 1904. The probable explanation is that prior to 1893 the orchard had been in sod and no cultural methods had been employed. Since the beginning of the experiment, however, the orchard was plowed and managed according to the cover crop system each year. It was much more productive under the latter treatment.

The results as to color lack uniformity. They were not definite enough in a sufficient number of seasons to warrant the assumption that the color was effected in any way by the fertilizers applied. The influence on the color was most marked in years when the climatic conditions were most unfavorable to the development of the fruit.

Results seem quite conclusive for the Station orchard. Fifty three years of orchard cropping did not reduce the soil to a condition where a "complete" fertilizer was necessary. In summing up his conclusions, Professor Hedrick says, "The results of this experiment should not lead the grower to conclude that his soil does not need the nutrients supplied. They suggest, however, since the soil of the Station orchard is an average piece of soil for western New York, that there may be many other orchards in

the state that do not need these fertilizers.

The practical application of the results obtained is that fruit growers should not apply manures in quantity until good evidence has been obtained as to what food elements, if any, are wanted in the soil. As long as the trees are making good growth and producing average crops of well colored fruit, it may be taken for granted that they need no additional food from fertilizers. If the contrary be true, the fruit grower should put in operation tests with fertilizers to ascertain what plant foods his soil needs.

If the above be true of an orchard that has stood for fifty-three years in sod, then in view of the fact that perhaps few orchards older than that are worth renovating, it would seem that fertilization should be carried on only very cautiously, for although the fertilizers applied would not be detrimental to the trees, yet they would not benefit them materially and their application would only result in financial loss.

If, however, after careful observation it is found that the soil is distinctly lacking in some essential element of plant food, **it** might be well to apply the deficient element alone. There would perhaps never be a case where a complete commercial fertilizer would be necessary.

For the purposes of the above the principal source of the three essentials are here briefly discussed.

Nitrogen.

The sources of nitrogen in the soil are many and it would seem unnecessary to add nitrogenous fertilizers in the chemical form, when natural agencies are so rapidly

at work under good conditions of tillage in keeping up the supply. Through the action of certain nitrogen-fixing organisms which live in conjunction- "symbiotically"- with the leguminous crops such as clover and vetch, nitrogen is added to the soil in available form in large amounts. The decay of all organic material is another great source of available nitrogen. In this connection the trees supply themselves in some measure with organic nitrogen through the decay of the leaves which fall from them each year. There may be occasions when these sources do not supply sufficient nitrogen in which case any of the following manures may be used;

Dried blood.- This is obtained by drying the blood and debris from slaughter-houses and as usually sold contains from 9 to 13% available nitrogen.

Tankage.- This is composed of refuse matter such as bones, trimming of hides, hair, horns, hoofs, and some blood. These are usually dried, ground, and mixed with a little slaked lime to prevent rapid fermentation. It usually contains from 5 to 7% of nitrogen and because of its slower rate of decay it is not quite so rapidly available as dried blood.

Flesh meal.- This is the flesh refuse from slaughter houses which is sometimes kept free from the tankage, dried, ground and sold as flesh meal. It contains from 4 to 8% nitrogen.

Fish scrap.- Fish flesh is very rich in nitrogen. The offal parts, as heads, fins, tails, and intestines are dried and prepared as a fertilizer. It readily undergoes fermentation and is therefore a quick-acting fertilizer.

The above, together with some seed residues, are the main sources of organic nitrogenous **fertilizers** that are spread over the ground. There are however, some chemical fertilizers which are very important sources of available nitrogen. They may be enumerated as follows.

Sodium nitrate (NaNO_3) This is commonly known as Chilli Saltpeter. It is found in an extensive natural deposit in Chili, Peru, and in the United States of Columbia.. When pure, this salt contains 16.49% of **available** nitrogen but the ordinary commercial article contains on an average 16% and cost anywhere from \$50.00 to \$60.00 a ton, making the nitrogen itself worth about 15 or 18 cents a pound. It is soluble, and does not have to under go the ordinary nitrifying processes. It is therefore one of the most, if not the most active nitrogenous fertilizer being as ~~it~~ is directly available as plant food.

Ammonium Sulphate ($\text{NH}_4\text{S O}_4$)

This salt is obtained as a bi-product in the manufacture of illuminating gas and is extensively sold as a fertilizer.

Phosphate Fertilizers.

The chief sources of phosphate fertilizers are,-

(1) Phosphate rock- This is found in many parts of the United States, particularly in South Carolina, Florida, Virginia and Tennessee. They usually contain from 17 to 30% of phosphoric acid.

(2) Phosphate slag- In refining of iron ores by the Bessemer process, the phosphorus in the iron is removed as a basic slag. This is variable in composition and at present but little is formed in this country that is available as

fertilizer.

Bones in different forms are very prolific sources of phosphates,- as bone ash, it contains about 36 %; as steamed bone it contains from 22 to 29%; as dissolved bone it contains from 15 to 17% phosphoric acid. Bone black, after having been used in sugar refininf is sold as a fertilizer and contains about 30% P O .
2 5

Potash Fertilizers.

Wood ashes are an important source of potash for the farmer. The per cent ranges all the way from 2.5 to 10.2.

The following table gives the amount of potash in 10,000# of woods of different kinds;

White oak	10.6 lbs.
Red oak	14.0 lbs.
Ash	15.0 lbs.
Pine	0.8 lbs.
Georgiapine	5.0 lbs.
Dogwood	9.0 lbs.

Stassfurt Salts- These combinations of potash, sodium and magnesium salts are a valuable source of potash fertilizer.

Kainit. This mineral is mined at Stassfurt and is mixed with gypsum, salt, potassium chloride and other bodies. It contains about 12% K_2O and is one of the most important of the Stassfurt Salts.

Nutriate of potash or (KCl) Contains from 35 to 60% of potash^{sh}. It is a manufactured product, is readily soluble and is a quick acting fertilizer.

Sulphate of potash (K_2SO_4) is prepared from some

of the crude Stassfurt Salts and contains the equivalent of about 50% K₂O. It is one of the most concentrated forms of potash fertilizers and is particularly valuable because it can be safely applied to some crops which would be injured by the presence of the chlorine in the muriate.

Lime.

Lime is used more as an amendment than as a direct fertilizer. Its action as a flocculating agent in the soil is extremely beneficial and it also acts to neutralize any possible acidity. It is also an essential plant food but not considered as a commercial fertilizer because it is usually present in sufficient quantities to meet the needs of most plants. It may be applied as calcium sulphate (land plaster) quick lime (O), hydrate (Ca(OH)₂) or carbonate of lime (CaCO₃). The CaO and Ca(OH)₂ are usually used only on very sour land (acid). If lime is applied every four or five years it should not be used in excess of 500# per acre, but usually in starting up an old orchard the first application should be greater than this— from 1,000 to 2,000# per acre.

Pruning.

In perhaps fifty percent of the old orchards which it would pay to renovate, the ^urejuvenation of the trees is accomplished as much by their being too close together as by any other one factor. Farmers fail to notice what is happening until the trees become greatly damaged. The decrease in yield does not call attention to the trouble until it is too late. When the tops begin to meet so as to shut out light from the lower limbs then one half of the trees should be cut out. If this is not done, these lower limbs will begin to bear inferior fruit, then no fruit at all, and finally they will die. The

Changes take place so gradually that the owner usually fails to realize what is happening until some year he finds that, instead of an orchard of well rounded trees he has a lot of forest trees with a bouquet of leaves at the top.

In the end the bearing surface becomes the nearly level surface on the tops of the trees. This is a very small surface when compared to a succession of well rounded tops. If trees are 30X30 and left till they interfere so as to kill the lower limbs the bearing surface approaches the level surface on the tops of the trees. Each tree approaches 900 sq.ft. of exposure to sunlight or bearing surface; or 2 trees approach 1800 sq.ft. The area of the surface of a well rounded tree 32 ft. high and having a spread of 40ft. is about 4000 sq. ft. Trees of this size still lack 2.4 ft. of meeting if they are 42.4 ft. apart; and 30% of the surface of the ground is exposed to the sunlight. There can be no doubt in any bodies mind which is the more profitable from a dollars and cents standpoint; the 2 trees with a total bearing surface of 1800 sq. ft.; or the one tree with a bearing surface of 4,000 sq. ft. This calculation assumes the tree to have a regular form and is of course hypothetical; but it clearly indicates that there are two reasons why trees planted too close together do not bear as well as trees at a normal distance;

- 1 They are not so healthy.
- 2 They do not have so much bearing surface.

Trees that are too close together furnish favorable conditions for fungous diseases and insect pests; they are hard to spray; the apples are more difficult to pick and, because they do not get the sunlight, are of poor color and quality. Perhaps the

the most serious result is an indirect effect of the death of the lower limbs. Trees are left until the large lower limbs die for want of light. They are then removed and the wounds are too large to heal. In time they cause the trunk to decay.

The evident remedy for this state of affairs is to thin out the trees. If the trees are planted in squares, the best way to thin is to cut out every other tree in each row. This is done by cutting out every other row diagonally. It leaves the trees in squares corner wise of the field. (See accompanying figure) It is interesting to note what removing $\frac{1}{2}$ of the trees would mean. Some persons think that in doing so in an orchard that is planted 25X25 it would leave the trees in squares 50X50. As a matter of fact they would be in squares 35.3X35.3 when viewed from the corners of the field. If they were 30X30 and $\frac{1}{2}$ were removed, the remainder would stand 42.4 X 42.4. If 33X33 and $\frac{1}{2}$ were removed, they would be 46.7 X46.7. None of these distances are too large for large, mature trees. If 35X35 and $\frac{1}{2}$ removed the remainder would stand 49.5x49.5 or approximately 50x50. Large Baldwin trees can make good use of this much space.

One of the problems to be met in thinning is that, if every other tree is removed regularly there will be some places where the tree to be cut out is better than the one to be left; or it may occur that the one to be left may be missing. Will it pay to leave a tree that would other wise be removed, if it comes next to a vacant place? This question must be answered as each case arises, but it is well to remember that if the tree is left, it will damage one side of three other trees. Before cutting out the trees, it will pay to make a map of the orchard and

locate the vacant spaces and poor trees, and so determine which way of cutting will include the greatest number of these

L	M	N	O	P	Q	R	S	T	U	V	W	X
LO	O	O	⊗	O	⊗	O	O	O	O	O	O	O
KO	O	⊗	O	O	O	O	⊗	O	O	O	O	⊗
J⊗	O	O	⊗	O	O	O	O	O	⊗	O	O	O
IO	O	O	O	O	⊗	O	O	O	O	O	O	O
HO	O	O	⊗	O	O	O	O	O	O	O	O	⊗
GO	O	O	O	O	O	O	O	⊗	O	O	O	O
FO	O	O	O	O	O	O	O	O	O	O	O	O
EO	O	⊗	O	O	O	O	O	O	O	O	O	O
DO	O	O	O	O	O	O	O	O	⊗	⊗	O	O
CO	O	O	O	⊗	O	O	O	O	O	O	O	O
BO	O	O	OM	O	O	O	O	O	O	O	⊗	O
A⊗	O	O	O	O	O	O	O	O	O	O	O	O
O	O	⊗	O	O	O	⊗	⊗	O	⊗	O	O	O
	A	B	C	D	E	F	G	H	I	J	K	L

EE

In the figure, the rows AA, CC, ~~EE~~ etc. or the rows BB, DD, FF etc. may be cut out. Suppose the black circles to represent poor trees or vacant spaces. According to the figure there are 21 of these. By cutting out rows AA, CC, EE, etc. fourteen of these spaces are included, where as by cutting out the other rows only 7 are included. By making such a plan as this seven trees were saved in this case, enough to much more than pay for the trouble of the map.

It require courage to go into an orchard and arbitrarily cut down large virile trees. But in many orchards the time has come when a choice must be made between two poor trees and one good one. If one has definitely made up his mind that his trees are crowding, perhaps the best way to thin them is to do as the owner of a fine Baldwin orchard once did. He decided which rows would be removed. Then, to be sure he would not repent, and have some of the trees saved, he went away for a two weeks visit while the boys did the work.

After half the trees are out, providing such a course is necessary, then attention must be turned to the remaining trees.

The probabilities are, that if the trees have had to be thinned out, those that are left will be too high for convenient handling. The cost of picking, spraying and in fact all the orchard operations which involve the tree directly, is nearly if not quite doubled in the case of the tree forty feet high over that of the tree from 20 to 30 feet high. Therefore it is essential, to get the head down. Before beginning this operation, however, every stick of dead wood, large or small should be taken out of the trees. After his tree is cleared of useless lumber, the pruner knows just what he has to work with. After taking all the

dead wood out his top may not be symmetrical, but it is quite evident that an unsymmetrical live tree is better than a symmetrical dead one. Therefore clean the trees out **thoroughly**.

He now has a tree, every part of which is alive and with a head anywhere from 10 to 20 feet to high. How to get it down is the question. It is a well known physiological fact that very severe pruning will induce the growth of suckers. It is the result of an effort on the part of the tree to reestablish the proper balance between the root system and the top. According to this fact, a severe pruning of the top branches should induce a growth of suckers from so-called adventitious buds lower down on the trunk. This is precisely what happens. And from this new growth of suckers may eventually be formed an entirely new head. There is another important factor in this cutting down process which it would be fatal to disregard. It is the action of the sunlight on the green leaves that furnishes the tree with its entire supply of carbo-hydrate foods, i.e., sugars and starch etc. If therefore, the entire top should be cut off a tree, its source of this kind of food would be totally destroyed and the chances are one hundred to one that the tree would die. Therefore do not "dehorn" the tree all the same season. Rather cut say $1/3$ of the top out the first year, leaving the remainder to ^{d.}_Anurish the tree till the new sucker growth has developed somewhat. The second year cut out another third of the old top. By this time the first years sucker growth will have attained sufficient development to play its part in the nourishment of the tree. By following out this plan, the beginning of the fourth year will see an entirely new head on the old trees, and the trees themselves none the worse for **wear**. By selecting the

lowest suckers a head may be developed as low as is desired, and though perhaps at **times** the suckers will not come where they are wanted, yet in the large majority of cases they will.

"Dehorning" may be practiced in the above manner with very little risk of loss. It is only when a man goes into an orchard and blindly and thoughtlessly slashes around with an ax that the dehorning fails; and then strictly speaking, it is not dehorning; it is simply chopping down the trees and in that case no one expects them to live.

In making cuts, the limbs should be sawed off as close as possible to the parent branch so as not to leave a stub. Within a day or two the wound should be painted over with some material to keep out rot fungous spores. A good material to use for this purpose is white lead paint to which has been added a little lamp black to give it as nearly as possible the same color as the tree. If very large wounds are necessary to be made it is advisable to repaint them at least once a year until they have entirely healed over. Otherwise rot may get in and destroy the tree. It is essential not to leave a stub because there is no life in it and therefore the wound on the end will never heal over. If stubs are left there are just three alternatives. One is to keep them painted all the time which is a great bother; another is to cut them off, which doubles the work of pruning; and the third is to lose the tree, in which case it would have been better never to have begun renovating.

The opinion of practical growers seems to be almost un-aminously in favor of scraping down the bark when it is very loose and scaly and when the trees are more or less affected with scale, either oyster shell or San Jose. Under the above con-

ditions it is perhaps advisable to scrape the bark the first year, but any repetition the second year would be useless as the lime sulphur spray seems to have a tendency to keep the bark clean.

Spraying.

It is in the old neglected orchards of the country, which have been left to themselves, that all manner of fungous diseases and insect pests run riot, not only ruining the trees themselves, but also endangering the health and possibly the very life of neighboring orchards. And so, in the work of renovating, a stiff fight must be put up against all such conditions, which is not only one of preventing as would be the case in a well cared for orchard, but also one of cure, involving in many cases very radical methods of procedure.

Those fungous diseases and insect pests which are more likely to be in evidence in neglected orchards are here set forth, together with the most efficient methods of control as determined by experiment and successful practice.

New York Apple Tree Canker.

The cause of this disease was worked out in 1898 by Wendell Paddock of the Geneva Exp. Station and found to be due to a fungous called *Aphaeropsis* Pk.

It is widely distributed in orchards in New York State especially in old ones which had become infected before preventive measures had been worked out. The cankers form enlarged and darkened areas on the larger limbs of the infected tree. The bark is roughened and in the center of the canker it may be missing. It is very adhesive to the surface of the decaying wood, and it is this feature which distinguishes it from sun scald where the bark peels off

readily. The scars are formed by the spores of the fungous entering through a wound in the bark. They seem unable to penetrate through living bark to the cambium, but as above stated must have a passage made for them. This fact is suggestive of preventive measures. In regions where canker is prevalent the utmost care must be exercised to avoid wounding the bark. Often wounds are made by the pickers in scraping their ladders against the limbs, or by the cultivators or plows barking the trunk during the cultivating operations. All such accidents are to be strictly avoided if this disease is to be successfully prevented. Often cankers can be cured (if they have not completely girdled the limbs, in which case the limb should be removed) by cutting off the diseased area until clean wood and bark ^{are} reached, and painting the wound with white lead to which a little lamp-black has been added just as in pruning. Paddock recommends painting the wound with the following wash.

Thale oil soap----1 part.

Slaked lime-----2 parts.

Water-----4 gallons.

Wood ashes to thicken as desired.

Dissolve the soap in hot water, then stir in the lime. When the ingredients have been reduced to a smooth state by stirring, dilute with water to 4 gallons, then stir in the wood ashes until the wash is of the desired consistency.

Fire Blight.

This is a bacterial disease caused by *Bacillus amylovorus*. It is a disease to which young trees between the ages of eight ^{and} to fifteen years of age are especially susceptible. It occurs, however, on older trees and is often the cause of their death. Many parts of the tree are affected by it, and its extensive

distribution over the tree has led to its receiving different names according to the manner in which it shows itself. Accordingly, there is the blossom blight, which causes the blossoms to wither prematurely and often times preventing the fruit from setting; or if the fruit should set, causing it to remain small and unsightly; the twig blight which causes the death of many of the fruit spurs and is usually a direct infection by the blossom blight; then there is the blight which manifests itself on the larger limbs and trunk, properly known as fire blight or just plain "blight". The cankers appear as discolored and somewhat sunken areas of smooth bark, the margin along the advancing border being raised in a sort of blister. The tissue in actively spreading canker is of a darker ^{color} than that of healthy bark and is very watery or sappy. On damp cloudy days drops of a milky sticky fluid exude from the cankered tissues through the lenticels or pores of the bark^s. A large proportion of the cankers are active during only one season but there are always some which are perennial and live over to the next season. The diseased bark is usually killed to the wood to which it sticks tenaciously the first season. It gradually decays, however, and falls out, leaving the wood bare and exposed. The bacillus can gain entrance into the bark in any of the following ways:

1st. Through infected water sprouts or suckers.

2nd. Through infected pruning instruments.

3rd. Through wounds made in the bark by careless workmen in cultivating.

4th. Through the agency of insects which puncture the leaves and small fruits.

The dissemination of the disease is furthered by damp

weather. Abundant water is necessary for the development and multiplication of the organism. From these causes preventive and curative measures may be suggested as follows:

If the cankers are very extensive, cut the tree out of the orchard and burn it up. If not so large they may be cut back to healthy wood and bark as in the case of the apple tree canker and the wound swabbed with a weak solution of corrosive sublimate or a 3% solution of CuSO_4 (copper sulphate or bluestone) as a disinfectant, and when dry, painted with some heavy lead paint. Repeat the painting until the wound is completely healed.

Preventive measures,- remove all dead wood from orchard and burn it. Cut out all cases of twig blight from both pear and apple tree as soon as it becomes apparent and especially watch any pear tree that may be in the neighborhood as that tree is very susceptible to the blight. When pruning paint all cut surfaces with the disinfectant mentioned above. Also paint and disinfect all accidental wounds. Carefully watch all water-sprouts which are to become new heads and remove all not needed for that purpose. Keep the trees well opened up.

These two diseases are perhaps the two which cause the greatest damage to old apple trees. The insects which are particularly bad in the apple tree are as follows:

San Jose scale and Oyster Shell Scale.

It would be well to give the life history in brief of these pests so that they may be more intelligently combated. In this climate the male San Jose Scale insect matures in April and about one month later the females begin to give birth to their young. Unlike most insects, these young are brought forth alive, the average number from each female being about 400. They continue

producing for 6 or 7 weeks. The newly born scales are microscopic in size and remain under the parent scale for a short time, finally coming out to wander about for a while until they find a suitable place on the bark to locate. As soon as they settle down, the waxy thread like secretions begin to appear on their backs. These secretions form the scales. Owing to the comparatively long period during which young are produced it is difficult to ascertain how many generations occur in a year. Judging from the scales as they appear in winter, however, it is probable that the young are produced until the latter part of the summer or early in the fall. After all their young have been produced, the old females die, the young surviving to continue the species.

The Oyster Shell scale or Oyster-shell Bark Louse as it is usually called is very similar in life history to the San Jose scale. The main difference are that whereas the San Jose young are born alive, the oyster shell young are hatched from eggs, and again, whereas the San Jose female gives birth to 400 or more, the oyster shell female gives birth to but from 40 to 60. The latter is not so destructive or so rapidly disseminated as the San Jose but in many districts- noticeably in the neighborhood of Elmira, N. Y.- it causes much damage. It is especially prevalent in localities where its development has never been checked, i.e., where the trees have been allowed to deteriorate and go to ruin. It would be well to look for this insect, therefore, along with San Jose Scale where the work of renovation is contemplated.

For both these pests it has been recommended to spray with lime sulphur wash, using the commercial article at a concentra-

tion of from (1 to 8) to (1 to 10), applying either in the fall after the leaves have dropped, in the spring before the buds open or in very extreme cases at both times. For usual, average cases however, one spraying is sufficient.

Codling Moth.

Perhaps the most injurious biting insect pest known to New York apple growers is the codling moth. It is a small brown moth, seldom seen in the day time, which lays its eggs on the young fruit or leaves. As soon as the caterpillars hatch out, they migrate to the "blow" or calyx end of the apple where they take their first meal preparatory to entering the fruit. They eat their way into the core of the apple through the calyx end and stay there until they become full grown in July or August, when they bore a hole out through the side and leave for the loose bark, where they spin a cocoon and hibernate over the winter. In most parts of the country there are two broods annually, the second one being the one to hibernate over the winter and thus perpetuate the species.

It is of course impracticable not to say impossible, to attempt to exterminate the pest by reaching the mature moth. The most vulnerable period of its life history is right after it hatches and before it enters the fruit. If its first meal contains a small dose of poison, it is very likely to be its last and it cannot hope to get very far on its way into the core of the fruit. Therefore have the poison ready for it by spraying with arsenate of lead 2# to 50 gallons just as soon as the fruit sets and the petals have fallen. At this time the calyx is open and the poison can reach the calyx tube. It will be useless to spray after the calyx has closed up, as the cater-

pillar will not get any of the poison, but will pass into the apple unharmed.

Some nozzle that drives the spray rather forcibly is preferred for this spray as a misty spray will not reach the desired point.

Leaf Blister Mite.

The leaf blister mite causes serious damage to the foliage by mining in the leaves between the upper and lower epidermis, causing dead areas or blisters to appear **wherever** they have worked. During the winter-i.e., from the time the leaves begin to fall till the buds begin to open in the spring the mites live underneath the bud scales. It is during the period of their migration from the leaves to the stems, or when they emerge in the spring to infest the young foliage that they can be reached by a spray. The time to spray, therefore, is in the fall just after the leaves have fallen, or in the spring just before the buds open. It is useless to spray for them later than this, for once they get inside the leaf, they are protected and cannot be reached. Any contact spray such as lime sulphur or the miscible oils, is efficient in controlling this pest. Usually the spray applied in the spring for the scale will usually get the mite if applied late enough. If sprayed for at the proper time, there is little difficulty in controlling it.

Apple Scab.

This is a disease known as "Scab", "the Fungous" or "Black Spot". It is very destructive and attacks both the fruit and foliage. It is caused by a minute fungous which grows just under the cuticle of the apple and when ready to form spores or "seeds" pushes the cuticle up and shoves it to one side causing a dark spot or scab to appear. The spores are disseminated through the

air by wind and insects and infects more fruit. The process continues all summer and if not checked will prove very injurious. In the fall a new (asexual) kind of a spore is formed which infects the leaves and lives in them all winter in the ground. In the spring they have matured and formed many other spores in small dark sacs or perithecia on the upper surface of the leaf. By a peculiar device they are **discharged** into the air with considerable force in much the same manner as a pea comes from a pea-shooter and, being very small and light, are carried by the wind to the young fruits. This is about the time when the petals have just fallen. Some fungicide, like lime-sulphur is very efficient in controlling the disease at this time, and usually the spray applied for codling moth will also get the scab.

It sometimes happens that there is a later infection by scab so it ^{is} ~~is~~ well to protect the young fruit by another application of the fungicide about two weeks after the first. The first spray, however, is the more important one, as it gets the spores before they have a chance to infect the fruit.

The above mentioned diseases and insects are not the only one that will trouble the fruit grower, of course, but a spray calendar which will cover them, the most important ones, will also take care of the other and lesser pests. It will be unnecessary, therefore, to discuss any other life histories at this time. It might be well though to say something about the application of the spray. Up until very recently it has been advocated to spray with the wind. This is a good practice in the early spring before the foliage has started out, when spraying for scale or blister mite. The spray will be carried to all the little crevices in the bark and will reach every part of the tree. But in the case of the spray for conditions are very different. It is necessary

to be most efficient, to have the spray enter the calyx, and it is evident that this is impossible if sprayed from the windward side, because all the petals of the blossoms will be turned away from the sprayer. It will therefore be necessary to spray against the wind directly into the calyx, driving the liquid under comparatively high pressure from a coarse spray nozzle. Of course it would not ^{do to} spray thus against a heavy wind, for most of the liquid would not reach its destination any way, but would be blown back and lost. It would be better to wait for the wind to subside.

In summing up the matter of spraying, it might be well to append a calendar for spring spraying which would be universally applicable for the above-mentioned pests, and only subject to slight modifications in time of application according to variations in season and weather.

SPRAY CALENDAR.

No.	Material	Time	Pest
1	Commercial lime- Sulphur 1-10 Arsenate of lead 2# to 50 galls.	Just before buds open in the spring	San Jose Oyster-shell Blister mite Bud Moth
2	Commercial lime- Sulphur 1-40 Arsenate of lead 2# to 50 galls. H O. 2	Just before blossoms open	Scab(early stages) Bud Moth.
3	Same as 2	Just after petals fall	Scab. Codling Moth
4	Same as 2 minus the arsenate.	2 weeks later	Scab

Profits.

Does it pay to renovate the old orchard? That is a question to be considered carefully before any attempt at renewal is made, for if it does not it were better to pasture the old orchard and feed the wormy drops to the pigs than to spend money simply for the satisfaction of having a nice looking, picturesque bit of landscape near the house for the aesthetic edification of your city friends.

On the face of it, it would seem to be a profitable undertaking, because so many fruit growers, who are not in the business for love, are taking it up and making money out of it. It will take, in the worst case of deterioration, not more than four years to get a good paying commercial crop of apples whereas if a new orchard were set out there would be no apples even in the ^{case of} earliest bearing varieties before six years. If, therefore, a man has an old orchard and wants to grow fruit, by all means get the old one in shape while waiting for the new one to come into bearing, and realize some revenue from the business. Some may be pessimistic as regards the real value of this work. For them a few concrete examples might be helpful.

A Vermont orchardist reports the following results from renovating a twenty acre orchard.

1908	nothing.
1909	gross sales,- \$13, 000
1910	" " ,- 20,000
1911	not sold yet, fruit in storage.

These figures seem large but are by no means impossible.

A man in Connecticut reports the following results from two orchards, one 40 years old and the other 90 years. He

worked with them 10 years so that now the one is 50 years old and the other 100 years.

"Have no accurate figures as to cost and returns but have sold from \$200 to \$300 per acre from winter fruits for several years,- and there is certainly a handsome profit in the operation."

Another reports,- "Formerly one to two barrels, No.2 and No. 3, now 5 to 8 barrels, No. 1, per tree.

An orchardist in Floradale, Pa. reports an increase in his profits of "over 200%".

The Frost and Bartlett Co., Landscape foresters and entomologists, when questioned concerning the value of renovation state;- "It is impossible to quote you exact figures from a commercial standpoint as to the value of orchard treatment. I can state positively, however, that many of the orchards that have not borne fruit for many years, have produced enough fruit to pay for the treatment of the trees, both pruning and spraying, cavity work, etc., and to give a handsome profit besides. Each year after such treatment, they have improved and it is almost all profit after this done.

Another man from New Hampshire writes as follows:

In regard to profits, will say that I have established a retail trade for all my best apples; for the past two years have sold all of my fancy grade as follows:

	bbl.	box
Baldwins	5.00	2.00
McIntosh	7.00	2.50

And sell good No. 1's at \$4.00 per bbl. My cheaper grades go through the commission merchants, where I think I can do the best. Have put in lots of work, but think it is paying

a good return.

The following very suggestive report is had from a New Hampshire grower.

From 1902 to 1908 his trees were neglected with the following results.

Year	No. bbls.	Receipts.
1902	408	\$750
1903	305	737
1904	299	408
1905	186	400
1906	172	257
1907	245	551
1908	102	300

In 1908 he began to look after his trees again in a scientific manner with the following gratifying results.

Year	No. bbls.	Receipts.
1909	473	\$1,000
1910	475	1625
1911	508	1487

Most of these were exported to Liverpool. The figures quoted are net profits, not gross receipts.

Even the most pessimistic will have to acknowledge that there is money to be had if the old orchard is renovated properly, in the light of the foregoing array of facts. Men in New York State owning old orchards should profit by the experience of those **outside** the state and put into their pocket books what is now dropping on the ground or going to the codling moth. If they don't want to do it themselves let them sell their places to men who are anxious to, and to "dog in the manger".

Summary.

In the first place, decide whether or not you are going to renovate. If you are, do it well; if not, do not start. Half way methods will accomplish no results other than perhaps a more fluent vocabulary and a general aversion to all things horticultural.

Then, if the trees crowd, follow the suggested plan and cut half of them out, cutting all dead wood from the remaining trees. Burn all the brush. Pruning should be approached with due consideration to the carbohydrate needs of the tree, and the tall ones should be brought down by degrees and not in one year. Form the new heads low from the induced water sprouts.

Turn the sod over as soon^s as the ground breaks up sufficiently in the spring and follow immediately with a ~~cul~~away and spring tooth harrow. Keep the orchard cultivated until the middle of ^rJuly of the first of August, and then sow a cover crop, preferably buckwheat, the first year. This cover crop should be turned under the following spring.

It might be well to apply lime at the rate of from 1,000# to 2,000# per acre, the first year the amount to vary with the apparent needs of the soil. Do not apply fertilizer the first year, anyway. It is quite impossible to know what ~~is~~ wanted at that time, if indeed anything is, and the chances are that turning over the sod and loosening up the soil will make sufficient plant food available for the needs of the trees.

Follow the spray calendar as closely as possible and there will be little trouble in controlling any of the diseases and pests common to old apple trees. Spray against the wind for codling moth; not with it.

By following the above suggestions there is little doubt that many a man can change the condition of his old orchard from one where it is now costing him the rent of the land it is occupying to one where it will not only pay that rent itself but be a source of **revenue** considerably over and above it.

OUTLINE.

I Introduction.

II Cultivation.

III Fertilization.

1. Kinds of fertilizer.

2. Use of using fertilizer.

3. Effects on trees and fruit.

IV Pruning.

Opening up orchard.

 " " trees.

"Dehorning"

Scraping bark.

V Spraying.

Insect and fungous pests.

Commercial sprays.

Spray Calendar for N. Y.

VI Profits.

Discussion

 Concrete examples.

 General summary and conclusion.

