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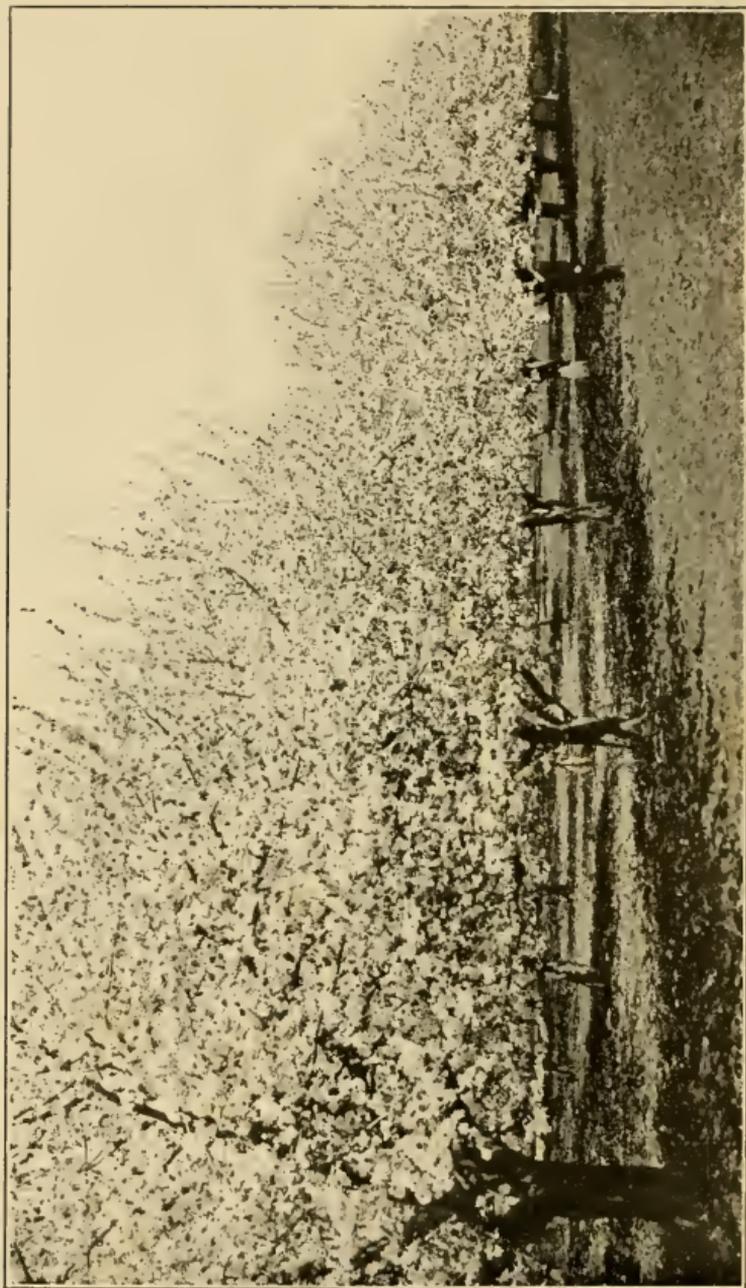
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THE AMERICAN
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THE ORCHARD AT BLOSSOM TIME

The American Apple Orchard

A Sketch of the Practice of Apple
Growing in North America at the
Beginning of the Twentieth Century

By
F. A. WAUGH

Fully Illustrated

ORANGE JUDD COMPANY
NEW YORK

1909

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TO
THADDEUS L. KINNEY
APPLE GROWER

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The American Apple Orchard

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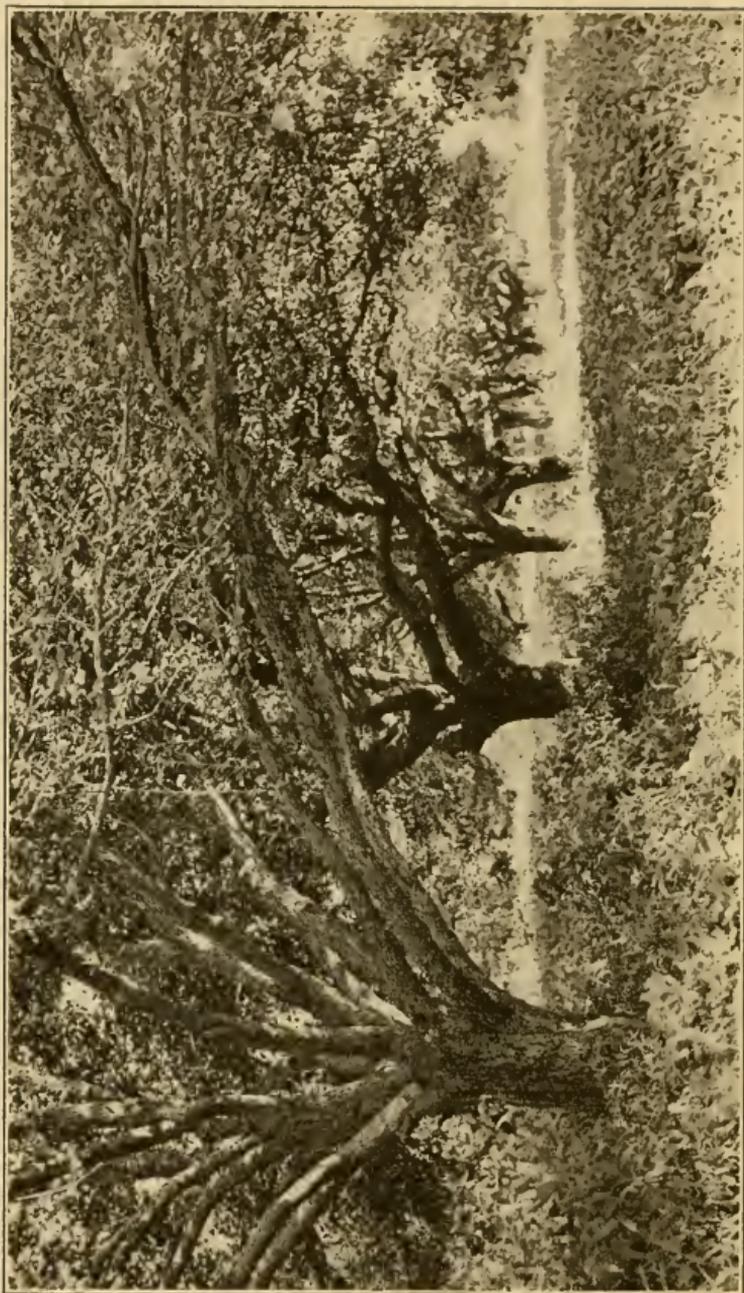
The American Apple Orchard

I

THE GEOGRAPHY OF APPLE GROWING

THE apple is the most widely grown of tree fruits; and though it cannot cover quite so great a range of latitude as the plum, it is, after all, more generally known and prized than any other fruit of any longitude or zone. Nevertheless the extreme northern and southern agricultural regions of our continent are practically outside the apple country. Even within the apple country there are great inequalities of distribution. Certain regions are not well adapted to apple culture, while in others this fruit has become the basis of a great industry. The ten leading states, as shown by the number of apple trees reported in the census of 1900, were as follows:

States	Trees
Missouri	20,040,399
New York	15,054,832
Illinois	13,430,006
Ohio	12,952,625
Kansas	11,848,070
Pennsylvania	11,774,211
Michigan	10,927,899
Kentucky	8,757,238
Indiana	8,624,593
Virginia	8,190,025



AN OLD ORCHARD OF NORTHERN SPY

Of course some of these states rank above others simply because of their size. Statistics taken by counties show in a yet more striking manner how the planting of apple trees has been developed in special localities. The ten counties in the United States which led in the number of trees growing in 1900 were as follows:

County	State	Trees
Benton,	Arkansas	1,613,366
Washington,	Arkansas	1,555,146
Niagara,	New York	924,086
Wayne,	New York	796,610
Marion,	Illinois	795,188
Monroe,	New York	789,409
Clay,	Illinois	751,724
Erie,	New York	631,283
Orleans,	New York	629,401
Wayne,	Illinois,	604,215

It is a striking fact that these ten counties represent only three states.

There are several well-recognized apple sections which may be separately characterized. The principal ones are:

1. **The Lake Ontario Section**—This comprises the northwestern counties of New York and adjacent parts of Ontario. A part of southeastern Michigan naturally belongs to this belt. It is a section largely devoted to Baldwin and Rhode Island Greening. Other varieties grown commercially on a considerable area are Northern Spy, King and Roxbury.

2. **The Mississippi Valley Section**—This includes portions of Ohio, Indiana, Kentucky, Kansas and Arkansas, with practically all of Missouri and Illinois.

While this great region can be subdivided to some extent, yet varieties and methods are sufficiently alike in the several states to justify us in grouping them together. Ben Davis is the characteristic variety, though many other sorts are grown commercially, as Jonathan, Grimes, York Imperial, Willow and Missouri Pippin.

3. **The Allegheny Section**—This comprises those lands along the slopes of the Allegheny mountains lying in Pennsylvania, western Maryland, West Virginia, western Virginia, eastern Tennessee and western North Carolina. The characteristic variety here is York Imperial, though other varieties are extensively grown, as Ben Davis, Paragon, Winesap, Grimes, and in Virginia the famous Albemarle Pippin.

4. **The Nova Scotia Section**, comprising rather limited areas in Nova Scotia, where, however, the apple-growing industry is highly developed. The most striking feature of the Nova Scotian industry is the development of the British markets. The leading varieties grown are Baldwin, Roxbury (locally called Nonpareil), Northern Spy, Rhode Island Greening and Gravenstein.

5. **The Pacific Coast Section**, including several segregated and somewhat dissimilar districts in Washington, Oregon and California. The varieties mostly grown are Esopus, Jonathan, Newtown Pippin and Yellow Belleflower.

There are various places outside these sections where apples are grown commercially and where very interesting local adaptations are to be found. These five sections, however, produce the great bulk of all the fruit which annually reaches foreign and domestic markets.

II

APPLE SOILS

THE apple thrives on a great variety of soils. Indeed, it is grown to some extent on almost every kind of arable soil in America. When planted on large commercial areas with a view to profit, however, it becomes necessary to select those particular soils which give the best results.

First of all, it is obvious that apple trees can be accommodated only in a deep soil. Naturally the roots extend to considerable depths, and unless a porous open subsoil is present the tree does not have proper opportunity for rooting. In soils with impervious hardpan, or in those where the water table is near the surface, apple trees do not succeed well. It is generally known that apple trees are very impatient of wet feet. This can easily be seen in orchards where there are small spots of poorly drained land where the water stands. In such spots the trees are always poor, and they usually die out early, leaving blank places in the orchard. It has been observed that a twisted growth of the apple tree trunk indicates imperfect underdrainage. Some of these soils of course can be improved, or the difficulty entirely corrected, by thorough underdrainage. As a rule, however, only those soils which are naturally deep and well drained should be chosen for apple orchards.

A somewhat gravelly soil, or even one verging somewhat on stony, has been found by experience to be highly satisfactory for apple growing, provided

only there is an abundance of plant food present. The gravel and small stones doubtless assist in the drainage, and this fact probably explains in part the superiority of such soils. As a rule we may say that gravelly loam, fairly rich in plant food, is the ideal apple soil. The soil surveys now being made in various parts of the country have, in a general way, verified the commonly accepted opinion on this point. Some of the soils well known as successful apple producers have now been described, mapped and given names. That soil known as Porter's black loam, found in extensive areas along the eastern slopes of the Allegheny mountains, is noted for its adaptation to the growing of apples. It is upon this soil that the Albemarle Pippin of Virginia is grown. In western New York the Miami stony loam may be mentioned as a soil of well-proved adaptability for apples. This is widely represented in Wayne county, known as one of the best apple-growing counties in America.

In other parts of the country sandy loams or even silt loams are found to be successful in the production of apples. The Miami silt loam furnishes the principal basis of a large apple-growing industry in Clinton county, Ill., while the so-called Marion silt loam is the soil chiefly developed in the famous Clay county, Ill., apple district. On the Delaware Peninsula, where the production of early apples is coming to be an extensive and profitable industry, orchards are planted chiefly on the Norfolk loam and Norfolk silt loam.

A rule which the writer has been in the habit of giving for popular use is that any soil especially adapted to the growing of Irish potatoes will usually be satisfactory for apples. If any difference is to be distinguished it would be in the way of allowing a

larger amount of gravel or loose broken stone in an apple orchard than in a potato field. Indeed, there seems to be no limit in the amount of loose stone which may be present in an apple soil, except the limit of cultivation. Even this limit is not so soon reached as might be expected, for proper tools will give satisfactory cultivation in apple orchards containing remarkable quantities of broken stone on the surface.

EXPOSURES

A great deal of time has been spent in the discussion of the proper exposure for orchards. The popular theory is that southern exposures are dangerous because they induce early blossoming of the trees, thus giving opportunity for the blossoms to be killed by late frosts. In those localities where serious late frosts frequently occur this objection obviously has some force, but a careful study of the situation reveals the fact that such localities are decidedly rare. High-lands with good air drainage are generally preferred; but this for other reasons than because of late spring frosts.

III

WINDBREAKS

A PROPER site being chosen, some protection from wind may still be desirable. Tracts of land freely exposed to constant hard winds are undesirable, but almost any orchard may be benefited by a certain amount of protection.

The utility of windbreaks for orchard protection is a subject which has been often discussed among American fruit growers. It is a subject, moreover, on which a fair unanimity has been reached. There may still be a few exceptions to the statements noted below, but for the most part the matter is fairly well settled.

There are three general purposes for which windbreaks are cultivated: (1) Protection during winter; (2) summer protection; (3) protection of fruit in picking time. It will be best to discuss these in order.

Perhaps the object which has been most often discussed is that of winter protection. It seems to have been felt, especially in the more northern states, that the common fruits are all more or less tender and, therefore, subject to damage during the cold weather of winter. A great deal has been said about winter-killing; and, indeed, more or less damage to young growth and to fruit buds has been observed by almost every fruit grower, no matter in what part of the country his work has been done.

It must be said, however, that the principal use of the windbreak does not seem to be that of furnishing winter protection. Nor is it the best use. Even when

winterkilling is a serious factor in the management of an orchard the greatest protection does not come apparently from the use of windbreaks. It is doubtful if they ever mitigate low temperatures to any important extent. They do stop the wind to some degree, even in winter, and thereby reduce slightly the evaporation of moisture from the twigs, which is apt to be the greatest source of winterkilling. Perhaps they are more useful as a means of winter protection from the fact that they usually hold the snow on the ground. They also prevent the blowing of leaves and such other litter as may help to hold the snow, and which may give some protection. The snow and litter thus retained on the ground protect the soil from severe freezing, and from alternate freezing and thawing; whereas, without the windbreak, the ground might remain bare, and the roots of the fruit trees might be disastrously frozen in consequence.

In most parts of the country the protection of trees in summer is of vastly more importance than their protection in winter. The mechanical strain brought about by the pressure of excessive winds is often the source of serious trouble to the orchardist. In exposed localities or where heavy winds prevail during growing time it is very difficult to secure a symmetrical top on rapid growing trees. It is a not uncommon sight to see a young tree with the top all on the north or northwest side, due to the action of the wind. A windbreak which prevents the sweeping of direct winds across the orchard during the summer, moreover, is of considerable help in the conservation of moisture. It has been shown by careful experiments, and it is a matter of wide observation among practical men, that the soil dries out very rapidly when the

wind is allowed to pass over it, and that evaporation is much less from ground not open to the sweep of the wind. Since the conservation of moisture is one of the large and fundamental problems in orchard management, the use of the windbreak in securing this end is highly desirable.

Perhaps the most important use of all to which the windbreak is put in the management of apple orchards is the protection of the fruit toward picking time. It is not at all uncommon for heavy September gales to bring down 25, 50 or even 75 per cent of the entire crop of apples; the losses from this source sometimes amount to hundreds, or even thousands of dollars, in individual orchards.

There are objections which always come up with more or less force when the planting of a windbreak is considered. In the first place the windbreak takes up a certain amount of land. It never requires less room than would an entire row of fruit trees of the same length, and it usually requires more. Even when a space somewhat greater than this is allowed to the windbreak, it is often found that the outer rows of fruit trees are starved by the greedy feeding of the trees in the windbreak. In other cases atmospheric drainage is seriously interfered with, though this defect can usually be remedied by proper foresight. In some cases windbreaks harbor insect pests, but though this objection has been frequently urged against them, it has usually been considerably overdrawn. In fact, the only important objection, in the judgment of the writer, is the one first mentioned.

All windbreaks will naturally be planted on that side of the orchard from which the wind comes. Since the prevailing winds are sometimes from one quarter

at one season of the year and from another quarter at another season, it becomes necessary to consider whether the windbreak is intended chiefly for winter, summer, or picking-time protection. Sometimes all three are required; many of the best orchards have windbreaks around their entire circumference. There is too much trouble and expense, however, attached to the maintenance of a windbreak to justify a man in keeping one where it is not plainly required.

The materials which may form the windbreak are various. Each man must judge for himself which is most practicable in his own locality and under his own circumstances. In many cases the lay of the land may be depended on. Some of the best orchards and fruit-growing regions in America are to be found on sharp mountain slopes or along steep hillsides. In such cases the slope of the mountain or hill may be sufficient to furnish all necessary protection from the wind. In other cases natural woods or belts of timber occur in convenient proximity to the orchard and in such a way as to furnish the desired shelter. Natural woods give the greatest possible protection, but, more than any other windbreak, they are open to the charge of harboring noxious insects, rabbits, mice and other vermin.

Under most circumstances it is necessary to plant artificial timber belts for the protection of the orchard where protection is desired. These may be either of evergreen trees or of deciduous species. The conifers, such as pines, spruces, hemlock and arbor vitæ, all make good windbreaks, and are especially desirable where winter protection is the main consideration. They are somewhat more difficult to transplant and establish than deciduous trees are, but there is seldom

any difficulty with them, provided they are intelligently handled. The particular species which should be chosen cannot be pointed out. If spruce thrives best in the soil and locality under consideration, then spruce should be planted. In some neighborhoods arbor vitæ is easy to establish and is very satisfactory. In other places the white pine is generally regarded as one of the best trees for protective timber belts.

Deciduous trees, besides being easier to establish, are usually more rapid growers during their early years. It is easier to form a dense belt of them in a short time. They are more likely to thin out below, thus avoiding the objection of obstructing atmospheric drainage. In case a very thick and altogether effective windbreak is desired, alternate rows of evergreens and broad-leaved species would best answer the requirements.

In some orchards it is possible to arrange the fruit trees in such a way that they will furnish more or less protection for each other. It is customary in some localities to plant the trees closer together east and west than they are north and south. They soon form thick rows—sometimes almost hedgerows—of trees running crosswise of the course of the principal winds. Sometimes tall growing and sturdy varieties like Spy and Ben Davis are planted on the outside of the orchard next to the wind. The fruit of Spy trees very seldom blows off. The same is true in a less extent of Ben Davis. Such varieties may be used, therefore, as windbreaks for the rest of the orchard.

In young orchards temporary protection may sometimes be secured at picking time by planting between the rows with tall-growing varieties of dent corn. The corn will reach such a height before picking time

as to prevent the too free circulation of the wind among the trees. This plan, however, is a makeshift and not to be generally recommended.

When trees are planted for windbreaks they should nearly always be set at the same time the fruit trees are. If spruce, pine or hemlock are to be used, however, and if it can be conveniently done, it may be best to put out the windbreak two or three years in advance of the fruit trees. Spruce and pine start so slowly that they often give very inadequate protection during the first years, when perhaps their help is most needed by the young fruit trees.

IV

WINTERKILLING

IN considering geographic and climatic factors we must give some attention to another matter which is of considerable importance in certain localities. Winter-killing has always been a large and interesting problem with fruit growers in this country, but is of comparatively little importance in growing apples, especially in the management of commercial orchards. In the great apple-growing regions winterkilling is practically a negligible factor. In sections where winter-killing is a serious danger apple growing can never become an extensive industry. Since, however, every householder in every civilized community in temperate climates wishes to grow some apples, and since winterkilling is a really serious matter in some of these localities, it is necessary to consider this subject with due care.

Winterkilling is of three sorts: (1) The killing of the buds; (2) the killing of the young growth; (3) root killing. The killing of fruit buds, though a very serious matter in peach growing and with some varieties of plums, very seldom occurs with apples. Apple buds are well protected and hardy. Any variety sufficiently hardy to carry its wood through the winter will usually save its buds also.

The young growth on apple trees sometimes kills in severe winters. This damage is more likely to occur on newly planted trees than on those well established. It has been shown that this damage occurs largely

through the drying out of the young shoots, due to the fact that, while some evaporation still goes on during the winter, the tree cannot take up water from the frozen soil to make good this evaporation. The young shoots, therefore, become so thoroughly dried out during cold weather that the tissues are killed. Some varieties, of course, are more subject to this damage than others, and in northern regions a distinct variation of hardiness among different varieties is well recognized. The Russian apples, so widely recommended a few years ago on account of their superior hardiness, are, as a class, conspicuous for their ability to withstand this sort of damage.

There are no very certain means of preventing winterkilling of this kind. Anything which can be done to prevent the ground from freezing deeply and for a long period will give the best possible protection. Heavy cover crops which hold the snow and protect the soil from freezing are especially valuable. It has usually been said that pains should be taken to have the wood ripen up as early in the fall as possible as a means of guarding against winterkilling. This theory has unquestionably been overworked.

Root killing is doubtless the most serious form of winter damage suffered by apple trees in northwestern localities. The great freeze of February, 1899, which killed hundreds of thousands of trees in the northwestern states, accomplished this destruction chiefly by root killing. The ground was bare of snow at the time and the cold was very intense. When it is considered that all ordinary orchard trees are grafted or budded upon miscellaneous stocks, it is easy to understand that nearly all of these stocks might be more tender than the hardy varieties which had been grafted

upon them. Thus the roots were killed in many cases where the tops were able to withstand the weather.

In cases where root killing is likely to occur from time to time—that is, in sections where severe freezing is likely to come when the ground is not covered by snow—special precautions should be taken to prevent this sort of damage. The best of these is to propagate the apple upon a very hardy stock; and probably the best of these stocks is the Cherry crab (*Pirus baccata*). Unfortunately these stocks are available only in small quantities and at comparatively high prices. Trees propagated on these roots cannot be bought in any ordinary nursery. The next best preventive of root killing, and the one easiest to adopt, is the cover crop. A good heavy cover of clover, alfalfa, or vetch gives the ground some protection in itself and helps to hold whatever snow may fall.

V

STARTING THE ORCHARD

A MATTER of prime importance in starting an apple orchard is to begin with good trees. Everybody seems to know what constitutes a good horse, a good pair of boots, or a well-made suit of clothes, but very few people appear to have the necessary basis for judging the value of nursery stock. It is altogether amusing to see a file of ordinary customers select nursery trees for themselves in nurseries where such direct purchase is possible. Very often large trees are selected without regard to the roots, apparently with the idea that the bigger the top the better the tree. Even when more regard is paid to the proper balance of branches with the root system the principal idea still seems to be to get the biggest trees. The more such a customer can get for the money the better he seems satisfied. Even when these crude errors are avoided others almost as bad are fallen into. Yet this matter is a very important one. It is just as desirable to have good nursery trees as to have good seed, and every farmer considers this one of the first requirements in agriculture. There is as much difference between good trees and poor ones as between good coffee and chicory mixture. On what, then, should a man base his judgment?

A GOOD NURSERY TREE

First of all, the trees should be free from insects and disease. Nowadays nursery stock is nearly all liable

to official inspection, and this inspection professes to discover all trees infested with obnoxious insects or fungous diseases and to throw them out of the market. A great deal has been accomplished by this system of inspection, although it must be said that in some places it is less effective than in others, and even at its best it cannot furnish an absolute guarantee of immunity. The man who buys the trees should himself inspect them and he ought to be sure that he is able to recognize the more important noxious insects and fungous disease likely to be transmitted in nursery stock.

In the second place a tree should be well grown. It should be clean and straight, with a well-formed head. Of course the size and form of the head depend greatly on the variety to which the tree belongs. Some varieties of apples make better heads than others. One should not expect Longfield to have as well-formed heads as Ben Davis or McIntosh. The fact that tree buyers persist in laying too much stress on this point has had a great influence in driving out of the market many good varieties of apples simply because they do not naturally form comely tops in the nursery. While the buyer will always seek to secure the cleanest and best-formed trees, he will not enforce this rule at the expense of good varieties.

A tree should be not only well grown, but well preserved. Most of our nursery stock, especially fruit trees, is now dug in the fall and sold in the spring. During the winter it is kept in storage. The idea of keeping nursery trees in cold storage, as eggs and apples are kept, appeals to most men as a dangerous practice. It is not necessarily so, however. If trees are well managed in storehouses they do not lose any

part of their vitality. Yet if they are mismanaged, it is always to their detriment. If the bark looks black and shriveled, or if it is dry and hard, or if it is soft and loose, peeling off readily when touched, then the tree has not been well kept. It is likely to be in bad condition and the chances are it will not grow.

There is sometimes a controversy broached regarding the comparative merits of northern and southern grown nursery trees. So far as we are concerned this is also involved with the question as to whether or not it is best to plant trees grown in the immediate neighborhood. There is a feeling in many quarters that northern grown nursery trees are more hardy, and in all cases this is supplemented by the feeling that home-grown trees are likely to be more successful through being already acclimated. Long observation and experiment have convinced me that these points are usually very much overdrawn. There may be something in them at times, but I have really never been able to see it, although the matter has been frequently tested under my observation. If the tree is sound, well grown, free from disease, well kept and otherwise in good physical condition, it is a safe tree to plant. Any inquiries as to its place of origin are hardly worth while. Indeed, such inquiries are quite likely to be futile, because it is nearly always impossible to ascertain where a certain tree has actually been grown. Very few nurserymen grow all the trees they sell. They depend on buying what they need in whatever market is most advantageous. It is, therefore, a matter of considerable satisfaction to feel that we do not need to trace the history of every tree, but that we may plant with confidence any nursery stock which conforms to the simple physical tests herewith

outlined. Such tests every man can make with his own hands and eyes.

HOW TO GET TREES

When a man starts into orchard planting he has to have trees. These he can either propagate for himself or buy from a nursery. When large commercial orchards are projected it is possibly best to undertake the propagation of the necessary nursery stock on the premises, providing the delay thereby incurred is not too serious an objection. The advantage of propagating at home is not so much that the trees are secured more cheaply, though there is something in that, as it is that they may be had when wanted and that their history is always known. The planter secures varieties which are true to name. They are the kinds he has chosen. They are propagated from reliable stock. He knows the entire history of every tree, and this is often of importance. There is a considerable advantage, too, in having trees at hand at planting time. There are no delays in shipping, no damage to trees in storage, and the stock is on hand when the ground is ready, the holes dug, and the men prepared to plant.

Now that the San José scale has come to be a factor in orchard planting in certain districts, there is an added advantage in having home-grown trees. Nursery stock bought from a grower in another neighborhood or state often requires fumigation. Either one must run the risks of fumigation or else the danger of infection from the scale. Both these risks may usually be avoided by home propagation.

In some quarters there is a well-founded prejudice—I hardly dare to call it more—in favor of tree-breeding by the selection of scions from bearing trees of special individual excellence. It is easy to observe that in a block of apple trees of one variety, say, McIntosh or Greening or Winesap, there are individual trees which bear more and better fruit than their neighbors. In so far as this is not due to the influence of the stock, but to the individuality of the tree itself, it can presumably be reproduced by grafting. From such trees accordingly do the modern apple growers of the advanced school prefer to select their scions. The present writer warmly shares the prejudice in favor of this practice, but admits that it rests on a plausible theory rather than on an established principle.

When the nursery stock is grown on the place the strongest and best trees may be selected, a large number of inferior specimens being discarded. One is apt to get, therefore, a generally higher grade of stock, providing he is willing to stand a certain amount of loss in the nursery, when he plants from his own nursery rows.

Nevertheless in the great majority of cases it is more practicable to secure trees from some nurseryman than it is to grow them at home. This is emphatically true if the number to be planted is comparatively small, and if the planter is not an expert propagator. It is the nurseryman's business to propagate trees, and he can do it better and more cheaply than the unpracticed fruit grower. The suspicion usually attached to nursery-grown trees is almost always unfounded. The unsophisticated farmer has been habitually gulled by the fruit tree agents from the earliest

times, but the very large majority of nurserymen are honest and reliable. They grow good trees as nearly true to name as careful foresight can insure, and they sell them at reasonable prices. The planter should simply be sure that the nurseryman with whom he deals is a good reliable business man. He should take the same precautions which he would in buying a barrel of sugar, a dairy cow or a carload of fencing wire. The itinerant fruit tree agent should never be patronized, of course, except to get rid of him—never with the expectation of getting any useful trees.

The prices of nursery stock are so low, and the character of the goods furnished generally so high, that the orchard planter can hardly consider this one of his serious expenses. Above all other things he should not practice a false economy in this part of the project. The best trees should be bought from the most reliable man in the market. A saving of \$2 or \$3 in the price of nursery stock may be lost a hundred times over before the first crop is gathered.

METHODS OF PROPAGATION

A great deal has been said at different times and in different parts of the country about methods of propagation. There has been a long argument over the respective merits of grafting and budding trees; and the advantages and disadvantages of so-called "whole-root" grafting as compared with the "piece-root" grafting have been hotly debated in many a horticultural gathering. On this point the experience of planters is quite strongly agreed. The net result may be stated as follows: The various methods of

propagation have their advantages and disadvantages in the hands of a nurseryman. Some are more economical for him because they give quicker or surer results, or because they are less expensive. But for the fruit grower there is absolutely no advantage of one method over another. Grafted trees will live as long and thrive as well as budded trees, and those grown on piece-roots are just as good as those grown on whole-roots. It is still a question of getting sound, thrifty trees. That is the only point of interest to the orchardist. Such a great amount of testimony has been collected in recent years on this point that the truth may be stated with considerable positiveness.

At what age should a tree be planted? Some planters prefer one-year-old stock, and when it is large and well grown it is almost, or quite as good, as two-year-old stock. For the most part, however, two-year-old stock is to be recommended for apples. Anything older than two years is strictly undesirable.

FALL VS. SPRING PLANTING

The question is often asked as to whether fall or spring planting is to be preferred. The answer is that there is not much choice and that sometimes one season will prove more favorable, while at other times the other season is better. There are certain general advantages in fall planting. There is more time for the work than during the spring rush; it is easier to buy nursery stock and get the varieties of one's selection; the trees if properly planted in good soil will make some root growth and will become, to a considerable degree, established before the

opening of spring, so they start in the year with a certain advantage over the spring-planted trees.

On the other hand there are some drawbacks to fall planting. In order to sell trees betimes in the fall nurserymen sometimes dig them prematurely. If the soil is not well drained, or if other conditions are unfavorable, the trees may receive serious damage during the winter. They may also be injured by mice. On the whole, the case seems to stand like this: When all conditions are favorable—trees good, soil good, drainage perfect, planting well done—then fall setting will be successful and is to be preferred. Lacking any of these conditions, spring planting is safer.

DISTANCES FOR PLANTING

In the principal apple-growing districts there is a fairly unanimous agreement that 35 feet apart each way is the proper spacing for standard apple trees in orchards. On fertile lands in western New York 40x40 feet is often recommended; while in a few sections, notably in California, closer planting is practiced. It may be said positively that the present tendency is toward closer planting. This is coupled everywhere with a tendency toward closer pruning and the formation of smaller headed trees. This tendency in turn is strongly promoted by the spread of the San José scale and of other noxious insects and diseases which require very thorough spraying. Smaller trees are more easily sprayed, and may be more closely planted.

If one is to follow the conventional methods of orchard management, therefore, he will plant standard apple trees 35x35 feet. He may make this

40x40 feet if he plants large growing varieties, like Spy, on rich land. On the other hand if he has clear and definite plans for repressive pruning he may plant closer. This may mean as close as 20x20 feet with small growing sorts, like Wealthy and Duchess. But such close planting must not be undertaken except by the man who has the knowledge and the courage to carry out a rigorous system of management all along the line.

PLANTING TABLES

The following table will show the number of trees to the acre planted at various distances:

		Trees Per Acre			Trees Per Acre
9 ft. x	9 ft.	537	12 ft. x	30 ft.	121
9 " x	10 "	484	12 " x	36 "	100
9 " x	11 "	440	12 " x	42 "	86
9 " x	12 "	403	12 " x	48 "	75
9 " x	14 "	345	12 " x	54 "	67
9 " x	15 "	322	12 " x	60 "	60
9 " x	18 "	268	15 " x	15 "	193
9 " x	20 "	242	15 " x	18 "	161
10 " x	10 "	435	15 " x	20 "	145
10 " x	12 "	363	15 " x	24 "	121
10 " x	15 "	290	15 " x	30 "	96
10 " x	18 "	242	15 " x	36 "	80
10 " x	20 "	217	15 " x	42 "	69
10 " x	24 "	181	15 " x	48 "	60
10 " x	30 "	145	15 " x	54 "	53
10 " x	36 "	121	15 " x	60 "	48
10 " x	42 "	103	18 " x	18 "	134
10 " x	45 "	96	18 " x	20 "	121
10 " x	48 "	90	18 " x	24 "	100
10 " x	54 "	80	18 " x	30 "	80
10 " x	60 "	72	18 " x	36 "	67
12 " x	12 "	302	18 " x	42 "	57
12 " x	15 "	242	18 " x	48 "	50
12 " x	18 "	201	18 " x	54 "	44
12 " x	20 "	181	18 " x	60 "	40
12 " x	24 "	151	20 " x	20 "	108



ORCHARD OF STANDARD APPLE FILLED WITH DWARFS

		Trees Per Acre			Trees Per Acre
70 ft. x	24 ft.	90	38 ft. x	42 ft.	27
20 " x	30 "	72	38 " x	48 "	23
20 " x	36 "	60	38 " x	50 "	22
20 " x	42 "	51	38 " x	54 "	21
20 " x	48 "	45	38 " x	60 "	19
20 " x	54 "	40	40 " x	40 "	27
20 " x	60 "	36	40 " x	42 "	25
24 " x	24 "	75	40 " x	48 "	22
24 " x	30 "	60	40 " x	50 "	21
24 " x	36 "	50	40 " x	54 "	20
24 " x	42 "	43	40 " x	60 "	18
24 " x	48 "	37	42 " x	42 "	24
24 " x	54 "	33	42 " x	48 "	21
24 " x	60 "	30	42 " x	54 "	19
30 " x	30 "	48	42 " x	60 "	17
30 " x	36 "	40	48 " x	48 "	18
30 " x	42 "	34	48 " x	54 "	16
30 " x	48 "	30	48 " x	60 "	15
30 " x	54 "	26	50 " x	50 "	17
30 " x	60 "	24	50 " x	54 "	16
35 " x	35 "	35	50 " x	60 "	14
36 " x	36 "	33	54 " x	54 "	14
36 " x	42 "	28	54 " x	60 "	13
36 " x	48 "	25	60 " x	60 "	12
36 " x	54 "	22	70 " x	70 "	8
36 " x	60 "	20	80 " x	80 "	6
38 " x	38 "	30	90 " x	90 "	5
38 " x	40 "	28	100 " x	100 "	4

DOUBLE PLANTING

When an orchard is planted 35x35 or 40x40 feet, there is a good deal of waste space left during the early years of its growth. For 15 to 20 years a considerable part of the ground remains practically unoccupied and useless. Some crops are occasionally raised between the trees during the earliest years, but experience has generally been against this practice. On the other hand when the trees have actually filled up the space allotted to them, and when we say the ground is fully occupied, there is, in fact, still another waste.

This comes from the fact that the bearing area of the tree has been simply moved out with the growth of the branches, leaving the space next each tree trunk unproductive. Apples never grow in the center of the tree. There is only a comparatively thin rim around the periphery where blossoms open and fruit matures. Thus, while we waste space outside of the tree during the early years of the orchard, we waste space inside the tree when the orchard grows old.

This waste often amounts to 50 per cent of the land, sometimes more. On land worth \$50 to \$100 an acre (and there are large areas of land worth \$100 an acre now growing apples) such an amount of unproductive soil is a serious consideration. There are two possible remedies for this condition of things. The first is pruning; the second interplanting.

If we had a system of pruning which gave us practical control of our apple trees, we might be able to prevent their continuous and undue increase in size. We could thus keep them within bounds. Trees might be planted 20 feet apart, say, and not allowed to overpass the limits set upon them. It is perfectly evident, however, that we have not yet worked out a system of pruning which will compass this end. That is one of the great problems resting with the future of American pomology. We shall certainly have to solve this problem before we can pretend to have a perfect system of fruit-growing; but this solution appears to be still further away from us than the one next to be mentioned.

Interplanting, or the use of "fillers," has been considerably discussed during the past decade or two, and has been occasionally tried. For the most part

the experiments made with mixed or double planting have been unsuccessful, or at least unsatisfactory; and there is at present in the general horticultural mind an undoubted and fairly founded prejudice against it. The waste of land, however, incident upon wide planting is so positive and obvious a hardship that many men are willing to face the prejudice and the bad results of earlier experiments in order possibly to find some improvement for this condition.

The general object of mixed planting or interplanting is to increase the revenue of the orchard during its early years. Whatever method of procedure, therefore, will give the quickest and largest returns without damage to the permanent apple orchard is the method to be pursued. And if double planting is to be practiced at all, the best method of mixing different trees in the orchard comes to be an interesting practical problem.

Before going further with this discussion, it seems necessary to consider in detail the objections usually made to double planting and the arguments commonly presented in favor of it.

The first and commonest objection is that the fillers are never cut out when they ought to be. In many cases fruit-growers seem to be ignorant of the time when the fillers should be removed. They do not appreciate that any damage is threatened from them until long after the damage has occurred. In most cases, however, the neglect is chargeable to the disinclination of the fruit-grower to cut out temporary trees which are giving him some regular income. It has been repeatedly laid down as a rule that fruit-growers will not do this. A good Nova Scotia fruit-

grower summed up the matter thus: "Cut out the fillers? Yes! Cut off your head!"

In answer to this objection it should be said that if a man is fairly forewarned of the danger of leaving fillers too long in his orchard, and if he is a man of moderate intelligence, he ought to be able to realize that what he is after is the maximum profit from his orchard; and if he has any way of knowing when the profit from the fillers begins to be gathered at a greater expense from the permanent trees, then he should willingly destroy the less for the greater income. A man ought to have no more compunction in cutting out a tree from an orchard than in cutting out a limb at pruning time. In either case he removes a part of his fruit-bearing capital for the sake of getting better returns from the remainder. It is doubtless a fact that the common careless fruit-grower will not remove fillers when he ought to, and this is sufficient reason why the practice of double planting should not be indiscriminately recommended. It is not any reason, however, why the intelligent fruit-grower—the man who knows enough really to look out for his own business—should not practice it.

The second objection is urged against the somewhat common method of filling apple orchards with trees of other species, especially stone fruits, such as peaches, apricots, plums and cherries. The objection is that these different types of fruit require different methods of culture, and that while striving to do what is best for the peaches or plums, the grower does what is not best for his apples. This objection, of course, rests upon the same ground as the one previously considered; namely,

that the fruit grower does not have the intelligence or the courage to do what is for his own good. If a man fills his apple orchard with temporary peach trees, there is no reason why he should not give the apples the best culture of which he is capable, and take as a gratuity whatever may come to him from the peach trees. That is what they are there for.

Some sticklers on orchard culture have carried this objection so far as to say that pears and early varieties of apples should not be used for interplanting in standard orchards of commercial apples. They say that pears and early apples require peculiar methods of cultivation. So far as pears are concerned, this is largely true, since high fertilization and thorough working of the soil is likely to induce blight. So far as early apples are concerned, this distinction seems to be rather finely drawn. There doubtless are a few apple growers in America who have arrived at that refinement of practice which leads them to apply one method of treatment to Ben Davis, another to Grimes' Golden and another to Red June, but these men are single examples among thousands.

Nevertheless, the objection to filling apple orchards with other species of fruit, especially stone fruits, should be given careful consideration; and in most cases it is probably better practice to use apples for fillers in apple orchards, if fillers are to be used at all.

Another objection which has not been commonly presented in this connection, but which seems to me to have much more practical weight than either of the others, is this—that the planting of fillers in an orchard interferes more or less seriously with the necessary working of the ground, growing cover crops and

spraying. Room has to be left in the orchard for the spraying outfit to pass readily about within reach of all sides of all the trees. If a row of fillers is placed midway between two permanent rows, there is always a certain amount of land which is thereby kept out of cultivation. If cultivation is a good thing—and it certainly is—then its benefits are mitigated by so much as the cultivated area is reduced. If cover crops add valuable elements to the soil—and they undoubtedly do—then the amount of these elements is reduced in proportion as the fillers occupy space otherwise available for clover or peas.

In answer to this last objection, it may be said that inasmuch as cultivation, fertilization and growing of cover crops are directed chiefly to the end of furnishing to trees an adequate food supply, the inroads made upon the stock of plant food by the fillers, and by the reduction in cultivation and cover crops, may be largely made good by the application of an extra amount of fertilizer. It is, of course, fully recognized that when fillers are planted in an orchard, much more liberal fertilization must be given. The temporary trees must not be allowed to feed at the expense of the permanent ones.

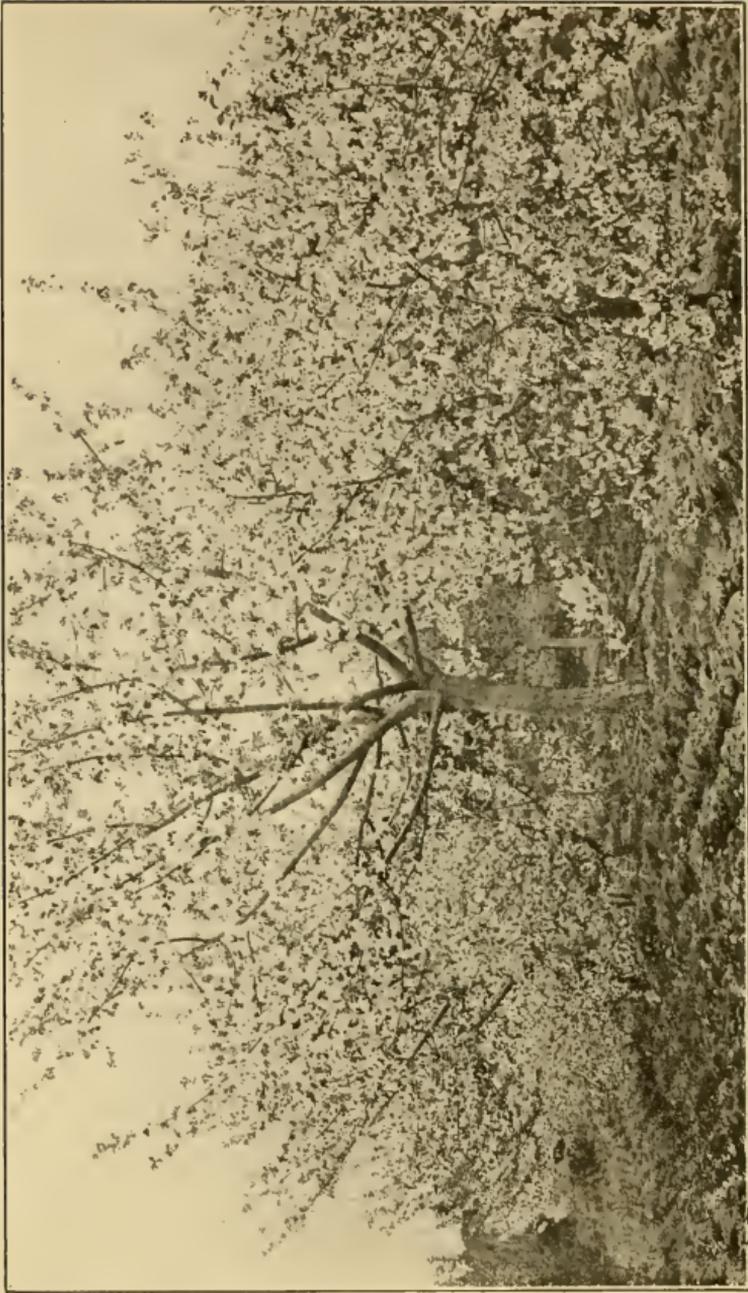
Considering fully the arguments on both sides of the question, and entirely without prejudice, I feel bound to believe that the practice of interplanting in apple orchards is desirable for fruit growers who have the intelligence to understand their own business and the courage to attend to it. I may add, furthermore, that I have sufficient faith in the modern up-to-date fruit growers to believe that a great many fulfill these requirements. Another argument for the feasibility of double planting is that this system has

been carried out with marked success by various practical fruit growers. If, then, mixed planting is to be undertaken in certain cases, we come back to the important question as to what methods are most likely to give success.

We have already briefly considered the question as to whether fillers should be of the same species as the permanent trees. It is doubtless safer to have them so. There are certain varieties which come early into bearing, and some of these are comparatively small trees and may be put in the temporary rows. Missouri Pippin and Winesap are generally recommended for the West; in the East experience has not settled upon any particular varieties except Wealthy. Fameuse fills the requirements to a certain extent where it is a market variety. In Nova Scotia I find that Ben Davis is being considerably used for this purpose, which will certainly be a surprise to the men in the "land of the big red apple." In the northern states and certain portions of Canada, Wealthy has been generally recommended; and persons who are inclined to grow Wagener will find that tree suitable to the purpose in hand.

In many cases it seems best to have the temporary trees of the same variety as the permanent ones—that is, if one is planting a permanent orchard of Ben Davis with trees 40 feet apart, he may put in an extra row of Ben Davis half way between. He will thus have during the first few years a Ben Davis orchard with trees 20 feet apart.

It will be seen in the presentation of the arguments above that the writer does not believe it altogether an impossible practice to use stone fruits for fillers in an apple orchard. While the peach has doubtless been



GRAVENSTEIN APPLE ORCHARD FILLED WITH MORELLO CHERRY

oftenest used and recommended for this purpose, plums and sour cherries would probably answer the requirements of the case better. They are slower growers, make smaller heads, and are much less likely to overtop the permanent apple trees. If, as has already been said, the grower will concentrate his best efforts in behalf of the permanent apple trees and will make his cultivation of plums or cherries a strictly secondary matter, there is no reason why these crops should in any way work against the best development of the main crop. The practice usually recommended as being the very best for apples comes near enough to satisfying the requirements of the plum trees, at least near enough so that good returns may be expected from fillers of this sort.

Whatever species and varieties are selected for mixing, the whole treatment given the orchard from the very first must favor the permanent trees. These must be urged to dominate the fillers. In some cases, especially when the fillers are apple trees, and still more especially when they are of the same variety as the permanent trees, it is good practice to set the main orchard first, putting in the fillers one or two years later. This gives the permanent trees a start. In any case, some system of repressive pruning is to be recommended for the fillers, in order to keep them strictly under control, and to prevent any one of them overtopping a neighboring tree of the elect.

The arrangement of an orchard will usually be more or less affected by the project of using fillers between the permanent trees. Sometimes it is found best to adopt the old-fashioned quincunx system. This is perhaps especially suited to those cases in which

apples are used for fillers between apples. The permanent trees are put where they are to stand, say 40 feet apart, and in the middle of the square, equidistant from four of these trees, a temporary tree is placed. This increases the number of trees to an acre by exactly 50 per cent.

When plums or cherries or dwarf pears are used for fillers, a much larger number can be put in to advantage. Perhaps the best way then is to plant the permanent trees in rectangles, say 24 by 32 feet, then an entire row of fillers can be run through the wide spaces, making the rows 16 feet apart one way and 24 feet the other. The fillers would then be planted 12 feet apart in the row, and there would be one and one-half times as many of them as permanent trees. In case a still heavier interplanting seems desirable, the most practical way would be to set the permanent trees in squares once more, then to run temporary rows half way between them in both directions. If the permanent trees are 40 feet apart then fillers are put in half way between, in both directions, making the entire orchard stand, as originally planted, with its trees 20 feet apart. In this case there are just three times as many fillers as there are permanent trees, and the number of trees in the original orchard is increased by 300 per cent.

Land is sometimes economized in a slightly different way, namely, by interplanting with small fruits. The writer has seen gooseberries and currants rather successfully used in this way. They are worth trying. Raspberries and blackberries are also planted occasionally, but their use is attended with considerably greater difficulties. They should be interplanted be-

tween orchard trees only under circumstances of great urgency.

Strawberries are sometimes grown between tree rows, especially for the first two or three years after the orchard is put out. There is no special objection to them. They are not likely to cause any damage to the orchard. At the same time the strawberry plants are very easy to get rid of when the ground is needed for the trees; and, in fact, the diminishing size of the strawberries will very soon lead to their removal. For this reason strawberries are to be considered a safe crop in young orchards.

Elsewhere mention is made of the practice of growing various garden and farm crops between the trees of a young orchard. The fundamental principle is that it is bad management ever to grow any crop which, directly or indirectly, in whatever degree, is a detriment to the trees which are to form the permanent plantation.

Since the prime object of double planting is economy of land, and since, with this object in view, the trees are set unusually close together, it follows that considerable repressive pruning is likely to be needed. Pruning has already been mentioned as one of the means of economizing land; and doubtless the most satisfactory system of orchard management would combine double planting with repressive pruning. The fillers must always be kept headed back to such an extent that they do not interfere with the proper development of the permanent trees, and if this heading back is kept up in such timely and foresighted manner as to keep the fillers fully under control, the time of their removal may be considerably postponed.

In conclusion, the writer feels compelled to say that he would not recommend the practice of double planting to everyone. There are many men—men who would be fairly successful in following some simpler method—who are sure to fail under the difficulties involved in managing two orchards on the same ground. It must be clearly understood, too, that double planting involves a complete readjustment of the entire system of fruit growing, pruning, fertilizing, cultivating and all. Anyone who interplants an orchard and then adheres to the methods of pruning and cultivation suited to the open style of planting is foredoomed to failure. Yet it is such failures as these which have unjustly brought double planting into a certain degree of disrepute.

PREPARATION FOR PLANTING

The nursery tree requires some special preparation immediately before it is put into the ground. This refers, of course, to pruning. Some growers advise that trees be planted first and suitably cut back immediately afterward; but this is certainly not the best practice. It is easier to prune nursery trees with a heavy pair of shears just before they are planted than it is to walk all over a twenty-acre field to prune them after they are set out.

It has usually been accepted as a horticultural axiom that an extensive, symmetrical and well ramified root system is always desirable or even necessary. In recent years this belief has been strongly challenged, especially by the so-called Stringfellow system. Mr. Stringfellow's scheme, succinctly stated, is to cut off all the side roots entirely and to shorten the tap

root to a length of 4 or 5 inches, leaving thus of the whole root system only a single short and naked stub. The top is treated in a similar manner, all branches being removed and the main stem being cut back to a height of 18 inches or less. The trees are thus reduced to something a little more than cuttings.

This theory is so heretical that it has called out a storm of discussion. Now after the storm has subsided we have found, as is usual in such matters, that there is something worth saying on both sides of the question. Many experiments have been made, and it must be said that the results give very little comfort to the extremists on either side of the debate. Mr. Stringfellow himself has recently seemed inclined to retreat from his most advanced position, and the horticultural world in general has been greatly surprised to find how much truth there was in his contentions. From the wealth of observation and experience recently brought into circulation we may fairly draw the following conclusions relative to this whole matter:

1. A large or widely ramified root system is not important except as an indication of the health and vigor of the tree.

2. A good nursery tree with a heavy root system may be very severely cut back without greatly injuring the vitality of the tree or interfering with its first year's growth.

3. The fibrous roots which may be present on the nursery tree are altogether useless. New fibrous roots have to be formed in any case before the tree can feed itself.

4. Extreme stub root pruning is not advisable in any case, though under certain circumstances it may give as good results as any other method.

5. The contention that stub root pruning causes the tree to form a deeper or better root system has not been proved.

6. Severe cutting back of roots and tops appears to be most advantageous with peaches, Japanese plums and pears of the Kieffer type. It is more successful in the South than in the North. It is better on light, warm, not too dry soils than on heavy clay or dry sand.

The judgment of the present writer may be summed up, therefore, by saying that it is best to prune nursery apple trees thoroughly, even severely, just before planting. Not only should all straggling and broken roots be cut off, but all the main roots should be cut back within 3 or 4 inches of the trunk. Such trees are much easier to handle than those differently treated; they can be more rapidly planted, and the work would be more thoroughly done. At the same time the tops will be cut back at the point where the head is to be formed. If the heads have already been formed in the nursery at a height satisfactory to the fruit grower the best plan will be to shorten all branches to stubs of 2 or 3 inches long, taking some pains to see that these are not too thickly placed. If a suitable head has not been formed in the nursery, or if, as is often the case, the head has been formed too high, the entire top should be cut off. Even two-year-old trees can be thus cut back to bare stumps of 12, 18 or 20 inches tall, from which satisfactory growth will be secured the first year after planting in the orchard. This matter is more fully discussed under pruning.

PLANTING OUT THE TREES

To the novice the planting of a tree is something

wonderful. There are mysteries connected with it. He approaches the work with fear and doubting, and with the feeling that failure lies much nearer than success. The old orchardist has learned that it is very difficult to kill a good tree. If anything like reasonable attention is paid to it, it is sure to thrive. Trees seem to grow with a very free will for an experienced tree planter. The inexperience of the novice shows in every movement. He takes much more time and pains in planting his trees than the expert does, though it seems doubtful if he gets any better result. When large orchards are to be planted the expense of setting the trees is a considerable item. The practical orchardist, therefore, economizes at this point, but never in such a way as to lose money by it. In planting a large number of trees economy of time demands an organization of the work and a clear fore-established plan for conducting the operations. The work must be arranged in such a way that it can be done expeditiously and at the same time properly.

Having decided on the scheme of planting to be adopted, there are various ways of carrying out the planting plan. The man who delights in clean, straight rows is apt to take considerable pains in laying off the field. Sometimes a surveyor is employed with his transit to run off the lines. The writer has several times seen this done and has tried it himself, but does not recommend it.

The next most accurate method consists in smoothing the ground thoroughly, and then going over it with a marker hauled by a steady horse and driven by a careful man. In this way the rows may be located with considerable exactness; and if there are small kinks in the line they can easily be straightened out

by the eye as the trees are set. When this system of marking is undertaken the marker should be driven across the field in both directions and the trees located at the intersections of the lines. In small plantings it is feasible to mark in one direction and then to stretch a garden line or rope at right angles to the marks, making the plantings along the garden line.



ORTHODOX METHOD OF TREE PLANTING

This latter method, however, is not suitable to large undertakings.

When the trees are located in this way by the intersection of marks, the exact point at which the trees are to be placed is lost when the hole is dug. It is customary under such circumstances to use a particular contrivance sometimes known as the "planting-jack" for locating the tree. As shown in the illustration, this consists of a lath or small board 5 to 6 feet long, 6 inches wide, and 1 inch thick. This is

notched at either end and in the middle. Before the hole is dug the jack is laid on the surface of the ground with the middle notch resting against the stake where the tree is to be set, the ground having been carefully staked out in advance. Small stakes are then placed in the two end notches. The jack is removed, the middle stake taken out and the hole dug. The jack is then put back into its original position with the two ends fitting upon the end stakes. The tree is then put into the hole with the trunk or collar coming into the notch in the middle of the jack, so that the tree is held exactly where the original stake was taken out. The roots of the tree are then covered, the jack is removed and the planting is complete.

This manipulation is not fast enough, however, for the rushing business methods of modern orchard planting. The plan adopted is more commonly about as follows: After the land is properly prepared for the trees, the rows are measured off on all four sides of each rectangular field. Good, tall stakes are set to sight by. It is best also to set a row of stakes across the middle of the field in each direction, being careful that the stakes are accurately aligned with the corresponding stakes at the four sides. Next a steady team is hitched to a plow—a double mold-board or listing plow is best—and a deep dead-furrow is turned out along each line, in one direction only, across the field. It is often necessary or advisable to run the plow twice or even oftener, in a furrow in order to secure depth. A second time through the furrow usually helps also to straighten out small irregularities. The ground is now marked in one direction and the stakes which are still standing enable a planter with a

quick eye to set a tree in position by sighting in both directions.

The planting gang is now put to work. It should consist of four men. The first man prepares the trees for setting by separating them from the bunches and by pruning them with a pair of sharp pruning shears which he carries in his hip pocket. He then goes ahead of the other three men and drops a tree at each place. The duty of the second man is to hold the tree in position while it is being planted. The third and fourth men carry shovels and fill the soil in about the roots. It is the duty of the third and fourth men also to sight the tree into position. As soon as one tree is planted the second man walks forward to the next tree, picks it up and places it approximately in position. One of the shovelers who has stayed behind for the purpose sights forward down the row to bring the tree into line with the stakes. He motions to the man who holds the tree until the alignment is secured. The other shoveler meanwhile has stepped to one side where he is able to sight down the line in the other direction and in like manner to indicate the cross alignment for the man who holds the tree. As soon as the tree is placed in its proper position the two shovelers begin to fill in about the roots, one from one side of the furrow and the other from the other. Two or three shovelfuls of earth from each shoveler are quite enough in most cases. These are tramped down quickly by the man who holds the tree, and the gang proceeds rapidly to the next point, where the operation is repeated.

After a little practice, planting can be done very rapidly in this way, and very efficiently, too. If the long, spreading roots are all cut off, as already ad-

vised, there need be no delay for spreading out and locating the main roots as the amateur commonly does it. The trees do not need to be very thoroughly covered in, because it is expected that the furrows will be promptly filled by plowing back toward the trees with a steady team. A gang of four men working in this way can readily set 5 to 15 acres of trees a day, depending on the number of trees to an acre, the condition of the soil and other factors. It will surprise the man who has not seen it done, too, to see how well the work is performed and how good an alignment is secured.

When holes are to be dug by hand it is best to use sharp, square-pointed, short-handled spades in hard ground, long-handled spades in medium ground, and long-handled, round-pointed shovels in light, loose or stony ground. Of course different men have their own preferences in this respect, but they will not depart far from the rule here laid down. There are some special devices for digging the holes, usually more or less on the post-auger pattern, but, like patent farm gates, they are of little practical value.

Especial caution ought to be observed when planting is being done to see that the stock is all on hand, that it is in the field where it is to be used, and that it is in proper condition. The stock should be heeled-in on the borders of the field where it is within easy reach of the planting gang.

The use of water poured about each tree in planting is hardly to be recommended. It is impracticable in large operations on account of the bother and expense connected with it and it is doubtful if it does any good. At any rate, if the ground is in good condition this little irrigation will not be needed.

DOUBLE-WORKING

At this point a few words ought to be given to the interesting practice of double-working trees. The fruit grower following this plan plants trees of some healthy, clean-growing variety, but not the variety from which he hopes to gather fruit. When these trees have reached a suitable size they are topworked to the variety which the orchardist really wants to grow.

This second working is usually done by the cleft-graft process, but some men prefer budding upon the smaller branches.

The age at which the trees are reworked may vary. Some growers top-graft the first or second year after planting two-year-old nursery trees in their places in the orchard. The entire top is removed and two scions take its place. Other growers prefer to wait till the stock-variety has formed its principal crotches and then work upon the main limbs. The former method is the more expeditious; the latter secures the advantage of better crotches for weak-growing varieties or for those, like King, which are subject to canker in the crotches.

It is sometimes claimed that this method brings trees into bearing earlier, but it is hard to see how this happens, for it is certain that double-working may delay the time at which trees come into bearing.

Double-working has certain definite and obvious advantages in growing tender, badly formed varieties, or those much subject to defects of tree. Such sorts as Canada Red, Tompkins King and Esopus Spitzenberg, may properly be handled in this manner. A good, strong trunk and frame can be formed by

some thrifty, healthy, comely growing variety, and only the outer shell of the top need be of the fruit-bearing sort.

Another possible advantage of this double-working lies in the opportunity to use selected scions. It is well known that there are striking individual differences among different trees of the same variety. Of two adjoining trees of the same variety in the same row one will give brighter colored fruit than the other; one will bear annually, while the other bears biennially; or one will habitually yield twice as much as its neighbor. It is generally believed that these differences can be reproduced by selecting grafts from the best trees. The fruit grower, therefore, who develops his orchard by the double-working process has the opportunity to choose scions from specially productive trees or from those which bear specially attractive fruit.

The varieties usually chosen for stocks when apple trees are to be reworked in the orchard are Spy, Tolman, Duchess and McMahan. The last two are particularly hardy and are used chiefly at the North where the Russian Hibernial is also sometimes used. Tolman is hard to buy in American nurseries, but is one of the very best for this purpose. Spy makes too large a tree and should be headed very low if it is to be reworked, as double-working has a tendency to make higher headed trees. Ben Davis is sometimes used, and has at least the advantage of being always purchasable.

VI

ORCHARD CULTIVATION

THERE was a time, within the memory of even young men, when the advisability of cultivating orchards was held to be a debatable question. The development of the modern commercial orchard, however, has set the argument at rest. The man who is growing fruit on a large scale for the money there is in it cannot carry on the business without cultivation. Where the orchard is a mere incident in a system of mixed farming it may often be most convenient and satisfactory to have it in grass, or to depend on pigs or poultry for the cultivation of the soil; but this is not really fruit growing, and is not to be regarded as an exception. It may still be possible under very unusual conditions that certain orchards will thrive as well without cultivation as with it. The cases are still more frequent in which small tracts of land may be wisely planted to apple trees, though the ground is too rough and stony to admit of cultivation. It is certain, however, that, as a business proposition, the man who would select such a tract for a commercial apple orchard would deliberately place himself at a serious disadvantage in his competition with the men who plant their orchards on good tillable soil, and who follow the best practices of modern tillage in the management of their trees.

In recent years there has been a good deal of discussion of the "Hitchings method," advocated by a few eminent horticulturists, especially by Mr. Grant

Hitchings of New York state. This method consists in seeding the orchard down to clover and grasses, in mowing this herbage several times each summer and leaving it mulched around the trees. Mr. Hitchings himself claims the following advantages for his method:

1. Less cost of maintenance.
2. Earlier, better colored fruit.
3. Better keeping qualities.
4. Wood matures better and earlier.
5. The trees can be headed lower.
6. The sod mulch favors bacterial action.
7. Leaves more time for other work.
8. Prevents deep freezing of the soil.
9. Easier driving through orchard for spraying, etc.
10. Soil improves each year.

Some of these claims are unquestionably well founded; others are fanciful. Some of the strongest of these claims are fully offset by other advantages belonging to the more orthodox methods of cultivation. These advantages will be explained more fully in the following paragraphs.

One of the most serious practical objections to the Hitchings system is that very few men will carry it out properly. When not fully carried out it is dangerous and bad; whereas almost any sort of tillage is beneficial, and only in the most exceptional cases can tillage be harmful.

Thus we may lay it down as a rule, subject to minor exceptions only, that the commercial orchard is always to be cultivated. We are concerned, then, simply with the objects, the methods and the means of culture.

OBJECTS OF CULTIVATION

The purposes served by the cultivation of the soil are several. Sometimes one is more important than another, but the killing of weeds—long regarded by farmers as the only motive for cultivation—is certainly of the very least importance. The principal objects are as follows:

1. To improve the physical condition of the soil.



IDEAL TILLAGE

The soil is broken up, made finer, thus allowing the roots to ramify farther and deeper through it, and also making it hold moisture better. If cultivation is deep, as in general it should be, it brings new layers of soil into use, unlocking stores of plant food previously inaccessible and increasing the water storage capacity of the soil. It is possible thus, by deeper cultivation, for a man to double the amount of his

farm land without buying another acre. The best farmers recommend a gradual deepening of cultivation, say at the rate of $\frac{1}{2}$ inch to 1 inch each year, down to the lowest practicable depth. Just what the lowest practicable depth may be will vary greatly, of course, in different cases; it has been determined only in a very few instances anywhere in this country. It is safe to say that a farmer should use his fields to a depth of something more than a foot, no matter what the soil formation, and that in favorable soils he should go down to a depth of 16 to 18 inches, or even to 2 feet.

Deep cultivation seems, at first thought, to be impracticable in an orchard. This matter will be discussed in a subsequent paragraph; but just here it should be remarked that no crop works deeper than fruit trees. They require a soil, therefore, opened to the lowest practicable depth. The deepening of the soil for crops of fruit trees is largely a matter of preparation before planting, but it is a matter, too, which cannot be forgotten whenever the subsequent cultivation is talked of.

2. Cultivation promotes drainage. A good farming soil should be in such a condition that it will dispose of any ordinary rain without allowing any of it to pass off as surface drainage. Surface drainage on plowed fields is wasteful and dangerous. It is wasteful because it means just so much water lost, much of which might have been saved for the use of the crop. It is dangerous because it washes away the best soil and much of the fertilizer. It carries away the farmer's capital and his stock in process of manufacture.

A loose, well-cultivated, thoroughly pulverized soil acts like a sponge: it takes up the water as fast as it falls. A hard, uncultivated soil acts like a block of wood: it grows damp if left out in the rain, but requires more than ordinary means to squeeze any water out of it after the shower is over.

If the field is supplied with underdrains, as perhaps in most cases it should be, the spongy, well-cultivated soil protects them from flowing while the rain is falling, and gives up to them the excess of water more slowly afterward. The rains are thus made to do better service.

3. Cultivation releases new plant food in the soil. Any good agricultural soil gives up its store of plant food very slowly. The so-called exhausted soils in many fields still contain food enough to grow good crops for hundreds of years, only it is not available. There is enough plant food in the broken stone ballast on a mile of good railroad track to grow a luxuriant row of apple trees and to ripen abundant crops for a century. But, aside from other inconveniences, the principal drawback to the railroad ballast as a medium for growing apple trees is that it lacks pulverization. In every way cultivation feeds the plants by making available more of the chemical elements naturally in the soil.

4. Cultivation helps the crop to appropriate any fertilizer which may be used. The frequent stirring of the soil brings new particles of fertilizer into contact with the air and with the rootlets of the trees. The air and the root acids break up these particles of plant food so they may be absorbed for the nourishment of the tree.

5. Cultivation conserves moisture. We have already seen that deep cultivation enables the soil to absorb and retain great quantities of moisture which would otherwise rapidly drain away. Shallow cultivation helps very greatly to hold this moisture after it is caught. One of the greatest sources of loss of moisture is evaporation from the surface of the ground. If the soil is uncultivated it soon hardens—a fact which everyone has observed repeatedly. The hard surface layers are then filled with thousands of little capillary passages through which the water is quickly pumped up to the surface, thence to be evaporated into the air. When cultivation is practiced these capillary tubes are broken up, the movement of water to the surface is prevented, and the wasteful discharge of water from the soil into the atmosphere is greatly mitigated. The fine, loose soil left on the surface by proper cultivation acts as a mulch, preventing the evaporation of water from below. Everyone knows how a mulch acts on the soil. The preservation of this soil mulch, or dust blanket, as it is sometimes called, has now come to be recognized as one of the best established and most useful of agricultural practices.

6. Finally, cultivation kills weeds. Weeds steal moisture and plant food, and, therefore, ought to be killed. But the good farmer or fruit grower has very little quarrel with the weeds. He kills them incidentally while he cultivates for more important purposes.

METHODS OF CULTIVATION

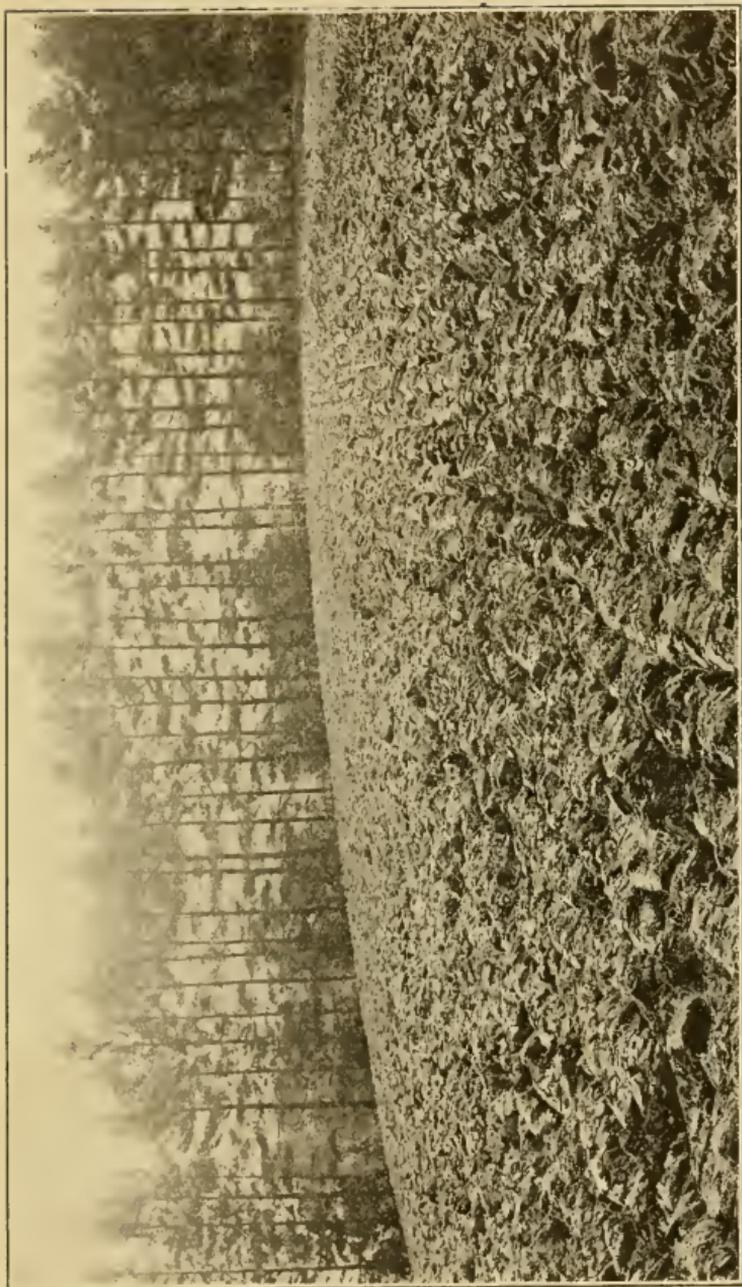
The fruit growers of this country are almost unanimously agreed as to what constitutes the best routine

of cultivation for an orchard. We have, therefore, what may properly be called a system of culture. The system may prove to be wrong, and it may be greatly improved in the future; but for the present we may confidently follow it as the best working outline at hand.

Preparatory Cultivation—In the first place it is very generally agreed that a field should be brought into the best possible state of cultivation before it is planted out to fruit trees. There are still to be found occasional cranks who preach that fruit trees should be set out in sod. Mr. Stringfellow of Texas, who may be called a crank without offense, has recently advised the setting of orchards in sod, using a crowbar as the only tool, and cutting off all the roots of the young trees to make them fit the crowbar hole. Still more recently, however, after trying this method on a large scale, he has reported that it was not successful.

The preparatory cultivation of a field destined for fruit trees should be clean and thorough, because otherwise it is difficult to give clear and thorough cultivation after the trees are set out. If the ground is full of sassafras, hackmatack, poison ivy, blackberry briars or perennial grasses it is much easier to get rid of them before the trees are planted than after.

This preparatory cultivation should be not only clean and thorough, but it should be deep. The ground should be loosened up as deeply as plowing will do it. Or, some soils the use of a good subsoil plow, run down to a depth of twenty to twenty-six inches, is particularly indicated. Soils which are too loose, and are subject to leaching, may come in here among the exceptions.



GOOD FALL PLOWING—THE RIGHT BEGINNING

Tile drainage of land appropriated to apple trees has been shown to be practicable and altogether advisable in all those soils, of which there are many, which benefit by underdrainage for other crops. In fact, in any case of doubt, one would adopt tile drainage for land to be planted to apple trees rather than though the same land were to be given to almost any other crop. This is first because the trees are to occupy the land for a long time, and second because the total investment in an apple orchard (and the total income) are apt to be larger than with most other crops.

When spring planting of the trees has been decided on it is usually best to plow the land the fall before, leaving it as rough and ridgy as is consistent with good plowing. The largest possible mass of soil is, in this way, exposed to the freezing and thawing winter weather. The lumps are broken up by this intermittent action of the frost, and the whole upper soil is disintegrated and pulverized.

In the spring, before planting, the ground may then be reworked, either by plowing again or by going over it with a disk harrow, spading harrow, or some similar implement, depending on the nature and condition of the soil.

When fall planting is practiced there is somewhat greater difficulty in getting the ground into condition. Perhaps the ideal way is to summer fallow the fields destined to fall planting with fruit trees. In such cases the ground should be subsoiled, or at least very deeply plowed in spring, and the surface cultivation during the summer should be frequent and thorough. Otherwise the soil is apt to dry out and bake. It is highly important, especially in fall planting, that trees should be set in loose, friable, moist earth; and the soil is put

into the most desirable condition only by careful preparatory cultivation.

In cases where summer fallowing is not deemed best the ground should at least be given to some light crop which comes off rather early and which may be cultivated frequently during the summer. Potatoes, beets, onions, cabbages, beans, cowpeas, and similar crops should be given first consideration. Or, it is equally good practice to sow cowpeas, beans, vetch or some similar leguminous crop early in the spring and plow it under just before the time when the trees are to be set.

Treatment after Planting—The management of the soil in an orchard during the first few years after planting naturally differs more or less from the management given an old bearing orchard. The treatment which the trees receive at this time determines their future usefulness to a very great degree. One of the most important considerations in securing a profitable commercial orchard is to see that the young trees are kept growing just as vigorously as possible and absolutely without interruption from the very first. A tree which is stunted from any cause, which stops growing for a time on any account, might as well be abandoned at once. It is therefore a matter of practical necessity that an orchard should receive thorough cultivation during the years of its beginning according to some well-matured and judicious plan.

The plan of cultivation that receives sanction of the best experience of the day, and that also accords best with modern theories of soil physics and chemistry, is about as follows. The ground is plowed deeply and thoroughly as early in spring as possible without damage to the texture of the soil; that is, as soon as it is

thoroughly dry. The amount of sand in the soil will largely determine this point, which, since it is all a matter of local experience and of judgment, cannot be more accurately specified in print.

When we speak of deep plowing in an orchard after the planting of the trees we call up another common objection to this system of cultivation. It is sometimes said that deep plowing is impossible or impracticable in an orchard because it cuts off the roots of the trees. It is true that if one attempts to send down the plow to a depth of twelve or even eight inches in an orchard which has never been cultivated, he will meet with some difficulties in the shape of large roots. The cutting of these roots will entail a large amount of hard work and may weaken the trees. On the other hand it may not hurt the trees. It is altogether unsafe to assume that any real damage is done even in cases where large roots are broken in plowing.

But the objection fades away utterly in the case of orchards which are deeply plowed from the beginning. Under this treatment large roots are never formed near the surface. They all grow below the reach of the customary plowing. All possible damage of this sort is thereby prevented, and the tree is better for being deep rooted.

After the deep, early spring plowing the ground should be frequently and thoroughly stirred on the surface. Frequent surface cultivation saves moisture and keeps the weeds from getting a start. This scarification of the surface should be repeated once a week, or, in case of insufficient rainfall, twice a week. It is a good plan also to break up the surface after every rain or heavy shower just as soon as the cultivator or the harrow can be safely put on the ground.

If no other crops are to be grown in the spaces between the tree, this sort of cultivation can be kept up till about midsummer. Cultivation in general should slacken and stop simultaneously as the growth of the trees slackens and stops. When cultivation ends for the summer the ground should be sown to some cover crop, as explained elsewhere.

In many orchards, especially in those which are not double planted (see page 27), it is feasible to grow some catch crop between the rows of young trees, at least during the first few years. Some men think it is never best thus to crop a young orchard, but with proper care and liberal feeding, there can be no damage to the trees from the presence of catch crops of the proper sort.

Strawberries make a very satisfactory crop for the spaces between orchard rows, but they cannot be grown very successfully after the trees become large enough to cast an appreciable shade. Annual garden crops are usually best for this purpose, partly because they are usually well cultivated, partly because they tempt the manager to liberal fertilizing, and partly because cultivation ends for them at the same time when it would properly end for the trees. Early beets, early carrots, early turnips, radishes, peas and beans are the best. Early corn is advised sometimes, but is not quite so good. Late vegetables should be avoided because they require late cultivation.

Grain crops of all sorts, such as grow without cultivation should be absolutely prohibited, except that rye, barley and oats may possibly be used to some extent as cover crops. In that case, however, the grain is not harvested, and even under these circumstances

these cereals are seldom the best crops that can be sown.

Cultivation of Bearing Orchards—When the trees have attained approximately their full dimensions the problem is changed somewhat. No catch crops can be grown between the trees, and perhaps even the temporary trees, or fillers, in double-planted orchards have to be removed. Possibly the trees shade the ground so completely that no weeds can grow, although that will hardly be the case in any well-managed plantation. Under such circumstances the fruit grower is apt to feel that cultivation is hardly necessary any longer.

When we consider the fundamental objects of tillage, however, it will be seen that the requirements of the full-grown, mature, bearing orchard are the same as those of the young orchard. Plant food is still being used in quantities as great as ever, perhaps greater; and to unlock the stores of plant food in the soil requires continual cultivation. The physical condition of the soil is as important now as it ever was, and a good physical texture is preserved chiefly by the stirring of the soil in cultivation. No, it is a great mistake to suppose that when an orchard is fully grown it no longer needs the cultivator, or that it needs cultivation less than formerly. The work must still go on.

It is more difficult, of course, to plow and harrow an old orchard than a young one. But it is less trouble than is commonly supposed. If cultivation has been frequent and deep from the very first there will be no large roots to catch the plowshare or cultivator teeth. As for the large branches which heavy bearing has borne down to the ground, they are a difficulty, but not a positive bar to further work. Suitable tools,

proper harness, steady horses, and, above all, some experience on the part of the workman, will make a very satisfactory cultivation possible at no serious expense.

Those who have not tested it are apt to think that close planting and low heading of orchard trees, both of which are recommended in this book, will interfere seriously with the operations of plow, cultivator and harrow. Where proper heading of the trees, proper pruning and proper cultivation, go forward together from the establishment of the plantation no difficulty whatever arises. The failures with this system of combined close planting, low heading and frequent cultivation come from improper adjustment of one part of the system to the other parts, or they come oftener still from a slack enforcement of the system. This method of fruit growing is not adapted to careless handling. It is in many respects a forced system—a high-pressure system. If the manager relaxes the pressure temporarily, if he lets go for a time at any point, he loses control, and the whole machinery is thrown out of order. If pruning is neglected for a year or two the trees get too big and sprawling. If cultivation is stopped for a time the roots occupy the soil and get in the way of future plowings. The whole scheme must be thoroughly understood and conscientiously practiced from the start. Then it succeeds admirably.

The cultural methods suited to young orchards may be applied, with obvious modifications, to old orchards, providing, as explained above, the old orchard has been properly brought up on the same general system. The soil should be plowed in early spring as soon as it can be properly done. Deep digging with a spading harrow may be substituted for plowing in many cases.

Then light surface tillage follows at frequent intervals during the first half of the summer; and some time from the middle of June to the first of August a cover crop is sown.

VII

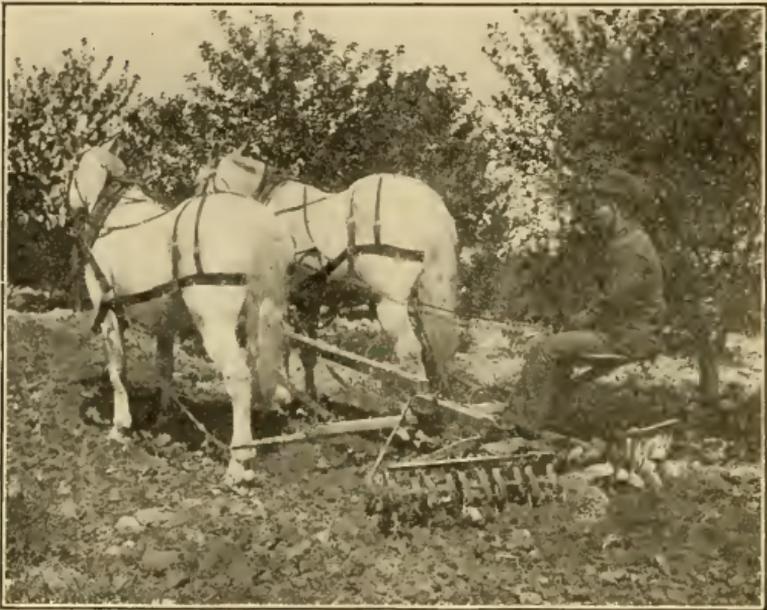
METHODS OF CULTIVATION

It is difficult to speak in any general way of the tools used in orchard cultivation. They vary greatly from year to year and in different localities. There are several distinct types in use, however, and these may be briefly described.

Plows—The ordinary turning plows are commonly employed in the cultivation of tree plantations. Usually the lighter forms are desirable, since very deep and heavy plowing is impracticable. The plain, iron beam, chilled steel plow best suits the taste of the writer. For working up very close to trees a small one-horse plow is desirable; and if this has a set-over beam—a form which can be had in the market—it is all the better. Double or triple gangs of plows are sometimes used in orchards, but they can hardly be employed advantageously except where there is more space between the rows than there ought to be.

In an earlier paragraph we have spoken of subsoil plows for preparing ground for planting. These may be used also occasionally along the middle of the orchard interspaces while the trees are young and the roots are reaching out for new feeding grounds. Subsoil plows are not very popular, and are seldom seen at the implement stores. They can always be had on order, however. The very simplest forms are best. Rigidity and strength are the requirements in a subsoil plow.

Harrows—Spading, cut-away or disk harrows are now deservedly popular among fruit growers. These all have the same general form. They differ chiefly in the character of the disks. In the original cutaway harrows simple concave disks are used. In the more recent spading harrows these disks are cut into several



THE CUTAWAY IN THE ORCHARD

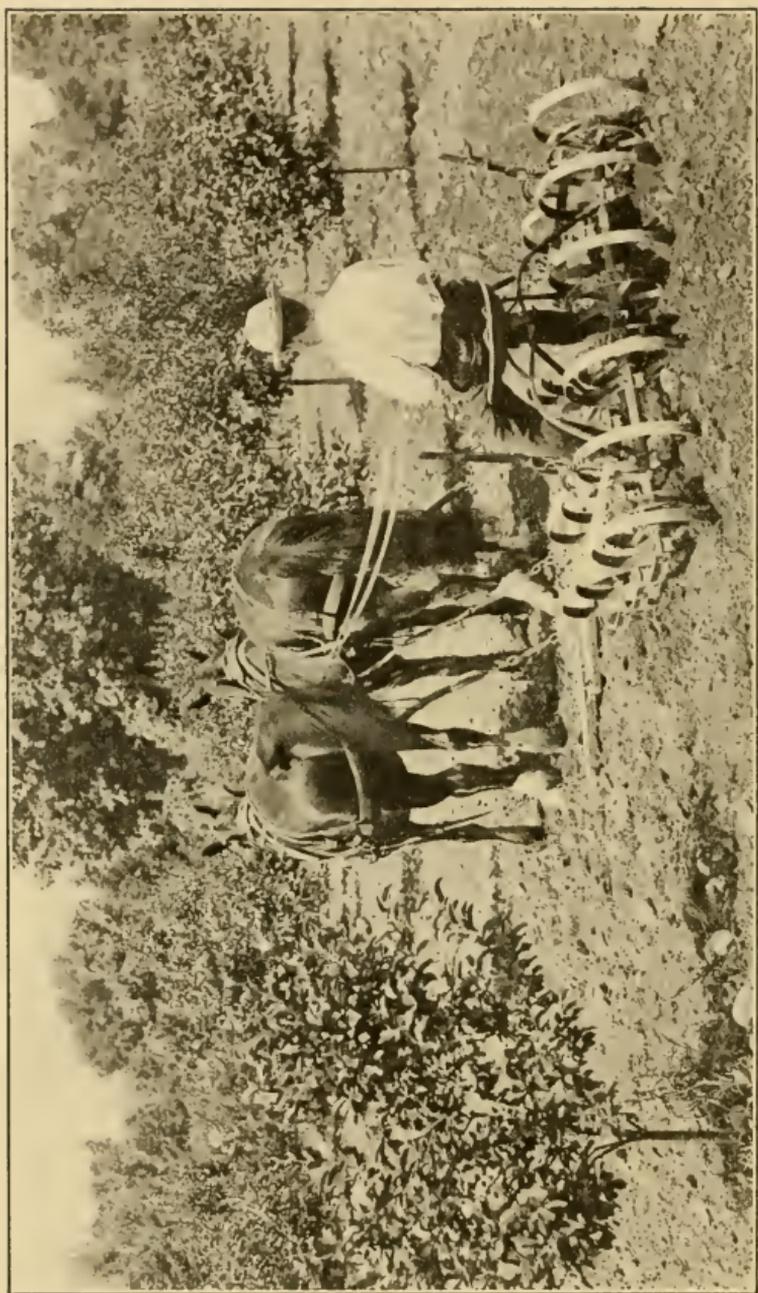
sections, each section acting like an independent spade as the disk rolls on its way. This latter form gives much better results on hard soil. It is adapted to deeper and more thorough working of the ground. For light surface tillage, such as is most desirable in preserving the dust mulch for the conservation of moisture, the plain disks are doubtless better.

The best form of disk, cut-away or spading harrow for orchard use has the two sections arranged in such a way that they may be set out a considerable distance from the central line of the machine. They are enabled in this way to run far up under trees where horses cannot be driven. This adjustment is of the greatest convenience.

The Acme type of harrow is excellent for surface cultivation, especially in good, friable, clean soil. This harrow is made also with the extension frame, so that the two halves may be set out like wings to run up under the orchard trees. On very stony, hard or trashy land this tool does not work so well, but on the ideal orchard land it is about as good a surface harrow as has yet been invented. It is especially adapted for breaking up the surface after dashing rains, and for preserving the necessary dust mulch during dry weather.

The spring-tooth harrow is an excellent tool on rough stony land. On very trashy ground it clogs badly, and on wet land it does not do the best work. On clean, light, friable soil, better results can usually be secured, either with a disk harrow, an acme harrow, or a common smoothing harrow. The spring-tooth harrow is therefore a special tool for special cases, but does not have such a wide range of usefulness as some other instruments of tillage. The writer, from acquaintance among farmers, is led to believe that the spring-tooth harrow is used oftener than its merits warrant, especially in New England. In many cases some other cultivator could be used to advantage.

Smoothing harrows of the ordinary sort, set with teeth, are indispensable in orchard cultivation. The best forms are arranged so that the slant of the teeth



THE SPRING-TOOTH HARROW FOR ORCHARD WORK

can be easily varied. For very light smoothing on well-prepared ground the teeth are set so as to slant backward at a considerable angle. As the teeth are set more and more nearly straight up and down they cut deeper and deeper into the soil; so that, in loose ground, they can be made to do a good deal of digging.



THE GRAPE HOE FOR CLOSE CULTIVATION

These smoothing harrows are also often made nowadays with extension wings for running up under the orchard trees. Such a harrow, adjusted in this way, is one of the best implements known for surface cultivation on most soils during the summer. It fails only on very hard, very stony or very trashy land.

Other cultivators, such as those of the Planet Junior type, are sometimes used in fruit plantations. The

common corn cultivators used so generally in the western states are not infrequently seen in orchards. In the cotton and tobacco growing regions it is not unnatural that cotton and tobacco tools should find their way more or less into orchard use. All these implements are merely makeshifts when brought into tree plantations. Especially when fruit growing is conducted on a large scale one cannot afford to carry it on with tools designed primarily for other purposes. The selection of the best tools for orchard cultivation in different soils is not the easiest problem in the world, but it is a most important factor in successful orchard management, and one to which the fruit grower must give careful and constant attention.

VIII

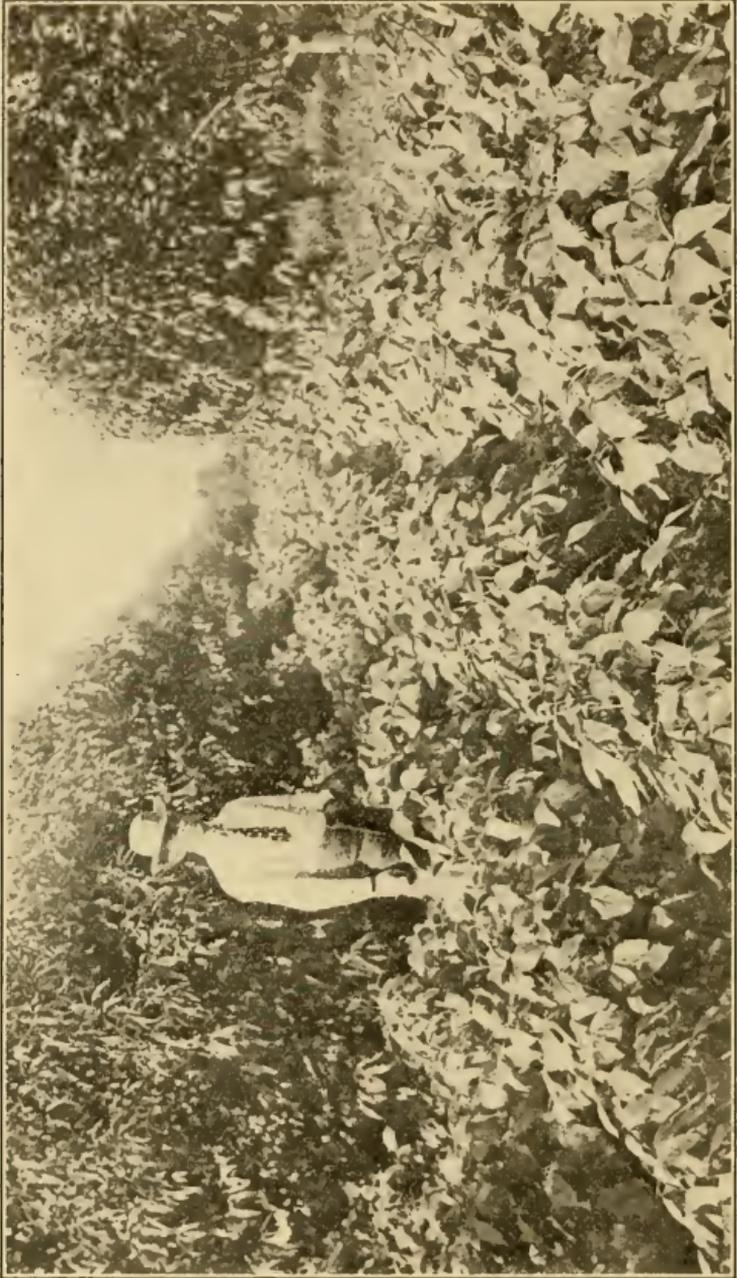
COVER CROPS

IN discussing tillage we have several times spoken of cover crops. The cover crop is nowadays considered to be an important—in fact, almost an essential—item in a proper system of orchard management.

The term cover crop stands for any sort of annual crop sown among fruit trees during the summer and plowed under the following spring. It is grown solely for the benefit of the land and the trees. In this respect it differs from what is often called a "catch crop," such as potatoes or corn, often grown between orchard rows. The catch crop is grown and harvested for itself, and though it may prove a real benefit to the land, this is not its sole or prime end.

A cover crop performs various valuable services. Those especially worthy of notice are the following:

1. The cover crop helps to check the growth of the trees in late summer, thus preventing late growth, and encouraging the early maturity of the wood. In regions where winterkilling is serious this service becomes important. It should be remembered, however, that apple trees carrying heavy crops of fruit seldom need anything more to check their growth; and as this check is applied by taking a certain amount of water from the soil, and as the trees will sometimes need this water in maturing a heavy crop of fruit, the cover crop may become



COVER CROP OF SOY BEANS

a detriment at times. Considerable judgment should be exercised with regard to this point.

2. Cover crops which grow late in the autumn, especially those like hairy vetch, which live over winter, save considerable amounts of fertility from leaching away. Soluble plant food in porous soils is quite apt to drain away during late fall and early spring when the tree roots are not actively foraging for it. Such plant food is caught by the cover crop, and when plowed under and rotted, becomes available for the trees. Cover crops, like buckwheat, which die early in the year, evidently are less useful in this way.

3. A good cover crop prevents washing of the land in winter and early spring. On loose sloping lands serious damage often occurs from erosion; and this is one of the strongest facts in favor of growing grass in orchards. However, the benefits of tillage can be combined with this advantage of grass management, to a great extent at least, by sowing a suitable cover crop. For this purpose the vetches are good, the hairy or winter vetch especially so.

4. The cover crop adds humus to the soil. The greatest drawback to a system of constant tillage in an orchard is that it exhausts the supply of humus in the soil. On light, warm soils this exhaustion comes early; it is apt to be very complete and very detrimental to the trees. On heavier soils the humus supply will last longer, but its final depletion is likely to be even more disastrous. The supply of humus may be kept up by the application of barnyard manure; but the cover crop offers a cheaper and a better way of doing the same thing.

5. Leguminous cover crops (that is, those belonging to the pea family of plants) add nitrogen to the soil.

These plants, such as vetch, cowpea and the clovers, collect more or less nitrogen from the atmosphere. When the crops are plowed under and decomposed this nitrogen becomes available for the trees. As nitrogen is the most expensive element of plant food, this source of supply is always welcome. While the quantity of atmospheric nitrogen available from cover crops has probably been greatly exaggerated in some estimates, it is still sufficient in many cases to supply the entire needs of the orchard. With a good annual growth of cowpeas, soy beans or vetch, apple trees will need no further allowance of nitrogen.

METHODS OF MANAGEMENT

The usual method of handling a cover crop is to sow the seed broadcast at the last cultivation of the soil. Usually this comes during the first two weeks of July. Later sowing may prove successful in southern states, where a long growing season may be depended on. In northern districts where frost comes early somewhat earlier sowing of the cover crop is desirable.

Indeed, this desirability of earlier sowing has suggested a modification of the common procedure as outlined above. This consists in sowing the cover crop considerably earlier, usually the middle of June, but possibly even earlier than that. The cover crop is then put in with a drill, the drills being 18 inches to 2 feet apart. The crop is then cultivated once, twice or three times, by running a light cultivator between the drills. Thus the season of cultivation is made to overlap the growing season of the cover crop. An additional and highly important advantage lies in the fact that this method insures a quicker, even and

stronger germination and growth of the cover crop, which is apt to be slow and uncertain by reason of summer drought when the crop is sown broadcast.

This method is particularly adapted to districts having a short growing season, and to coarse cover crops, such as cowpeas, soy beans, etc. It has been successfully used by the writer for some years.

The cover crop should always be allowed to remain on the ground over winter, and should be thoroughly plowed under at the first spring plowing. Occasionally some difficulty will be experienced in turning under the cover, but any such difficulty can be met and overcome by any good, practical farmer.

THE VARIOUS CROPS

We will now consider the main characteristics of the most popular cover crops.

The clovers all make good cover crops and are largely used on soils where clover makes a good stand. On many soils it is hard to get a good catch of clover, particularly at midsummer when the weather is dry, as it is apt to be at cover-crop time. Mammoth clover is probably the best of its genus for the purpose in hand. Common red clover may be successfully used, but it makes less growth than Mammoth clover. Crimson clover is an excellent cover crop in some localities, while in others it does not succeed at all. It seems to be especially adapted to the improvement of impoverished sandy soils. Alsike clover makes a fairly good cover crop, but is seldom to be recommended in preference to Mammoth or Crimson clover. Alfalfa is also used at times.



GANG PLOW TURNING UNDER A CLOVER COVER CROP

Cowpeas form the best possible cover crop in southern latitudes, more especially on light soils. They serve excellently in the improvement of run-down soils. As they require a rather long growing season, they cannot be profitably used north of a certain latitude. This limit seems to run a little north of New York city at the east and Omaha at the west.

Soy beans are by no means so well known as cowpeas, and are perhaps not adapted to so wide a latitude of country, but in northern states they very successfully take the place filled by the cowpea farther southward. They are especially satisfactory when grown by the drill and cultivator method recommended above. The early maturing varieties of soy beans are to be preferred for northern localities.

Other kinds of beans sometimes make excellent cover crops. The common white pea bean does very well, indeed. Mr. W. T. Macoun of the Central Experimental Farm, Ottawa, Canada, has had first-rate results from the use of the English broad bean.

The vetches are in some respects an ideal cover crop. They form a close mass of herbage which kills out weeds and holds the soil. They accumulate remarkable quantities of nitrogen. The winter vetch lives through even hard freezing weather and makes a quick growth in the spring. In fact early plowing is necessary to eradicate it. Its greatest drawback is the high price of the seed, which at about \$7 a bushel is too expensive for practical use. The summer vetch costs considerably less, yet it makes a fine cover crop either drilled or sown broadcast.

Common field peas ("Canada peas") make a good cover crop, more especially if sown with barley. The barley supplies a support on which the peas climb.

Buckwheat is by far the best of all the non-leguminous cover crops, and is worthy of consideration under any circumstances. It is best suited to northern and northeastern states. Its great advantage lies in the fact that it will germinate and give a good strong cover no matter how late it may be sown. It also leaves the land in good physical condition, which is a matter of large importance.

Rye, barley and oats are occasionally used separately as cover crops, but are not to be recommended. Rye may be used as a last resort, but oats should never be sown among fruit trees.

The following table shows the usual

QUANTITY OF SEED PER ACRE

Mammoth clover, pounds.....	12
Common red clover, pounds.....	12
Crimson clover, pounds.....	15
Alsike clover, pounds.....	12
Alfalfa, pounds	20
Cowpea, bushels	1½-2
Soy bean, bushels.....	1½-2
Broad English bean, bushels.....	1-1½
Summer vetch, bushels.....	1½
Winter vetch, bushel.....	1
Canada pea, bushels.....	1½
Buckwheat, bushel	1
Rye, bushels	1½
Barley, bushels	1½-2
Barley and peas, bushel, each.....	1

IX

PRUNING

PRUNING is unquestionably one of the most important practices in horticulture and this importance has always been recognized. Yet it must be confessed that our knowledge of pruning is highly inadequate to our needs. The progress made during recent years in other forms of pomological practice, as in tillage and spraying, has no parallel in pruning. In this very influential matter we are hardly better off than our grandfathers were.

Pruning practice is exceedingly diverse, even among successful horticulturists. Some prune in winter, some in spring, some in midsummer. Some do not prune at all, others cut back their trees without mercy. Some grow their trees with tall trunks; others head them down to the ground. In this state of knowledge and practice it is manifestly dangerous to lay down stringent rules for the guidance of the novice.

These bewildering differences of method come to light immediately when we begin to discuss the preparation of the nursery tree for planting. On the one hand Mr. Stringfellow advocates cutting away nearly the whole tree, root and top. On the other hand old-fashioned gentlemen leave everything intact, using the knife only to smooth broken roots or branches. And the confusing fact is that both methods succeed. This matter is discussed in its proper application, page 38.

The next problem in order is that of forming the head of the orchard tree, and here we have another

division of opinion and practice as to whether trees should be formed with tall trunks or short ones.

HIGH HEADS VERSUS LOW HEADS

The argument has long been maintained as to whether fruit trees should be formed with high heads or with low heads. The same division of opinion exists with respect to the training of all kinds of fruit trees, but it is most often discussed in connection with apple orchards. It is one of the questions which will never be settled, because men's ideas necessarily differ. In fact, what seems a low head to one man will seem high to another.



A HIGH-HEADED TREE

Anyone who has followed this matter for a number of years will be struck by the fact that the general horticultural opinion has undergone a great change in recent years. This change is marked and unquestionable. It has been a change favorable to lower heads. Men who formerly advocated high heading now recommend something considerably lower. This fact is all the more striking and significant because the

change has been coincident with a similar change in policy favorable to the cultivation of orchards. One of the old arguments against low-headed trees was that the low heads interfered with cultivation. The simple fact now is that cultivation is more common than it used to be, and a great deal more thorough, while at the same time modern orchards are trained with much shorter trunks than those of a decade ago. Indeed the most ardent advocates of low-headed trees are, in the majority of cases, the very men who also practice the most thorough systems of cultivation.

Low heads undoubtedly have many advantages. The trees are stronger and less likely to blow over. This is most conspicuously the case during the first few years of growth. A young tree with a bushy top on a trunk 8 feet long is peculiarly vulnerable to wind and ice storms. It is also



SUTTON BEAUTY
Headed too high

subject to many other attacks from which the low-headed tree is comparatively safe. Sun-scald is always much worse on long trunks than on short ones. In fact, nearly all the disorders to which

tree trunks are liable, such as attacks of borers, frost cracks, etc., are more frequent on long trunks than on short ones.

It is much easier to pick fruit from a low tree than from a tall one. The expense of operating such an orchard is less. This difference is proportionately greater with peach trees, plums and other small trees than with apples. Nevertheless it amounts to something even in the case of old apple orchards. Low-headed trees are much easier to spray. It is almost laughable to see some of the high tower sprayers used in old orchards. There are apple trees doing business in this part of the country which are tall enough for forest trees. Such apple trees are always objectionable. There are many ways of preventing the formation of such high heads, and a shortening of the trunk is only one of them. In fact it is perhaps a minor means when considered in the long run, but it is a method which should not be overlooked.

Without saying, therefore, whether trees should be headed 2 feet from the ground or 8, we may lay it down as a general principle, strongly supported by the best modern experience, and exemplified in the best modern practice, that low-headed trees are to be preferred to high heads.

THE FRAMEWORK

The most critical work in pruning is that connected with the formation of the head during the first three years of growth in the orchard. It is everywhere known to be important that the formation of weak crotches should be avoided, but just how this is to be done is by no means so clear. Some varieties, as King

and Winesap, have a tendency to make weak crotches; while others, as Tolman and McMahon, always form strong, clean forks. The fruit grower, by careful and timely attention during the first two years, can secure the formation of branches practically where he wants them. Such attention is most timely during the early summer months—May and June—when shoots undesirably placed can be quickly rubbed out with the gloved hand. The following spring a very little going over with the pruning shears will complete the work, leaving a few vigorous well-grown symmetrically placed branches where naturally there would have been a lot of crowded, weak, half-choked shoots.

The question is sometimes discussed whether there should be three, four or five branches reserved to form the framework of the tree. It is largely a matter of taste. The present writer prefers four or five; but different varieties should be treated differently. Spy naturally forms many main branches, King and Pumpkin Sweet much fewer. Whatever the number decided on, the sooner the competing shoots are taken out the better. We have already said that it is best to rub them out in May or June, when they are first starting.

THE SECOND STAGE

The framework of the tree having been designed, the work of pruning enters upon its second stage. The chief question now is that of the ultimate size which the fruit grower desires to develop in his tree. There are two general and quite different lines of practice in this matter. The common and certainly the simpler method is to let the tree have its own sweet way. Each tree is allowed to grow and extend its top as far as its

nature and the food supply will carry it. The opposite method assumes that the natural spread of the top can be profitably restricted by proper pruning. Necessarily this second method comes into practice along with close planting and other intensive measures adopted by the unterrified progressives. It should never be undertaken except by those who know just what they are trying to do, who are determined to keep steadily to their ideals, and who have sufficient reason for adopting the riskier and more laborious method.

If the tree is to be allowed its natural and unrestricted development, then the second stage of its life—from the formation of the head to its maturity—is comparatively uneventful. There is no pruning to be done except to keep the head open. On the other hand if the method of repressive pruning is to be adopted this second stage becomes the most critical of all. Heading back must be systematically practiced from the beginning. It should never be remitted for a year on any account.

While it is manifestly impossible to reduce this method of pruning to exact rules, the following program, practiced with intelligence and good judgment, will give good results. It has been carefully tested by the writer.

1. In the beginning be sure of the purpose and method. Unless close planting has been adopted, close pruning will not be necessary, nor advisable. Unless reasonably intelligent labor can be commanded the work is greatly handicapped.

2. Pay strict attention the first year to the formation of the framework. This should consist of four strong branches, symmetrically placed, no two leaving the trunk at the same height from the ground. If

these main branches make a growth of more than 3 feet the first year they may be bent back, without breaking or cutting them, the middle of July. This bending will check the growth somewhat and will cause these shoots to lay on a greater proportion of growth near the base. It is specially understood that these main shoots are to be formed near the ground—the first one 6 to 18 inches from the ground—it being not worth while to practice close pruning on high-headed trees.

3. The second spring the four main branches should be severely cut back. This cutting will be done at a distance of 12 to 24 inches from the main stem, 18 to 20 inches being preferred.

4. During the second summer two secondary branches should be allowed to form on each of these primary branches, all others being rubbed out as soon as they start. This is most quickly, easily and economically accomplished by rubbing with the hand protected by a glove. A light pair of pruning shears will do the work. On good soil these secondary branches may easily make a growth of 4 to 6 feet, in which case they should be bent back in mid-July as advised for the first summer.

5. In February or March of the third year the secondary branches should be headed back, leaving the stubs 18 to 20 inches long.

6. During the third summer one, two or three tertiary branches, normally two, will be formed on each secondary branch. Summer pruning will still be followed in order to insure the development of these tertiary branches by rubbing or clipping out all other shoots as soon as they start. These third-year shoots which are left may make such a strong growth that

bending down in midsummer will be again advisable, though after the third year this practice should usually be abandoned.

7. Each succeeding winter or spring the annual growth of the previous year will be cut back from one-third to two-thirds its entire length, and this practice will be followed indefinitely. Under proper management, however, a part or all of this heading-in may profitably be transferred to the summer season, being given some time in July. The exact time and extent of this summer pruning will depend on many local conditions, so that this part of the method should be adopted only under the eye of a competent and judicious man. In any case the work may be reduced to one annual pruning after the fourth or fifth year.

8. Even with the drastic cutting back here outlined the spread of the tree will go on increasing, and it is still only a question of time when it will outgrow the limited space allotted to it. This result may be considerably postponed, or even indefinitely put off, by introducing a system of renewals, somewhat after the manner practiced in the pruning of grapes. If in the course of time one of the secondary, tertiary or quaternary branches be removed, the work may be begun all over again from that point, a new branch with all its ramifications being redeveloped. This renewal work needs to be done with great care, but nature sometimes offers special opportunities for it through the breaking of a branch by ice or other accident.

A word ought to be said just here regarding water sprouts—the soft long upright shoots which form in the midst of the tree top, especially in old and neglected trees. Most horticulturists seem to regard this as the most iniquitous form of tree growth. Professor

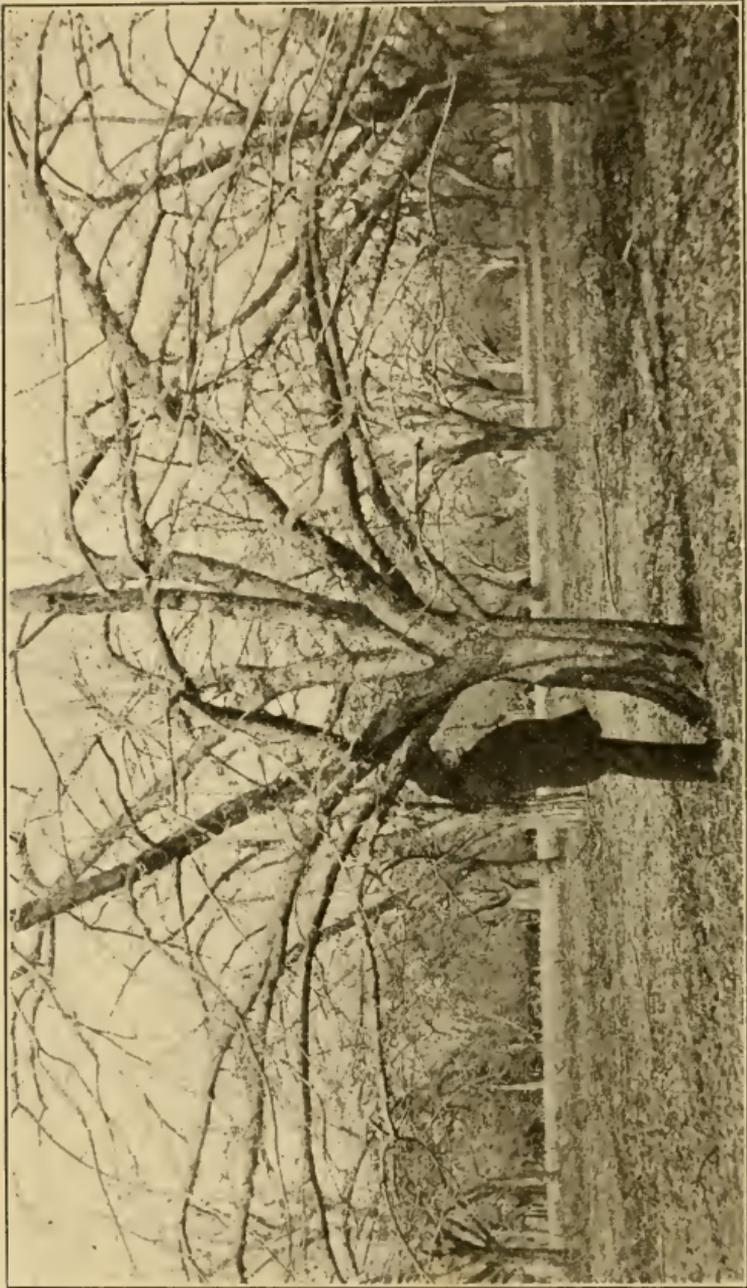
Baily has summarily convicted them of larceny and has sentenced them to be cut and burned. While these water sprouts usually ought to be removed at the earliest possible moment—that is, before they get to be a foot long—they are not always so objectionable. They represent a legitimate effort on the part of the tree to renew its framework. In almost every old untended tree may be found young lusty fruiting branches easily recognizable as quondam water sprouts. A strong, favorably located water sprout often gives the very material needed for renewing a portion of an old tree.

THE FRUITING STAGE

A standard apple tree should come into bearing at four to nine years from planting, and should continue to produce profitable crops anywhere from 10 to 100 years. During this period the work of pruning is directed simply toward maintaining a permanent condition of fruitfulness. There are five principal considerations to be kept in mind. These are:

1. To keep up a supply of fruiting wood, well furnished with fruit spurs.
2. To secure an annual setting of vigorous blossom buds.
3. To maintain the size of the tree, so it will occupy the full space allotted to it and yet not crowd its neighbors.
4. To keep the head sufficiently open.
5. To remove diseased and broken parts.

Let us look at these five problems in order. When dwarf trees are grown in special forms, as they are in the old country, the supply of fruiting wood and of fruit spurs is kept up by very definite methods of pruning. As we practice fruit growing in this country on



A WELL-FORMED OLD APPLE TREE

a much larger scale, the same precise and careful methods are hardly practicable.

It is easy to observe, however, that a condition of healthy and moderate growth in a mature tree tends to give the maximum fruitfulness. If the tree is starved new branches are not formed, the old fruit spurs soon deteriorate and crops become scant. A poor tree, if choked from lack of pruning, will send up many water sprouts, but these will not have strength enough, nor room enough, to develop into fruiting branches. On the other hand a tree which is making too much growth unchecked does so at the expense of fruit spurs and fruit buds. It must be remarked, however, that the cases wherein apple trees are injured or made unfruitful by over-feeding or over-cultivation are rare. The majority of mature trees bear too much fruit rather than not enough; so that if heavy growth tends somewhat to check fruitfulness it is commonly a favorable symptom. In any case where too vigorous growth seems to prevent the formation of fruiting wood this tendency may be promptly checked by early cessation of cultivation or by withdrawing the allowance of nitrogenous fertilizer.

A proper condition of growth being established in the tree, the production of sound fruit spurs set with vigorous fruit buds depends chiefly on an abundant growth of foliage. The foliage should not only be abundant, but should be vigorous, healthy, dark green. Insect or fungous pests which destroy the leaves of the trees thereby largely prevent the formation of fruit buds. It must be remembered, however, that the fruit buds are formed comparatively early in the summer—mostly before July first—so that any damage to foliage

occurring in the latter part of the season makes less difference in the succeeding crop than a similar amount of defoliation occurring earlier.

It can be easily understood, in the light of these facts, why spraying is much more valuable in spring than in late summer. It will be seen further that, while spraying may serve as a protection for the present crop, it serves an equally important purpose in assisting the development of next year's crop.

The majority of fruit growers have accepted the principle that the size of their trees is a matter beyond their control. All they hope to do is to plant trees far enough apart so that they will never crowd one another, or else to cut out every alternate row when branches begin to intermingle. If a man adopts this view there is little more to be said. If, however, he rejects it—as many progressive fruit growers are now doing—it is necessary to adopt in the permanent system of pruning some method of repression whereby the branches may be periodically shortened in. This is a somewhat delicate and difficult matter, but amounts in reality only to an extension of the heading-in process already discussed on page 83. In spite of its greater difficulty this system is likely to be more widely adopted as fast as men learn by experience how to manage it.

The head of the tree should be kept open for two purposes—first, to allow the sun to color the fruit; and second, to aid in the formation of fruit buds. The first of these considerations is sufficiently obvious; the second is even more important. It can be observed anywhere that fruit sets only in the top and on the outside of thick-topped trees. This is because fruit buds cannot be formed where the sunshine does not penetrate.

It must be noticed however that the degree to which a tree top should be kept open will vary considerably. In Kansas or Missouri, where sunshine is abundant and apt to be hot, tree tops should be encouraged to form thick tops, while the same varieties in New York or Ontario would require to be thoroughly opened out.

The removal of dead, broken or diseased branches is a necessary labor, but a very simple one, and should require no special explanation. Such work should be done whenever the injury is discovered.

ODD YEARS

We have now to notice a few matters of general interest in connection with the subject of pruning. One of these is the odd-year proposition. It is commonly understood that most varieties of apples have a tendency to bear in alternate years, giving little or nothing in intervening years. This habit is especially emphasized in the Baldwin, so that in the region where this variety predominates the "even year" is understood to be the "apple year," while the "odd year" is the year of famine.

It is also known to most experienced fruit growers that many trees fail to fruit in the odd years simply because they are impoverished by overbearing during the even years. It is known, further, that in case some accident prevents a tree or a block of trees bearing during the even year fruit buds are likely to form and a crop follow in the odd year. Theoretically it ought to be possible, by thinning the crop during the bearing year, and by feeding the trees well, to equalize the crops from year to year, thus making the annual

performance of the orchard uniform. While the best fruit growers are undoubtedly making progress in this direction, it cannot be said that the theory has yet been brought to such a system of practice as to make it workable for everybody.

THE TIME TO PRUNE

The best time to prune has always been a very popular matter of dispute. The mere fact that the question is still open indicates plainly that no simple answer will cover the ground. It is an old saying that "the time to prune is when the saw is sharp," and this proverb is fair to the extent that pruning may safely be done, under certain circumstances, at any season of the year. As a matter of practice, however, it is better to fix two annual seasons as specially suited to this work. The first of these is the dormant period, say between November 1 and April 1. The other is at the height of the growing season, which in the northeastern states would be the first two weeks of June.

The most important difference in result between summer and winter pruning lies in the physiological effect. Winter pruning has a tendency to promote wood growth, including the formation of water sprouts, and correspondingly to check the production of fruit buds. Summer pruning has the opposite tendency, promoting the formation of fruit buds and checking wood growth. While the results in these ways may be very marked at times, they are not usually so conspicuous as to give the fruit grower great concern.

Winter pruning has certain practical advantages—so has summer pruning. There is usually more time

in winter, most men are better used to this kind of pruning, the débris can be more conveniently removed and burned, it is easier to paint over the wounds. On the other hand wounds heal better, if made in early summer, it is easier to detect the presence of dead or diseased branches, some waste of growth is saved, and the physiological effect on the tree may be more satisfactory.

It is probably true that the adoption of a system of summer pruning would be a distinct improvement in orchard practice in a majority of our leading apple plantations.

PAINTING WOUNDS.

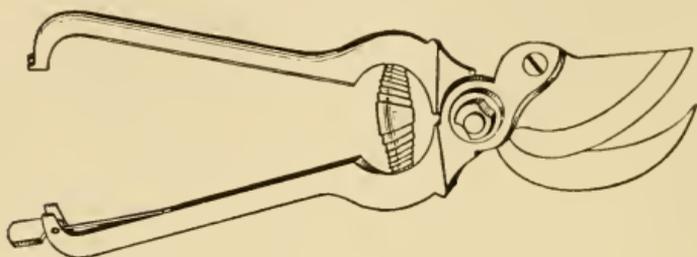
After long discussion and experiment, fruit growers have almost universally decided that the best covering for wounds is a heavy coating of thick white-lead paint. The addition of some neutral color to the white lead is advisable. It is proper to reiterate in this connection that large wounds are to be avoided wherever possible.

PRUNING TOOLS

The best pruning tools are the hand shears. The style commonly called grape shears are especially advised; and if these are used everywhere with sufficient promptness and judgment there will be much less call for larger and heavier tools.

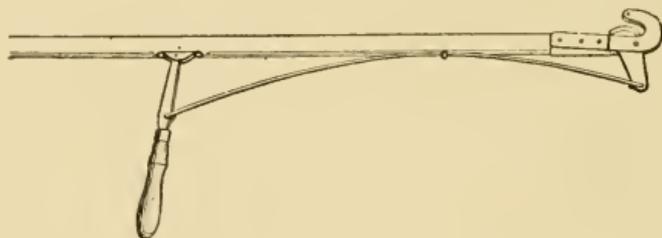
The next tool to be recommended is the long-handled or extension shears, made on handles of 4, 6, 8 and 10 feet in length and shown on page 92. These are indispensable in ordinary pruning. Heavier shears

for use with two hands are sometimes employed, but are not especially valuable. The pruning chisel is a tool sometimes mentioned in the books and catalogs, but not used in the orchard.



HAND PRUNING SHEARS

For cutting large branches, when large branches must be cut, a saw is necessary. The regulation pruning saw sold by all dealers in horticultural supplies is the best form to be chosen. The chief drawback is



LONG-HANDLED PRUNING SHEARS

that the saws usually sold are of distinctly poor quality. These saws are made in two forms, the one with straight, the other with curved blade. Some men prefer to use one; some prefer the other.

Every orchardist likes to carry a pruning knife. Since this tool is chiefly for ornament or personal

amusement, it should be well made and pretty, preferably with an inlaid handle. Such a tool is really useful at times in the nursery, but any man who has a day's work to do in the orchard has got to have something besides a knife.

Ladders are often necessary in pruning large trees. For this work the same ladders may be used which are used in picking the fruit.

HOW TO MAKE THE CUT

The question of where and how to cut off a limb has caused a good deal more discussion than its importance merits. Branches should always be cut back close to the main stem, of course. Occasionally one sees stubs left 6 inches or a foot long, but such work is done only by the blundering ignoramus who knows nothing about fruit growing and who will never read this book. The cut should be made as close as possible to the parent branch while at the same time leaving the minimum surface exposed when the cut is completed.

X

FEEDING THE TREES

THERE has long been a feeling in agricultural circles that chemistry ought to furnish the key to the successful management of the soil. This was the idea attending on the work of Liebig and all the earlier agricultural chemists; and even Horace Greeley supposed that the chief secrets of plant growth were to be solved whenever a complete knowledge of the chemistry of plant foods should be available.

It must be said at once that agricultural chemistry has not thus far justified the high expectations entertained of her. Chemistry has not yet given us a single receipt for the fertilization of our arable lands, and does not seem likely to. Our knowledge of the use of fertilizers is still fragmentary and empirical. We know in part and we prophesy in part—in a very small part, too. We know almost nothing except what we gather from experience, and experience is so scant and contradictory that her teachings are hard to follow. A recent extended inquiry among leading American fruit growers shows nothing so emphatically as that there is little agreement in practice. It is plain also that very few men have thought out and adopted a complete and consistent system for their own orchards. It will therefore be manifestly impossible to outline a definite schedule of practice which can be adapted to all sorts of soils, with all classes of fruits, in various climates, and by all kinds of fruit growers. Only the

most general of general principles can be given. Some of these, however, are worth studying.

It may be assumed that the reader has a fair understanding of the ordinary fertilizers, and the general principles governing their use. As a matter of review it may be proper to recall that plant foods supplied to the soil in the form of fertilizers are of three kinds; i. e., furnishing three different chemical elements. First and most expensive of these is nitrogen, second is potash, and third is phosphoric acid. Plants require many other chemical elements in the course of their growth, but these other elements are almost always present in the soil in sufficient quantity. Lime is sometimes used as a fertilizer, but usually it is employed only for its secondary effects and not because the plants really need more lime.

It may be said roughly that nitrogen is useful to the plant in making a large growth of fresh green wood; potash is valuable for the assistance it gives in the physiological process of plant growth, enabling the leaves to take up the carbon in the atmosphere; while phosphoric acid helps in building up the fruit. This statement of the various offices of the different elements is extremely rough and not really very useful.

In practice, nitrogen is applied when the plants do not make enough growth. When an orchard looks yellow, instead of a dark, bluish green, the indications are that more nitrogen is needed. It may be true that the soil is in such a condition that the plants cannot use the nitrogen already present; but at any rate, for one reason or another, the plant is not getting what nitrogen it needs. In such cases nitrogen fertilization may be adopted or the methods of cultivation may be revised.

Regarding the various sources from which different fertilizing elements may be most effectively drawn, the fruit grower will follow somewhat the same rules followed in general farming. The fruit grower is somewhat better situated than the general farmer, however, as regards that most expensive element, nitrogen. If the fruit grower follows the system of cultivation now commonly recommended and grows a leguminous cover crop, he will be able to supply nearly all the nitrogen which his fruit trees need without any expense except what he pays for the seed of his cover crop. When other nitrogenous fertilizers have to be applied, nothing can surpass well-rotted barnyard manure. In a few instances the writer has known of the successful application of muck; but this can be recommended only on farms where muck of good quality can be secured with very little trouble. Nitrate of soda has been considerably recommended during recent years and is doubtless one of the cheapest forms in which nitrogen can be purchased and one of the most effective forms in which it can be used. Its specific characteristic is its rapid working, so that it is especially adapted to the immediate correction of unsatisfactory conditions after the season of cultivation has begun.

In deciding what forms of potash and phosphoric acid to employ the apple grower can give himself the benefit of the fact that slowly available forms will usually answer his purposes as well as the more rapidly available ones. As the former are usually the cheaper, this point is of importance.

Partly on this account and partly on account of the lime contained, basic slag, Thomas phosphate powder, should stand high in favor with the orchardist as a source of phosphoric acid. Unfortunately this material

has not been so cheap in American markets in recent years as its composition would seem to warrant, and careful buyers have been apt to content themselves with high-grade phosphates of the usual sort.

As a source of potash the muriate has usually been recommended, but the sulphate of potash is doubtless better for most soils. The muriate soon makes a soil sour, and apparently does not give good results on the fruit itself. Kainit, which has been used to some extent, is objectionable because the potash in it costs more a pound than in other forms, and also on account of impurities it contains.

Coming now to more specific suggestions, we may quote a few formulas, some of which have been previously published.

Prof. W. P. Brooks of the Massachusetts Agricultural College recommends for average conditions:

Basic slag meal 400-500 pounds

Low grade sulphate of potash .. 300 pounds

In years when the orchard bears freely there may be added 75-100 pounds of nitrate of soda, though possibly the growing of leguminous cover crops may make this application of nitrogen unnecessary. The slag meal will supply phosphoric acid at about 3 cents a pound, and it also gives a large amount of lime, which is very valuable.

Mr. George D. Leavens, fertilizer expert, of New York, recommends a more liberal ration, as follows:

Basic slag meal 1500 pounds

High grade sulphate of
potash 300 - 500 pounds

Nitrate of soda 200 - 400 pounds

This is for an orchard in full bearing, and it is especially understood that the nitrate of soda must be

used with caution. The figures in this, as in all other formulas here given, represent the amounts to be given annually for each acre.

Dr. L. L. Van Slyke of Geneva, N. Y., recommends the following formula:

Cottonseed meal	100 pounds
Raw ground bone	100 pounds
Acid phosphate	100 pounds
Muriate of potash	100 pounds

Dr. E. B. Voorhees of New Jersey, in his work on fertilizers, recommends the following:

Raw ground bone	400 pounds
Acid phosphate	400 pounds
Muriate of potash	400 pounds

A glance will show that the last formula represents a considerably larger amount of plant food than the preceding formula. This may be due to somewhat different conditions held in view by the two eminent gentlemen quoted. The quantities of plant food to be given will obviously vary between wide limits. Fertile soils will require less than poor soils. Young orchards will use less than old ones. Then if truck crops are grown between the young apple trees the needs of these crops have to be considered.

XI

THE INSECT CAMPAIGN

THERE are about 300 different species of insects that have gone on record at one time or another as attacking the apple tree or fruit in some way. Of these perhaps 100 have at times done real damage. Taking the country at large, however, and one year with another, the number of serious apple enemies can be calculated at less than a dozen. It is proper and even necessary to keep an eye open for some of these less important pests, for occasionally one or another comes forth in large numbers in some particular locality and plays havoc with the apple industry.

Those insects which may be regarded as permanent factors in the apple-growing business are the San José scale, the codling moth, the apple maggot, the forest tent caterpillar, the fall web worm, and the borers.

San Jose Scale is undoubtedly one of the worst insects known in those districts where it has become established, and it has become established over a wide range of country. Eventually all the apple-growing sections will find the scale in their programs. On the whole we may as well understand that the scale is here to stay and that we shall have to fight it.

For some years nursery inspection, quarantine and fumigation has been looked on as a means of controlling the spread of the scale. They have unquestionably contributed somewhat to this end. Nursery inspection in some states has always been rigid and thousands of infested trees have been destroyed which

otherwise would have been sold and sent out to carry the insect to new orchards. Fumigation has also killed millions of scales on infested trees and has prevented their distribution among unsuspecting tree buyers. And yet neither nursery inspection nor nursery stock fumigation is perfect, and in spite of both the scale has continued to spread.

Any tree buyer should take every possible precaution against introducing the San José scale into his grounds. He should see that the trees he buys are accompanied by a certificate of inspection, and he should do all he can to learn that that certificate means something. If possible, he should have his trees fumigated. For while improper fumigation does sometimes injure nursery stock, proper fumigation is very effective in killing scale. After both these matters have been duly attended to the tree buyer will do well to give his trees a thorough inspection on his own account. It is fundamentally necessary of course that the fruit grower himself should know the scale when he sees it.

Yet, after all, the San José scale problem is not one of inspection nor of fumigation, but of fighting the insect in the orchard. In this campaign it is best to cut down and burn a good many old trees or those very badly infested before discovery. The battle is hard enough anywhere; but in old, unpruned, high-topped trees it is almost surely a losing fight. It is important that young trees be headed low. The San José scale has done more than all other agencies combined to popularize the low heading of fruit trees.

On individual small trees the scale may be killed by fumigating the entire plant with hydrocyanic acid gas,

but this method is so impracticable as a general treatment that it need not be described.

The only truly practicable method of controlling the scale in orchard practice is by spraying; and the cheapest and most effective spray known at this writing (1908) is the lime sulphur mixture. (Formula on page 137.) Very thorough spraying in early spring with well-made lime-sulphur spray is plainly the best treatment to be recommended. In southern localities, where there is considerable open weather during the winter, much of the spraying can be done at that season.

Next to the lime-sulphur mixture the best remedy for San José scale now known in unquestionably some one of the so-called "soluble oils." These are specially prepared petroleum products, and for the present are all sold under proprietary names. The most prominent for the moment are Target Brand, Scalecide and Kil-o-scale. These oils are put into water, with which they mix more or less perfectly, and are ready for immediate use. The amounts used vary from 1 part of oil to 10 of water down to 1 part oil to 20 of water. Under favorable conditions the mixture is perfect, but in many cases the oil is only partly dissolved in the water. Under such circumstances it is plain that the strength of the solution will vary and that the results may be seriously affected. There seems to be no injury to the trees when these soluble oils are used during the dormant season.

These oils have the great advantage of being easy to mix and use. They do away with many of the most disagreeable features of the lime-sulphur treatment. At present prices they cost from 10 to 25 per cent more

than the lime-sulphur mixture. There is a slight disadvantage also in the fact that they do not show on the tree as the lime-sulphur spray does. It is much harder therefore to determine when a tree is perfectly sprayed. If windy weather necessitates several turns on each row this difficulty becomes really serious.

At the present moment there are being introduced by various experiment stations certain formulas for the home preparation of oil sprays. Enough experience has already been gained to show that these will probably equal the proprietary brands of soluble oil in efficiency when properly prepared. Beyond this we can add only that they have the same advantages and the same disadvantages (except as to cost) as the proprietary articles.

In a general way it seems that these oil sprays prove more satisfactory in the southern states and less so in northern orchards.

Various formulas have been recommended for self-boiling lime-sulphur washes, but while they have sometimes been successful they cannot be generally recommended at present. There have also been put on the market several proprietary insecticides for use against the San José scale. Most of these are pure fakes, and none of them seems to be really worth while.

Leaf-Eating Caterpillars—There are several species of insects which feed on the leaves of apple trees. A few of these sometimes become sufficiently numerous to cause serious damage. The two most common ones are the tent caterpillar and the fall web worm. Occasionally there are outbreaks of the forest tent caterpillar or other insects which do very great damage, but in most years the injury to foliage by insects is only moderate in extent and is confined to a few

weeks eating by the species already mentioned. Under nearly all circumstances these leaf-eating caterpillars can be killed by the use of arsenical sprays. The essential point in meeting these attacks is that the poison must be given the insects before they reach maturity. While the caterpillars are young, small and tender a very trifling dose of arsenic will end their careers. If they are three-fourths grown much larger doses are required to kill them. Moreover after they have reached maturity they are through eating. Their damage is done. It is hardly worth while to poison them then if we can. The absolute necessity of taking these caterpillars in the first stages is often overlooked by the men who use the spray remedy.

Experience has shown that even in the severest attacks of forest tent caterpillar the arsenical sprays will protect orchards provided the work is promptly and vigorously done, and provided other conditions of orchard management are satisfactory. Some very striking examples of this sort have come under the writer's personal attention.

Perhaps a special word should be said regarding the fall web worm, which is one of the leaf-eating insects most frequently seen in the northeastern states. This insect appears almost every autumn, and on account of its conspicuous webs in the apple trees, makes a comparatively great showing. The fruit grower is apt to be unduly alarmed because these worm nests are so conspicuous. It should be remembered, however, that the insects may be much less numerous and voracious than those which make much less show earlier in the year. An even more important fact is that at the time the fall web worm appears the apple tree has practically completed its growth for the season. The leaves

are already drying and to some extent falling from the trees. The buds for next year have already been ripened. Even if large quantities of leaves are eaten from the trees at this time of year, therefore, the practical damage is very much less than it would be if a similar defoliation should occur in early spring.

Tree Borers—There are several different species of borers which attack the apple tree trunks and branches. Only two of them, however, are of any great economic importance, namely, the flat-headed and the round-headed borers. The distinctions between these two species are not of great practical consequence. In many young orchards these insects do enormous damage, sometimes killing a large percentage of the planting between the ages of two and ten years especially.

The presence of borers in the apple trees can nearly always be detected by the chips thrown out by the working larvæ. These will usually be found about the base of the trunk.

Borers are especially likely to injure trees standing in grass or weeds. Clean culture is therefore a preventive, to a considerable degree, of this sort of damage. Application of lime, ashes, lye washes and other caustic materials have some effect in driving away the borer or killing the eggs, but cannot be relied on as preventives.

The most effective treatment of trees once infested, and indeed the only effective treatment, is to dig out the larvæ by hand. These worms eat into the wood and under the bark of the trunks and can be reached and killed if one takes the necessary labor. A man can cut out a majority of them by using a sharp knife. Although some damage will result to the tree by this sort of cutting, it will always be less than will result

from the continued work of the insect. A strong, pliable copper wire, however, is better than a knife in most cases; and if taken in combination with the knife makes the best set of instruments for fighting the borer. This pliable copper wire can be thrust into bores made by the larvæ, and will kill a majority of them without making it necessary to cut open the tree.

Codling Moth—This is one of the best known and most widely distributed enemies of the apple. Newly settled districts have nearly always enjoyed a temporary immunity from this pest, but experience has shown that the moth cannot long be kept out of any commercial apple-growing district. Apparently the ravages of the codling moth are more serious in central and southern latitudes, where two or three, or even as many as four, broods are hatched in a year. However, the campaign against this insect is an annual one, and has to be fought in practically all the commercial orchards in the country.

The principal preventive of damage is the spray pump, using poison sprays. Paris green is largely used at the present time, but is being somewhat generally supplanted by lead arsenate (see formulas on page 142). Thorough spraying at the right time with these insecticides will very greatly reduce the percentage of damage. Indeed, in many cases the work of the insect is practically eliminated. As in dealing with every other insect or fungous pest, thorough spraying at the proper time is highly essential. The proper time in this case is within one week to 10 days after the falling of the blossoms. A longer delay cannot be made with safety. After about 10 days the calyx, or blossom leaves of the young apple, close and the apple turns to a pendant position. Before this time the newly

set fruit stands erect with the calyx lobes open. A poison spray properly distributed falls into this calyx cup and the poison lodges there. As many of the young larvæ enter the apple by eating in at this blossom end they secure with their first meal a taste of poison which usually prevents any further apple eating on their part.

Special attention should be called to the fact that apple trees should not be sprayed while in blossom. Spraying at this time is not always totally without value, but in many instances it is not only unnecessary, but even highly dangerous, to the crop. Under all circumstances it is very likely to poison the bees working on the apple blossoms. This sort of damage is far reaching in many cases; and as the bee is one of the fruit grower's best friends we cannot afford to murder whole swarms in this way.

This early spraying, just after the blossoms fall, will not usually catch quite all the codling moth, even all the first brood. When the second or third brood hatches later in the year a still smaller percentages can be poisoned by the arsenical sprays. Nevertheless it pays to give additional sprayings for this purpose in case the second and third broods appear to be large.

In many cases it seems to be worth while to supplement spraying by the use of bandages on the tree trunks. These are made of burlap or coarse paper, preferably the former. As a considerable number of larvæ descend the tree trunks seeking for a place to hide while they pass through the change from larva to moth—pupation—many of them gather under these bands and can be taken out and destroyed.

It is also important in the campaign against the codling moth to destroy all windfalls and inferior fruit.

A very large percentage of early windfalls are infested with codling moth, as well as with other insects. Probably the best way to get rid of these is to allow hogs or sheep to run in the orchard. This is not always practicable, inasmuch as apple trees loaded with fruit are very tempting to hogs and sheep. These animals will often pick considerable quantities of fruit from the lower branches of the trees, or will even injure the trees themselves by browsing the lower branches or barking the trunks. Nevertheless, by taking proper precautions, this sort of damage may frequently be prevented and the sheep or hogs pastured in the orchard with great advantage, not only to the apples, but to the animals as well.

Apple Maggot—The apple maggot, frequently called also the railroad worm, is a comparatively recent orchard pest in this country. It is also one of the worst. It attacks some varieties with special enthusiasm. Indeed, in many localities it is practically impossible to grow Tolman Sweet, Porter, Primate, Mother and certain other tender-fleshed varieties for which this insect has a special taste.

The apple maggot hatches from a small fly which deposits her egg just under the skin of the fruit at almost any time during the growing season. The little worm hatches, feeds about through the flesh of the apple, mining it in every direction, and making it practically unfit for human food. There are often large numbers of these small maggots in a single fruit. Apples attacked in this way show a peculiar pitting on the outside something remotely like small-pox pits. Inside the fruit will be found discolored, thread-like traces of the course followed by the maggots. Sometimes the flesh is punky or corky.

This insect is peculiarly difficult to fight. It cannot be poisoned, as it does not eat any of the external portions of the tree or fruit at any time during its existence. There has been found no effective method of keeping the fly from laying her eggs in the fruit. About the only practical method of checking the work of this insect is to clean up and destroy very thoroughly all windfalls, dropped fruit and seconds of every sort. Nothing is so effective for this purpose as a flock of sheep or a herd of swine. The difficulties and advantages of fighting insects by these means has been discussed in the paragraph on codling moth.

The Curculio, which really should confine its attention to the stone fruits, frequently attacks the apple. At such times the damage is likely to be serious. The young fruits are punctured on the sides, and though the larvæ or small worms seldom hatch and work into the apple, the fruit grows one-sided or warty from the effects of these punctures. This injury seems to be especially common in the states of the Mississippi Valley, though the writer has seen serious cases of it in New England and Quebec.

The insect usually responsible for this work is the ordinary plum curculio; though there is another species which is sometimes called the apple or quince curculio, which also does considerable damage at times.

Any of the curculio working on apples may be practically kept at bay by proper application of arsenical poisons. Paris green, arsenate of lead or disparene, used as recommended for general orchard practice, will almost completely prevent the injury.

Oyster Shell Bark Louse—The little animal which commonly receives this name is one of the scale insects, and one of the most common and destructive of

its kind. It is found everywhere, but especially in the northeastern states and provinces of Canada. It is larger than most scale insects and of an irregular oblong form, which enables one to distinguish it readily from the little round black pimple known as the San José scale. It is found especially on old apple trees, but may be found in some cases on young trees the first year from the nursery. The damage wrought by the oyster shell scale is much less severe and summary than that which comes from the San José scale, but it is nevertheless very serious. In many cases it practically kills trees or even entire orchards. In this, however, it is nearly always assisted by the systematic neglect of the owner, for the oyster shell scale is seldom very serious on orchards well cared for.

Almost any thorough sort of spraying will check the increase of the oyster shell scale or drive it out entirely. Even bordeaux mixture contains enough lime to make this insect very unhappy, and its continued use is incompatible with the increase of scale. It has been discovered that pure lime whitewash sprayed on the trees in fall or midwinter will practically clean out the oyster shell scale. Any alkaline wash will serve the same purpose more or less effectively according to its composition and the methods of its application. One pound of concentrated lye or crude potash dissolved in 5 gallons of water will do the work thoroughly. The lime-sulphur spray recommended for San José scale will answer admirably for the oyster shell scale also; but if the latter insect alone has to be fought milder weapons will do as well.

In giving treatment for any sort of scale insect a preparatory course of pruning and scraping is very important. In the campaign to dislodge the oyster

shell from old apple trees this preliminary work is indispensable. Old shaggy bark must be scraped off. For this purpose a tool may be made of an old hoe. The handle should be shortened to 16 inches and the blade sharpened. A better tool, which can be bought ready made or made by any handy blacksmith, has a triangular blade, about $3\frac{1}{2}$ inches on each edge, with a 14-inch handle in the center. After scraping the trees should be well pruned. This subject is discussed in detail under the renovation of old orchards, which see.

XII

THE PRINCIPAL DISEASES

THERE are many diseases which attack the apple tree or fruit, but as far as the practical business of fighting them is concerned only three or four need be seriously considered. The most destructive of these are caused by fungi. These fungi are very small plants, usually so small that a high-power microscope is required to see them. However, they make up in numbers for what they lack in size. They are parasites, living on the apple tree, foliage or fruit, and taking the nourishment which the fruit grower never intended for them.

These fungi are usually distributed by means of spores, which take the place of seeds, but are thousands of times smaller than even the proverbial mustard seed. These spores are usually carried by the wind, and they usually lodge in the rough bark or on the rough bud scales of the apple trees. They can be killed most easily just at the moment when they germinate, and the best thing for killing them is some form of copper solution. Here is where the copper sulphate of bordeaux mixture comes in. As soon as the spores germinate the fungous plant which grows from them penetrates into the tissues of the apple bud, twig or leaf, and is then quite out of reach of any remedy.

While every disease has its own specific fungus and behaves in its own peculiar way, this general statement fairly covers the case for all our common fungous diseases. A brief consideration of the facts here recited

will lead to a few inferences of considerable practical importance.

1. All spraying must be preventive. The fungus must be killed in the spore stage. There is no such thing as curing a fungous disease.

2. Early spraying does the most good. After the spores have germinated and the fungus has gained entrance to the plant, spraying does no good. Late sprayings are useful only in killing later crops of spores, but as a rule these are comparatively unimportant.

3. Spraying must cover the entire tree. A fungous spore is less than the ten-thousandth of an inch in diameter, but the copper sulphate has to touch it to kill it.

Scab or Black Spot—The apple scab is the worst disease which the orchardist has to meet. It is the most widespread, and on the whole the most destructive. It does great damage to the foliage in some cases, though it is more conspicuous on the fruit. The leaves when attacked by scab show irregular browned patches of dead tissue. Sometimes these are so abundant as to give the whole tree a half burnt appearance. On the fruit the fungus causes black patches, which sometimes crack open, making the fruit unsightly and unsalable. Different varieties are susceptible in differing degrees to the attacks of scab fungus. Fameuse, McIntosh and all apples of that type are especially subject to injury.

The scab, once established on a tree, works in the small twigs and throughout the growing tissues. It also continues to develop in the fruit after picking, so that fruit put into storage in reasonably good condition but affected with scab will deteriorate rapidly, especially if the storage room is warm.

Fortunately the scab fungus is comparatively easy to fight. At least it is in most years. There are occasional seasons when it seems to be epidemic and beyond control. Under all ordinary circumstances thorough and timely applications of bordeaux mixture will entirely subdue it. The most useful application, however, is the dose of plain copper sulphate solution given just before the buds open. At that time the spores are resting on the apple buds, and this is just where, a few days later at budding time, the most serious fungous invasion occurs. Later applications of bordeaux serve to check the spread of the fungus.

Apple Tree Canker—The apple tree canker has only recently been recognized as a serious disease. Even yet it is not present in all orchards to such an extent as to cause much damage. Young orchards and sections where apple growing is a new industry are apt to be comparatively free. But in nearly all old orchards there is an abundance of canker, and in the old apple-growing sections, where neglected apple trees are as common as flies in a country hotel, the canker is a well-established and ever-present menace to the business.

The canker appears in the form of large patches of dead bark, more frequently in the crotches. Sometimes, however, small canker spots can be seen on young branches. As the canker eats in during the course of two or three years, the bark peels off, leaving patches of exposed wood. These are rough, and the edges are black, and more or less wrinkled. This wrinkling along the margins of the canker spots is particularly striking in cases of long standing, where it is emphasized by the successive annual attempts of the tree to cover in and heal the canker sore.

Sometimes the canker appears about the base of the tree. In this form it is sometimes called collar rot. There are certainly several diseases, closely related, caused by different fungi, which may all be roughly grouped under the name of canker.

Different varieties of trees differ greatly in their susceptibility to canker. Tompkins King is especially vulnerable. Esopus Spitzenberg is another. Spy and Tolman are practically immune. In view of such facts some enterprising growers are adopting the practice of top-working varieties like King on trees like Spy. The tree which is used for top-working in this way should be allowed to form a good head before regrafting in order that the crotches may be sound and free from cankers.

Pruning and spraying with general good treatment is the preventive, and to some extent a practical remedy, for canker. The cankered branches should be cut out and burned, as far as possible. Where there are large branches which cannot be spared but which have canker spots, these spots should be scraped, pared down to healthy wood and painted with a heavy coat of thick white lead paint. Thorough spraying with bordeaux kills the spores of the canker fungi; and an orchard carefully sprayed every year, as spraying is done for the scab fungus, will never suffer from canker, unless it be under the most exceptional circumstances.

Bitter Rot—The same fungus which causes one form of canker causes also a disease of the fruit, known as bitter rot. This disease is very destructive some years in certain localities, especially in southern Illinois and Missouri. In this neighborhood the entire crop is occasionally ruined. The rot appears on the

fruit in the form of circular black spots with granular surface, and with fine concentric rings at the margins. It spreads rapidly, even after the fruit is picked; and when it is first seen the time for fighting the disease has usually gone by.

Like all the other true fungous diseases the bitter rot can be controlled by bordeaux mixture if applications are timely and thorough. The regular program of spraying—that is, three applications of bordeaux in spring—will serve to check the bitter rot, and in some seasons will afford sufficient protection. This disease has been very thoroughly studied at the Illinois experiment station, and Prof. J. C. Blair gives the following advice as to its treatment:

“ 1. In addition to the three early sprayings for apple scab and codling moth make applications of bordeaux at intervals of ten days, commencing the third week in June, making the final application on the date of the first discovery of bitter rot. In case bitter rot fails to appear before the first of August, the applications should be continued up to the end of July, making in all four to five applications. In most seasons three sprayings with standard bordeaux mixture, one applied the last week in June and the two following at intervals of ten days, are sufficient to control the disease, but on account of the irregularity in the time of infection in different seasons, this practice is not wholly safe and the extra treatments are recommended as a wise precaution.

“ 2. In case the precautionary sprayings above recommended are not given, the most thorough sprayings to coat the fruit completely with bordeaux mixture should be made immediately upon the first discovery of an infected apple. Failure to spray promptly at this time will result, in a season favorable

to the development of the disease, in almost complete destruction of the crop.

" 3. Mummied apples which remain upon the trees after the leaves have dropped in the fall should be picked off and destroyed in order to do away with this source of infection during the following summer.

" 4. Bitter rot cankers upon the branches of the trees, a second source of infection, should be cut off and burned, the limb being cut a few inches below the cankered spot. Care should be taken not to cause fresh bruises in the bark of other branches while this operation is being performed, and the pruning tools should not be allowed to touch the cankers for fear of carrying the infection to the freshly cut surfaces below the diseased bark."

Professor Blair is very certain that thorough spraying for bitter rot pays in Illinois. His advice, of course, applies with equal force in all sections where the rot is prevalent.

The Apple Scald—This disease has proved very serious in recent years, manifesting itself particularly in the storage houses. It appears on the fruit at any time during the winter, causing it to show a baked or scalded appearance. Though the disease attacks only the surface of the fruit, and does not itself injure the culinary quality, it usually opens the way for other agencies of decay, so that when the fruit shows scald it is on the way to rapid deterioration. In fact the appearance of the fruit is so much injured by the scald itself that it is made more or less unsalable, sometimes entirely so.

The cause of the disease is very obscure. It is not a fungus, nor even a bacterium, but is thought to be an even more obscure agent, which the chemists call an enzym. It can be most closely compared to the trypsin and pancreatin of the stomach and intestines which

digest the food we eat. A disease of apples due to such a cause is obviously hard to treat.

Different varieties show very different degrees of susceptibility to scald. Rhode Island Greening is the most notable among standard commercial varieties in its tendency to show this trouble, but other sorts suffer almost equal damage. In the storage experiments of Mr. G. Harold Powell, the following varieties were found to be seriously affected by scald:

Arctic,	Nero,
Arkansas,	Paragon,
Baldwin,	Rhode Island Greening,
Ben Davis,	Smith Cider,
Gilpin,	Stayman Winesap,
Grimes,	Wagener,
Huntsman,	Winesap,
Lankford,	York Imperial.

Scald also varies greatly with other conditions, such as the ripeness of the fruit, temperature of storage, etc. Some of the more important of these conditions may be summarized as follows:

1. *Maturity of the fruit.*—Thoroughly mature, well-colored fruit suffers less than fruit picked green or underripe. However, as ripening progresses in storage, scald increases.

2. *Methods of handling between picking and storage.*—Immediate storage gives least scald, while any delay in storage will show proportionate increase in scald.

3. *Temperature.*—A storage temperature of 31°-32° proves best for practically all varieties.

Mr. Powell's own suggestions, made on the basis of his experiments, are that "from the practical

standpoint the scald may be prevented to the greatest extent by producing highly colored, well-developed fruit, by storing it as soon as it is picked in a temperature of 31° - 32° , by removing it from storage while it is still free from scald, and by holding it after removal at the coolest possible temperature."

XIII

OTHER TROUBLES

SPRAYING is not exactly a universal reliance in the care of fruit trees, for the reason that there are some sorts of damage caused by other agencies than fungi and insects. A few words on the more common troubles should be entered here.

Blight—Fire blight, or twig blight, is a disease of bacterial origin; and as the bacteria which cause all the trouble circulate in the sap of the tree they cannot be reached by sprays. These bacteria are carried from tree to tree by various insects, sometimes by bees; but there seems to be no practicable way of preventing their dissemination. It is well known that the blight is worst on young trees, making a rank, soft growth; and this fact suggests a preventive in such forms of culture and fertilizing as do not produce rank growth. Where blight is bad it may be best to stop the cultivation of the orchard for a year or two. The free use of nitrogenous fertilizers, such as barnyard manure, which is seldom to be recommended, is especially to be discouraged in times when blight is prevalent.

The weather has a striking influence on the development of the blight. Hot, moist, muggy weather in July or August is always favorable to it. At such times the new growth will be struck and withered in a day or two, leaving the tree burnt and blackened as though burnt over by a scorching fire. Hence the name fire blight.

After the blight has struck a tree or an orchard there is little that can be done by way of immediate relief or to check its present spread. The pruning knife, which is the main dependence, cannot be used to much advantage at the moment. Nevertheless the removal of the blighted wood is the best thing that can be done, and if this can be accomplished before growth ceases in the summer so much the better.

The dead wood can be recognized during the winter by the shriveled and blackened bark, and can be pruned out at any time. But heavy pruning during the dormant season—October to April—is apt to start the trees to the production of a lot of soft growth, water-sprouts, etc., which growth is especially vulnerable to the attacks of blight. So that the pruning, designed to check the ravages of the blight, becomes the means of keeping it going. Nevertheless pruning should always be done because the blight spreads from the blighted portions of the tree to the sound portions. The blighted parts should be cut out and burned as soon as may be. The burning of the prunings is highly important.

Sun Scald—This form of damage is very common in some localities, so common, in fact, that a tree which escapes it is a rarity. This sun scald, which has the appearance of being caused by the burning of the sun, occurs in reality during the winter when the snow is on the ground. The greater part of the damage occurs in late winter, or during the warm spring days when the snow is going off. During the warm afternoons the sun, reflected from the snow against the southwest sides of the tree trunks, becomes very warm. The trunks are thoroughly warmed on that side. They are thawed out, and the bark becomes soft, sappy and pliable. Then when the sun goes down and the temperature falls

again to zero, the bark is again frozen tight as a drum. The next day the same thing happens, and so day after day the young bark freezes and thaws, and by this means is torn to shreds. When spring arrives the bark is killed and broken open. Then various kinds of fungi get in and the damage which begins by freezing and thawing ends with spread of canker and other troubles all round the trunk of the tree.

The best preventives of sun scald are low heads and veneer protectors. High-headed trees, which are of doubtful value anywhere, are altogether inadmissible in places where sun scald is bad. The protectors of newspaper or wood veneer recommended below for mice and rabbits will also give practical immunity from sun scald. This trouble is a very serious one. It is not uncommon to find entire young orchards ruined by it. In sections where this trouble is prevalent great pains should be taken to protect young orchards from it.

Mice and Rabbits, in some sections, do great damage, particularly to young trees during the winter. Rabbits can usually be thinned out by shooting and trapping, but the mice must be circumvented by other means. In small and newly planted orchards the damage by mice may be generally prevented by tramping down the snow around the trees after each snowfall. The mice work under the snow, and this tramping spoils their field of operations.

As a general rule, however, the cheapest and safest protection is secured by wrapping the trunks of young trees with some defensive material, such as paper, wood veneer, or corn stalks. Cornstalks will sometimes serve where they are to be had abundantly and in good condition from the feed

yards where cattle are fed on whole corn fodder. But they are troublesome to put on and not so safe as other protectors, and are therefore not to be recommended. Newspapers wrapped round the trunks and tied with soft twine make an excellent protection. They are cheap, easy to put on, and effective.

Probably the best of all protection is afforded by the strips of thin wood veneer got out by various manufacturers especially for this purpose. This veneer is a little less than a quarter of an inch thick, and is cut in pieces about 8 inches wide by 24 inches long. In some cases the lower end is tarred. These strips cost about \$5 a thousand, or less in large quantities. They will last for several years.

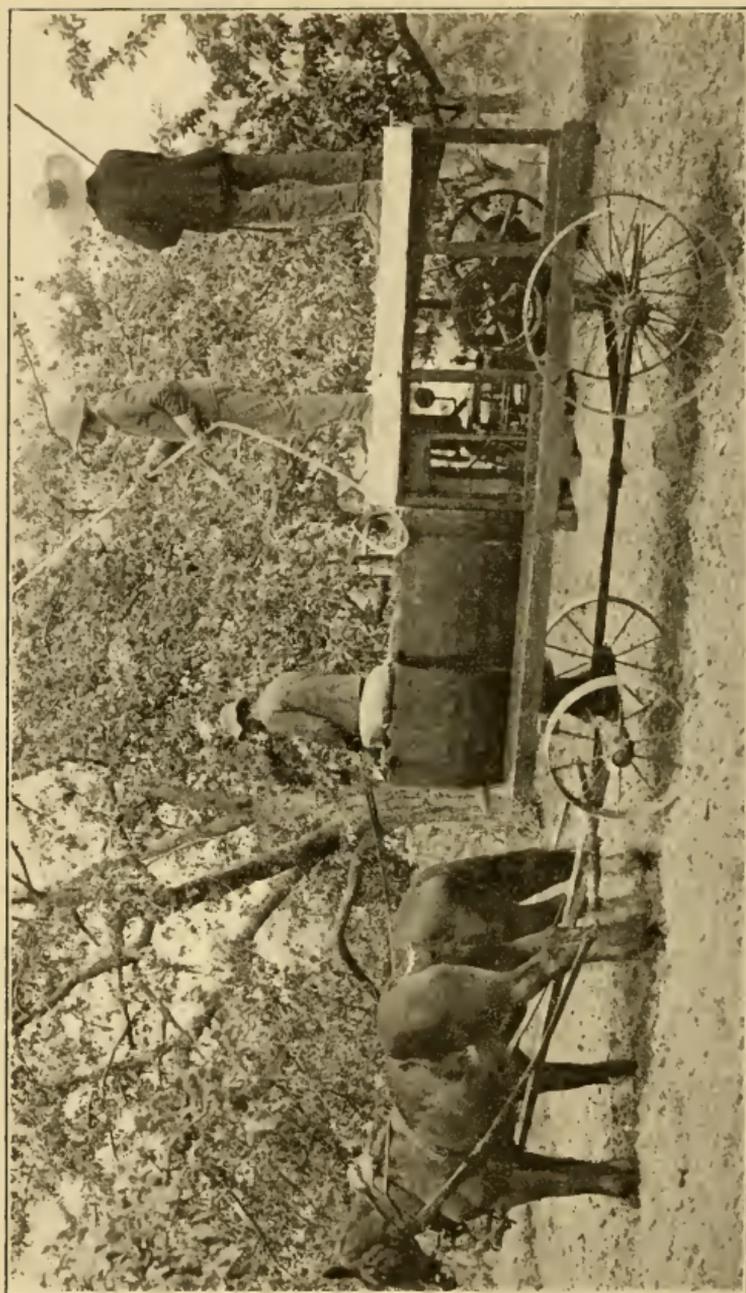
One of these strips of thin wood is wrapped round the trunk of the young tree, and tied with a strong string. Sometimes they are treated so as to give them a permanent curve, and then each protector holds its own place without tying. As a rule the protectors should be removed every spring and replaced in the fall. These wood or paper protectors not only prevent damage by mice or rabbits, but also prevent sun scald.

XIV

SPRAYING MACHINERY

THE question is often asked: What is the best spray pump? Such a question cannot be answered. Even when the requirements are somewhat definitely known no one can truthfully say that one make of pump is better than all the others. In fact, a good nozzle, conveniently rigged to a well-made cylinder makes a good spray outfit. The particular pattern or maker's name is of small consequence. It may be said at the outset that hand pumps are most practicable for small plantations. Anyone with less than 200 mature apple trees will hardly need a power sprayer. For any undertaking larger than 200 mature trees, however, some form of power machine will prove an economy.

Of the hand pumps there are all kinds, but they may be somewhat arbitrarily divided into two general types. The first would include the small single-acting pumps mounted on a barrel; the second would include larger pumps, usually double-acting, and usually mounted on larger tanks. The barrel pump, which is the smallest and cheapest practical outfit for effective spraying, can be conveniently loaded into any wagon. Preferably it is placed on a low-down truck. It can even be hauled about on a stone boat. If some tank larger than a barrel is required, it is best to buy one of the ready-made sort put out by leading dealers. These tanks usually hold 200 gallons, and cost \$18 to \$20. The common form is semi-cylindrical, with the flat side uppermost, making a convenient place for mounting the pump.



GASOLINE ENGINE AND SPRAY TANK

A word should be said about agitators. In most of the barrel machines, as they come from the factory, there is some sort of mechanical agitator to keep the spray mixture stirred up. In larger machines the stirring is accomplished by pumping back into the tank a portion of the liquid taken through the pump. This agitation is important, especially with bordeaux mixture. On rough ground, however, especially where trees are small, and there is much driving from tree to tree, the shaking of the wagon may give all the agitation necessary. The presence of any considerable sediment in the bottom of the tank after pumping out a tankful of mixture indicates that more thorough stirring is needed. Of course, it may, and probably does, indicate also that the mixture is improperly made; but the poorer the original mixture the greater the demand for vigorous stirring.

With respect to pumps in general it must be remembered that the cylinder is the vital organ. This should be perfectly smooth and true, and should be lined with brass or other non-corrosive material. Brass is the material now most in use. All the other linings of connecting working parts which come in contact with the liquids should also be of brass. The nozzles are practically always of brass.

Power Sprayers—Coming now to the power sprayers, in which the force is supplied from some other source than human muscle, we find three general types in common use. These are: (1) traction sprayers, (2) engine or motor sprayers, and (3) those which operate from air or gas pressure. It may be said at once that any form of power sprayer, properly operated within the scope of its adaptabilities, will give much better results than hand power. Experience shows that the

hand pump gives a very variable pressure on the liquid, running from 125 pounds down to nothing, and seldom averaging over 50 or 60 pounds. With any sort of power sprayer, properly managed, a pressure of 100 pounds or upwards is easily maintained. With some machines this pressure, say of 100 or 125 pounds, as desired, can be kept up very steadily for hour after hour, with practically no variation. In order to do any sort of effective spraying a pressure of 65 pounds or over is essential, about 100 pounds being the most practicable figure.

Traction Spray Machines—A good example of the first type of power sprayer, the traction machine, is the Wallace pump. This machine takes its power from the motion of the wagon wheel, which is provided with heavy lugs for that purpose, and is communicated to the pump by a sprocket chain and wheels. While the wagon is in motion this power is stored by compressing air into a large air chamber; and this compressed air forces out the liquid for several minutes after the wagon stops. The air chamber and the pumps are connected with a barrel mounted on the same truck; or better still the whole machine is mounted on a large special tank holding 200 or 300 gallons of mixture.

In our experience it is not practicable to operate a traction sprayer at a pressure of more than about 80 pounds. This pressure goes down slowly as soon as the wagon stops, but will not go below 65 pounds in less than 2 or 3 minutes in operating two gangs of vermorel nozzles. In young orchards where the trees are small, and on comparatively level land, and where the most thorough spraying is not required, the traction machines seem to be worth while. When any one

of these three conditions is absent, however, as when trees are large, the ground rough, or very careful work is necessary, some other form of power is better.

Engine Power Sprayers—Steam engines have occasionally been used in spraying. As a rule they are not to be recommended. Still occasionally there is a farm on which a small steam engine is already owned, and where the men know how to manage it. Where the land is reasonably smooth, and a fairly light mount can be secured, the steam engine may prove satisfactory.

Gasoline motors come more nearly meeting the special requirements of the apple grower who wants to spray his trees. There are several manufacturers who are putting such outfits on the market. Each machine consists of a gasoline motor, of about two to three horse power, more or less conveniently mounted on a truck with a two-hundred gallon tank. The gasoline engine or motor is comparatively simple and easy of management, so that a really intelligent farm hand can usually make friends with it. It may as well be accepted at the beginning of things that an ignorant and heedless hired man cannot manage a spray outfit. The gasoline motor has one practical advantage which strongly commends it to many farmers; viz., it can be used for many other purposes when the spraying is not going on. It will saw wood, cut silage, pump water or run the milking machine.

Compressed Air Sprayers—In this form of machine two air-tight metal cylinders or tanks are mounted side by side on the truck. One of these cylinders holds the spray liquid; the other is charged with compressed air. In order to charge this cylinder some stationary form of power is required, as a horse power, water power,



PUTTING ON SOLUBLE OIL IN WINTER WITH A HAND PUMP

or a gasoline engine. A special air pump is installed and connected with the horse power or gasoline engine, and this pump forces the air into the air cylinder of the spray machine up to any reasonable pressure. About 200 pounds is the practical limit. The air cylinder is connected with the liquid cylinder by means of suitable cocks. By opening these the liquid is blown out and through the nozzles onto the trees. The pressure goes down slowly during the process of discharging the liquid; but when properly managed does not fall so low as seriously to impair the results.

Perhaps the chief difficulty in the way of the popularity of the compressed air sprayers is the cost of installing the original power plant. This is said to be about \$250, though it varies, of course, with circumstances. On farms where a reliable source of power, as a gasoline engine, is already established, the cost is much less; and under such circumstances the claims of the compressed air machines should be carefully considered before buying any new outfits. The power is very cheap, once the machinery is installed, and the outfit is light and easily hauled through the orchard.

Gas Power for Spraying—There has recently been introduced and widely sold a novel machine for spraying purposes, which derives its power from purely chemical sources. A small tank or cylinder is charged with carbon dioxide gas. This is the same gas used in soda fountains, and it is used in spraying in almost the same way. A strong air-tight metal tank holding 50, 100 or 200 gallons of spray mixture is mounted on a suitable wagon or truck. The cylinder of gas, about 8 inches in diameter by 4 feet long, is fastened on beside this tank. The gas pressure is opened into the tank of

liquid by a suitable system of cocks, and the spray mixture is blown out through the nozzles. When a tube has been exhausted of its gas it is returned to the soda water factory to be recharged. Counting the cost of returning and recharging tubes, it may be computed that this method of spraying, under favorable conditions, costs about the same as to spread the same amount of mixture by hand pumps. There are several distinct advantages, however. The pressure is greater and more uniform, so that much better work is the result. There is practically no machinery to break and get out of order. The outfit is lighter to transport about the farm than any kind of pump can be. The better quality of the work is certainly the chief advantage.

These gas tubes give a comparatively high pressure, ranging even above 200 pounds; but this pressure can be regulated accurately after a little experience. A pressure of about 100 to 120 pounds will be found best for ordinary work with bordeaux or lime-sulphur spray.

XV

SOLUTIONS FOR SPRAYING

HUNDREDS, even thousands, of spray solutions have been introduced during the last 15 years. Several of them have met with temporary favor, but for practical field work the list is now reduced to three or four. Only the most important ones need be given here, as this is a book for the practical worker, not for the experimenters.

The making of almost any spray solution is an exacting task. Often it is dirty and highly disagreeable also. This applies particularly to bordeaux mixture and the lime-sulphur spray, which are probably the two most important sprays now in use. On account of this disagreeable nature of the work hired men, and even orchard owners themselves, are sometimes inclined to slight the task. They seek short cuts and shabby improvements—always to the detriment of the spraying. It might as well be accepted as a fundamental fact at the outset that spraying is hard, dirty work, and that it must be done with great care in spite of the drawbacks. Close attention should be paid to the minutest details in making up and putting on spray mixtures.

BORDEAUX MIXTURE

By all means the most important fungicide which we use is bordeaux mixture. This has superseded practically every other fungicide yet introduced. The

changes in the formula for bordeaux mixture have been very few and of a minor nature, showing that it is as nearly perfect as such things can be. The mixture is made in various strengths for various purposes, but probably the best formula for spraying apple trees is the standard mixture, as follows:

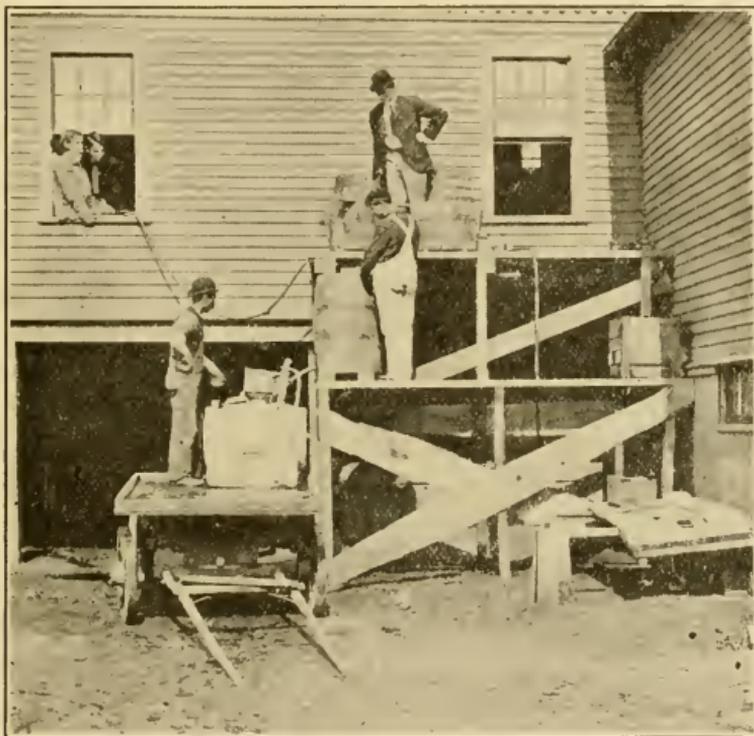
4 pounds copper sulphate (blue vitriol),
4 pounds lime,
50 gallons water.

To make up the mixture first dissolve the copper sulphate. This process can be very much hastened by using hot water. The usual method, however, is to put the copper sulphate into a gunny sack and hang it on a fork handle in the top of a barrel or tub so it will just barely be immersed in the water. As fast as it dissolves it sinks toward the bottom of the vessel. If only 50 gallons (say one barrel) of mixture are to be made it is well to dissolve the copper sulphate in 25 gallons of water.

The next step is to slake the lime. This should be done by adding a little water at a time, just enough to keep the lime slaking, but not enough to quench the heat generated in the process. When the slaking is finished more water can be added, making the lime into a thick cream. It can then be diluted so as to make 25 gallons or half a barrel of solution, and, if necessary, it should be strained. With good lime, however, the straining can be omitted.

The two solutions are now ready—the copper sulphate in one tub or barrel and the lime in another. To make the mixture dip or pour the copper sulphate into the lime, or else pour both solutions at once into a third barrel. In either case the mixture must be stirred vigorously during the pouring. Under no cir-

cumstances should the process be reversed and the lime poured into the copper sulphate. This little detail, which is of no obvious importance whatever, really makes the difference between a good and a very bad mixture which may ruin the foliage on every tree it touches.



ARRANGEMENT FOR MIXING BORDEAUX

When a big campaign of spraying is on and much bordeaux has to be made, the best plan is to make up stock solutions. To do this dissolve say 40 pounds of copper sulphate in 40 gallons of hot water, and set it aside for use. Then in a suitable box slake 40

pounds of lime, and add enough water to make 40 gallons of this solution also. With care these solutions will keep for some time; if they stand for several weeks they become considerably concentrated through evaporation of the water.



BORDEAUX INJURY

To use these stock solutions in making up a barrel of bordeaux for spraying take 4 gallons of the copper sulphate solution and dilute it to approximately 25 gallons. Then take 4 gallons of the lime solution and dilute it in another barrel making approximately 25 gallons. Then pour the copper sulphate solution into the lime solution as before directed, stirring thoroughly.

No matter how the bordeaux mixture is made it should be strained before using. To do this put it through cheesecloth as it goes into the spray tank.

In making up large quantities of bordeaux a great amount of labor can be saved by a convenient arrangement of barrels or tanks. The usual way is to build a platform, preferably in two stories, as shown in the picture, page 133. The stock solutions are made up in tubs, barrels or tanks on the upper platform. They are also ladled out and diluted on this upper stage. They are then allowed to run together into a trough conducting them to a barrel on the lower platform.

They mix as they run together into the trough and this mixture should be vigorously stirred in the barrel during the operation. The mixture thus completed is drawn off by gravity into the spray tank, passing through the cheesecloth strainer on its way.

This staging must be made high enough so that the completed mixture will run down into the mounted spray tank; and there must be arranged a convenient water supply sending water easily up to the top platform. This staging can be used in making and handling other sprays, though it is especially adapted to the manufacture of bordeaux.

A word needs to be said about the chemicals used. Copper sulphate is seldom adulterated though sometimes it is not so clean as it ought to be. The granulated form costs about one-half cent more a pound than the lumps, and is easier to dissolve. If the amount of work to be done will justify it the copper sulphate should be bought by the barrel. A barrel contains in the neighborhood of 200 pounds and costs from $6\frac{3}{4}$ to $7\frac{1}{2}$ cents a pound at present, with a tendency for the price to go higher.

The proper selection of lime is more important. The lime must be of good quality, well burned and not air slaked. The fine lime sometimes preferred by masons should not be used. Lumps are better.

Always use lime enough. The quantity recommended in the formula already given will be quite sufficient if good lime is used; but in case of doubt more lime can be used. It is customary in books and bulletins to recommend the so-called ferro-cyanide test, but in actual practice it is better to rely on good lime. The idea of this ferro-cyanide test is to determine whether the lime has completely neutralized

the copper sulphate. A solution of potassium ferrocyanide (yellow prussiate of potash) is made by dissolving say 1 ounce of the ferro-cyanide in 6 ounces of water. A few drops of this solution may be dropped into the bordeaux mixture to be tested, when, if the copper sulphate has not been neutralized, it will instantly give a deep brownish-red color. If the mixture is properly neutralized no color will appear. This test is very accurate and reliable, provided the bordeaux is evenly mixed; but it is too much bother for practical use in the field.

Even with the greatest care in making and applying bordeaux there sometimes results considerable damage to fruit and foliage from the action of the spray mixture itself. This damage is usually most conspicuous on the fruit, and appears in the form of russety patches or rings. The weather evidently has a good deal to do with the amount of injury, but on the whole this trouble is not very well understood. On account of it careful growers and experimenters now generally use a more dilute bordeaux mixture than formerly. The formula already given is weaker than sometimes recommended, but it may be still further diluted if any ill effects are seen. In case of bordeaux injury it will be best to substitute the following formula:

3 pounds copper sulphate
4 pounds lime
50 gallons water

COPPER SULPHATE SOLUTION

In early spring before the buds open a thorough spraying with a strong fungicide gives very great returns. Indeed this is probably the most profitable

spraying of the year. When lime-sulphur mixture is used for San José scale in spring it will take the place of any other spraying before the buds open. In all other cases some solution of copper sulphate should be applied. Bordeaux mixture will serve the purpose; but as this work is to be done before the buds open, the lime may be omitted. The liquid thus becomes a plain solution of copper sulphate. The recipe would be about as follows, though the exact proportions are not very important:

3 pounds copper sulphate
50 gallons water

Simply dissolve the copper sulphate in the water as already directed, page 132, and the solution is ready to apply.

THE LIME-SULPHUR MIXTURE

This is doubtless the dirtiest, messiest and nastiest spray mixture yet invented. Perhaps for that reason it is one of the most effective. At any rate it is indispensable, at least in the northern states, in fighting San José scale. It also serves to kill many other insects, as oyster shell bark louse, and moreover has a distinct fungicidal value. When it is used during the spring no further application of bordeaux or other fungicide need be made till the fruit has set.

Various recipes are given for making the lime-sulphur mixture. The following is the formula used and preferred by the writer:

16 pounds unslaked lime
16 pounds flowers of sulphur
50 gallons water.

In moderate quantities this mixture can best be made in a large iron kettle. To make up the full

recipe as given a 50-gallon kettle would be required; and, in fact, such a vessel (shown on this page) is the cheapest and best provision for handling a small orchard, say up to 200 or 400 trees. When the orchard reaches 600 bearing trees requiring lime-sulphur



BOILER FOR LIME-SULPHUR MIXTURE

treatment some more elaborate cooking apparatus should be provided.

The making of the lime-sulphur mixture is begun by slaking the lime in the kettle, using hot water. In fact the fire under the kettle should be started at this time. As the lime slakes add water slowly. When

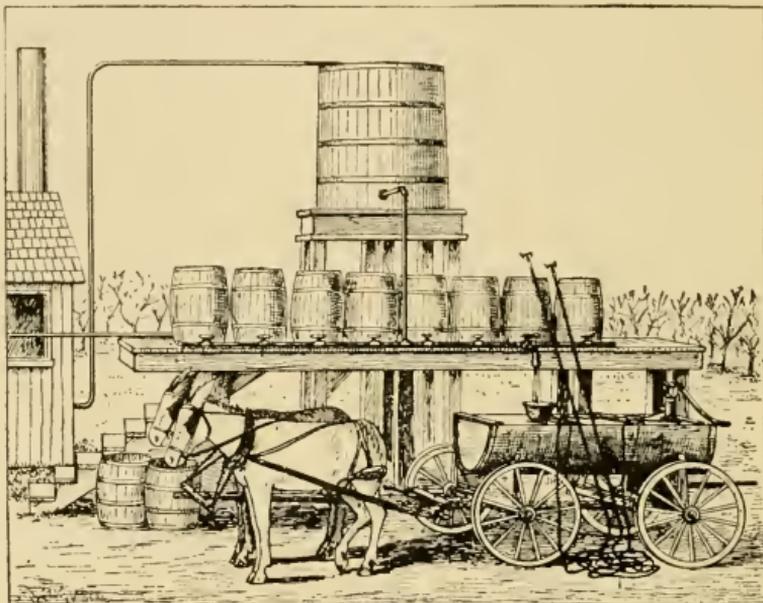
the slaking is well under way the sulphur should be added. Then the heat generated by the slaking lime will help to melt it. At this stage the kettle should contain only 10 to 15 gallons of water. Vigorous and constant stirring of the mixture is necessary during this period, which will occupy about 15 minutes. When the lime is thoroughly slaked and the sulphur dissolved the rest of the water (preferably hot) may be added. The whole is then brought to the boiling point and vigorously boiled for 40 minutes to an hour. Most observers agree that a full hour of thorough boiling is time and fuel well spent. During this cooking the mixture changes to a dark reddish orange, very characteristic and easily recognized after once seen. This color is one of the best tests for a well-made mixture and certainly no lime-sulphur solution should be used unless this color appears unmistakably.

Some sediment will be found in the bottom of the kettle. This is mostly undissolved particles of lime or unburnt bits of limestone. Any considerable amount of this sediment indicates a poor grade of lime. The solution should be strained before using, and must be used at once, hot out of the kettle. Solution which stands overnight can be recooked and used, but is not so good. The hotter the solution can be put onto the trees the better, within practicable limits.

When considerable quantities of lime-sulphur mixture are to be used it will usually be best to establish a steam cooking plant. Any steam boiler will answer for the generation of the steam, which can then be conducted through pipes or steam hose to barrels or tanks. Here the live steam is turned into the mixture

and a boiling heat easily produced. The arrangement of such a cookery will be best understood from the illustration below.

Good lime is of great importance in making the lime-sulphur spray, as in making bordeaux. Air slaked or half burnt lime should never be used. In



PLANT FOR MAKING LIME SULPHUR

any case of doubt the amount of lime in the mixture should be increased. An excess of lime can do no possible injury, and it is a positive advantage in that it whitens the trees and makes it easier to follow the work.

Good clean flowers of sulphur should also be used. The so-called "sulphur flour" now largely substituted at a saving of about one-fourth to one-half cent a

pound is not so good. In buying sulphur it is best to secure samples and prices from different dealers and then to buy in not less than barrel lots. Barrels usually hold a trifle less than 200 pounds. The large wholesale city druggists or manufacturers of chemicals can commonly quote the best prices.

Lime-sulphur is used at any time when the trees are not in foliage. Winter spraying is common in states south of Delaware and Kansas; but north of Mason and Dixon's line, where the lime-sulphur is more exclusively used, fairly late spring spraying is most effective. The work must stop however when the buds begin to open.

PARIS GREEN

For the omnipresent codling moth and for all leaf-eating insects some form of poison is employed, nearly always some form of arsenic. The most popular arsenical poison is undoubtedly paris green. This standard chemical (or mixture of chemicals) has certain positive advantages, and should generally be used by those who are growing fruit on a small scale. It is occasionally adulterated, but by buying of reliable dealers one can nearly always avoid trouble. However, as adulterated paris green is likely to do serious damage to the foliage, the fruit growers should be careful at this point. It is well to remember that paris green can be tested by dissolving in ammonia. Pure paris green dissolves perfectly, making a bright bluish solution. Impure paris green does not dissolve completely in ammonia, there being some sediment.

Paris green is now usually used in combination with some fungicide, as explained later; but when an insecticide only is needed, as to meet an invasion of

tent caterpillars, for example, it may be made up as follows:

4 ounces paris green
50 gallons water

The paris green will mix readily with the water, but does not dissolve. It is best to make up a paste of the green with a little water before putting it into the barrel. Some men find it advisable to add a small amount of lime, but with pure paris green this should not be necessary.

ARSENATE OF LEAD

In one form or another the arsenate of lead is largely taking the place of paris green. Probably the bulk of the spraying done by the largest and most up-to-date operators is done with this insecticide. It may be made from the following recipe:

4 ounces arsenate of soda (50% strength)
11 ounces acetate of lead
150 gallons of water

Put the arsenate of soda into a wooden pail with 2 quarts of water, and the acetate of lead in another wooden pail with 4 quarts of water, preferably warm. As these substances are very poisonous, it will be as well not to use a milk pail or one commonly used for the family drinking water. When the chemicals in both pails are dissolved mix them together with the 150 gallons of water, and the whole is ready for use.

Most fruit growers prefer to buy their arsenate of lead ready-made. Some of the commercial brands appear under trade names, as, for example, Bowker's "Disparene," which is simply an excellent grade of arsenate of lead. The ready-made article costs from

15 to 30 cents a pound. In hundred-pound kegs it can be bought for about 18 cents a pound. It is simply mixed with water, using 2 to 5 pounds to the barrel. For fighting the codling moth 3 pounds to 50 gallons of water is recommended. At this rate it is considerably more expensive than paris green; but the fact that there is less danger of burning the foliage, and the more important fact that the arsenate of lead will stick through all ordinary rain storms, probably justify this increased expense.

In using arsenate of lead it is best to make it up into a paste with a small amount of water. Then simply put the required amount into the spray tank and pump in the water.

ARSENITE OF LIME

A somewhat similar insecticide occasionally used is arsenite of lime. It is made as follows:

- 1 pound white arsenic
- 2 pounds fresh lime
- 1 gallon of water

Boil together in an iron kettle for 45 minutes to an hour and keep in tight bottles or fruit jars. When ready to use add 1 quart of this stock solution to 50 gallons of water. Some lime water should usually be added also.

This is the cheapest form of arsenical spray yet devised, costing in reality only from one-tenth to one-third what other arsenical sprays cost. As it is effective, it is worth considering, though most orchardists seem to prefer ready-made arsenate of lead on account of its easier manipulation and its sticking qualities. This arsenite of lime is best when used with bordeaux mixture.

SOLUBLE OILS

At the present moment there is much interest in the so-called soluble oils sold under proprietary names such as "target brand," "kil-o-scale," "scalecide," etc. These seem to be giving especially good results on young and medium-sized apple trees in southern and middle latitudes. They have not generally been found successful in the northern states, and it seems certain that they cannot be relied on anywhere to give results equal to lime-sulphur mixture properly made and thoroughly put on. They also cost from 50 to 100 per cent more than the lime-sulphur spray. Their great advantage is the ease with which they are made up. The oil is simply poured into the water with which (under favorable conditions) it mixes instantly, and the outfit starts immediately for the orchard. All the tiresome and supremely disagreeable work of making up the lime-sulphur is obviated.

Anyone who has many acres of apple trees south of Pennsylvania infected with San José scale ought to experiment carefully with fall and winter applications of soluble oil; but as the case stands at this writing he should make it a real experiment and be perfectly sure that the scale is being radically suppressed before committing himself to this form of insecticide.

COMBINED INSECTICIDES AND FUNGICIDES

In actual practice the custom is to combine an insecticide with a fungicide. Bordeaux mixture is the fungicide in almost universal use, and the various insecticides are mixed with this. What really goes through the spray pump, therefore, is bordeaux mixture plus paris green, or bordeaux plus arsenate of

lead. Other combinations can be used with equal facility, but these two are the most common.

These combinations give quite as good results as the same chemicals applied separately. In fact paris green is better when mixed with bordeaux, as the lime tends to neutralize the free acids, which sometimes burn the foliage. Again, bordeaux mixture is improved by the addition of arsenate of lead, as it sticks to the foliage much better. Of course there is no more labor required to put on both the insecticide and the fungicide than there would be needed to put on either one separately. The saving of labor is the chief item, and it is a very large one.

DUST SPRAYS

A few years ago considerable interest was aroused by the introduction of dust sprays, but these have now been almost abandoned. The chemicals are simply made up in dry form, very finely pulverized, and are thrown upon the trees from a powerful blower. Paris green is mixed with a little lime or with fine road dust or other practicable dry powder.

Dust spraying is easier and cheaper than liquid spraying; but experience everywhere shows that it is very much less efficient. It cannot be depended on to control fungous diseases to any extent. In fact, the only service which it can perform with any degree of efficiency is the control of the codling moth. Even in this it is less successful than equally careful applications of liquid insecticides.

On account of their lightness and portability the dust blowers can be handled in some orchards which are so stony and rough that ordinary spray pumps cannot be used. On such land the dust method of spray-

ing can be freely recommended; but it is the firm conviction of the writer that land too rough to admit of economical tillage and spraying should never be planted to apple trees. Some men seem to have a notion that land which is too rough and rocky for pasturing goats can be used for growing apples. The apples will grow well enough; but the growers who plant orchards on good land will soon teach these rock-bottom orchardists a hard lesson.

SOME GENERAL OBSERVATIONS

1. Spray thoroughly. Careless work in any line of fruit growing does not pay, but nowhere else is thoroughness so absolutely essential as in spraying. Careless spraying may even injure the trees.

2. Spray every year. That excellent gentleman who "took a bath every Fourth of July whether he needed it or not" is the model for the sprayman to follow. There are seasons when fungi and insects seem to be absent. The fruit grower is then strongly tempted to save the expense of spraying, but it is a great mistake to do so. The spraying done in a good year counts in the bad years, for the effects of proper spraying are not all seen the first year.

3. Spray intelligently. Some men use paris green to kill aphid or bordeaux mixture on San José scale. It is absolutely impossible for either solution to give the slightest result in these cases. Spraying is a complicated business and unless a man knows exactly what he is trying to do, and why, he is apt to waste his entire time and labor.

4. Do not spray while trees are in bloom. It injures the blossoms, and it also poisons the bees which are necessary to fertilize the flowers.

5. Solutions or mixtures containing copper sulphate, arsenate of lead or corrosive sublimate should always be made up or stored in wooden, glass or earthen vessels. Pump cylinders and other working parts of the machinery should be of brass.

6. Sulphur solutions or the lime-sulphur mixture should be made in iron or wooden vessels; and it is better to have pump linings of iron rather than of brass.

7. "Handle with care" all substances used in spraying, as most of them are poisonous—some of them very much so. Everything should be kept correctly labeled and preferably put away under lock and key.

THE SPRAYING CAMPAIGN

It has been seen that the fruit grower cannot usually wait till a disease or an insect pest becomes established in his orchard, then diagnose the trouble and apply some specific remedy. The best practice is to lay off a campaign which is intelligently planned to meet all probable troubles, and then to carry out this plan with vigor and thoroughness. In all ordinary circumstances the year's spraying will not vary much from the following program:

1. In orchards infested with San José scale spray in late winter or early spring with lime-sulphur (page 137), or possibly with soluble oils (page 144).

2. In orchards not treated with lime-sulphur apply copper sulphate solution (page 136) just before the buds open. This treatment is important.

3. Spray again just before the blossoms open, using bordeaux mixture (page 131). If bud moth or similar insects are on hand, add paris green to the bordeaux (page 141). This spraying may be omitted.

4. Spray immediately after the blossoms fall—never while the blossoms are open—with bordeaux combined with some good insecticide (page 144). Next to No. 2 this is the most important spraying of the year.

5. Apply the same solution—combined fungicide and insecticide—two weeks later.

6. Repeat No. 5 after an interval of two weeks.

This program amounts to three or four sprayings each year. This is considerably above the average number actually given, even by successful fruit growers. Still there are practical men who give more than this number and who make money by it. Almost every apple grower will say that he does not spray as much as he ought to. It is very rare for any man to say that he has sprayed too much.

Additional sprayings, beyond the number outlined in the foregoing program, may be required in emergencies, such as a very rainy season with late development of scab, or a late outbreak of bitter rot.

XVI

HARVESTING AND MARKETING THE FRUIT

It is generally conceded that the methods used in harvesting and marketing the crop have about as much influence on the profits realized as the methods of growing. In fact, this commercial part of the subject is of such great importance that the present writer has already devoted an entire volume to it.* The principal portion of the present discussion is adapted from a shorter pamphlet on the same subject prepared by the present writer.†

Methods of handling the apple crop have been changed very greatly in recent years. Those who have any ambition to make money by handling apples on a large scale will be obliged to adopt up-to-date methods which handle the largest possible quantity of fruit in the best order at a minimum cost.

PICKING APPLES

It is a delicate question to determine just when apples ought to be picked. There are some reasons why it is desirable to pick as early as possible. Early picking reduces the danger from wind storms and saves

*F. A. Waugh, Fruit Harvesting, Storing, Marketing; Orange Judd Co., New York, publishers.

†Packing and Marketing Fruits, published by the Fruit Grower Co., St. Joseph, Mo.

considerable loss from windfalls under all circumstances. On the other hand, apples color up best when they are left comparatively long on the trees. Many varieties do not color thoroughly until after the leaves thin out considerably. Some varieties can be left to advantage long after the first frost. This depends a good deal, of course, on the variety itself and its habit of holding on the tree. Northern Spy and Ben Davis hold on extremely late, while Wealthy and Wagener are apt to fall as soon as they are ripe, or even before.



THE APPLE HARVEST

If apples are to be sent to storage another factor comes into consideration in determining the proper time for picking. It used to be thought that apples should be picked before they were mature in order to have them hold well in cold storage. The extensive experiments of the Department of Agriculture in recent years have shown that this idea is wrong. Nearly all varieties stand cold storage best if thoroughly ripe and well colored, but not overripe. Such varieties as

are subject to scald should be given special attention in this respect, as it is found that the scald is worse on apples picked before maturity. Thoroughly ripe apples, well colored, are not nearly so much subject to scald as are green, uncolored specimens.

The importance of having the fruit nicely colored and ripened when picked is so great that many of the best growers who make a specialty of fancy grades have adopted the practice of picking the apple trees over two, three, or even four times. At each picking they take off such fruit as is ripe, well colored, and up to size. The balance is allowed to hang, and it is found that the apples will increase greatly in size toward the end of the season and will color up and otherwise improve long after the first lot would have fallen to the ground. Of course, this method of picking over the trees several times would be too expensive with cheap fruit and with all poorer grades of apples. It is strongly recommended, however, for early varieties and fancy grades.

There have been all sorts of mechanical pickers advertised, but none has ever become popular. They are of two kinds. The first kind, intended to pick a single apple at a time out of the higher branches, consists of some sort of a pocket hung on the end of a long pole. These contrivances are too slow and cumbersome for any commercial work. The second style presents some modification of the old practice of shaking apples off the trees. It furnishes some kind of a spread held under the branches upon which the apples are shaken down. While the method is cheap enough to make it commercially available, it is too rough for the exacting demands of present-day business. By all

means the best way of putting up commercial apples is to pick by hand from the trees.

There is something of a knack in picking apples, but unfortunately expert apple pickers are not often to be hired. The fruit-grower is usually obliged to put up with ordinary day labor and to make up in the carefulness of his own supervision the lack of experience on the part of the pickers. Apple pickers usually get the prevailing day wages; that is, from \$1 to \$1.75 a day.



PICKING BASKET

Apples are sometimes picked by the bushel or barrel, but this practice is not common and is not to be recommended. When it is indulged in, the price paid is from 8 to 15 cents a barrel. The writer has recently been told, on pretty good authority, of a picker who picked 100 barrels of apples from the trees in one day. Any such slam-banging work as that ought to

be prohibited in any well-regulated orchard. The ordinary picker will pick from 12 to 20 barrels a day.

Apples should be picked with the stems on and not torn from the trees. Where the stem is pulled out of the apple, the skin is usually broken and an opportunity for decay given.

Some pickers prefer to pick into a sack tied over the shoulder. The best contrivance, however, is undoubtedly the swinging-bail half-bushel basket. This is

made in various styles, usually of oak or elm splints. These baskets are now used in such large quantities that they can be bought at very reasonable prices. If fine fruit is to be handled with special care, it is worth while to have the baskets padded inside. Each basket should be furnished with a hook made by bending a strong $\frac{3}{8}$ -inch wire into the form of a very crooked S. This can be hooked over the limb of the tree so as to leave the picker free to use both hands. When the picking is being done in large trees this same hook allows the basket to be let down to the ground by a strap or rope, where it is emptied by an assistant, thus making it unnecessary for the picker to climb up and down the tree for every basketful.

Picking is greatly expedited by the use of suitable ladders. The best ones are of two forms. The first form is the stepladder, which should always have three legs instead of four. These stepladders are made in large quantities now for this particular kind of work. It is probably cheapest to buy ready-made ladders if any considerable number is wanted. Of course, any handy man can make one or two such stepladders if that is more convenient than to buy them.

The second type of ladder used in apple picking is adapted for taller trees. It is of the ordinary form; that is, with two rails. Very often the two rails are brought together at the top, making the top pointed. This makes it easier to adjust the ladder securely into or against the top of the large apple tree. This ladder should also be as light and strong as possible. They are made in large numbers and sold at low prices.

Various practices prevail with regard to the immediate disposal of apples when they are taken from the

trees. Sometimes they are placed in piles on the ground. Sometimes they are put into barrels without sorting and left in the orchard; sometimes they are put unsorted into barrels and carried to the temporary storage house; sometimes they are immediately sorted, barreled, headed up and sent to storage. If the stock is going to cold storage, which is now the customary method, the last named plan of handling the fruit is undoubtedly the best. It certainly is a mistake in all cases to leave the fruit on the ground even for a few hours. If there is good storage at home and handy by, it is a very good practice to put the apples into barrels unsorted and take them immediately to the storage house, where they can be sorted and packed more at leisure. Under all circumstances, however, they ought to be put into as cool a place as possible with the least possible delay. In handling fancy grades of stock in barrels, it is probably best to pick the fruit, sort, pack and head it up at once and put it immediately into cold refrigerator cars, sending these off as expeditiously as possible to the cold-storage plant. This method is actually practiced on a large scale by some of the best growers. There is no extraordinary expense in it; in fact, nothing out of common except the expense of the refrigerator cars, which has been shown to be profitable with good fruit.

When apples are taken to the temporary storage houses without sorting, it is best to grade them over as soon as convenient. This is more necessary if the grade of the fruit is low. If there is considerable fungus, they should be sorted at once, all first-grade fruit being put by itself. In case the fruit comes from the trees in extra good condition, with no fungus and very few culls, there is not so much urgency in this early

sorting. In general, however, it is a mistake to leave the fruit ungraded, as is sometimes done, up to the time when it is sent to market, which may be late in the spring.

SORTING APPLES

The grading of the fruit is extremely important from every point of view. There is hardly anything which affects the price secured more than this. Many fine apples bring outrageously low prices because they are carelessly, ignorantly, or deceitfully graded and packed.

Proper grading requires good judgment and considerable experience. The man who sorts and packs the fruit should be the expert of the gang. The manager can afford to pay him good wages, although, as a matter of fact, such men rarely secure more than \$2 a day.

Some men spread the fruit on the ground for sorting. It is a good deal better to have sorting tables, which should be 3 feet wide and 6 to 8 feet long. They should be 8 inches deep, and should be put on trestles or legs so as to stand about 3 feet 4 inches from the ground. It is good policy to have the bottom and sides padded to prevent bruising of the fruit. We have frequently seen the bottoms made with slats, the idea being to allow the leaves and other rubbish to sift through. This is not a good practical construction. In the first place, it weakens the bottom, and in the second place, these slats are always inclined to bruise the fruit more or less. It is easy enough to dispose of the rubbish in some other way.

On the table like that here described from two to four barrels of fruit can be spread out at once. It is

desirable to have a considerable quantity of fruit within the reach of the man who is sorting in order that he may work rapidly and secure a uniform grade.

Some of these sorting tables are made with a chute or spout at one end, usually furnished with a cloth spout leading into the barrel, through which the apples



PACKING AND HEADING BARRELS

are allowed to run. If managed with some care the apples can be handled in this way without severe bruising. In the judgment of the writer it is much better, however, to sort the apples into baskets. These should be of the kind already described for picking. The half-bushel swinging-bail basket can be let down into the

barrel and the fruit poured out with a minimum of bruising.

It is desirable that sorting be done as much as possible by one man. Frequent shifting about on this job always gives an uneven grading of fruit.

The question of whether a certain apple should be put into the first or into the second grade is largely a matter of judgment in the end. It depends also upon the run of the lot. If the apples are all running large, then medium-sized specimens should be put among the seconds. In other words, it is more important that a barrel of apples should be uniform in size than that they should attain any particular size. The question is relative rather than absolute.

Nevertheless the Apple Shippers' Association has adopted a rule, which is departed from when necessary, and which is enforced in critical cases. Their rule is as follows:

"The standard for size for No. 1 apples shall be not less than $2\frac{1}{2}$ inches in diameter, and shall include such varieties as Ben Davis, Willow Twig, Baldwin, Greening, and other varieties kindred in size. The standard for such varieties as Romanite, Russet, Winesap, Jonathan, Missouri Pippin, and other varieties kindred in size shall not be less than $2\frac{1}{4}$ inches. And, further, No. 1 apples shall be at time of packing practically free from the action of worms, defacement of surface, or breaking of skin; shall be hand picked from the tree, a bright and normal color and shapely form.

"No. 2 apples shall be hand picked from the tree; shall not be smaller than $2\frac{1}{4}$ inches in diameter. The skin must not be broken or the apple bruised. The grade must be faced and packed with as much care as No. 1 fruit."

THE APPLE BARREL

Before going on to see how apples are packed, it will be best to stop a moment to consider the standard apple packages. Of these the barrel stands first.

The standard American apple barrel has the following dimensions: diameter at top, $17\frac{1}{4}$ inches; circumference at middle, 64 inches; length of staves, $28\frac{1}{2}$ inches. This is known everywhere as the standard apple barrel, or the 100-quart barrel.

In Nova Scotia, and occasionally in Ontario, another barrel is used considerably different from the one just described. It is just a trifle longer, but the most distinctive difference lies in the fact that the staves are straighter. The barrel is made nearly cylindrical. The dimensions of the Nova Scotia barrel are: diameter of top, $17\frac{1}{2}$ inches; diameter at middle, 19 inches; length of staves, 29 inches. The two barrels may be more readily compared in the following table:

COMPARISON OF NOVA SCOTIA AND AMERICAN APPLE BARRELS

	Diameter at Top	Diameter at Middle	Length of Staves	Capacity
American	$17\frac{1}{4}$	20 1-3	$28\frac{1}{2}$	100 Quarts
Nova Scotia	$17\frac{1}{2}$	19	29	96 Quarts

The American apple barrel is a stronger package than the Nova Scotia barrel and will stand rough handling, such as loading on and off cars and trucks, better than the straight stave barrel. When it comes to shipping by boat across the Atlantic, however, the Nova Scotia barrel has the call. This is because the

longer, straighter barrel, when stowed on its side on shipboard, does not rock so much as the barrel with bended staves. It therefore keeps the fruit in better condition in going across.

There is, of course, a certain advantage to the grower in using a 96-quart barrel in place of a 100-quart barrel. Four quarts of apples are worth saving. At this rate a man would gain one barrel in 25, which would be a saving of 4%. In most factories any adjustment which accomplishes a saving of 4% is considered well worth making. A smaller barrel furnishes an even three bushels, which is all the purchaser is really entitled to. The question of adopting the 96-quart barrel in the United States has often been discussed, but the proposition has never made much headway. It will doubtless be a long time before we ever come to it.

Apple barrels are made out of all sorts of lumber, usually from such timber as is not very valuable for other purposes. Elm is used to a considerable extent and makes a good barrel. Hickory used to be used, but it is now too expensive. Hemlock and spruce are used to some extent; so is cheap pine. Chestnut and birch are occasionally worked up into barrels. The hoops are usually made out of the same stock, although occasionally timber which is not fit for anything else is worked up into hoop stock. In some parts of the country split hoops are used, in which case young birches and large alders are worked up.

The best method for one buying apple barrels is to get them knocked down, staves, heads and hoops separate. It is best, of course, to buy this stock in car lots. It is then delivered on the farm of the grower to be worked up into barrels on the premises. A small

cooper shop can be easily rigged up. In the apple-growing sections itinerant coopers go about from farm to farm during the summer and autumn working this stock up into barrels. A good handy man on the farm, with a little practice, can learn to put up apple barrels himself. A small kit of tools is required, but nothing very elaborate or expensive. The apple barrels made up in this way cost all the way from 15 to 35 cents each, depending very largely, of course, on the original cost of the stock. During the last two years stock has been very scarce and high, owing, it is said, to the operation of a barrel trust. At present the production of barrel stock seems to be catching up with the demand, and the tendency is toward easier prices.

In many places it is customary to use second-hand barrels for packing apples. The common flour barrels are the ones usually impressed into this service. A common flour barrel has the same capacity and dimensions as the standard apple barrel, and answers the purpose fairly well. However, a second-hand barrel can never be made to look as good as new. In many cases dirty barrels are bought and are used without proper cleaning. In such cases they detract greatly from the appearance of the fruit, and the commission man knocks off the price accordingly. The apple grower who has a considerable crop to handle cannot afford to bother with flour barrels. He should by all means use fresh made apple barrels.

APPLE BOXES

During recent years there has been a good deal of discussion as to the merits of the apple box. Many growers believe that there is a future for apples

packed in this way. While the use of the box has been strenuously objected to in some quarters, especially by the commission men and fruit dealers, it has



LEVER BARREL PRESS

not always been clear that their advice was disinterested. In fact, it is common knowledge that in some cases they have bought apples in barrels and re-

packed them in boxes, making quite a profit for themselves thereby.

The writer feels justified in relating here an item of personal experience. A few years ago we had some Gravenstein, McIntosh and Fameuse apples ready for market in October. We wrote to the commission men with whom we were doing business at that time—a thoroughly reliable firm, by the way—asking them if they would advise us to ship in boxes. Their reply was about as follows: “The fruit is yours. You can do as you please with it. Our advice would be, however, not to use any boxes.” Inasmuch as we were anxious to learn how the fruit would handle, and as we had the boxes on hand, we divided the shipment, sending one-half in barrels and one-half in boxes. The fruit was all of the same grade, but that in boxes was wrapped in paper. The whole lot was sent to the commission man whose advice has just been quoted. When the returns came back we found that the barrels had sold for \$2 each, which was the top quotation at the time; but the boxes had also sold for \$2 each. In other words, one bushel of apples nicely wrapped and packed in boxes brought just as much as three bushels of the same fruit in a barrel.

The three boxes cost 45 cents. A barrel at that time was worth 35 to 40 cents. A little more time was consumed in packing the three boxes than in packing one barrel. The cost of the paper wrapping may be fairly disregarded.

The great advantage of the box lies not so much in the fact that it displays the fruit to better advantage, for it does not always do so, but in the fact that it presents a quantity of fruit which many consumers prefer

to purchase. There are very few city families who find it convenient or economical to buy a barrel at one time. The quantity is more than the family will consume without waste, and there is no place in the house where there is room for the barrel to stand. A bushel of apples, however, is not too much for the smallest family, and a neat square box can be easily stowed even in a New York city flat.

Experience has demonstrated that the use of the apple box will be extended. This does not mean, however, that it will supplant the apple barrel. It certainly will not do so, at least for many years to come. The apple box must be used only for fancy grades of fruit. This is not so much because the package costs more as because the expense of selling it is somewhat greater and because the person buying a package of this kind expects it to contain something good. If the purchaser buys a box of apples and finds the fruit inferior, his resentment is much greater than if he has been cheated on a barrel of apples. Most purchasers have grown accustomed to being more or less swindled on apples in barrels.

A great many different boxes have been proposed. These have been of different sizes, different forms, and differently constructed. We seem to be settling down rather rapidly, however, to a bushel box of standard size and construction. This box, which is now the most common, has the following inside dimensions: 10x11x20 inches. This gives a capacity of 2,200 cubic inches. A standard bushel contains 2,150.42 cubic inches, so that the box furnishes a little over the standard struck bushel (not a heaping bushel).

These boxes are made with the ends of $\frac{3}{4}$ inch

stuff, and with the top, bottom and sides of lighter stuff. These last may run anywhere from $\frac{1}{4}$ to $\frac{1}{2}$ inch, but $\frac{3}{8}$ inch stuff is about right

There have been some experiments recently with smaller boxes, especially with half-bushel sizes. The



HEADING UP THE BARREL—SCREW PRESS

writer feels confident that something of this kind will eventually find a place in the market, but nothing yet has been accomplished which can be given general recommendation.

The bushel basket has been used to some extent, especially in the Chicago market, for apples, and has some advantages. It is easy to handle and pleases the customer. Such bushel baskets with covers cost about \$12 a hundred. Half-bushel baskets of the same form cost from \$10 to \$11 a hundred.

PACKING APPLES

A man who packs apples should have some experience, and the judgment born of it, in order to do his work well. Next to the man who grades the fruit, the one who packs it has the greatest responsibility. Many a sale of good fruit has been spoiled by poor packing. When fruit is to be shipped some distance, as across the ocean, the packing must be irrefragable. If barrels are poorly packed the fruit works loose, becomes bruised, and in many instances quite worthless.

In packing a barrel with apples the barrel is placed on its head with the bottom out. Some good clean apples are put in for "facers." It is best to pour in 20 to 30 such apples at the start—just about enough to cover the head. The packer then places these in even circular rows, beginning around the outside and working in, setting each specimen with the stem down. It is important to see that the apples in this first tier—the facers—fit snugly together. Then a second tier is put on, facing stems down like the first. Now the real filling of the barrel begins. The sorted

fruit, preferably placed in the swing-bail half-bushel basket already recommended, is poured in. This basket can be let down into the barrel and emptied with the least possible disturbance of the faced layers. After each half bushel of loose fruit has been poured in the barrel should be vigorously shaken. This shaking is essential. It settles the fruit together, and prevents the otherwise disastrous loosening when the barrel is shipped. When the barrel is practically full the top layer (which will be the bottom layer after the barrel is packed) is faced stems out in as neat a manner as possible. When the apples are all in and this last layer of facers on, the fruit should stand up even with or very slightly above the top of the barrel.

The head (or what is really the bottom of the barrel) is then put in place. A barrel press is now necessary. There are two types of barrel press in common use—the screw and the lever press. The writer prefers the latter. With either one the heading proceeds in the same manner. The upper hoops of the barrel are slightly loosened. The head is pressed down even with the chines, the hoops are driven home, and some sort of cleat is tacked in to help hold the head in place.

The barrel is then marked with the stencil of the grower or packer, and with the name of the variety and grade. Sometimes it is also marked with the name of the dealer to whom it is to be shipped. It is then ready for delivery, either to the buyer or to the storage house.

In packing apples in boxes the fruit is all put in by hand, especially when it is to be wrapped in paper. Care must be taken to get the boxes full. It is even harder to make a box of apples full and tight than a barrel. Some shippers cover the packed fruit with

paper and make it solid by putting in a quantity of excelsior next to the cover. This is practiced more especially when sending boxes across the ocean, but is not to be generally recommended.

When apples are nicely packed in boxes they should go in rows and tiers just as oranges are packed. On the Pacific coast, where all these tricks are better understood than on this side of the Great Divide, they do this thing excellently well. Mr. E. C. Dickerson of North Yakima, Wash., explains his methods as follows:

“There are some 30 or 40 commercial sizes of apples, covering all the varieties and their various grades, which can be packed into the standard apple box in 30 or 40 different styles. For commercial packing and shipping requirements most of the ordinary grades of apples grown can be handled in seven or eight different styles of packing, of which six different styles are shown and described below.

“Figure 1 shows a four-row box of apples. This box is the largest sized apple than can be packed into the four-row grade. The box contains just 96 apples. There are nine grades of the four-row apple, the smallest of which is shown in Figure 2 and contains 128 apples. Every layer in this box of 128 is packed in the same manner as that shown by the top layer. In the box containing 96 the width is too great to allow of their cheeks being all turned up, so in the layers below, according to the size of the apples, one or more of the layers are placed stem down.

“Figure 3 shows the largest apples that can be packed into the five-row grade. The box contains just 140 specimens. This grade cannot be packed

FIG 1.

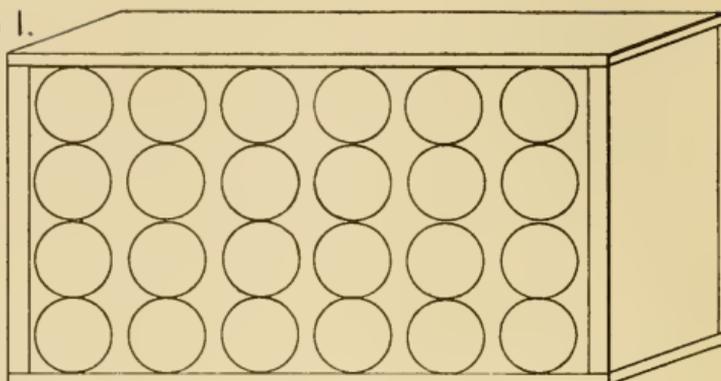


FIG 2

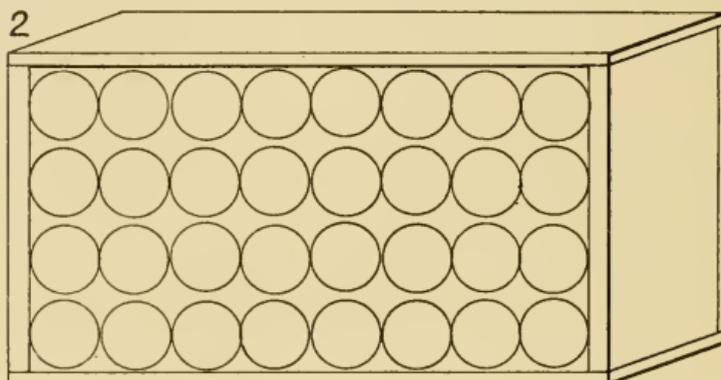
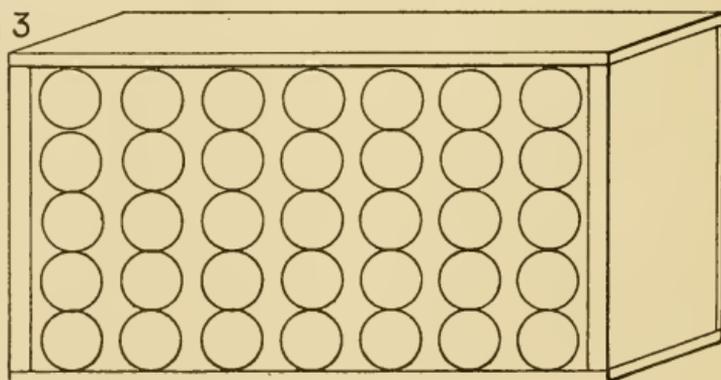


FIG 3



DIAGRAMS SHOWING METHODS OF BOX PACKING

FIG 4

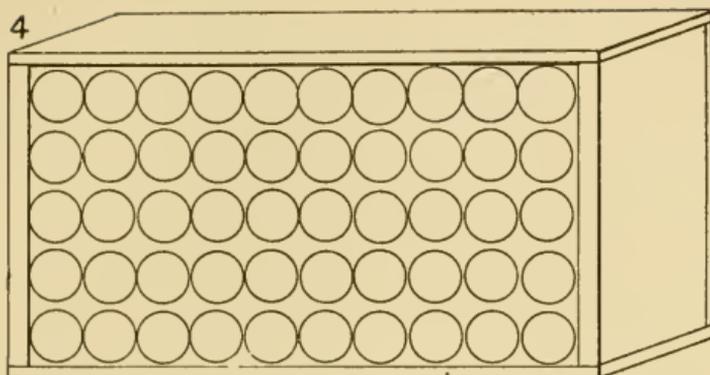


FIG 5

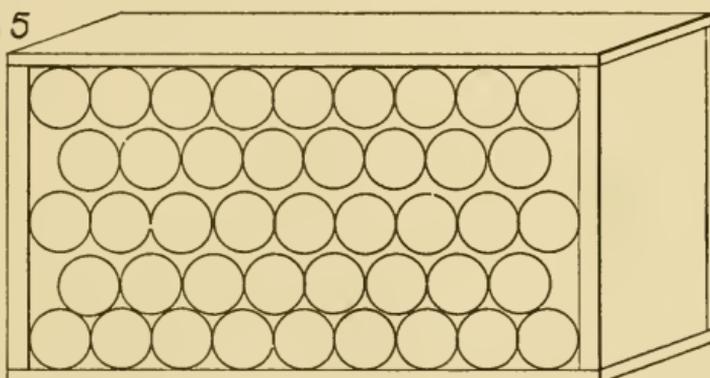
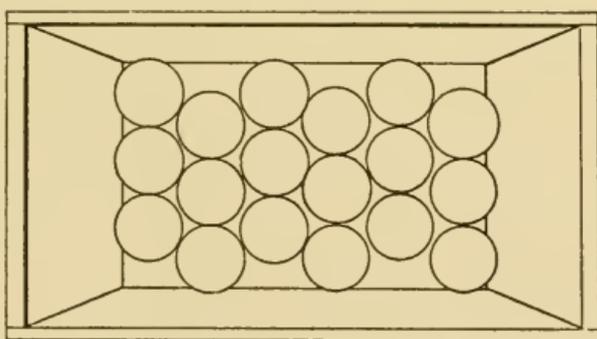


FIG 6



DIAGRAMS SHOWING METHODS OF BOX PACKING

with a long and narrow apple, as there must be four layers in this box.

"Figure 4 shows the smallest five-row apple that can be packed in this grade. The box contains five layers and 250 apples. All the layers in this grade are placed in the same manner as shown in the top layer. This grade cannot be packed with a long apple. The five-row grades, which are sometimes called straight fives, are found in 23 different grades reaching from 140 down to 250 specimens in each box.

"Figure 5 shows an odd grade of five-row apples. Without this style of a pack it is almost impossible to pack all the apples from the orchard and have them all packed neatly and correctly. The box shown in Figure 5 contains 213 apples. In this grade the center of every apple in the third and fifth layers comes directly over the center of its corresponding apple in the first layer. The center of every apple in the fourth layer comes directly over the center of its mate in the second layer. There are three grades of this style. In one the first row will contain eight apples, the second seven, the third eight again and then seven and eight, making a total of 188 apples in the box. In the second grade of this style, the first, last and every row will contain eight apples, with the box holding just 200 specimens. In the third grade of this style the first, third and fifth rows will contain nine apples, while the second and fourth will contain only eight, making the box hold 213 apples.

"The sixth and last style of packing shown is represented by Figure 6. This box will contain 72 apples. Only the first of its four layers is shown. The cores of all apples in the third layer will come directly

over their mates in the first layer, but not over the cores of any apples in the second layer.

“Nothing has been said of the various grades of six-row apples, as they are too small to offer to the apple-eating public, though some pack and ship them to the penny fruit stands. The top layers of the apples in any of the grades must be high enough that when the cover is nailed on, the cover will touch each and every apple in that layer and touch it hard enough to compel every apple in the box to remain in touch with its neighbor apple in the box, the walls of the box itself, or both, as the case may be, throughout its entire period of transportation.

“When a box is finished packed the apples at the end of the box must not be more than 1 inch above the top of the box, while the center of the box should be from 1 to 2 inches higher, so as to make a beautiful curve for the top of the box, which helps to hold the apples in the box together more snugly. Though every person has not the gift for the making of a good apple packer, most of them after a careful reading of the above can after more or less practice succeed in packing neatly and rapidly. But, remember, practice makes perfect. In box apple packing rapidity and perfection do not go hand in hand.”

APPLE STORAGE

The storage of apples presents one of the largest factors in the modern apple business, because the bulk of the trade is with winter fruit, which is always stored for a greater or less period. Even from the first there has been some storage. In olden days apples used to be stored in piles in the orchard, in pits in

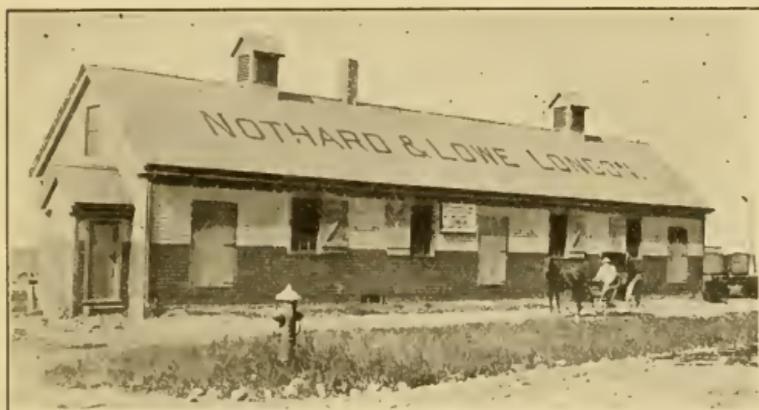
the ground, in bulk in the haymow, in bins in the cellar, and in various other ways. Nearly all of these old-fashioned ways are still practiced to some extent, although they have very little influence on the modern apple business.

Following these crude methods of storage there came into practice a few years ago different methods of handling apples in specially made storage houses. At the beginning these were seldom or never supplied with artificial refrigeration. The theory of construction was simply to provide a well-insulated wall and then to cool down the storage chamber by ventilation. Such houses or storage compartments are now all classed together under the name "common storage," which is distinguished from "cold storage," the latter referring to such houses or chambers as are supplied with artificial refrigeration.

There has been a strong tendency in the last few years to do away with the common storage in favor of the genuine cold storage. Great improvements have undoubtedly been made in the process of cold storage, and the matter is much better understood than it was a few years ago. Such storage is therefore both safer and cheaper. Nevertheless the common storage has not altogether gone out of use. One of the largest dealers in New York state—a man of wide practical experience in all systems of storage—recently told the writer that he would as soon have apples in common storage as in the best cold storage. This is perhaps an extreme view, but it shows that the difference between the two systems is not so great as we have sometimes been led to believe.

The construction of a house for common storage may best be understood by examining one or two con-

crete cases. As one example, we may take the storage house of Mr. Charles L. Green, of East Wilton, Maine, built in 1903. This building is 30x40 feet, with 12-foot posts upon the sills. It also has a cellar or lower story dug out of a gravel bank and facing toward the south. There is a large door to this basement story so a load of apples can be backed in without unloading. The cellar walls are built of quarried granite laid solid in cement. The underpinning is of granite



A COMMERCIAL VENTILATED STORAGE HOUSE
IN NOVA SCOTIA

laid in Portland cement and lined with brick. The basement will hold 1000 barrels, and the first floor will hold approximately the same amount.

The building is sheathed on the outside with matched hemlock covered with thick sheathing paper and this in turn covered with clapboards and well painted. The studding were also sheathed again inside and then a new course of studding set around inside of the first and sheathed again. This gives two dead air spaces and three matched sheathings besides

the paper, clapboards and paint. The floor between the storage room and the cellar is double, with hemlock for the under course and matched birch on top with heavy paper between. Both storage rooms have double doors and windows with matched board blinds inside. There is an attic room which will accommodate 1,200 empty barrels. The building cost \$1,200.

Another very excellent building for the common storage of apples which has been frequently described and which is certainly a model of its kind is that owned by Mr. T. L. Kinney, of South Hero, Vermont. This house was built in 1888 and stands 30x50 feet on the ground. It has a basement which will accommodate 1,000 barrels, and the main floor will receive an equal number. There is an attic for the storage of empty barrels, cooper's stock, etc. The walls are constructed in the following manner: The studding are 3x4 inches. On the outside is a course of 1-inch matched pine covered with building paper and again with clapboards. On the sides of the studs small furring strips are run in. Upon these a lath and plaster coat is made from stud to stud. This produces a double dead air space. On the inside of the stud is another 1 inch course of matched pine covered by building paper and by $\frac{1}{2}$ -inch boards all over the inside. There are glass windows and heavy matched board blinds. This house cost \$1,500 and has been successful.

Various other houses more or less like the two here described have been built in all parts of the country. So far as the writer knows these have proved uniformly successful in the northern states where they have been well built and intelligently managed. In

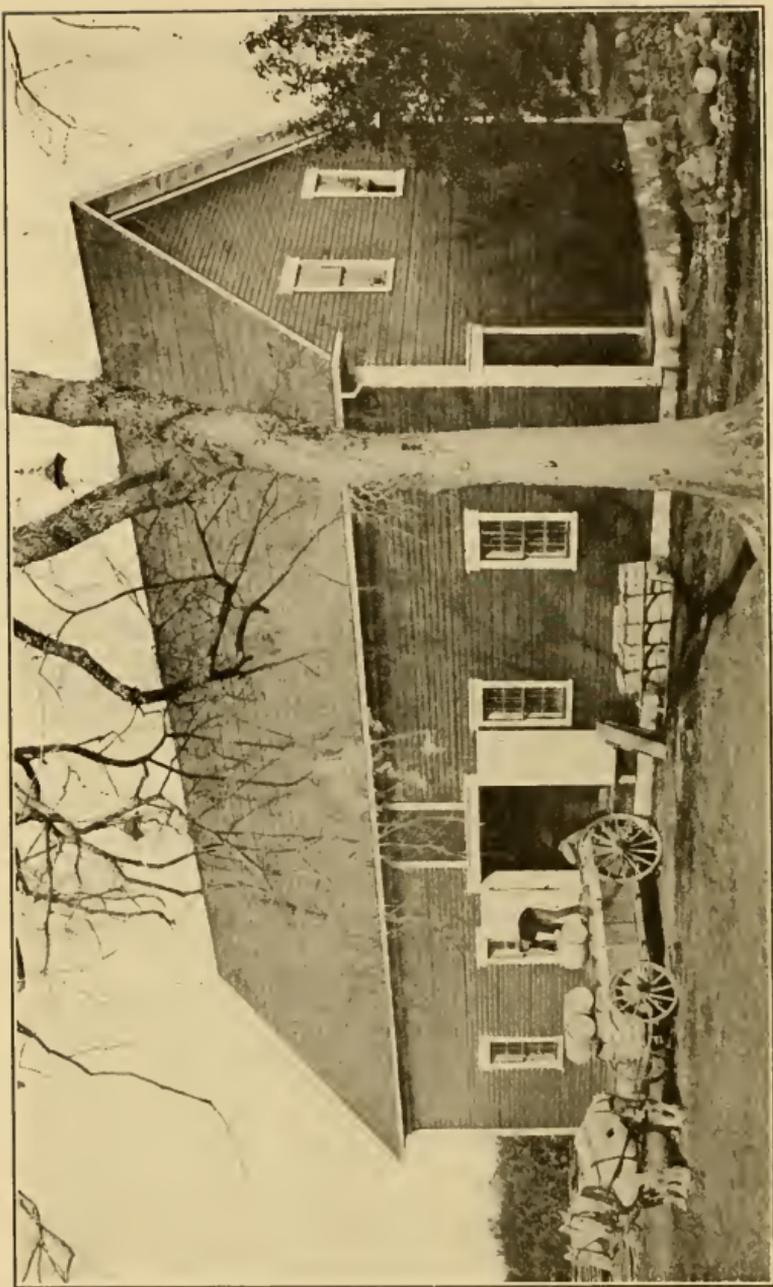
the southern states they are less satisfactory, and in any case they are unreliable when mismanaged.

The two important things to be looked after in building these houses for common storage are (1) insulation, and (2) ventilation.

Insulation is provided as described above by making very tight walls with dead air spaces. Formerly it was recommended to fill the spaces with sawdust or some similar material. This is now known to be inadvisable.

Ventilation should be secured by having a reasonable number of windows which may be easily opened and shut. These should be near the floor or else special ventilators should be provided at the floor level, opening on all sides of the building. An adequate discharge for warm air must also be provided from the upper part of the storage room. This is usually secured by ventilating shafts running from the storage room to the roof. A circulation of air can be secured at critical times with this construction by lighting a lamp and placing it on a small shelf in the ventilating shaft. The windows of such storage houses are opened at night when the temperature is low and are closed early in the morning before the thermometer goes up. In this way a storage house can be thoroughly cooled off and can be held at a very uniform temperature when once it is cooled. Of course the cooling is not so positive as with artificial refrigeration, nor can it be so quickly accomplished.

The construction of cold storage houses with artificial refrigeration is rather a complicated matter, which even the refrigeration engineers do not understand any too well. It would be going too far to take



A GOOD PRIVATE STORAGE HOUSE ON THE FARM

up that matter here, especially as very few apple growers ever undertake to build such storage houses.

The ordinary practice in dealing with cold storage is for the grower or buyer to send the apples to a refrigerating house in the city. Space in these houses is rented. The ordinary price is from 30 to 50 cents a barrel for the season. A certain temperature is guaranteed. The apples may then be removed whenever the owner desires.

It should be clearly understood by every one who undertakes the cold storage of apples that the function of the storage house is merely to maintain a uniform temperature of a desired degree throughout the compartment and during the storage season. Cold storage will not make number one fruit out of number two, nor will it altogether prevent the natural process of deterioration. It simply checks the ordinary processes of decay. It appears that many persons have expected too much of cold storage in the past.

While it is not necessary for the apple grower to know about the different systems of mechanical refrigeration, it is, nevertheless, a matter of considerable interest to him. Storage rooms are sometimes cooled directly with ice, although the direct cooling systems are not in very common use. Usually the rooms are cooled by the evaporation of the liquid gases. The gas is allowed to evaporate in or near the storage room and during its evaporation it takes up the heat from the room or fruit, thereby lowering the temperature.

The following description of the methods usually employed is taken from G. Harold Powell's bulletin entitled "The Apple in Cold Storage."

“The refrigerating gases generally used are anhydrous ammonia, sulphuric acid, and carbonic acid (also known as carbon anhydrid) and carbon dioxide. The cold temperature in the warehouses is usually produced by either of two methods, commonly known as the compression and the absorption systems.

“The compression system takes its name from the fact that the refrigerating gas—whether ammonia, carbonic acid, or sulphuric acid—is first compressed in a machine called a compressor. Heat is generated by the compression; the gas is then cooled and condensed in pipes or coils called the condenser, either immersed in water or having water running over them, and this converts the gas into a liquid. The liquefied gas then passes an expansion valve to pipes or coils called the refrigerator cooling coils or cooler, where it is evaporated by the heat which is withdrawn from the surroundings. The gas formed by the evaporation of the liquid returns to the compressor, is again condensed, then re-evaporated, and the cycle of refrigeration is repeated over and over.

“In the absorption system the gas is obtained by heating strong aqua ammonia in a still, thereby driving off the ammonia gas. The gas is then reduced in a condenser to a liquid in a manner similar to the compression system. The liquefied ammonia produces refrigeration by evaporating in the cooling coils, and the gas is then absorbed by weak aqua ammonia in coils called an absorber. The resulting strong liquor is then pumped back to the still. The cycle of refrigeration is repeated continuously, and consists, first, in the generation of a gas by heating strong aqua ammonia in a still; second, in condensing the gas which is deposited from the water to a liquid

in the condenser coils; third, in its evaporation to a gas in the cooling or refrigerator coils; fourth, in its absorption by the weak aqua ammonia in the absorber; and fifth, the ammonia liquor is piped to the still and redistilled.

“There are three general methods of producing the desired temperatures in cold-storage rooms, and these are known as the direct-expansion, the brine-circulating, and the indirect or air-circulating systems. All three systems may be used in a cold-storage plant, and in a given room or compartment the air-circulating system is sometimes used in connection with the brine or the direct-expansion systems.

“In the direct-expansion systems, the liquefied gas evaporates directly in the cooling refrigerator coils or pipes which are placed in the refrigerator rooms. The heat used in the evaporation of the gas is absorbed from the room or from its contents, and the temperature is thereby reduced. The gas then returns to the compressor in the compression system, or to the absorber in the absorption system, and after being distilled in the latter case begins the refrigerating cycle anew.

“In the brine-circulating system, the liquefied gas, instead of evaporating directly in coils in the storage room, evaporates in pipes surrounded by brine, or in a brine cooler. The heat used in the evaporation of the gas is absorbed from the brine rather than from the room and its contents, as in the direct-expansion system. The cold brine is then pumped to coils in the storage room and the heat of the room and its contents is absorbed by the cold brine. The warm brine is then returned to the tank or cooler from which it started and is recooled, while the gas returns to the

condenser or to the absorber to renew the cycle of refrigeration.

"In the indirect or air-circulating system the air in a well-insulated room, which is sometimes called a coil room or a 'bunker room,' is first cooled, either by the direct-expansion or by the brine-circulating system. The cold air of the coil room is then forced through ducts to the storage rooms. After passing through the storage rooms it is returned by ducts to the coil room to be re-cooled and purified and to begin the circuit anew."

Extensive experiments in the cold storage of fruit, especially apples, carried on by the United States Department of Agriculture under the supervision of G. Harold Powell, have added materially to our knowledge of the subject in recent years. These experiments have strongly emphasized the importance of immediate storage. The fruit should be put into the storage room with the least possible delay after picking. Indeed, we know of one large apple grower who has cooled refrigerator cars standing on the railroad track waiting before picking begins. Just as fast as the fruit can be sorted it is barreled and hauled directly into these refrigerator cars. These cars are run right into the refrigerating house to be unloaded, so that the apples are out of cold storage for only a few hours at most from the time they are picked until they are sold.

It used to be thought that a temperature of 40 to 42 degrees was best for storing apples, but recent experience has shown conclusively that the temperature in the storage chamber should be 31 or 32 degrees, and that this should be maintained with the least possible variation throughout the storage season.

There is a diversity of custom with respect to putting up the apples for storage. Usually they are stored in barrels, but the reason for this is often that the fruit handles more easily rather than that men have any notion that the apples will keep better when put up in that way. In fact, a good many fruit-growers who practice home storage of apples habitually store the fruit in bins. This is not the best method. In fact, it may fairly be questioned whether storage in bins is ever good practice. If fruit is to be stored for a short time only it is better to have it in a small package. If the package is open or ventilated, so much the better. The cold air reaches all parts of the receptacle and cools off all the fruit. If apples are to remain some time in storage, however, it is better to have them in closed packages. Probably the best that can be done is to have them headed up in barrels. In open packages the fruit is likely to be injured by wilting.

Wrapping of the fruit in papers as it is put into the package nearly always helps it to keep better. It extends the life of apples in storage, under favorable conditions, a month or more.

A word ought to be said in this connection with regard to the scald. This is a malady which appears badly on stored fruit sometimes, especially in certain varieties, such as Rhode Island Greening. It seems to show worse on fruit that is picked before it is well colored and thoroughly ripe. A warm temperature in the storage room also tends to promote the development of the scald.

XVII

THE FAMILY ORCHARD

THIS book is written from the standpoint of the commercial fruit grower. It attempts to interpret the large wholesale methods of our modern extensive apple orchards. It must not be forgotten, however, that, while the great bulk of the American apple crop is grown in this way, the great majority of people actually interested in apple growing have only small home orchards. Some attention should be given therefore to their peculiar problems.

At the outset we must emphasize the great difference that exists between the methods proper in the commercial orchard and those to be recommended for the family fruit garden. These differences are many and important, yet they are commonly overlooked. The small farmer is apt to copy the methods of the great fruit grower, and almost always with unsatisfactory results. Of course, many of the principles laid down in previous chapters of this book will apply also to apple growing on a small scale; and it will be our task now to point out those modifications of practice necessary in passing from commercial to amateur fruit growing.

Let us consider first the site of the orchard. The man who expects to grow 5,000 barrels of Baldwins or Ben Davis annually and to sell them in competition with all the rest of the apples in the world, must choose a particularly favorable site. But it is neither possible nor necessary for the common farmer to be

so fastidious in his choice. He must grow the apples where he lives, on his own farm, and in reasonable proximity to the house. However, if he is a wise farmer, knows a little about fruit growing, and cares something for his own family, he will select a good soil and site for his fruit garden, knowing that this feature of his work does more to make a home out of his farm than anything else he undertakes. It is pitiful to see a farm, as one rather frequently sees it, having its orchard located on a rocky, inaccessible knoll too rough for pasturing goats, or in a swampy hollow where neither corn nor potatoes will grow. Sometimes the low, moist site seems to have been chosen in the belief that its superior soil and moisture supply would be a benefit to the apple trees; but such is, of course, not the fact. Let the family orchard be located conveniently to the house; let the soil be deep, well drained and fairly fertile; let the place be capable of good tillage; let the land be gently sloping if possible; and above all let it not be in the bottom of a hollow, swamp or ravine.

Taking up next the choice of varieties, we come upon a most radical difference between professional and amateur fruit growing. The commercial grower chooses one or two standard market varieties, which are often those of second or third quality, and sticks strictly to these sorts. The man who grows fruit for his own family use must plant a much larger collection of varieties. He will want some early summer apples, some ripening in fall, others for winter—in a word, he will want a complete succession throughout the entire apple season. He will also want to grow apples of the finest quality regardless of the fact that some of these varieties are shy bearers and others are



A DWARF APPLE TREE 22 INCHES HIGH
BEARING FRUIT

subject to disease. He is willing to take some extra pains to grow the family favorites.

It will be instructive at this point to contrast more sharply the rules of choice which govern in professional and in amateur fruit growing respectively.

RULES FOR CHOOSING VARIETIES

Commercial Orchards

Select a very few varieties
 Choose standard market sorts
 Give only second thought to quality
 Prefer late keeping winter varieties (the old rule, subject to exceptions)
 Choose only hardy, healthy sorts
 Plant no novelties or oddities

Home Orchards

Select many varieties
 Choose family favorites
 Put quality first
 Provide a succession of varieties
 Stick to some good varieties in spite of defects of tree
 Test occasional promising novelties, and grow some sweet apples, crabs, etc.

The dwarf apple tree, which has been mentioned only as a possible filler in the commercial apple orchard, may become the very foundation of the successful amateur fruit garden. The dwarf tree occupies less room, comes earlier into bearing, may be given better care, and has other advantages strongly recommending it to those who must grow fruit only on a small scale. In the suburban fruit garden it plays a commanding role. These facts are so important that the author has devoted an entire book to the discussion of dwarf fruit trees and the methods of their management.* It will be best for the reader who is interested in dwarf fruits to consult that work.

The amateur orchardist, whose object it should be to grow the very finest fruit without special regard to cost, ought to give better care and culture to his plantations than the commercial orchardist does.

* Waugh, *Dwarf Fruit Trees*, Orange Judd Co., New York.

At any rate he should give the best care of which he is capable. The idea of keeping a family orchard in grass, and mowing it for hay, is ridiculous; yet this plan is widely followed. As the family apple trees will usually be grown in some sort of garden along with the family peach, plum and quince trees, the currant and gooseberry bushes, the strawberries and possibly the cabbages and tomatoes, cultivation is all the more convenient and appropriate.

In the matter of fertilization the difference is least between the management of the home orchard and the commercial plantation. The methods already suggested in this book—pages 94-98—may be safely followed. As the small grower, however, will not care to mix special fertilizers for his apple trees, he should feel at liberty to use some other formulas, more convenient to secure, though possibly less exactly adapted to the needs of apple trees. As ready-mixed fertilizers are most commonly used by small farmers and householders, it may be well to notice that the so-called potato fertilizers sold by leading manufacturers will meet the requirements, though less economically. Even barnyard manure, though quite too rich in nitrogen, may be used on apple trees in moderate quantities without danger. There are thousands of apple trees in the country which would be benefited by a good ration of barnyard manure; but the writer cannot remember to have seen apple trees anywhere injured by getting too much of this sort of plant food.

Pruning in the home orchard will follow pretty much the same lines as in the commercial plantation. The chief difference is that the amateur grower cannot usually supply himself with such a complete outfit

of ladders and tools as the man who has 80 or 100 acres to prune.

When it comes to spraying, the small grower will usually be obliged to content himself with less machinery than the commercial grower; but his ideal should be to do as good or better spraying. The best sprayer is usually the barrel pump—see page 123—which can be carried about on an ordinary farm wagon, sled or stone boat. Of course the same insects and diseases attack the farm orchard as the commercial orchard, and are to be fought by the same means.

The man who is growing fruit for his own family use will usually want some sort of storage. Formerly apples were sometimes stored in haymows or buried in pits in the garden, but such crude methods do not satisfy the people of the present generation. Even the better plan of keeping apples in the general cellar under the house does not meet the wishes of many. When the house cellar is to be used a special compartment should be done off for apples and pears, in which the temperature can be kept considerably lower than in the rest of the cellar. On many well-to-do farms it is practicable to make special fruit storage rooms or even storage houses. Such provision can be made at an expenditure varying from \$300 to \$5,000. This subject is separately discussed and many designs given in the author's book on handling fruit.*

* Waugh, Fruit Harvesting, Storing, Marketing, Orange Judd Co., New York.

XVIII

RENOVATION OF OLD ORCHARDS

THE most profitable orchard is unquestionably one that is thrifty and moderately young. It is an orchard which is started right and which is kept on the right track from the beginning. Nevertheless many farms in the country have old orchards neglected for some time and partially run down but still too valuable to be abandoned. While such plantations cannot be regarded as the best basis on which to found the apple business, they are still worth taking into consideration.

There is no question about the practicability of renovating old orchards of this kind. The only question is with respect to the age and condition of the trees. If the trees form a satisfactory stand on the ground, that is to say from 60 to 90% of a full stand, and if they are not too badly broken by disease and neglect, the problem of bringing them into profitable condition is a fairly simple one. As a rule it may be said that trees more than 35 years old, those which have the tops badly broken, those which are badly infested with canker or San José scale, and orchards in which the stand is less than 60%, or those which are located in unsuitable soil, are not worth the labor and expense of rejuvenation.

In case it seems wise to undertake the rehabilitation of one of these old orchards the procedure is fairly simple. It consists merely in giving the best possible treatment all along the line. The thing cannot be

accomplished by the application of any one specific remedy. The program will be about as follows:

1. The physical condition of the soil must be improved. This will mean that cultivation should be adopted wherever possible. There are some old orchards worthy of rejuvenation in which the soil cannot be practically cultivated, but the majority of those orchards which will not pay for the cultivation of the soil will not pay either for the rest of the treatment. Cultivation of the soil in an old orchard which has been neglected for many years is of course a serious problem. Too much must not be expected at the outset. The ground should be plowed as well as it can be, but this of course will not mean nice thorough tillage from the beginning. However, better cultivation can be given the second year than the first, and some improvements made in succeeding years. After the land has been plowed and cross-plowed the soil can be worked into condition with a spading harrow. It is not necessary to make great haste in this direction. Indeed it is better that the subjugation of the soil should be gradual.

2. Plant food must be provided. In practically all cases old neglected orchards suffer from serious depletion of fertilizing elements. A moderate dressing of barnyard manure is an excellent beginning in bringing up an old orchard. As a rule, however, it is better to proceed with considerable caution in applying fertilizer to an orchard in this state of treatment. It is easily possible to overdo this matter.

3. The trees must be pruned. This part of the treatment is often overdone also. The best practice is to begin the first year by removing only dead and broken limbs. This work should be done in March. In

June of the same year another moderate pruning may be given, removing interfering limbs and opening the heads somewhat to the action of the light. As a rule it will be best to take out this time only about one-third to one-half of the total amount of wood to be removed, leaving the remainder to be taken out the succeeding June. March will answer for this sort of pruning also, but for this particular purpose June is safer. Trees pruned at this time have not so strong a tendency toward the formation of water sprouts. If the trees are too tall, as is apt to be the case, it will be well to head in the tops and side branches to some extent. This will serve the same purpose, in some degree, as opening up the center of the tree. Special attention should be paid in all this pruning to the removal of diseased and broken branches. As a rule all these prunings should be taken out and burned.

4. The trees should be scraped. The trunks and most branches will always be found covered with more or less old shaggy bark which furnishes a lodgment for all sorts of insects and fungous spores. In order to make spraying effective it is very desirable that this old bark be removed. Dealers in horticultural implements have for sale a triangular scraper made for this express purpose; or a satisfactory tool could be made from an old hoe.

5. Spraying must be regularly adopted. Thorough and systematic spraying, according to the best and strictest rules, must be kept up for a period of years in order to overcome the results of that neglect from which the trees have suffered. If the trees are infested with oyster shell bark louse or with San José scale the appropriate insecticides must be applied. It is also necessary under all circumstances to follow

up this treatment with regular applications of bordeaux.

The treatment here briefly outlined has been fully tested in all parts of the country and has never failed to bring satisfactory results. There is no use, however, in undertaking this kind of work if the effort is to be half hearted.

XIX

THE SELECTION OF VARIETIES

ONE of the most important, as well as one of the most difficult problems which the fruit grower has to solve is the choice of the varieties he is to grow. There are many things to be taken into consideration, and the novice is apt to be influenced by many notions and prejudices which have no foundation in fact. The following principles have been pretty well established by the experience of a whole generation of successful American fruit growers.

1. Choose very few varieties for commercial plantations. Two or three varieties are enough for most men. Any grower who now has even five varieties in bearing can easily show himself that one or two of them are decidedly more profitable than the others. It would therefore seem the part of wisdom for him to discard the less profitable ones.

2. Choose varieties which the market wants. A man may think that Fameuse is a better apple than Baldwin, but if the buyers want Baldwins and not Fameuse, the fruit grower must grow Baldwins.

3. Commercial varieties must be perfectly adapted to the soil and climate where they are to be grown. A man can grow the family favorites without regard to this rule, but when he is competing with thousands of other growers for a profit in the market he cannot afford to carry any unnecessary handicap. There is much yet to be learned regarding the niceties of soil and climate adaptations of varieties.

4. It follows that no man should plant a certain variety simply because it is successful in some other section or state. Fruit growing in the Mississippi valley states was retarded one whole decade because settlers from New York and New England insisted on planting Baldwin, Spy, Rhode Island Greening and the other favorites of their old homes.

5. Nevertheless each apple grower should exercise his personal prejudices as far as he can within the list of varieties which will succeed in his section. A man whose ideal apple is the Newtown Pippin will do better growing that variety. The value of this rule is commonly underestimated.

6. Varieties should be chosen with a careful view to the market which they are to reach. Cuban and Southern markets can use Ben Davis to advantage; the English market will pay for good Russets; the Boston market wants Baldwins and the New York market wants Greenings.

7. Late-keeping winter varieties have proved most profitable for the ordinary growers in recent years. As a rule such varieties will be best for men who grow apples on a large scale at a considerable distance from their markets.

8. On the other hand very early varieties have proved most profitable for a certain number of growers. Usually these early varieties should be chosen for growing near large markets, or wherever the grower can dispose of his crop at retail. Extreme southern localities which can make early shipments to northern markets also find first early sorts most profitable, more especially since these localities cannot grow late-keeping winter stock anyway. There are certain com-

mercial advantages in handling early fruit, such as saving the expense of storage.

9. Medium ripening autumn sorts also have their place and take the lead in certain sections. In northern sections where first early sorts cannot compete with southern grown stock, and where late-keeping winter apples cannot be produced to best advantage, such sorts as Wealthy and McIntosh may be highly profitable. These fall varieties fill a large gap in the market between the southern earlies and the standard winter apples. The market is more closely limited than for late winter stock, and the fruit must be skillfully handled; but the experience of many men in many different parts of the country shows that this is an attractive commercial field.

These suggestions apply specifically to the choice of varieties for commercial growing. The selection of varieties for the home fruit garden is discussed in another connection, page 186.

REMARKS ON PARTICULAR VARIETIES

It will be noticed that the list of commercial varieties is a very short one. Most of the standard market varieties are grown over a wide range of territory. Indeed one of the capital reasons why they are standard market varieties is that they will succeed under many skies and on a diversity of soils. Ben Davis is the prince of all these varieties, and comes the nearest to being the universal apple of anything yet discovered. But Jonathan, Grimes and Red Astrachan are successful market apples in two-thirds of the states in the union.

There is now an evident tendency toward lengthening the list of commercial apples. This is manifest

in the increasing respect shown to such secondary sorts as McIntosh, Rome Beauty and Duchess.

Baldwin still reigns supreme in New England and leads everything else in New York state. Outside this section it is hardly known. It is exactly the apple for the ordinary man. It is an ordinary apple.

Rhode Island Greening belongs to the same section as Baldwin and is still a favorite apple, especially in the New York city market. But it is losing favor with growers on account of scalding in storage. It is not much planted nowadays, though it still deserves to be.

Northern Spy belongs to a zone slightly to the north of the Baldwin district, thriving in northern Massachusetts, central Maine, New Hampshire and Vermont, northern New York and in certain districts in Michigan and Ontario. It is very fastidious as regards soil. It will succeed splendidly on one farm and fail on the next. It is very slow to come into bearing and does not bear heavily even at maturity. Nevertheless the unsurpassed quality of the fruit and the high price which it brings in the market make it worth the attention of those who can grow it well.

Ben Davis is grown everywhere where apples will grow at all, and is everywhere profitable. However, it does not pay so well as Baldwin or Spy or Grimes or a dozen other varieties in the hands of men who can grow the better varieties. It is, generally speaking, suited to men whose system of orchard management does not reach a high standard. This is true even in the Mississippi valley states, where Ben Davis is most at home.

Gano will succeed almost anywhere that Ben Davis will. It is very much like Ben Davis, being distin-

guished by more solid red coloring. It should be used to supplement Ben Davis.

Fameuse is the apple par excellence of the French Canadian country, especially of the Province of Quebec and adjacent counties across the international boundary. In this section it reigns supreme.

Jonathan is probably the most popular and most profitable apple in the central states. In that section where Ben Davis has the numerical leadership Jonathan is looked on as its superior. Moreover, the more expert apple growers are able to produce Jonathan at a larger profit than Ben Davis. It is now being more widely planted; but this wider planting is simply the index of improving cultural systems.

Grimes Golden competes with Jonathan for supremacy in the same field. On the whole it is a shade more expensive to produce than Jonathan, but it makes up for this by being even better in quality. The most heartening fact in the whole apple industry today is the wide planting of Grimes and Jonathan.

Winesap and its offspring, Stayman Winesap, are being considerably planted in southern and mid-southern states. They are rather hard to grow, but their fine color, high quality and aroma make them sell at the top of the market.

Yellow Transparent and Red Astrachan lead the list of first early varieties from Quebec to Louisiana. Early Harvest and Carolina Red June come next in this list.

Wealthy and McIntosh unquestionably lead the list of autumn varieties. The former succeeds over a wide range of territory and is fast gaining in popularity. Other valuable sorts in this group are Duchess and Fall Pippin.

Esopus Spitzenberg, Northern Spy and Newtown Pippin are generally regarded as the standards of quality. Certain other varieties reach a very high, probably an equally high, standard of quality in special circumstances. Of these are Mother and Pomme Royal. Certain men also have a special fancy for particular varieties, so that good judges may express an honest preference for Jeffris, Fameuse or King.

The Russets are now seldom planted and seem to be profitable only in Nova Scotia for shipping to British markets. Roxbury generally takes the lead, though inferior in quality to Golden Russet.

VARIETIES FOR VARIOUS DISTRICTS

The varieties which succeed best in each locality can be easily pointed out, and this is worth doing if people will not be misled by it. There are exceptions to all rules, and to these generalizations most of all.

The following lists are carefully made up from many sources, but chiefly from the direct testimony of the largest and most successful commercial apple growers in each locality. The intention has been to name only the leading commercial varieties or such as have an established reputation.

Nova Scotia.—Baldwin, Roxbury (Nonparcil), Ben Davis, Wagener.

Quebec.—Fameuse, McIntosh, Rosseau (Pomme de fer), Alexander, Duchess, Wolf River.

Maine, New Hampshire and Vermont.—Baldwin, Spy, Ben Davis, Rhode Island Greening, Wealthy, McIntosh, Gravenstein. In the northern counties of these three states the Quebec list would be preferred.

Massachusetts.—Baldwin above all others. Wealthy

and McIntosh are highly profitable where properly grown. Williams Favorite leads the list of early apples.

Connecticut and Rhode Island.—Baldwin, Ben Davis, Wealthy, McIntosh, Duchess, Rome Beauty.

New York.—This is the leading apple-growing state, the bulk of the crop being produced in the western counties. Baldwin leads. Then follow Rhode Island Greening, Spy, Hubbardston, Ben Davis, Wealthy, and Fall Pippin. Many other varieties succeed when properly handled.

New Jersey.—Proximity to the New York city markets makes early varieties relatively profitable. Carolina Red June, Early Harvest, Red Astrachan and Yellow Transparent are successful. Later ripening sorts which are grown are Smith Cider, Ben Davis and York Imperial.

Pennsylvania.—The southern and southwestern portions of the state should be counted with West Virginia in apple growing. The central counties succeed best with Baldwin, Winesap and York Imperial. Wealthy is also being grown to some extent; also Jonathan, Grimes and Rome Beauty.

Delaware and the Eastern Shore of Maryland.—On this low coast plain apple growing has once been abandoned but has recently been rehabilitated in a vastly improved form. This section now produces chiefly early apples for the markets of New York, Philadelphia, Baltimore and other nearby cities. Leading varieties are Red Astrachan, Yellow Transparent, Fourth of July, Williams Favorite, Early Ripe and Early Strawberry. Later ripening sorts which are also grown are Winesap, Stayman Winesap, Grimes and the ubiquitous Ben Davis.

Virginia.—The eastern tidewater counties generally grow the same varieties as the Chesapeake peninsula. The northwestern counties belong with West Virginia. The central and south central counties are noted for the famous Albemarle Pippins. (Pomologists generally regard this as a local name for Yellow Newtown.)

West Virginia, including western Maryland and adjoining counties of Virginia and Pennsylvania. Here is a thriving, booming commercial apple district, growing Ben Davis of course, but also Grimes and Jonathan. Besides these we may find Gano, York Imperial, Rome Beauty and Mammoth Black Twig.

North Carolina, South Carolina and Georgia.—The mountainous portions of these three states have large tracts of excellent apple land now being developed. The industry is not so well established as to have settled upon any list of varieties. Ben Davis and Gano are grown, of course, and for shipping south these are probably as good as any. Yates is a variety coming into prominence in this section. Shockley is also profitable. Other varieties grown more or less are Grimes, Rome Beauty and York Imperial. In the mountain sections the very early varieties do not seem to be so satisfactory, but Red Astrachan, Carolina Red June, Yellow Transparent and Early Harvest are grown for market to some extent.

Ontario produces large quantities of export apples, the surplus being destined largely for the British markets. Baldwin is the leading variety, though Rhode Island Greening, Spy, Roxbury, Ben Davis, Stark and many other sorts are grown. Alex McNeill,

a high authority, says that very early and very late varieties pay best.

Michigan.—This state grows a long list of apples, Baldwin leading, but by a greatly reduced majority as compared with New York and New England. Other market varieties are Jonathan, Ben Davis, Stark, Rhode Island Greening, Spy, Hubbardston, Twenty Ounce, Duchess, Wealthy and the usual list of early apples.

Indiana and Illinois.—Ben Davis, Gano, Jonathan, Grimes, Winesap, Willow Twig, Rome Beauty; and also the early varieties, such as Duchess, Yellow Transparent, Benoni and the mid-season Wealthy.

Kentucky and Tennessee.—Ben Davis, Gano, Winesap, Grimes, Jonathan, Paragon and the early varieties.

Wisconsin, Minnesota and South Dakota.—Wealthy leads, Duchess stands second. Other varieties are Northwestern Greening, Patten Greening and Malinda.

Iowa, Nebraska and Northern Missouri.—Ben Davis, Gano, Missouri Pippin, Duchess, Grimes, Northwestern Greening, Jonathan.

Arkansas and Southern Missouri.—Ben Davis, Gano, Winesap, Paragon, Grimes, Jonathan, Mammoth Black Twig.

Kansas and Oklahoma.—Ben Davis, Missouri Pippin, Winesap, Jonathan, Grimes, York Imperial.

Texas.—Mostly early varieties for northern shipment—Red June, Red Astrachan, Early Harvest and Yellow Transparent. Also to some extent Winesap, Jonathan and Ben Davis.

Montana.—Duchess, Wealthy, Alexander, McIntosh, Wagener.

Colorado.—This state has several different apple districts quite different in their character and requirements. The varieties mostly grown, however, are those of Kansas—that is, Ben Davis and Gano, Grimes and Jonathan, with Winesap, Rome Beauty and Wealthy following.

The Pacific Coast.—While the Pacific coast, from British Columbia to California, is a large district, and while the apple-growing localities are widely separated, the leading commercial varieties are much the same throughout the area. Yellow Newtown and Esopus Spitzenberg are the leading varieties, but they are closely followed by Jonathan. Then comes Belleflower, Arkansas Black and Winesap, with a few other varieties of decidedly minor importance.

KEEPING QUALITY OF VARIETIES

The behavior of different varieties in storage is a matter of vital importance in the handling of the commercial apple crop. The length of time to which apples may be expected to keep in merchantable condition is of especial interest. The following general principles are fairly well established:

1. Apples grown in a northern latitude or high altitude will keep longer than apples of the same variety grown farther south or at a lower altitude.
2. Apples from old or mature trees will keep longer than the same varieties grown on young trees.
3. Fruit from sandy soil will usually keep longer than the same sorts grown on clay or loam.
4. Well-colored, well-ripened fruit will keep longer in good condition than fruit not fully ripe. This is

contrary to the general opinion and is subject to possible slight exceptions in the case of fruit grown on young and very vigorous trees.

It has been fully proved also that the manner in which the fruit is handled has a great deal to do with its behavior in storage. The fruit should be carefully hand picked, handled the least possible, and placed in storage at the earliest possible moment. The common practice of allowing apples to lie in piles in the orchard for several days or even weeks is especially reprehensible.

The following list, based on the latitude of New York state, shows as nearly as practicable the market and storage season of the leading varieties. The table is made up from various sources, but special attention has been given to the results secured by G. Harold Powell in his extensive storage experiments.

Variety	Ready for use	Storage limit
Alexander	Oct. 1	Nov. 15
Arctic	Dec. 1	Mar. 1
Arkansas	Jan. 1	May 1
Arkansas Black	Feb. 1	June 1
Bailey Sweet	Nov. 15	Feb. 15
Baldwin	Dec. 1	May 15
Beach	Jan. 1	June 1
Ben Davis	Jan. 1	July 1
Black Gilliflower	Nov. 15	Jan. 1
Cannon Pearmain	Jan. 1	May 1
Carlough	Jan. 1	June 1
Coffelt	Jan. 1	June 1
Cogswell	Jan. 1	June 1
Colvert	Nov. 15	Jan. 15
Cooper Market	Jan. 1	June 1
Cullen	Jan. 15	June 1
Esopus (Spitzenberg)	Nov. 1	April 1
Fallawater	Nov. 1	April 1
Fall Pippin	Oct. 15	Jan. 1
Fameuse	Oct. 15	Feb. 1
Fanny	Oct. 15	Jan. 1
Fishkill	Nov. 1	Jan. 1

Variety	Ready for use	Storage limit
Gano	Dec. 15	May 1
Gideon	Nov. 1	Jan. 1
Gilpin	Dec. 1	Mar. 15
Golden Russet	Jan. 1	June 1
Gravenstein	Oct. 1	Dec. 1
Grimes	Nov. 1	Jan. 15
Haas	Oct. 1	Dec. 1
Holland	Nov. 1	Jan. 1
Hubbardston	Nov. 1	Feb. 1
Huntsman	Dec. 15	Apr. 1
Hurlbut	Nov. 1	Feb. 15
Ingram	Jan. 1	Apr. 15
Ivanhoe	Jan. 1	May 1
Jacob (Sweet)	Dec. 15	Mar. 1
Jeffris	Sept. 1	Oct. 15
Jonathan	Dec. 15	Apr. 1
Lady Sweet	Jan. 1	May 1
Lankford	Jan. 15	May 1
Lawver	Feb. 1	July 1
Leicester	Oct. 15	Jan. 1
Limbertain	Feb. 1	July 1
Longfield	Sept. 15	Dec. 1
Loy	Jan. 1	April 1
McIntosh	Oct. 1	Jan. 15
McMahon	Oct. 1	Dec. 1
Magog	Nov. 1	Jan. 15
Maiden Blush	Oct. 1	Dec. 15
Mann	Feb. 1	July 1
Melon (Norton's)	Nov. 1	Feb. 1
Milden	Dec. 15	Mar. 1
Minkler	Dec. 15	Mar. 15
Missouri (Pippin)	Jan. 1	April 15
Mother	Oct. 1	Mar. 15
Munson (Sweet)	Oct. 15	Jan. 15
Nero	Nov. 1	Feb. 1
Newtown Spitzenberg	Jan. 1	Mar. 15
Northern Spy	Jan. 1	April 15
Northwestern (Greening)	Jan. 1	June 1
Oldenburger (Duchess)	Sept. 15	Dec. 15
Ontario	Dec. 15	Mar. 15
Paragon	Dec. 15	Mar. 15
Peck (Pleasant)	Jan. 1	May 1
Pewaukee	Jan. 1	May 15
Pumpkin Sweet	Oct. 15	Jan. 1
Ralls	Jan. 1	April 1
Rambo	Nov. 15	Mar. 1
Red Canada	Jan. 1	May 1

Variety	Ready for use	Storage limit
Red Russet	Jan. 1	May 1
Rhode Island (Greening)	Dec. 15	April 1
Rome (Beauty)	Jan. 1	April 1
Roxbury (Russet)	Jan. 15	June 15
Salome	Jan. 1	May 1
Scarlet Cranberry	Jan. 1	May 1
Scott Winter	Jan. 1	April 1
Shiawassee	Oct. 1	Dec. 1
Smith Cider	Dec. 15	Feb. 15
Stark	Feb. 1	July 1
Stayman Winesap	Jan. 1	April 1
Sutton	Jan. 1	Mar. 15
Swaar	Jan. 1	May 1
Tolman (Sweet)	Jan. 1	May 1
Tompkins King	Dec. 15	May 1
Twenty Ounce	Nov. 1	Jan. 15
Wagener	Nov. 1	Feb. 1
Walbridge	Dec. 1	April 1
Washington Royal	Nov. 1	Jan. 15
Wealthy	Sept. 15	Feb. 1
Westfield	Jan. 1	May 1
Willow (Willow Twig)	Jan. 15	June 1
Winesap	Nov. 1	Mar. 15
Wolf River	Oct. 15	Feb. 1
Yellow Belleflower	Nov. 15	April 15
Yellow Newtown	Jan. 1	May 1
York Imperial	Jan. 1	Feb. 15

XX

CATALOG OF VARIETIES

THERE are several books which give at length the descriptions of varieties of apples. One who aspires to be an expert pomologist must own a considerable library of such books. Most of these books are large ones, showing that the subject is burdened with endless details, the methodical study of which forms the science of systematic pomology.* Obviously a modest hand book of practical apple culture cannot undertake to include full descriptions of all varieties. In place of this we shall give only a moderate list of the best known varieties with greatly condensed descriptions.

The fruit grower may confront himself—as mostly he does—with the knowledge that he is not required to know or identify many varieties. If he is a strictly up-to-date grower he will cultivate only half a dozen varieties, or even less. These he must know perfectly. He must know all their smallest points—their ins and outs—their weaknesses and idiosyncrasies—their diseases and their preferences—as he knows the members of his own family. But other varieties have only a general and distant interest for him.

Following is the variety list:

Alexander.—Large, conic, red, coarse fleshed, good, early fall. A showy apple, but not usually profitable.

Anisim.—Small, conic, yellow red, good, medium.

Arctic.—Large, conic, red, very good, late. Tree hardy and a good grower.

Arkansas.—Large, oblate, red, good, late.

Autumn Bough.—Medium, conic, greenish yellow, sweet, fair, medium dessert.

* Consult Waugh's *Systematic Pomology*, Orange Judd Co., New York. For extended descriptions of apples consult Beach, *The Apples of New York*; Downing, *Fruits and Fruit Trees of North America*; Thomas, *Fruit Culturist*; Warder, *American Pomology*; Budd-Hansen, *American Pomology*.

- Autumn Swaar.—Medium, conic, red, fair, early, dessert.
- Babbitt.—Medium, round, red, fair, late.
- Bailey.—Large, round, red, sweet, good, late. One of the best of the sweets.
- Baker.—Large, oblate, conic, yellowish red, fair, late.
- Baldwin.—Medium, oblate, conic, yellow red, fair, late. The leading variety in New York, New England and Nova Scotia. A reliable, profitable market sort for ordinary culture.
- Beach.—Medium, oblong, red, very good, very late.
- Belmont.—Medium, conic, yellow red, very good, late, dessert.
- Belle Bonne.—Medium, ovate, greenish yellow, good, late.
- Ben Davis.—Medium, ovate, yellow red striped, poor, late. The great stand-by. Profitable over large areas, but especially in the middle states.
- Benoni.—Small, oblate, yellow red striped, good early, dessert. Profitable for certain local markets.
- Bentley.—Medium, round, red, sweet, fair, very late.
- Bethel.—Medium, oblate, conical, yellow striped, very good, late.
- Bietigheimer.—Very large, oblate, conic, red, poor, medium.
- Black.—Medium, oblate, dark red, poor, late, dessert.
- Bledsoe.—Medium, oblate, striped, good, early.
- Blenheim.—Large, oblate, conic, yellow red striped, poor, late.
- Blue Pearmain.—Large, conic, dark red striped, fair, late.
- Bonun.—Medium, oblate, yellow red, fair, medium, dessert.
- Borovinka.—Medium, oblong, yellow red striped, good, medium, dessert.
- Bough.—Medium, conic, yellow, sweet, good, early, dessert.
- Bradford.—Medium, conic, yellow red striped, poor, late.
- Broadwell.—Medium, oblate, conic, yellow red, sweet, good, late.
- Bryan.—Medium, conic, red, very good, early.
- Buckingham.—Medium, oblate, conic, yellowish red, good, late.
- Bullock (American Golden Russet).—Small, oblate, conic, yellow russet, very good, late, dessert. Formerly grown for market, but now no longer planted.
- Buncombe.—Medium, oblong, conic, yellow red, poor, late.
- Camack.—Medium, conic, reddish green, sweet, poor, late.
- Canada Baldwin.—Medium, oblong, yellow red, fair, late.
- Canada Reinette.—Medium, oblate, conic irregular, green russet, good, late.
- Carlough.—Medium, conic, greenish yellow, fair, late.
- Carolina Beauty.—Medium, oblong, dark red, good, late.
- Carter Blue.—Medium, oblate, greenish red, fair, medium, dessert.
- Champlain.—Medium, oblong, yellow red, fair, medium.
- Charlamoff.—Medium, conic, red striped, acid, fair, early.
- Chenango (Strawberry).—Medium, oblong conic, yellow red, good, early. Showy and of good quality, suitable for local markets.
- Christmas.—Small, round, yellow red striped, acid, fair, medium.
- Clark Pearmain.—Medium, oblate, conic, red, fair, medium.

- Clayton.—Medium, oblate, conic, yellow red striped fair, very late.
- Clyde Beauty.—Medium, oblate irregular. green red, poor, late.
- Cogswell.—Medium, oblate, yellow red, good, late.
- Collins.—Medium, oblate, striped, good, late.
- Colton.—Medium, round, yellow, good, early dessert.
- Cooper.—Large, oblate, irregular, yellow red striped, poor medium.
- Cooper Market.—Medium, oblate, conic, yellow red striped, fair early dessert.
- Cornell Fancy.—Small, oblong, conic yellow red striped, fair, early, dessert.
- Cracking.—Large, oblate, conic, yellow red, poor, medium
- Cross.—Small, oblong, conic, yellow red, fair, medium.
- Cullasaga.—Medium, conic, yellow red, poor, late.
- Danvers.—Medium, oblong, yellow, sweet, fair, late.
- Derby.—Medium, irregular, red, good, late.
- Domine.—Medium, oblate, yellow red, fair, late.
- Donneghan.—Medium, round, green, sweet, good, medium.
- Doyle.—Large, medium season.
- Dutch Mignonne.—Medium, oblate, conic, yellow red, poor, late.
- Dyer.—Medium, round, yellow red, best, medium, dessert.
- Early Cooper.—Medium, oblate, yellow red, fair, early.
- Early Harvest.—Medium, oblate, yellow white very good, very early. One of the best early varieties
- Early Joe.—Small, oblate, conic, yellow red striped, very good, early, dessert. One of the best early apples.
- Early Pennock.—Medium, conic, yellow red, poor, early.
- Early Ripe.—Medium, oblate, yellow, poor, early.
- Early Strawberry.—Small, conic, yellow red striped, fair, early.
- English Russet.—Medium, conic, yellow red striped, fair, early.
- Esopus.—Medium, oblong, conic, red, best, late, dessert. One of the finest American apples, but tree poor and subject to disease. Is sometimes top-worked on better trees. Grown commercially on the Pacific coast.
- Evening Party.—Small, oblate, yellow red striped, fair, late, dessert.
- Ewalt.—Large, conic, yellow red, poor, late.
- Fallowater.—Very large, conic, yellow green red, fair, late.
- Fall Jenning.—Medium, oblate, irregular conic, yellow red, poor medium.
- Fall Orange.—Large, round, yellow red, poor, medium.
- Fall Pippin.—Large, oblate, conic, yellow red, very good, medium. An excellent and profitable fall variety.
- Fall Wine.—Medium, oblate, yellow red, very good, medium, dessert.
- Fameuse.—Medium, oblate, yellow red striped, very good, medium, dessert. A prime favorite in Quebec, and a leading commercial variety in that section.
- Family.—Medium, oblate, conic, yellow red striped, fair, medium, dessert.

- Fanny.—Medium, oblate, conic, red striped, fair, early.
- Fink.—Small, oblate, white yellow red, poor, very late.
- Foundling.—Large, ovate, red striped, good.
- Fulton.—Medium, oblate, yellow red, good.
- Gano.—Medium, oblate, irregular, yellow red striped, fair, late.
Much like Ben Davis but more highly colored. Profitable, especially in the central Mississippi valley.
- Garden Royal.—Small, oblate, conic, yellow red striped, best, early, dessert. For family use only.
- Garrettson.—Medium, conic, yellow, poor, early.
- Garfield.—Medium, oblate, conic, red striped, very good, late.
- Gideon.—Medium, conic, yellow, acid, small, early.
- Gilbert.—Medium, oblong, red, good, late.
- Gilpin.—Small, oblong, red yellow, poor, very late.
- Glass Green.—Medium, ovate, yellow striped, poor, early.
- Golden Russet.—Small, oblate, yellow russet, fair, very late.
- Golden Sweet.—Medium, oblate, yellow, sweet, fair, early.
- Golding.—Medium, oblate, conic, yellow red, fair, medium.
- Gravenstein.—Large, oblate, irregular, yellow red, very good, medium. Grown for market in Maine and Nova Scotia.
- Green Cheese.—Medium, oblate, irregular, yellow, good, late.
- Green Newtown.—Medium, irregular, green red, very good, very late.
- Grimes Golden.—Medium, oblate, conic, yellow, best, late, dessert.
Profitable in Kansas and neighboring states when highly cultivated.
- Haas.—Medium, oblate, conic, yellow red, fair, medium.
- Hagloe.—Medium, conic, yellow red, fair, early.
- Hall.—Small, oblate, conic, red, fair, late, dessert.
- Hewes.—Small, round, yellow, acid, very poor, medium, cider.
- Hibernal.—Medium, oblong, conic, red striped, acid, poor, medium.
Very hardy. The tree is used for top-grafting in the northwest.
- Hightop Sweet.—Small, round, yellow, sweet, fair, early, dessert.
- Hockett.—Medium, oblate, yellow red striped, sweet, poor, late.
- Hoover.—Medium, oblate, yellow striped, fair, late.
- Hopewell.—Large, oblate, striped, good, early.
- Horn.—Small, oblate, yellow red striped, poor, late.
- Horse.—Medium, round, yellow red striped, poor, early.
- Hubbardston.—Medium, round, ovate, yellow red striped, very good, late. Profitable in some places in Massachusetts and New York.
- Hunt Russet.—Small, oblate, conic, yellow russet, good, late, dessert.
- Huntsman.—Medium, oblate, conic, yellow red, fair, late.
- Ingram.—Medium, oblate, striped, very good, early.
- Irish Peach.—Medium, conic, yellow red, good, medium, early.
- Isham Sweet.—Medium, oblong, red, fair, late. One of the best sweets.
- Jacobs Sweet.—Medium, round, yellow red, sweet, good, late.

- Jeffris.—Medium, oblate, conic, yellow red striped, very good, early dessert.
- Jersey Sweet.—Medium, oblate, conic, yellow red striped, sweet, good, medium.
- Jewett.—Medium, oblate, red striped, fair, late.
- Jonathan.—Medium, conic, yellow red, very good, late. A fine apple and profitable in central states and on the Pacific slope.
- Judson.—Medium, conic, red striped, poor, medium, early.
- Julian.—Medium, conic, red striped, poor, early, dessert.
- July (Fourth of).—Small, oblate, conic, yellow red, poor, very early. Profitable first early out in middle and southern latitudes.
- Junaluskee.—Medium, oblate, yellow, fair, late, dessert.
- Kent Beauty.—Large, oblate, yellow red, poor, medium.
- Kernodle.—Medium, oblong, yellow striped, good, very late.
- Keswick.—Fair, conic irregular, yellow red, acid, fair, medium.
- Kinnard.—Medium, oblate, conic, irregular, yellow red, fair, late.
- Kirkbridge.—Small, oblong, irregular, yellow russet, poor, early.
- Krouser.—Medium, red striped, fair, very late.
- Lady.—Very small, oblate, yellow red, fair, late. Finds a special Christmas market in Boston and New York and is worth growing in small quantity.
- Lady Sweet.—Medium, oblong, yellow green red, sweet, good, late.
- Lankford.—Medium, conic, green red, good, late.
- Lansingburg.—Medium, oblate, yellow red, poor, very late.
- Late Strawberry.—Medium, conic, red striped, fair, medium, dessert.
- Lawver.—Medium, oblate, red, fair, very late.
- Lehigh.—Medium, yellow, fair, very late.
- Lily.—Medium, oblate, conic, green, good, early.
- Limbertwig.—Medium, oblate, conic, yellow red, poor, very late.
- Longfield.—Medium, conic, yellow, poor, early. Profitable when well grown. Requires high cultivation.
- Louise.—Oblate, fair, late, dessert.
- Lowe.—Large, oblong, yellow, fair, early.
- Lowell.—Large, oblong, yellow, fair, early.
- McAfee.—Medium, oblate, yellow green red, late.
- McIntosh.—Medium, oblate, yellow red, fair, medium, late. One of the most profitable varieties and succeeds over wide range of territory.
- McLellan.—Medium, oblate, conic, yellow red striped, fair, medium, dessert.
- McMahon.—Large, oblate, yellow red, poor, medium. A good tree suitable for top-grafting.
- Magog.—Medium, oblong, yellow red striped, good, late.
- Maiden (Blush).—Medium, oblate, yellow red, fair, early.
- Malinda.—Medium, conic, yellow red, fair, very late. Hardy Minnesota.

- Mangum.—Medium, oblate, conic, yellow red striped, good, medium, dessert.
- Mann.—Medium oblate, yellow green, poor, very late. A late keeper and a good low-priced market variety.
- Margaret.—Medium, oblate, yellow red, fair, early, dessert.
- Mason.—Medium, oblate, yellow red, fair, late, dessert.
- Maryland.—Small, conic, yellow red, fair, medium, late.
- Mattamuskeet.—Medium, oblate, conic, yellow red, poor, late.
- Maverack.—Medium, oblate, yellow red, sweet, fair, late.
- Melon.—Medium, oblate, conic, yellow red striped, good, late.
- Millboy.—Medium, conic, red, fair, medium, dessert.
- Milwaukee.—Medium, oblate, yellow red striped, fair, late. Hardy. A promising recent introduction.
- Minster.—Medium, oblate, conic, yellow red striped, fair, medium, late.
- Minkler.—Medium, conic, yellowish red, fair, medium, late.
- Missouri (Pippin).—Medium, conic, yellow red striped, poor, late. Profitable in Missouri, Kansas and Arkansas.
- Monmouth.—Medium, oblate, conic, yellow red, fair, late.
- Moore Sweet.—Medium, oblate, red, sweet, fair, late.
- Mother.—Medium, round, conic, yellow red, very good, medium, late, dessert. A fine dessert apple, but hard to grow.
- Munson.—Medium, oblate, yellow red, sweet, fair, medium, late.
- Nansemond.—Medium, oblate, conic, yellow red striped, poor, late.
- Nero.—Medium, oblate, red, fair, late.
- Newell.—Medium, oblong, yellow red striped, fair, late.
- Newtown Spitzenberg.—Medium, oblate, conic, yellow red striped, good, late dessert.
- Nickajack.—Large, oblate, conic, yellow red striped, poor, late.
- Northern Spy.—Large, oblate, conic, yellow red striped, very good, medium late. This good old variety will bring the top price when well grown. It is very fastidious regarding soil and situation, and slow about coming into bearing.
- Northfield.—Medium, oblate, red yellow striped, good, medium, early.
- Northwestern (Greening).—Large, conic, green yellow, fair, late. A good variety in the northern Mississippi valley.
- Nottingham.—Large, oblong, yellow red, good, late.
- Noyes.—Medium, oblate, red yellow, good, early.
- Oconee.—Large, oblate, yellow red, poor, medium.
- Ogle.—Medium, oblate, red, good, very late.
- Ohio Nonpareil.—Medium, round, yellow red, fair, medium.
- Ohio Pippin.—Large, oblate, yellow red, acid, fair, medium, late.
- Okabena.—Small, oblong, red striped, poor, medium, early.
- Oldenburg.—Medium, oblate, yellow red striped, acid, fair, early. Sometimes profitable.
- Oliver.—Medium, red, good, medium, late.
- Ontario.—Small, oblong, yellow red, acid, fair, early.

- Ortley.—Medium, oblong, yellow red, good, medium, late.
- Paragon.—Medium, conic, yellow red, good, late.
- Patten (Greening).—Large, round, yellow, fair, medium, late. Considerably planted in Iowa and Minnesota.
- Peach.—Medium, conic, yellow red striped, fair, late.
- Pease.—Large, oblong, red yellow, good, medium, early.
- Peck (Pleasant).—Medium, oblate, yellow red, good, late.
- Peerless.—Small, oblate, round, striped, fair, late.
- Perfection.—medium, round, yellow red striped, fair, medium, early.
- Perry Russet.—Medium, conic, yellow russet, fair, medium, late.
- Peter.—Medium, round, green yellow, fair, medium.
- Pewaukee.—Large, oblate, yellow red striped, poor, late. Tree hardy.
- Plumb Cider.—Medium, conic, yellow red striped, fair, medium.
- Pomme Gris.—Small, oblate, yellow russet red, very good, medium, late, dessert. An attractive small russet apple, much liked in Canada.
- Porter.—Medium, oblate, conic, yellow red, very good, medium. A favorite fall apple in New England, but badly attacked by apple maggot.
- Primate.—Medium, conic, yellow red, very good, early, dessert. High quality, but badly attacked by apple maggot.
- Pryor (Red).—Medium, oblate, irregular, green yellow red, very good, late.
- Pumpkin Sweet.—Large, round, green white, sweet, fair, medium, late. A favorite home use apple with some families, but not now often seen in the market.
- Quince.—Medium, oblate, yellow, acid, fair, early.
- Ralls.—Medium, oblate, conic, yellow red striped, fair, very late. Grown commercially in the central states.
- Rambo.—Medium, oblate, white yellow red, good, medium.
- Ramsdell.—Medium, oblong, conic, red, sweet, fair, medium.
- Raspberry.—Small, oblong, irregular, red, fair, medium, early.
- Red Astrachan.—Medium, conic, red green yellow, acid, fair, early. A fairly useful first early variety.
- Red Canada.—Medium, oblate, conic, yellow red, very good, late.
- Red June.—Small, ovate, conic, red striped, fair, very early. A profitable early variety in Delaware and neighboring states.
- Red Stripe.—Medium, oblong, conic, white red striped, fair, early.
- Rhode Island (Greening).—Medium, oblate, green yellow, acid, good, late. Formerly very profitable and widely grown in eastern states. Now not so much planted. Requires careful management.
- Ribston.—Medium, round, yellow red, acid, good, late. A fine dessert fruit when well grown.
- Ridge.—Medium, conic, irregular, yellow russet, fair, late.
- Rolfe.—Medium, oblate, yellow red striped, good, medium.

- Romanite.—Small, conic, yellow red, fair, late, dessert.
- Roman Stem.—Medium, round, white, yellow red, very good, late.
A good home apple in the central states.
- Rome (Beauty).—Large, conic, yellow red striped, fair, medium, late.
- Roxbury.—Medium, round, oblate, yellow russet, good, late.
Under the name Nonpareil this variety is still considerably grown in Nova Scotia for the British market.
- Russell.—Round, ovate, yellow red, good, early, dessert.
- Russian Baldwin.—Medium, oblate, round, green red striped, good, late.
- Salome.—Medium, round oblong, yellow red, good, very late.
- Saint Johnsbury.—Medium, round, yellow red striped, sweet, good, late.
- Saint Lawrence.—Medium, oblate, conic, yellow red, striped fair, medium. A valuable apple in Quebec.
- Scott Winter.—Small, round, conic, red striped, acid, fair, late.
Tree hardy.
- Shiawassee.—Medium, oblate, white red striped, good.
- Shockley.—Small, conic, yellow red, fair, late.
- Smith Cider.—Medium, oblate, conic, yellow red striped, fair, late.
- Smokehouse.—Medium, oblate, yellow red, fair, medium, late.
- Sops of Wine.—Medium, round, yellow red, fair, early, dessert.
- Stark.—Large, oblong, conic, yellow red striped, fair, late. Tree strong and hardy. Though of poor quality this variety has proved profitable in Nova Scotia and northeastern states.
- Starkey.—Medium, oblate, conic, round, yellow striped, good, medium, late.
- Stayman Winesap.—Large, conic, red, very good, late. A seedling of Winesap, and in some ways an improvement on the parent.
- Stephenson.—Medium, oblong, yellow red striped, fair, late.
- Sterling.—Large, conic, yellow red, good, late, dessert.
- Summer King.—Medium, oblate, yellow red striped, fair, early.
- Summer Pearmain.—Medium, conic, red russet, best, medium, dessert.
- Summer Queen.—Medium, conic, yellow red striped, acid, fair, early.
- Summer Rose.—Small, round, yellow red striped, fair, very early, dessert.
- Sutton.—Medium, oblate, conic, yellow red striped, good, late.
Worth planting commercially in Massachusetts and New York.
- Swaar.—Medium, oblate, green yellow, good, late, dessert. Worth planting for home use.
- Sweet Winesap.—Medium, oblate, conic, red, sweet, good, late.
- Switzer.—Medium, round, red, fair, early.
- Taunton.—Medium, oblate, conic, yellow red striped, acid, fair, medium.
- Terry Winter.—Small, round, conic, yellow red, fair, late.

- Tetofski.—Medium, oblate, conic, yellow red striped, acid, poor, early. A Russian apple of some value for first early.
- Titovka.—Medium, oblate, conic irregular, yellow red striped, fair, medium. A hardy Russian.
- Tolman.—Medium, oblate, yellow, sweet, fair, late. A favorite sweet apple, now unprofitable by reason of the attacks of the apple maggot.
- Tompkins King.—Large, oblate conic, yellow red striped, very good, late. A splendid apple, and was formerly considerably grown. Is still grown to some extent in New York. Tree a light bearer and subject to disease.
- Townsend.—Medium, oblate, conic, yellow red striped, fair, late.
- Trenton Early.—Medium, conic, irregular, yellow green, good, early.
- Twenty Ounce.—Very large, round, yellow red striped, fair, medium, late. Formerly grown for market, but now generally superseded.
- Utter.—Medium, round, yellow red, fair, medium. Hardy.
- Vandevere.—Medium, oblate, yellow red striped, fair, medium.
- Vanhoy.—Large, oblate, yellow red striped, fair, late.
- Virginia Greening.—Large, oblate, yellow red, fair, late.
- Wagener.—Medium, oblate, yellow red striped, late. Good quality when well grown, and sometimes profitable, especially in Nova Scotia.
- Walbridge.—Medium, oblate, conic, yellow red striped, fair late. Sometimes proves profitable.
- Washington.—Large, oblate, conic, yellow red striped, good, early.
- Watson.—Large, oblate, conic, red striped, fair, early, dessert.
- Wealthy.—Medium, oblate, yellow red, striped fair, medium. One of the most widely successful and profitable of autumn varieties.
- Westfield (Seek-no-further).—Medium, conic, red, very good, medium. Sometimes profitable in Massachusetts and New York, but not much planted now.
- Wetmore.—Medium, round, red, good, late.
- Whinery.—Medium, round, conic, red striped, fair, late.
- White Juneating.—Small, round, yellow red, fair, early, dessert.
- White Pearmain.—Medium, oblong, conic, yellow red, very good, late.
- White Pigeon.—Medium, conic, russet yellow, sweet, fair, early.
- White Pippin.—Medium, round, oblate, yellow red, very good, late.
- Williams (Favorite).—Medium, oblong, conic, red, fair, early. A first-class early apple, profitable in parts of New York and New England.
- Willow Twig.—Medium, oblate, conic, yellow red, fair, very late. A hard, late-keeping apple of some commercial importance in the central Mississippi valley.
- Windsor.—Medium, round, yellow red, fair, medium, late.

- Wine.—Medium, oblate, yellow red, fair, late.
- Winesap.—Medium, oblong, yellow red, acid, good, very late. Tree weak and subject to disease, for which reason the variety can seldom be grown at a profit. Fruit of high quality, however, and a favorite for home use.
- Winter St. Lawrence.—Medium, round, red striped, good, late, dessert. A good and profitable apple in lower Ontario and Upper Quebec.
- Wolf River.—Very large, oblate, red striped, fair, medium. Tree hardy, fruit showy. Adapted to northern and exposed localities.
- Yates.—Small, oblate, conic, yellow red striped, fair, very late.
- Yellow Belleflower.—Large, oblong, conic, yellow red, acid, very good, late. Formerly a favorite in the eastern states, but now grown commercially chiefly on the Pacific coast.
- Yellow Newtown.—Medium, oblate, yellow red, acid, best, very late. A favorite in California and in Virginia (under the name of Albermarle). A variety of high quality where well grown.
- Yellow Transparent.—Medium, conic, yellow, acid, fair, early. Very hardy. Adapted to the cold regions of northern New England and Quebec. Sometimes profitable for sale in local markets, but too tender for shipping far.
- Yopp.—Large, conic, yellow red, fair, medium.
- York Imperial.—Medium, oblate, irregular, lop-sided, yellow red striped, fair, late. This is a really successful commercial variety in Pennsylvania, West Virginia and neighboring states.

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