

Pruning Fruit Trees



Bulletin 145
of the
Agricultural Extension Service, The Ohio State University

Contents

Fundamental principles of pruning.....	3	Pruning bearing apple trees	27
Relation of growth to fruitfulness	3	Rejuvenating old trees.....	27
Judging a tree's growth.....	4	Pruning as related to fillers and planting distance	27
Season for pruning.....	4	Disposal of brush	28
Making the cuts	6	Adapting pruning to varieties	30
Wound dressings	6	Rome Beauty. 30	McIntosh 32
Fire blight canker solution	8	Stayman 30	Spy
Types of pruning.....	8	Jonathan 30	Golden Delic's 32
Movement of nutrients in branches.....	8	Baldwin 31	Transparent.. 32
Pruning affects growth near cut.....	8	Grimes 31	Wealthy 32
Heading-back pruning.....	8	Delicious 31	
Thinning-out and bulk pruning.....	10	Pruning the pear.....	33
Detail pruning.....	10	Pruning the young peach tree	34
Cutting to lateral branches.....	11	Bearing habit.....	34
Correction of weak crotches...	12	Age of tree to plant.....	34
Pruning as related to growth and production of young trees.....	13	Pruning at planting.....	34
Pruning as related to growth and production of bearing trees.....	15	The second year's cuts.....	34
Terminal growth.	15	Special problems in starting head	36
Fruit spurs.....	15	Modified debudding method.....	36
Pruning related to fruit bud development	15	The third year's pruning.....	37
Other benefits of pruning bearing trees....	16	Pruning the bearing peach tree.....	37
Color improvement.....	16	When and how severely to prune.....	38
Pruning aids in controlling insects and disease pests.....	17	Types of pruning.....	39
Pruning increases size of fruit	17	Placing renewal cuts.....	40
Pruning keeps fruiting wood vigorous .	18	Pruning methods compared.....	40
Training young apple trees.....	19	Pruning the sweet cherry.....	41
Pruning 1-year-old trees at planting ..	19	Pruning the sour cherry.....	42
Training by debudding.....	20	Fruiting habit	42
Pruning 2-year-old trees at planting....	21	Pruning at planting trees.....	43
Pruning after 1 year's growth in the orchard	21	Subsequent training.....	43
The modified leader tree.....	23	Pruning the plum	44
Subsequent pruning of young apple trees	24	Pruning the apricot.....	46
Bending or tying down branches.....	26	Pruning the nectarine.....	46
		Pruning the quince.....	46

"PRUNING FRUIT TREES"—*Extension Bulletin 145*
 (replaces Vol XXI, No. 8, same title)
 Sixth edition—July, 1935

Pruning Fruit Trees

By

F. H. BEACH

Extension Specialist in Horticulture, Ohio State University



THE KIND and amount of pruning is determined by the kind of fruit, variety, age of tree, existing framework, condition of bark and wood, growth, and fruiting habits. Heavy pruning is a dwarfing process, and is undesirable for normal young nonbearing trees. As bearing trees reach maturity, the amount of pruning may be profitably increased to maintain regular and efficient production of quality fruit. Training cuts that develop a strong framework increase longevity of trees and reduce loss of bearing wood by breakage.

FUNDAMENTAL PRINCIPLES OF PRUNING

Relation of Growth to Fruitfulness.—There is a relationship between the roots and leaves of plants and trees that must be recognized to understand the results from pruning.

Materials used by the plant in manufacturing its food supply come from the soil through the roots and from the atmosphere through the leaves. The various essential mineral nutrients are received from the soil in water solution. Those nutrients containing nitrogen are the most limiting ones in tree growth. From the atmosphere, through the open stomata of green leaves, is received carbon and oxygen in the form of carbon dioxide, which combines with hydrogen from water, in the process of photosynthesis, to form a class of compounds known as carbohydrates (starches, sugars, etc.). The mineral nutrients combine with the carbohydrates in various ways to form the elaborated plant foods used in all growth processes. The orchardist is, therefore, essentially interested in providing for a well balanced supply of carbohydrates, nitrogen, and water for his fruit trees.

To secure proper fruitfulness, there must be a balance between the nitrogen and carbohydrate supply, or between the nutrients received from the roots and carbohydrates manufactured in the leaves. If the materials supplied by either the roots or the leaves are insufficient, or the intake of nitrogen is excessive, an unfruitful condition results, particularly with young trees. An ample supply of carbohydrates beyond the requirements for growth is necessary to promote fruit bud formation and to aid in the proper ripening of wood and fruit. Sufficient nitrates and water must be available to promote satisfactory growth conditions and fruit setting in the early part of the growing season. An over-supply of available nitrates late in the growing season is associated with poorly ripened wood that may be winter injured and, with some varieties of apples, poorly colored starchy fruits.

Light exposure is very important, as sunlight is the energy used by green leaves in the manufacture of food for growth. Sufficient branch spacing

should be done by pruning to allow a relatively uniform distribution of sunlight on the leaves throughout the tree. The amount of branch spacing by pruning away large limbs and the amount of pruning by distributed small cuts should be coordinated to leave the trees well filled with efficient fruiting wood.

Generally speaking, an over-vigorous tree is rarely found in practical orcharding except in the case of young trees just before coming into bearing. The under-vigorous tree is very often found. In fact, it exists in nearly all Ohio orchards that contain mature trees. The balanced and fruitful condition is the one toward which all growers should strive.

When trees are growing too much they are receiving an over-supply of nutrients from the roots, and consequently need a cultural program which reduces the intake of mineral nutrients, especially nitrogen. Such trees also need all the carbohydrate foods they can get through their leaves, and should not have the leaf surface seriously reduced by pruning.

When trees are not growing enough, they may have been injured or they are not receiving sufficient nutrients from the roots. If they have been injured the first thing is to give the proper treatment to correct the condition. For example, trees defoliated by insects or diseases, or injured by borers, need treatment to control these pests. When trees have had their wood injured by winter freezing, the leaf surface will be much reduced. Relatively little pruning, with heavy applications of quickly available nitrogen fertilizer early in the spring, is then needed. When healthy trees do not receive enough nutrients from the roots, nitrogen fertilizers may be increased, and the trees might also be benefited by proper pruning along with an improved soil management program to increase the available supply of soil moisture and nitrates.

Judging a Tree's Growth.—Each kind and variety of fruit tree has a normal growth for a given age and growing location. With young nonbearing trees, it is desirable to handle them to get as much growth as possible each year and properly ripen the wood for winter. With bearing trees, sufficient growth is wanted to maintain desirable new fruiting wood each year. The most desirable amount of growth must be determined by experience.

A helpful guide is to examine a number of typical branches, observing the length and diameter of last year's growth from the tip back to the first annular growth ring. For bearing apple trees, from 10 to 15 inches or more of plump terminal growth is desirable. The ranker growing varieties, such as Stayman, Delicious, and Baldwin, should approach or exceed the longer extreme, which encourages fruit bud development on 2-year wood tending to annual bearing. Terminal growth of large diameter is associated with vigorous fruit spurs, large leaves, and ample storage of reserve carbohydrate foods in the branch structures. With bearing peach trees, a plump terminal growth of 15 to 24 inches is desirable. With the sour cherry a plump terminal growth of 12 inches or more is satisfactory.

SEASON FOR PRUNING

Most growers prefer to prune in the dormant season, because other orchard operations are less pressing at this time and branches can be easily seen. Also, pruning is hard work and goes well in cool weather. Trees are

not barked easily when dormant and at this time there is least danger of bark pulling away from around pruning wounds. Wounds usually heal best if the pruning is done just as active growth begins in the spring, and pruning can be best adapted to crop conditions for the year if done at this time. This is especially true for pruning bearing peach trees. But the need of getting the pruning done and the brush disposed of before spraying season starts, results in most commercial growers practicing dormant season pruning.

Mature apple trees and mature trees of other hardy fruits should be pruned first. Then in late winter and toward spring, the young trees and less

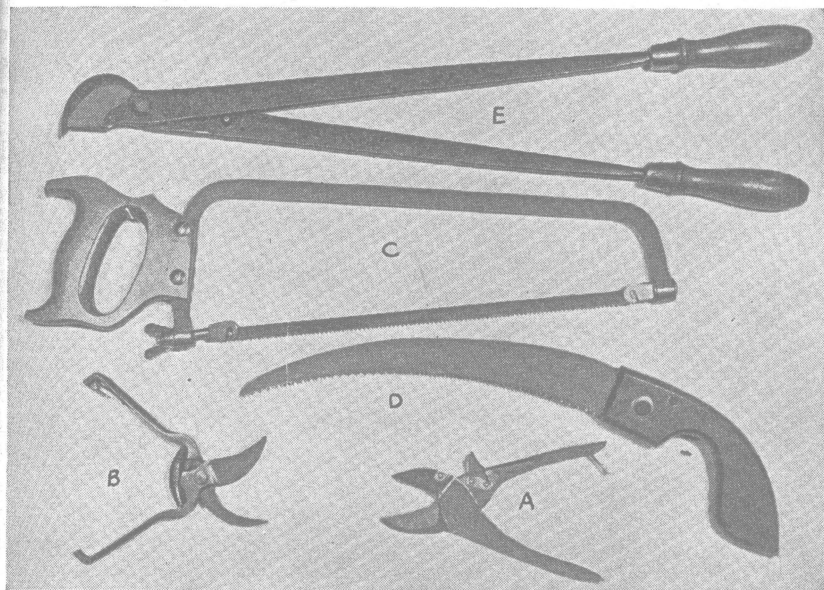


Fig. 1.—Small cuts are made with hand shears. The “roll cut” type hand shears *A* handle small twigs very easily and are very useful for detail pruning. The type hand shears at left, *B*, make snug cuts for all light pruning.

The swivel bladed orchard pruning saw *C* makes a clean close cut in narrow crotches and at difficult angles. The curved saw *D* which cuts on the draw or pull stroke works fast in larger limbs but does not make as clean a cut; this saw is very rapid in peach pruning.

The steel handled lopping shears *E* are indispensable in peach pruning and useful for mature apple trees where many limbs over an inch in diameter must be cut. Care is needed in placing blade of lopping shears to make a snug cut.

hardy fruits can be pruned. Summer pruning can be practiced where desirable to improve growing crops and to help fruit bud formation. This is often done with young and bearing peach trees. With apples and peaches it is sometimes profitable, when hand thinning during the summer, to do some pruning at the same time to reduce the labor of thinning, and cut away poor fruiting wood which can easily be judged at that season of the year.

Water sprouts are best “mopped off” in early summer, while succulent. It is the cheapest way to remove them. Removal of water sprouts in early summer also helps in aphid control, as this succulent growth is attractive to aphid and aphid eggs are often carried over winter on water sprouts.

MAKING THE CUTS

All cuts made with shears or saw should be made with correctly adjusted, sharp tools to give a clean smooth cut (see Figs. 1 and 2). In removing a branch, make the cut clean, close and parallel to the supporting limb. When cutting to a lateral, place the cut so it continues the line of direction of the lateral branch. Stubs do not heal, and may start decay.



Fig. 2.—A heavy leather belt supplied with wire hooks on which to hang tools is very handy while working. Swivel bladed orchard pruning saw, hand shears, and lopping shears, are hanging from this belt.

The entire margin of all cuts must be adjacent to the active cambium layer of the supporting limb to promote rapid and uniform healing (see Fig. 3).

In using shears, place the blade against the supporting limb to get a smooth, close cut. With hand shears, if the branch to be removed is bent over the jaw of the shears with one hand while closing the shears with the other, the cut is made with least effort. Never wiggle the shears through a cut, as this makes a ragged wound and may spring the shears. Cuts should travel across the limb or toward the end of the branch, and not downward toward the base of the branch, as such cuts are often ragged.

In removing a heavy limb with a saw, it is often helpful to do it with three cuts. First, make an under cut about 2 inches deep about 8 to 10 inches out from base of the limb. Then

cut from above, starting second cut 2 or 3 inches nearer the base of the limb than the under cut. Then the limb will fall off without tearing down bark into the supporting limb. The short stub can then be handled easily and a final cut made to remove the stub with a clean close cut against the supporting limb.

Wound Dressings.—Wounds under 2 inches in diameter seldom require wound dressings. For larger wounds on main branches or trunk of apple, pear, plum, and cherry, a wound dressing may be used. Hard brush wax is one of the best coverings, especially over the cambium layer of large wounds and for rabbit and mouse injuries. White lead and raw linseed oil mixed thick is a satisfactory cheap covering for the centers of large wounds. Shellac is often used for this purpose, and there are several good prepared wound dressings on the market.

A cheap satisfactory brush wax can be prepared from the following formula, or satisfactory brush waxes can be purchased from orchard supply firms, which also supply portable wax heaters.

Paraffin Brush Wax

Linseed oil.....	3 fluid ounces
Rosin.....	1 pound
Paraffin.....	5 pounds

High melting point paraffin is preferred. Melt the rosin and linseed oil together and pour into the melted paraffin. Mix well. Pour out into a shallow pan lined with oil paper to make a cake 1 to 2 inches thick. This can be broken up and melted in a heater as needed.

The wax is applied hot, but not super heated, with a small paint brush. A portable wax heater can be quickly assembled at home. Secure a wide-topped can with handle and a small alcohol or kerosene lamp with metal chimney. The lamp is placed in the bottom of can or on a wooden block to raise it as necessary. Fit a pint or quart can through the lid of the larger can and let it rest on lamp chimney, or provide wire or strap iron hanger to hold wax can above the heater. Perforate bottom of large can for air and notch top of lamp chimney if wax can rests on it. A piece of heavy wire can be put through wooden handle of brush to make a rest over top of small wax can to keep bristles off bottom of can. (This is described and illustrated in Bulletin 510 of Ohio Agricultural Experiment Station, "Grafting and Budding Fruit Trees.")

Where dead areas of bark or large disease cankers are found on large limbs and trunk, trim away dead and injured bark back to live cambium, pointing wound at upper and lower extremity wherever possible.

To promote rapid healing of wound leave bark at edge of wound with a vertical cut to the sapwood and not a sloping cut which retards healing. Diseased areas are best trimmed and treated in the dormant season to prevent spreading with tools. Special injuries, such as winter injury in framework crotches and on trunks, rabbit and mouse girdling, require prompt treatment and where bridge grafting is needed the work should be done in early spring as growth starts. For large wounds and where girdling has occurred, a bridge graft for every 2 to 3 inches of lateral injury is recommended.

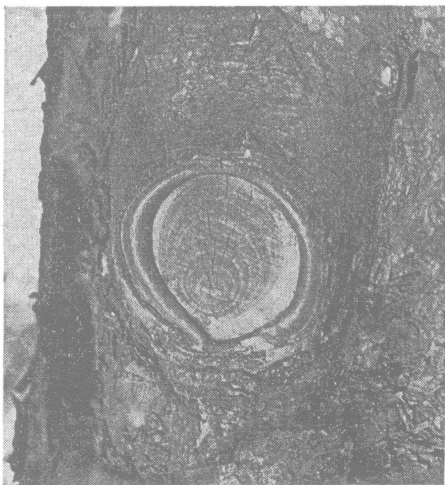


Fig. 3.—A close pruning cut healing satisfactorily.

Where cankers of diseases such as fire blight, bitter rot and black knot are present, it is desirable to cut away all dead twigs and larger limbs, and remove limbs which have been more than two-thirds girdled by any sort of canker.

Fire blight is the most common canker on apples and pears and these need not be cut out if the following solution is used to cover them.

Fire Blight Canker Solution.—To 3 ounces of concentrated hydrochloric acid add 1 quart of hot water in an enamel kettle, and in this mixture dissolve 9 pounds of dry zinc chloride powder. Commercial grades of chemicals are satisfactory for this solution. Add sufficient red or blue coloring, using any good dye, easily secured from a local drug store, so that areas treated can be closely checked for thorough work. After cooling, pour the above solution into 7 pints of denatured alcohol and mix thoroughly.

Store in tightly stoppered large glass bottles or jugs to prevent evaporation. Apply with small paint brush.

TYPES OF PRUNING

Movement of Nutrients in Branches.—The various mineral nutrients in water solution are carried up the trunk and branch structures of the tree through vascular tissues which, to a considerable degree, are unit structures as far as each branch is concerned. Therefore, when a large branch is pruned off, much of the vascular tissue which carried water and mineral nutrients into the branch from the root system becomes more or less nonfunctioning.

On the other hand, when the pruning consists of removing many small branches and twigs from a large branch, with cuts well distributed along the

entire branch length so as to leave the most vigorous fruiting wood well spaced, then there is opportunity for a larger dispersal of water and mineral nutrients into the remaining branches, twigs, and fruit spurs left on the large limb after pruning. It is desirable that the orchardist understand this physiological process, so that he can prune intelligently.

Pruning Affects Growth Near Cut.—The growth response from pruning is almost entirely localized in the immediate vicinity of the cut. Shoot growth following pruning is greatest near the cuts, and small branches and spurs near cuts are invigorated. The growth and fruiting habit on branches not pruned are affected very little by pruning cuts elsewhere.

Heading-Back Pruning.—When a terminal growth is left without any cutting, it normally continues its main growth from the terminal bud. If the terminal growth is

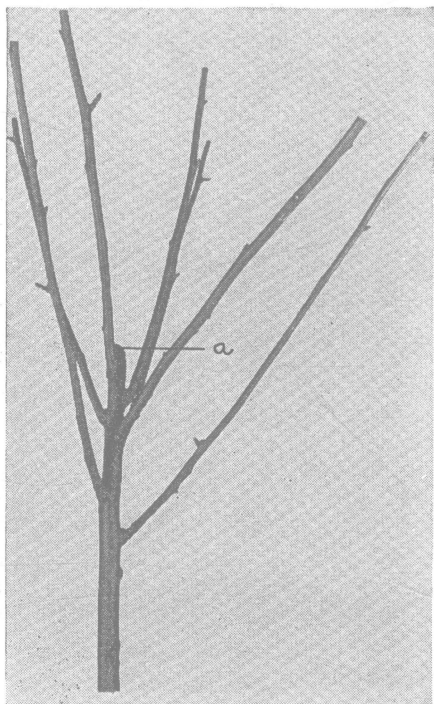
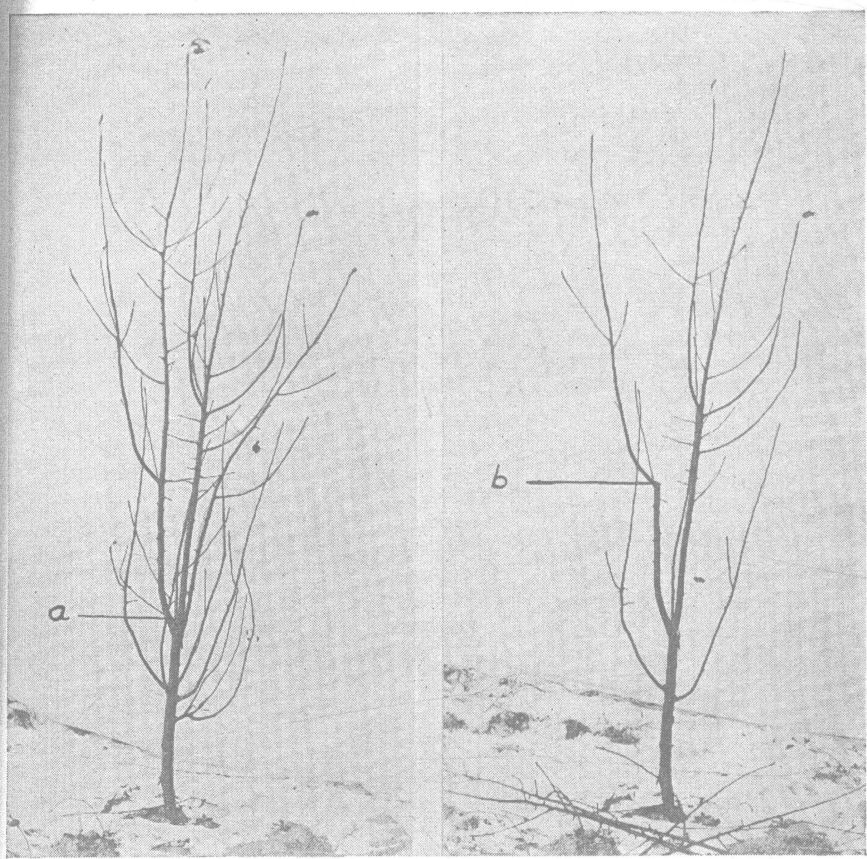


Fig. 4.—Result of a heading-back cut at *a* which forced buds just below the cut into vegetative branches. Such cuts develop thick trees with much unproductive wood.

cut back or "headed back," several buds immediately below the cut are forced into active growth, and develop into a number of vigorous and competing branches (see Fig. 4). Such pruning multiplies the number of terminal growths and discourages the normal development of lateral branches, twigs, and fruit spurs below the cut. If carried to extremes, this method of pruning



(a)

(b)

Fig. 5.—(a) Young apple tree before corrective pruning. The two main branches have formed a weak fork at a. (b) same tree after corrective pruning. One of the main branches has been cut back heavily at b to a desirable lateral. The pruned branch will gradually develop as a side limb, correcting the weak fork.

results in dense trees with a preponderance of strongly vegetative wood which retards bearing. Too many young trees have been dwarfed and kept out of bearing by "all-over" heading-back pruning.

Heading-back cutting is of value in pruning the young trees to enable the grower to start the head where he desires. It is also of value on trees that have made a very vigorous and leggy terminal growth to secure desirable placement of lateral branches.

When terminal growths are headed back, the cluster of shoots arising just below the cut often provides more branches than can be used at a given place (see Fig. 4). This means that the next time the tree is pruned, many of these shoots must be removed or the tree will become too dense. Considerable heading-back pruning, therefore, necessitates considerable thinning-out pruning later, which seriously dwarfs the tree, because of the large leaf area removed in the prunings.

Thinning-Out and Bulk Pruning.—Where branches are pruned away entirely it is termed *thinning-out pruning*. When confined to the removal of

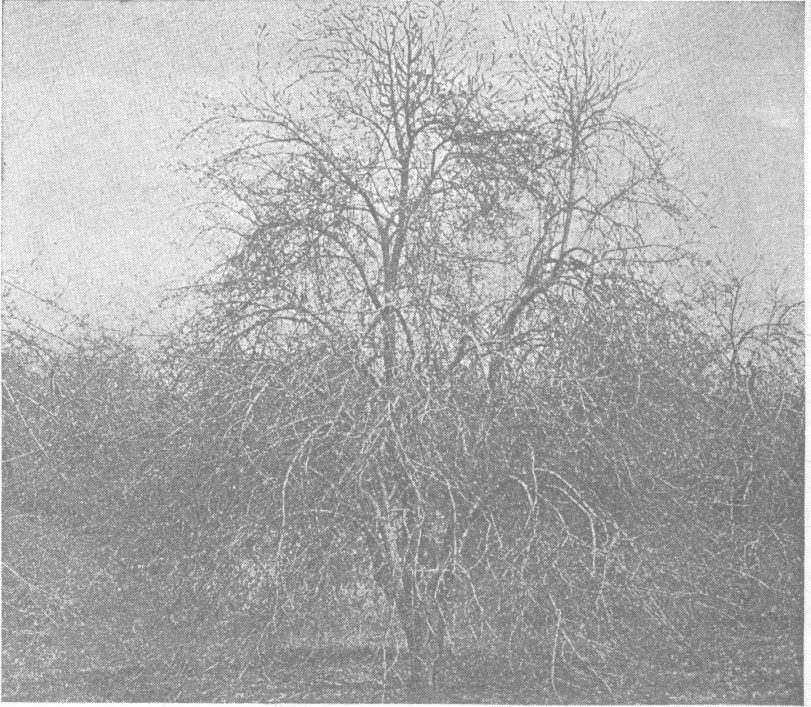


Fig. 6.—Old Rome Beauty apple showing deeply matted twigs at the ends of fruiting branches. This tree needs detail pruning with the hand shears, with cuts distributed over each main fruiting limb; very few large cuts are needed. Compare with Fig. 7.

rather large limbs, it is called *bulk pruning*. Most pruning is of a thinning-out type, to prevent trees becoming too dense, to make corrective cuts, to improve framework, and to remove branches which will no longer produce desirable fruit.

Detail Pruning.—When pruning cuts are confined to small, scattered shear cuts, well distributed over a long length of limb, it is called *detail pruning*. Such pruning is employed on bearing trees to maintain vigorous fruiting branches, spurs, and terminals. Well distributed small cuts are very useful in giving the remaining fruit spurs a larger supply of water and mineral nutrients. Accordingly, after such pruning, these spurs are more vigorous,

fruit setting on them is improved, and fruits grow to larger size and attain higher color. Because of more and larger leaves and more efficient leaves attached to these individual spurs and terminals, the quality of fruit is improved and fruit bud formation is encouraged each year (see Figs. 6 and 7).

In placing cuts, remove underhanging slender branches as much as possible. These are associated with small, under colored fruit. Leave the best located, large diameter fruiting branches. This procedure provides most favorable growing and fruiting conditions for the most desirable fruiting wood.

Detail pruning improves fruit setting, size, color, and eating quality, and also promotes annual bearing. Better spraying and pest control is secured on branches that are detail-pruned.

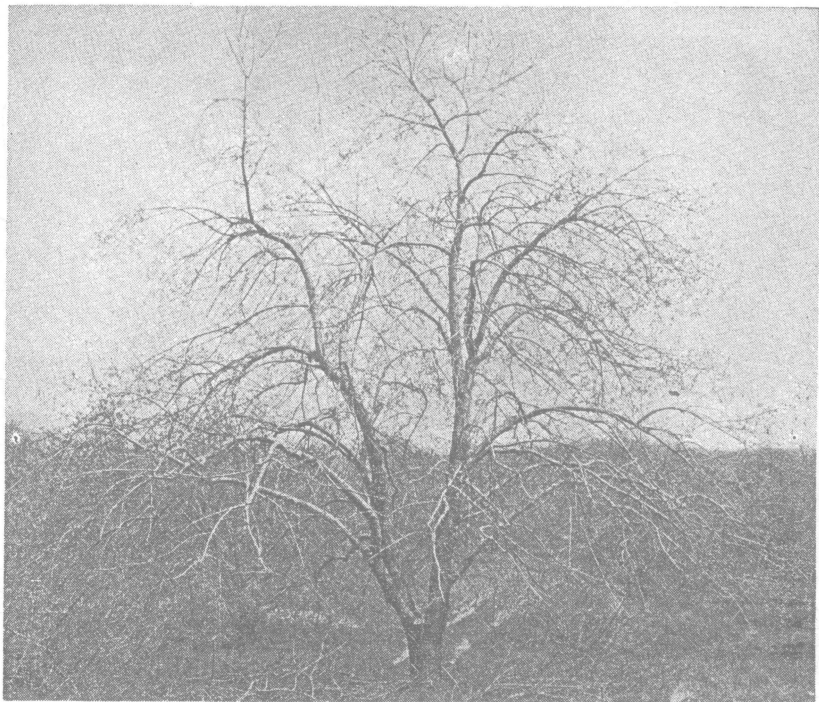


Fig. 7.—Old Roman Beauty similar to tree in Fig. 6 after pruning. Only a few large cuts were made. Pruning was started at top of tree. In working downward each limb was detail-pruned from tip back to base to leave fruiting wood on tree with best distribution over length of limb. Ladder was used to work over ends of high branches.

This tree required two hours of pruning labor but little hand thinning of fruit will be required. Tree has bearing capacity of 30 bushels or more.

Cutting to Lateral Branches.—Lowering or shortening a limb by cutting to a lateral branch does not start out as many side branches as does heading back. Also, it does not dwarf as much, particularly if the lateral is a strong growthy branch of about the same size as the main branch. As a result, cuts to laterals can often be made to shape and train a tree where a lower, shorter, or more open type of growth is desired.

This kind of pruning is employed to lower the tops of tall trees, and to keep trees from getting too tall to spray, thin, and harvest economically.

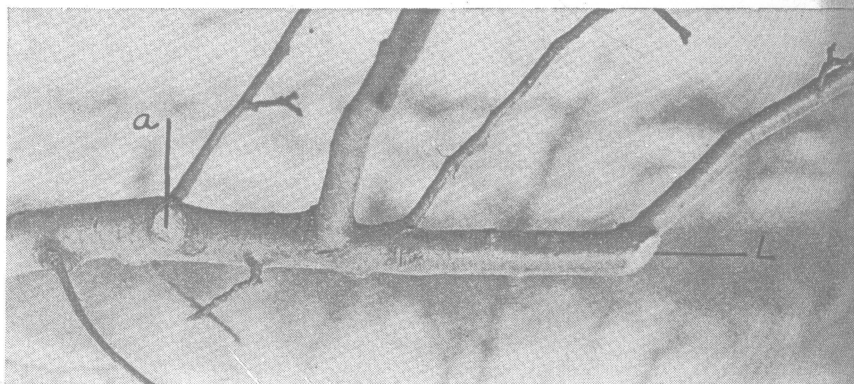


Fig. 8.—Cutting to a strong lateral, as at *L*, is the most desirable method of shortening a limb. The cut at *a* where a side branch has been removed is properly made.

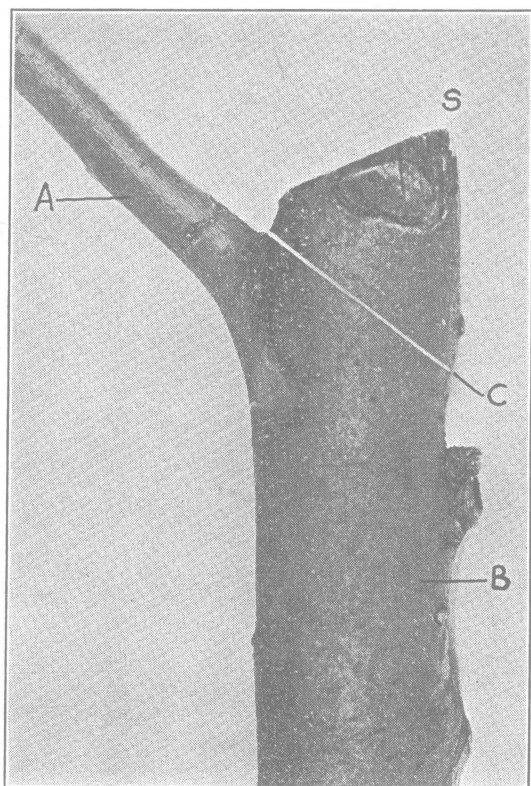


Fig. 9.—This cut to a lateral was improperly made. Lateral *A* is too small a limb at which to place cut. Compare with size of lateral used in Fig. 8. The cut across main limb *B* should have been on line *C* to permit healing of wound. Note high stub *S* is dying back because it is above active cambium in limb *A*—*B*. (*Ohio Exp. Sta.*)

Branches that droop to the ground or those which overgrow other limbs are often cut back to an upward growing lateral, preferably placing the cut on the under side of the main branch. Peach growers cut to outward laterals to hold trees at proper height and to keep the tops sufficiently open and spreading.

In making a heading-back cut to a lateral, the cut should follow the direction of the lateral so that the wound will heal to best advantage (see Figs. 8 and 9).

Correction of Weak Crotches.—When two branches come out at the same place and are of the same size, they will eventually form a very weak crotch which may split (see Fig. 10). The most desirable method to handle a weak crotch is to cut off the poorer branch. If a

lateral is wanted where one of the forks arises, cut one back heavily which dwarfs it into a lateral (see Fig. 5).

Framework branches which leave the trunk at an acute angle usually make a weak crotch and should be pruned away as soon as noticed. Encourage framework branches that leave the trunk at a wide angle, approaching 90 degrees, as these will develop strong shoulders at their union with the trunk (see Fig. 11a).

As the central axis of each branch remains at the same height while the limb increases annually in girth, it is desirable to arrange for both vertical and radical spacing of scaffolds. This insures strong shoulders that will never interfere with each other.



Fig. 10.—The result of allowing a weak fork at the head to remain uncorrected. If the left limb of the fork had been removed or cut back heavily to a lateral when the tree was young, this weakness would have been corrected.

PRUNING AS RELATED TO GROWTH AND PRODUCTION OF YOUNG TREES

That pruning has a dwarfing effect upon young trees is clearly shown by experiments at the Ohio Experiment Station and has been confirmed by the experiences of fruit growers everywhere. This is because pruning reduces leaf surface, and with young trees, until they become too dense, all leaves can function in manufacturing food for growth. While many terminal growths may be heavier after pruning a young tree, the total growth of the pruned tree is less than if it were not pruned, for the increase is not enough to make up for the amount pruned away plus normal growth. *With young trees,*

pruning should only be heavy enough to accomplish necessary training purposes; every unnecessary cut is an economic loss.

At the Ohio Experiment Station, heavily pruned trees were smaller for age and did not come into bearing as early as unpruned or lightly pruned trees. Unpruned trees, while largest, were ungainly in appearance, with many framework defects. Lightly pruned trees, properly trained, were best. Filler apple trees can be handled with very little pruning until they crowd the permanents.

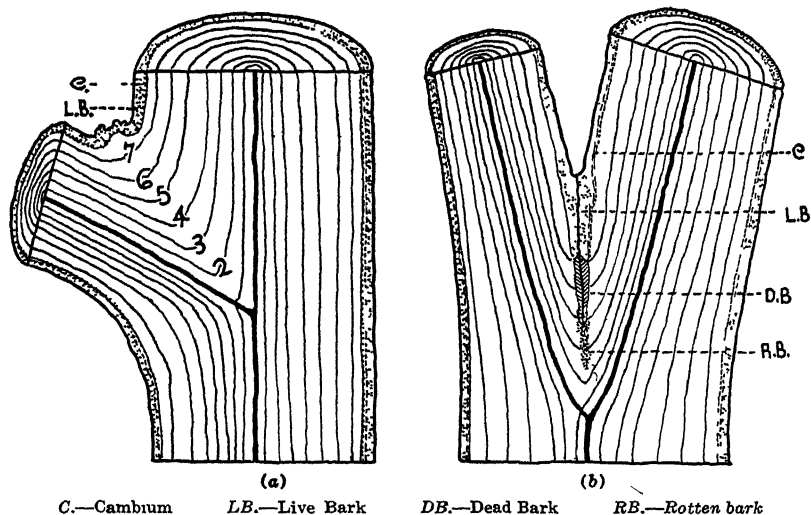


Fig. 11.—Wide crotch angles insure strength. The angle of crotch (a) is wide. Note relative thickness of the seven successive annual layers of wood (numbered) laid down by the cambium C in this crotch angle. The angle of crotch (b) is narrow. Observe that the bark of each branch in the crotch angle comes together before the crotch is filled with woody tissue. Annual layers of wood in the crotch are relatively narrow. A cleavage line results from the bark inclusions in the narrow crotch. Note that live bark (LB) dead bark (DB) and rotten bark (RB) are found in succession down the cleavage line of the crotch, which prevents a union and encourages decay. A narrow crotch is weak, splits down with overloads and is often associated with winter injury on adjacent bark. Use scaffold branches that leave the trunk with a wide angle.

The results in the table opposite were taken at the Ohio Experiment Station at Wooster with Baldwin and Stayman apple trees, planted in 1916, and the production includes the fruit produced up to and including the crop of 1932. It will be observed that pruning reduced the yield of Baldwin more than Stayman.

Pruning and Yield. Young Apples

	Baldwin Pounds per tree	Stayman Pounds per tree
No pruning	1701.8	1757.7
Light dormant pruning	1265.1	1952.6
Heavy dormant pruning	1179.9	1269.7

These records show that during the first 17 years from planting, light pruning reduced the yield of Baldwin by 26 per cent and heavy pruning still further reduced yield by 31 per cent as compared with unpruned trees. With Stayman, light pruning increased yield by 11 per cent, while heavy pruning reduced yield by 28 per cent as compared with unpruned trees. This further shows the need of adapting the pruning program to suit the variety.

Terminal Growth.—As the trees come into bearing, the production of fruit and the increasingly large top change the growth conditions in various parts of the trees. Annual growth becomes less with each succeeding year, until it affects fruitfulness. Pruning, as interrelated with thinning and a desirable soil management program, then becomes necessary to keep the annual terminal growth at the right stage and to maintain production of quality fruit.

Fruit Spurs.—Fruit spurs must be kept in a vigorous condition. In old trees, fruit spurs often become undersized and annual pruning, with cuts well distributed, is needed to keep the trees up to the proper growth standard. Large spurs are correlated with large well colored fruits.

Individual fruit spurs on an apple tree do not bear every year. The year a spur bears, it usually does not form a fruit bud for the following year. Thus each spur usually has a biennial habit of blossoming and fruiting.

Some varieties tend to grow short fruit spurs that are rather uniform in growth habits and all bloom in the same year. Such trees tend to biennial bearing:—as Baldwin, York, Wealthy, Transparent.

Other varieties grow fruit spurs of unequal length. As a result, only a part of these spurs bloom and fruit one year, while some of the others bloom and fruit the following year. Such trees tend to annual bearing:—as Jonathan, Grimes, McIntosh, and Stayman.

Other varieties lie between these two groups. When properly grown they may be annual bearers, but they easily become biennial as they grow older or as cultural treatment becomes insufficient. Examples of this type of tree are Delicious, Gano, and Ben Davis.

Still other varieties fruit from terminal buds as well as from spurs and tend to be annual bearers, because some terminal fruit buds are usually formed every year. Examples of this type of tree are Rome and Golden Delicious.

To encourage annual bearing, an increase in the amounts of pruning and nitrogen fertilizer used should be made in the winter and spring following the heavy crop.

Even with annual bearing trees, pruning with other orchard practices is necessary to keep spurs of unequal growth, and the trees in an annual bearing condition. Particularly is this true as the trees grow older.

Pruning Related to Fruit Bud Development.—Usually, the buds on fruit spurs are all alike at the start. Whether they become fruit buds, leaf buds, dormant buds, or dead buds depends on the food supply they receive. The buds with one leaf seldom get past the leaf-bud stage, but with three or more large leaves on a spur, the adjacent bud may develop into a fruit bud. For this reason, it is desirable to have several large, efficient leaves on each fruit spur. To secure such leaves, it is important that plenty of sunlight reach them. Pruning should, therefore, thin out the surplus limbs so that sunlight can reach the remaining leaves on the fruit spurs. With some varieties, detail pruning is also necessary to increase the supply of nitrates and water for the remaining leaves, fruit spurs, and terminals (see Fig. 12).

Varieties which respond profitably to detail pruning on mature trees include Rome, Stayman, Delicious, Mammoth Black Twig, R. I. Greening, Baldwin, Jonathan, Spy, York, Transparent, Oldenburg, and Wealthy.

OTHER BENEFITS OF PRUNING THE BEARING TREES

Pruning the bearing tree is done to improve quality, and may increase the quantity of marketable fruit. Pruning also improves color, assists in controlling insects and diseases, increases size of fruit, and keeps the fruiting wood on old trees vigorous. With some varieties, such as Jonathan and Rome pruning will largely take care of the needs of thinning and at less cost per tree.

Color Improvement.—Color in apples is determined largely by the inter-relation of two basic factors; first, the chemical composition of the fruit, and secondly, the intensity of exposure to sunlight on the fruit. For the chemical composition of the fruit to be favorable for coloring, the leaves must

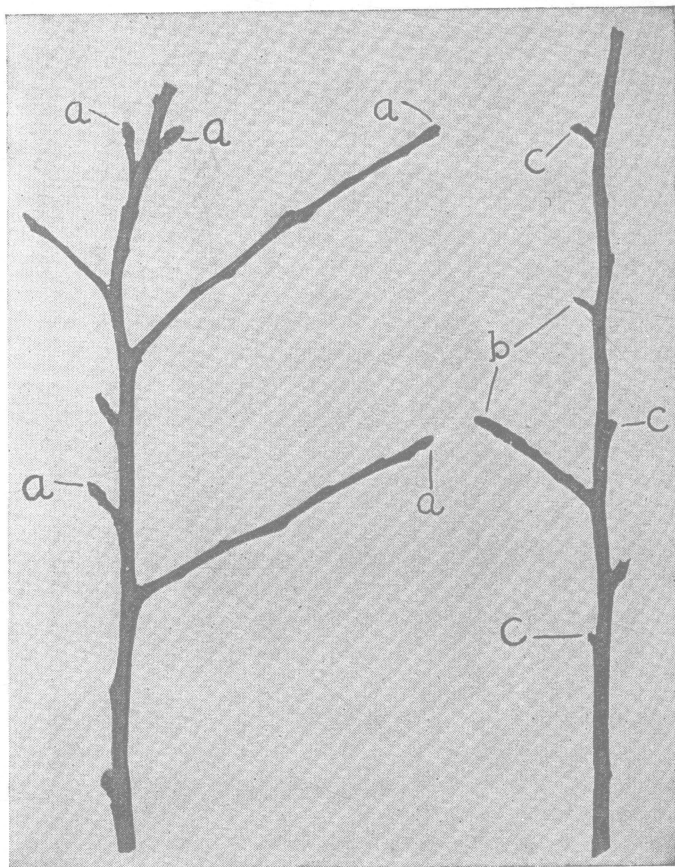


Fig. 12.—A bud study of apple wood. The buds *a* are large and strong and are probably fruit buds. Buds *b* are small and pointed, and are probably leaf buds. Where there are three or more large, healthy leaves on the spur to feed it, buds like *a* develop. Where there is a small leaf surface, a bud like *b* develops. Where there are no attached leaves on the spur, the buds die out as at *c*.

be manufacturing a supply of carbohydrates (principally sugars) beyond the requirements for growth, during the ripening period. Proper pruning assists in providing most favorable conditions by photosynthetic activity in the leaves and secures most favorable sunlight exposure on the fruit. At the Ohio Experiment Station at Wooster, with Baldwin and Stayman trees planted in 1916, light and heavy dormant pruning improved color in records taken in the crops of 1930 to 1932. On these varieties the color requirement for U. S. Fancy and U. S. No. 1 is a minimum of 33 and 15 per cent, respectively, of good red color characteristic of the variety.

Influence of Pruning on Color

Treatment	U. S. Fancy Per cent		U. S. No. 1 Per cent		Below U. S. No. 1 Per cent	
	<i>Baldwin</i>	<i>Stayman</i>	<i>Baldwin</i>	<i>Stayman</i>	<i>Baldwin</i>	<i>Stayman</i>
No pruning . . .	63.0	57.7	24.5	40.7	12.5	1.6
Light dormant pruning	76.3	91.8	13.2	8.1	10.5	.1
Heavy dormant pruning	88.6	91.4	7.3	8.6	4.1	0

With Rome and Jonathan, proper pruning, with emphasis on detail pruning, has maintained quite satisfactory color development, with little opportunity for further gains in most years from hand thinning. With varieties which often set in clusters, such as Wealthy and Grimes, pruning helps color, but in addition hand thinning is important for proper color development. Proper pruning should be given all varieties of bearing trees as a basic annual practice for color improvement, and hand thinning should be determined by fruit setting for the year and the varietal response.

Pruning Aids in Controlling Insect and Disease Pests.—Proper pruning avoids thick, matted branches and keeps trees in condition to be economically and efficiently sprayed with a minimum amount of spray material. As spraying usually represents about a third of the acre cost of growing an apple crop, this is important. It is very desirable that trees dry off rapidly after rains or after being sprayed, to minimize development of diseases and spray injury. Such diseases as apple scab, apple blotch, bitter rot, brooks spot, and sooty fungus, thrive in dense, humid areas of trees. It is necessary to spray apples all the way around to secure control of such pests as codling moth and apple maggot. When trees are kept reasonably open by good pruning, these pests can be controlled most satisfactorily. Also, damage from limb rubs is reduced to a minimum. Losses from aphid are reduced with open trees.

Pruning Increases Size of Fruit.—Dormant pruning promotes rapid size development, beginning with fruit setting. Gains in size improvement from hand thinning cannot start until after the thinning is done, and often this is too late in the growing season to secure greatest benefit. Therefore, pruning is of decided helpfulness in securing desirable size with all tree fruits, bush fruits, brambles, and grape vines. Of course, pruning must be inter-related with other practices, especially thinning, use of fertilizers, and soil management to secure greatest response in size improvement.

The following example of how pruning helped size improvement on 30-year-old thick Rome Beauty apple trees in a Lawrence County demon-

stration is cited. Enough thinning-out pruning was done to get good sunlight penetration, and considerable detail pruning with hand shears secured the right distribution of vigorous spurs and terminals throughout the tree. In this case, pruning not only improved size but also improved yield, color, and quality as compared to the adjacent unpruned tree. The pruned tree produced 13.5 bushels or 68 per cent of its crop 2¾ inches and up, which is very desirable for Rome, while the unpruned tree picked only 8.9 bushels, or 55 per cent of apples 2¾ inches and up. The grade-out follows:

Effect of Pruning on Size and Yield. Rome Beauty, 31 Years Old
Yield of Pruned and Unpruned Trees

	Total yield	2¾ inches	2½ inches	2¾ inches	3 inches and up	Culls
Pruned—Bu.	19.8	0.5	3	6	7.5	2.8
Unpruned—Bu. .	16.2	1.0	4.15	4.5	4.45	2.1

At the Ohio Experiment Station, Wooster, Baldwin and Stayman apple trees planted in 1916 were given light and heavy dormant pruning as compared with no pruning, and in two full crop years (1930 and 1932) when trees were 14 and 16 years of age, the following records were taken on the percentage of the various sizes of both Baldwin and Stayman apples, as influenced by the pruning treatments.

Influence of Pruning on Size—Trees Set 1916
Full Crop Years of 1930 and 1932

Treatment	Over 2¾ inches per cent		2½ to 2¾ inches per cent		Below 2¾ inches per cent	
	Baldwin	Stayman	Baldwin	Stayman	Baldwin	Stayman
No pruning	76.7	57.7	21.2	40.7	2.1	1.6
Light dormant pruning	64.4	91.8	35.	8.1	.6	.1
Heavy dormant pruning	85.7	91.4	14.	8.6	.3	0

Pruning, therefore, is very helpful in eliminating the unprofitable small apple. Its helpfulness increases as trees get older and it becomes more difficult to keep fruiting wood vigorous. When carried to extremes, pruning may greatly reduce yield, so it should not be heavier than necessary to secure the desired improvement in quality. Considerable study and skill is necessary to employ a pruning program that hits the happy medium between highest yields and satisfactory development of size, color, and all-around quality.

Pruning Keeps Fruiting Wood Vigorous.—On young trees that have just come into bearing, all conditions seem to be at their best. Almost every observer has noted the fine size, color, and quality of fruit that comes on trees of this age. Then, little pruning is needed. But from year to year the conditions change slowly to a lesser growth, thicker top, less color, smaller sized fruit, and less perfect control of orchard pests. Pruning must be practiced in a way to keep the fruiting wood of mature trees approaching the ideal growth conditions generally found in young bearing trees.

It is well known by experienced orchardists that it is more difficult to produce quality on old apple trees than on those in the earlier years of bearing. That it is possible to produce a quality crop from old trees when orchard practices are thorough and properly inter-related is shown by the grade-out of the 1933 crop from the 48-year-old Rome Beauty orchard of Stanley Plymale, which was packed by the Gallia Fruit Growers' Cooperative Association, Gallipolis.

During the winter of 1932-1933 the orchard was systematically pruned, as is the usual practice, and particular attention was given to rather heavy detail pruning with hand shear cuts distributed over every branch. Undersize apples were practically eliminated and relatively little hand thinning was needed. The crop graded 94.7 per cent U. S. No. 1, with a large amount sufficiently well colored to meet the requirements of U. S. Fancy, a splendid achievement on old trees in a year when pest control was especially difficult.

Grade-Out—48-Year-Old Rome Beauty Trees. 2364 Bushels. 1933 Crop
All Trees Detail-Pruned

U. S. No. 1—Bu.			Utility and Culls Bu. 2¼ inches and up	Below 2¼ inches— Bu.
2¼ inches	2½-3 inches	3 inches		
47	1800	394	121	2

TRAINING YOUNG APPLE TREES

In buying apple trees from the nursery, insist on well grown trees, true to name, free from disease and insect injury, and preferably with 1- and not more than 2-year-old tops. One-year-old trees, of large diameter and a height of 4 to 5 feet or more, transplant best. Well branched 2-year-old trees of about ¾-inch diameter, tops from 5 to 7 feet, are satisfactory. Avoid trees which are undersized, crooked, or with short, slender growth. Plant in the fall or early spring. If trees are dried out in shipment, plump in water for a day or two before planting. If planting has to be deferred, dig a trench running east and west, break bundles and place tops to the north, and heel-in well to keep roots moist.

The roots have been shortened in digging and handling, so no more pruning of roots is needed except to remove broken roots and ragged ends. Top pruning at planting time is needed to compensate for this root injury. Plant about 2 inches deeper than tree stood in the nursery. With branched trees, place heavy wood toward prevailing wind (usually southwest) and lean tree somewhat in that direction. Place top soil about each root and firm soil well as hole is filled.

Pruning 1-Year-Old Trees at Planting.—The usual method of pruning is to head-back the top to about 30 inches, just above a bud, toward the prevailing wind. It is desirable to select the first framework limb about 2 feet from the ground on the southwest side, to shade the trunk and prevent temperature extremes on this exposure. If a well placed lateral is available

for the first limb, use it, but most yearling trees are unbranched, and selection of framework scaffolds can seldom begin until the second year.

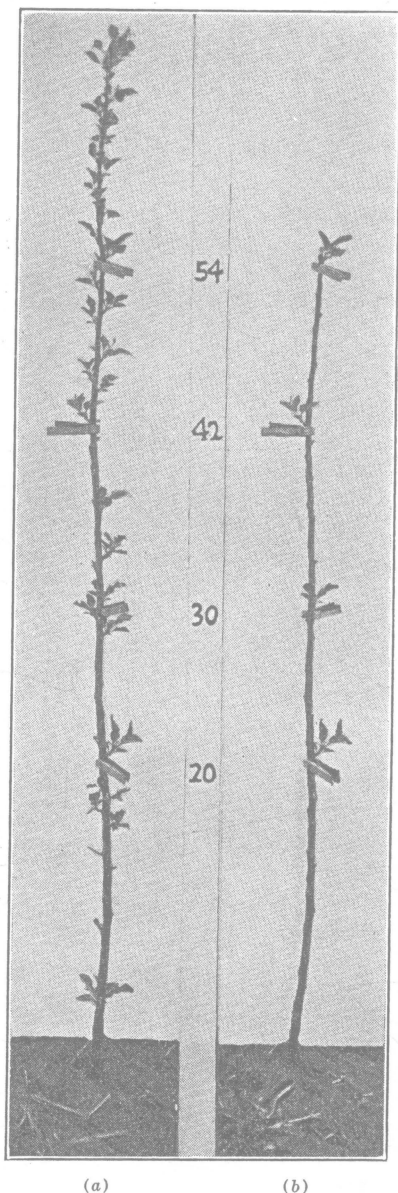


Fig. 13. — One-year-old Stayman at planting, before and after "debudding." Buds had developed into shoots about $\frac{1}{4}$ to $\frac{1}{2}$ inch long. Pinch clothespins were used to locate desirable shoots and to indicate their direction. Numbers indicate height above ground in inches. Eight to 12 inches are preferred between scaffolds. All unwanted shoots were removed.

Training By Debudding.—Where yearling trees of a height of 5 feet or more are planted, the debudding system of training offers many advantages. It is the quickest method yet devised to secure a strong, permanent framework. A minimum of training cuts are necessary in later years, which encourages early bearing.

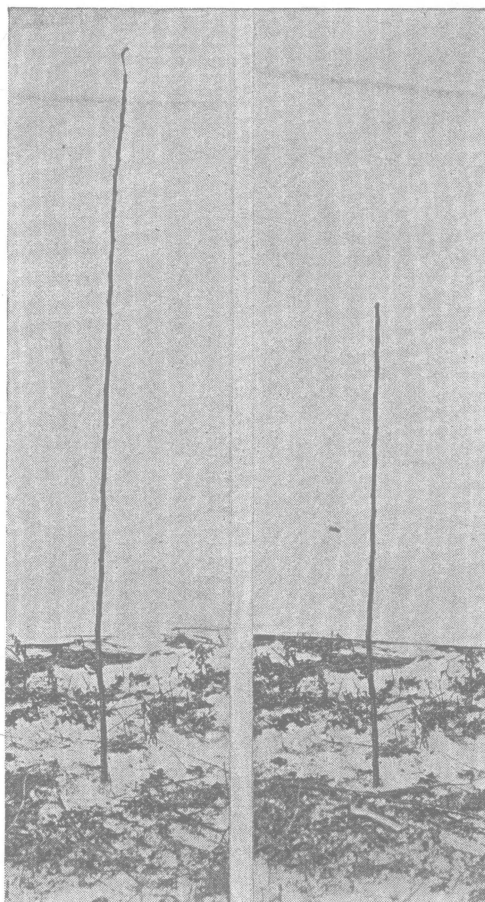
Begin training in early spring when buds have pushed out from $\frac{1}{4}$ to $\frac{1}{2}$ inch. Select lower branch from shoot, or branch on southwest 20 to 24 inches above the ground. Put a pinch clothespin just below this growth to locate it. Then go up 10 or 12 inches and a third turn around, and place another clothespin to mark the second limb location. In the same manner, select a third and fourth branch location. The upper shoot selected will be on the same side as the lower limb, which gives two branches directed into the prevailing wind, usually southwest. Cut top off above upper growth selected. The four clothespins now locate where branches are desired. Wipe off all growths not wanted from ground up and then remove the four clothespins (see Fig. 13).

Some orchardists prefer leaving clusters of about three buds at each level to secure more choice of wide angle scaffold limbs after growth gets under way. Often when as few as four growing points are left on trunk narrow crotches result. Where clusters of buds are left, go over trees again in midsummer and select the best branch at each level which leaves the trunk at a wide angle and prune off unnecessary shoots. This method is preferred with narrow crotching varieties like Stayman and Delicious.

It may sometimes be necessary to place limbs closer than 12 inches in order to get symmetrical trees, but 8 inches should be the least vertical distance to permit between limbs, to insure uncrowned unions of framework branches with the trunk as trees reach maturity. The vertical distance between the centers of limbs does not increase with age, so that as the limbs increase in circumference they appear to grow closer together. This is sufficient reason for wide branch spacing on the young tree.

Pruning 2-Year-Old Trees at Planting.— Prune roots and plant tree as suggested for 1-year-old trees. Select the strongest upright branch for a leader and remove branches that form close crotches with it (see Fig. 15). The leader is usually cut back about one-third, just above a southwest bud. Lowest branch is preferred on southwest at 20-24 inches. Two other wide-angled laterals may be left, if available, to give three well spaced branches around the tree, with 8 to 12 inches between limbs preferred.

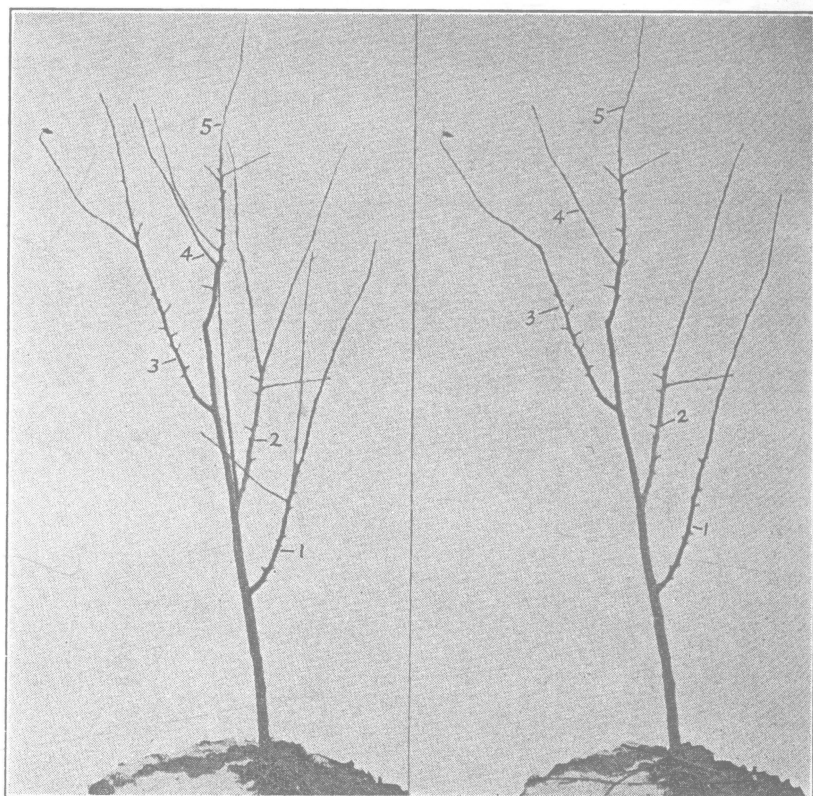
Laterals are usually cut back about one-half to buds placed to continue desired direction of growth. Where fewer than three good laterals are not available at planting, use only those that are desirable, and depend on future growth from the leader to supply needed framework branches. With many 2-year trees one scaffold and the leader are all that can be used at planting time. The important thing is to establish the leader.



(a) (b)
Fig. 14.—(a) One-year-old apple tree as it comes from the nursery before pruning. (b) Same tree after pruning; top has been cut back to 30 inches.

Pruning After 1 Year's Growth in the Orchard.—The yearling tree headed with one cut at planting time now has a number of laterals below the cut. Select the strongest for a leader around which to space the lateral scaffolds. Whirls, crotches, double and multiple leaders must be eliminated at this time. If possible, select three or four well placed scaffolds around the

leader, choosing limbs that make a wide angle with the leader. Cut away competing branches. No heading-back of leader or laterals is necessary unless growth is very long and unbranched, say in excess of 30 inches. In fact, heading-back cuts on young trees should be avoided except in the rare cases necessary to get placement of lateral growth. If necessary continue selection of desirable scaffolds in subsequent prunings.



(a)

(b)

Fig. 15.—Same Stayman as in Fig. 13 before and after pruning, after two years' growth. No pruning given after first year's growth. Two cuts were made on (a), scaffold 1, to remove a cross limb and another which arose too near the trunk for a main secondary scaffold. Water sprout cut from near base of scaffold 2 which also had fork corrected by removing less desirable branch. On scaffold 3 a cut to a lateral was made to prevent competition of this scaffold with leader and spread tree. Note upper shoot left at debudding (see Fig. 13) continued the trunk of tree, and scaffold 4 arises from it. Cut just above scaffold 4 removes branch which would otherwise compete with 4. The leader 5 can now be modified into an outward growing scaffold.

Scaffold 2 leaves trunk one-third the way around from scaffold 1, and scaffold 3 is one-third the way around from 2. Tree is now headed with four well-spaced lateral scaffolds around a modified leader.

With the debudded tree, only occasional cuts will be necessary to remove water sprouts and branches which started after the debudding, that may crowd the scaffolds. The upper shoot usually develops into a leader and in this and subsequent training one good lateral scaffold is allowed to develop on it into the prevailing wind. Then the leader is modified to develop as a side branch.

Where 2-year-old trees were planted and terminal growth of scaffolds and leader headed back, there may be some crotches to correct which formed below the old cuts. Take out, or cut back heavily, any branch which will make a bad crotch. Continue the selection of desirably spaced scaffolds around the leader; this may require three years or more. Remove water sprouts and branches which may crowd the scaffold branches selected. Adapt training to the natural growth habit of the variety.

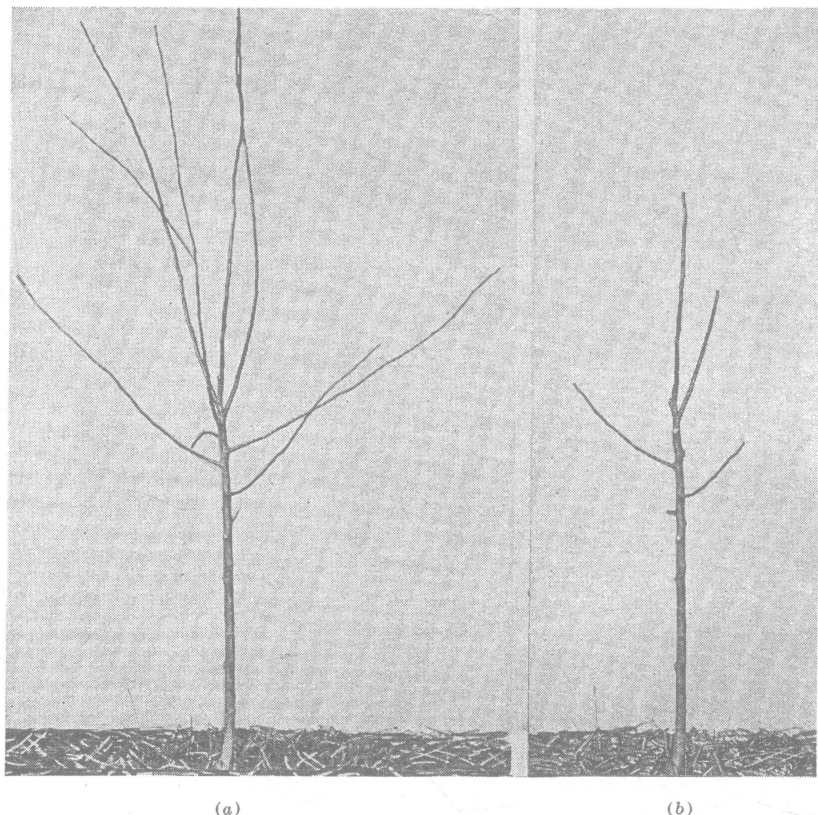


Fig. 16.—(a) Two-year-old apple tree after planting. (b) Same tree after pruning. Branches have been thinned out to leave a modified leader and well-spaced side branches. The side branches have been cut back about half their length, while the leader has been left somewhat longer to make it the dominant limb. These side branches are rather close and as others become available better spacing may be secured.

The Modified Leader Tree.—The modified leader tree is preferred for training apples, pears, plums, and cherries; a modification of it is coming into use with peach trees. It consists of a central trunk around which scaffold branches, of the desired number and spacing, can be arranged. Weak crotches and crowded scaffold branches are eliminated. After about four lateral scaffolds have developed, the leader is “modified” into the upper lateral scaffold by cutting to an outward growing lateral, or by cutting enough branches off the side of the leader toward the prevailing wind so that a drooping away

from the wind is secured. This training, assisted by early fruiting, pulls the leader out of the center of the tree into a side branch. This method of modifying the leader is commonly practiced with apples. Sometimes the leader modifies itself with desirable natural branching.

With peach or sour cherry the leader is modified by cutting to an outward lateral at a height of about 4 feet, while with apples it is often carried higher, to from 5 to 8 feet, then if it does not divide naturally into a desirable outward branching system, it is modified by pruning. A sufficient number



Fig. 17.—A well-pruned Rome Beauty apple tree trained to a modified, central leader with strong, well spaced, side branches.

of scaffolds can usually be selected by the time apple trees are 4 or 5 years old. The leader can then be pruned so that later fruit crops will force it out of the center into a main lateral scaffold branch (see Figs. 15 and 17).

Subsequent Pruning of Young Apple Trees.—In succeeding years, the orchard must be gone over annually for light, corrective pruning and to continue proper training. Keep the pruning light and if in doubt about a cut, don't cut. Leave small branches and spurs throughout the tree as long as they bear fruit of satisfactory quality. Filler trees need practically no training or pruning before bearing.

A few suggestions are given, but nothing will substitute for common sense judgment in determining the cuts for each tree.

1. Remove any dead, cankered, broken, or badly diseased limbs.
2. Remove as soon as observed, whenever they can be spared, branches which leave the leader with a narrow angle. These will make a weak crotch and are not desirable for permanent limbs. Small branches which are not competitive with the desirable development of the main scaffold limbs selected, can be left on as long as the fruit produced by them is satisfactory.
3. Where branches cross, one should be removed or, at least, shortened, preferably at a lateral, so that they no longer interfere.



(a)

(b)

Fig. 18.—Two water sprouts can be intertwined and tied to form a natural graft brace limb to strengthen a weak crotch. In subsequent growth a strong permanent brace limb is developed as in (b). Caution pruners to leave them and not cut them off as “freaks.”

4. Where branches are closely parallel, one or more should be cut out. If two limbs are concerned, the weaker, preferably the lower, is removed. If there are three or more, space by removing the middle ones.
5. Do not permit double leaders or whirls of main branches to develop.
6. Keep water sprouts removed except where needed to develop an important limb, or where they can be used for “natural bracing” of weak forks. Two water sprouts or small branches can often be used to twine together and form a natural brace limb to support a crotch (see Fig. 18). Tie at each

end and middle for the first year or two until they grow together, then remove ties. Such a brace will increase in strength as tree becomes older. Single water sprouts can be bridge grafted into a brace limb.

7. Modify the leader as necessary, usually by the time tree is 4 or 5 years old. About four lateral scaffolds, in addition to the leader (which is modified into the upper lateral scaffold), will develop a splendid framework for an apple tree. Secondary branches from these will build the tree to desired height and spread (see Fig. 19).
8. Remember the lower limbs, being the oldest, come into bearing first, and should be used for fruit production as long as the quality is satisfactory.

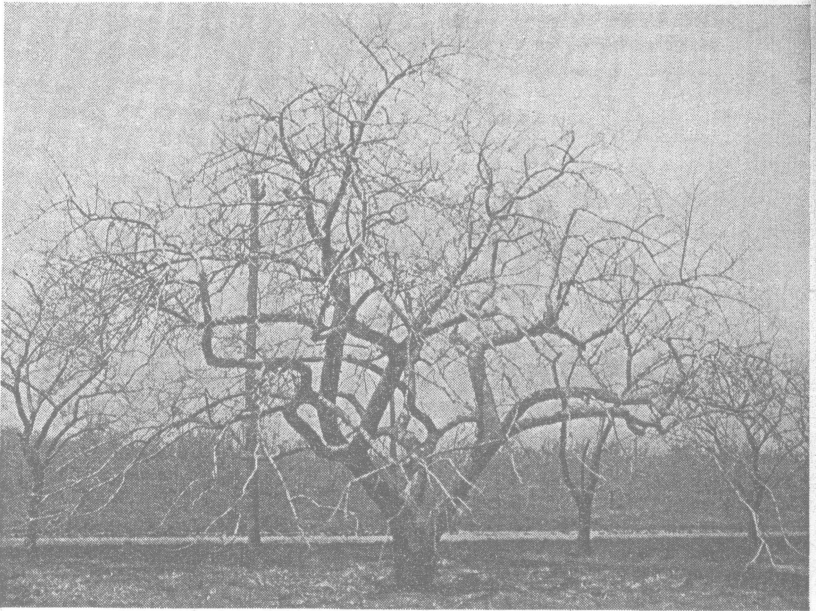


Fig. 19.—A 60-year-old apple which shows the possibilities of developing a splendid, long-lived tree by training to a modified leader with three or four permanent, well distributed and well spaced wide angled scaffolds. The modified leader branches naturally into an outward and upward scaffold. Vigorous fruiting wood begins near the ground and is well spaced throughout this ideal spreading tree.

Until apple trees bear, they are relatively upright in growth habit. Fruiting is the most satisfactory way to get desirable spreading of branches in the tops of trees. *Just before coming into bearing, there is often a temptation to prune to open up the trees. It is a serious mistake to prune heavily at this time to correct a condition that will be corrected far better in a natural way when cropping begins.*

Bending or Tying Down Branches.—A special practice sometimes used to train upward branches on dense young trees into outward growing laterals, is bending or tying down. For varieties such as Spy and Transparent it can be used to open trees without pruning them. It seems to promote early bearing. One way to tie down is to drive a staple in the trunk near the ground

and run a piece of binder twine from the staple to a tie with a large loop around the branch, well out on the limb, to hold it down in a spreading position. If done in the spring, fruit bud formation is encouraged during the summer. After being tied down a year, the branch is fixed in position and the tie can be removed. Padded, notched sticks are also used to spread limbs apart but this method does not bend as well as tying down.

PRUNING BEARING APPLE TREES

After trees reach bearing age, each year before picking observe carefully on representative trees of each variety where small, defective, and poorly colored fruits are being borne. This can best be observed by standing at the trunk and looking outward and upward.

A few notes taken at harvest time will help materially in guiding the kind and amount of pruning during the dormant season. In this way the minimum amount of pruning that will improve quality can be planned. Usually some pruning of lower limbs that have been overgrown and shaded will be needed first (see Figs. 20 and 21). Where branches droop to the ground or over other good limbs, they can be cut back to upward growing laterals. After the tops have come into heavy production, some thinning-out pruning will be needed to allow the lower branches to maintain satisfactory growth.

A common fault in pruning bearing trees is to leave a shell of unpruned branches around the edges of the tree, and to remove more inside and lower fruiting wood than necessary. The logical procedure is to try to secure the greatest benefit from the labor expended. A few suggestions follow:

1. Remove dead, broken, and diseased wood.
2. Do needed corrective pruning, including the removal of any large limbs necessary to improve the shape of the tree. Use judgment in pruning, so that direct sunlight will not cause sun scald on main branches left. Direct exposure of bark on large limbs to southwest sunlight is conducive to sun scald.
3. Start pruning at the top of the tree, making necessary thinning-out and detail-pruning cuts, and work down. A common procedure is to work around the top, then around the middle, and last around the lower limbs.
4. Begin pruning at the end of the branches and distribute cuts back to base of limb. Leave most vigorous wood to receive best light exposure. This procedure fruits the large branches as deeply as possible. Use ladders to detail-prune matted branch ends that cannot be reached by climbing. This is important with mature Rome and Spy trees.
5. Remove water sprouts, except where you can train into a branch to fill a vacant space.

Rejuvenating Old Trees.—Sometimes in a neglected orchard the lower limbs are dwarfed and eventually killed from lack of pruning. The top limbs continue growth unhampered. Under such conditions the tree becomes too tall to spray or harvest economically. If the lower limbs have been dwarfed but not killed, it is possible that the trees may be profitably lowered. Tall top branches can be headed back to strong side branches. Care must be taken

that such a pruning does not leave weak branches at the cut, or it may result in bad breaking. Care must also be used not to make a large opening in the center of the tree, because such openings cause sun scald on the main scaffold limbs. Real skill is required for a successful rejuvenation of old trees. If a grower is in doubt as to what to do, he should depend almost entirely on thinning branches in the tops. It is usually best to lower gradually the tops of neglected trees over a period of about three years.

Pruning as Related to Fillers and Planting Distance.—Trees planted between the permanent ones to increase the production of fruit before the permanent trees fully utilize the ground are known as filler trees. Such trees are given practically no pruning to encourage early and heavy production. As they begin to crowd, heavy cutting back of side branches is done only on the



Fig. 20.—Stayman apple which has become dense and matted in the lower portion. This wood is too crowded to spray thoroughly, and is producing a considerable quantity of small, poorly colored fruit. Note kind of pruning given in Fig. 21.

fillers, so that the permanent trees develop symmetrically without the slightest crowding at any time. Heading-back pruning is increased in severity on the fillers, flattening them until such time as the permanent trees need all the room. Then the fillers should be removed.

When fillers are headed back very severely, it is often desirable to ring the trunk late in May each year. This improves yields and quality on the smaller topped trees. (See Ohio Agricultural Experiment Station Bulletin 410 for procedure.)

A combination of heavy heading-back of all important branches on fillers, with annual ringing of the trunk to keep the heavily pruned tree fruitful, has considerable merit in handling filler trees. The fruit produced on filler trees handled this way is especially large and well colored. It definitely keeps

filler trees from crowding the symmetrical development of the permanent trees. When the permanent trees need all the room it is not such a mental hazard to remove a butchered filler tree as it is to take it out in its prime when it looks about like the permanent tree. Many filler trees have been successfully handled 8 or 10 years with successive annual trunk ringing, and heavy heading-back pruning.

Frequently, orchards of mature trees are found where the planting distance was too close. The trees have become crowded, and side branches interlace. Most of the vigorous growth is in the tops of the trees. The first problem here is to do something to get abundant sunlight on all sides of the best trees. Sometimes cutting out the diagonal rows to stagger the trees relieves the situation. At any rate, devise the best method of cutting out so that the remaining trees have plenty of space around them.



Fig. 21.—Thinning-out cuts followed by detail-pruning on this Stayman will improve size, color, and quality of the apples that will grow on these lower branches. Spraying can now be more thorough and with less material.

After trees in a crowded orchard have been intelligently spaced the remaining trees can be pruned. They often produce more and better fruit than could have been secured had all the trees been left.

Disposal of Brush.—For large orchards with long tree rows on relatively level land a brush rake attached to the front of a tractor is the most economical method of disposal. A brush burner, made by cutting open a section of a large sheet iron smokestack, and mounting it on skids, is satisfactory for young orchards, where the heat will not damage trees as the burner is pulled through, and where there is no fire hazard. Sections of woven wire fencing or sleds are often used to haul brush to piles where it can be burned. Brush should be promptly removed and burned each year. This practice aids in the control of insects and diseases.

ADAPTING PRUNING TO VARIETIES

Rome Beauty.—Rome Beauty, with its red sports, such as Gallia Beauty and Red Rome, constitute about 27 per cent of the trees in Ohio commercial orchards.

As young Rome trees come into bearing, the tree assumes a more spreading habit under the weight of fruit. Gradually the lower branches become filled with shaded wood and, due to the twiggy growth habit of the fruiting branches, the ends become deeply matted with small twigs unless pruning is properly done. Hand shears must be used in pruning bearing Rome trees, to properly thin out the thick areas at the ends of the fruiting branches. Each large branch is pruned as a unit from the end back to the base, distributing the cuts as well as possible and removing run-out and weak wood. It is important that the cuts be well scattered. Remove underhanging slender branches.

A common mistake in pruning bearing Rome Beauty trees is to start at the base of a large branch and prune outward, taking off all branches for a considerable distance, which leaves a long stretch of naked wood toward the base of the branch, with a cluster of unpruned, bushy twigs at the end of the branch. If the branches are pruned by beginning at the ends and working back to base, with small cuts well scattered, bearing wood is best distributed.

Well pruned bearing Rome Beauty trees need a relatively small amount of hand thinning of the apples during the growing season.

Stayman.—Stayman Winesap and its red sports, such as Blaxtayman and Stamared, constitute about 12 per cent of the trees in Ohio commercial orchards. Plantings of this variety are increasing.

On soils and culture that favor strong growth, this variety tends to develop many leggy branches without well placed laterals. Heading-back is necessary on young trees where unbranched terminal growth approaches 30 inches or more, to induce a desirable amount of lateral branching. Stayman is an open grower, requiring a relatively small amount of large branch removals except where corrective cuts, necessary to avoid double leaders or weak crotches, are necessary.

The Stayman tree is prone to develop many sharp angled, weak forks. Corrective cuts to eliminate these structural weaknesses are important. The wood splits easily. Large top cuts, used in heading back to laterals, must be made with caution. Frequently, water sprouts can be intertwined between weak crotches, to make a natural brace and strengthen framework. Because it is an open grower, lopping shears can be used considerably in the pruning work. High vigor is needed in the fruit spurs of Stayman to improve set, as this variety has serious pollination weaknesses. Small cuts well distributed give a larger food supply to the remaining fruit spurs. This type of pruning is very helpful with Stayman. Keep terminals growing 15 inches or more on producing trees for annual bearing.

Jonathan.—Jonathan is most numerous in the orchards of central and northern Ohio, and constitutes about 9 per cent of the trees in Ohio commercial orchards.

Jonathan trees grow many small branches and twigs. Soon after the trees come into bearing, shading develops in the lower part of the tree, and

branch spacing and detailed pruning there is coordinated with the production of high quality fruit. This variety does not respond well to heading-back cuts. Limbs headed back to relatively small laterals are frequently seriously stunted. It is best to confine pruning to branch removals, and then distribute small cuts on the remaining branches.

Pruning is relatively more important than hand thinning of the fruit with Jonathan, so that this variety should be given careful, annual winter pruning. Apple thinning experiments with Jonathan have shown a rather narrow margin of actual profit on well pruned trees.

Baldwin.—About 8 per cent of the trees in Ohio commercial orchards are Baldwin, with most of this planting in northern Ohio.

If this variety is grown with relatively little pruning, biennial bearing develops rather quickly. The amount of pruning on Baldwin can well be increased soon after trees begin to bear, and this will tend to reduce the strong tendency to biennial bearing. As this variety is a strong, dense grower, branch spacing is very important to admit light to the more desirable limbs. Lopping shears and hand shears can be used to scatter details cuts. As this variety tends to overbear, hand thinning is important in addition to pruning to improve size, color and quality. Detail pruning improves size and quality.

Grimes.—Grimes is most important in orchards of central and southern Ohio, with the tendency downward in the number of trees. At the present time, this variety constitutes about 7 per cent of the trees in Ohio commercial orchards.

A characteristic of Grimes is to bear its fruit relatively deep in the tree, therefore the small branches and spurs which arise toward the base of the larger limbs are quite important in fruit production with this variety. As trees become dense, the removal of large limbs to secure branch spacing is important. This allows light penetration between the limbs. The excessively heavy areas of fruiting branches can be thinned with lopping shears, beginning at the end of the branch and working back to the base. It is a great mistake to "cowtail" prune the large branches of Grimes. If the medium sized limbs and spurs are cleaned entirely off the base of the main branches, yields of fruit are reduced, as previously pointed out, and the most fruitful areas of the tree are largely lost.

Grimes responds splendidly to improvement in size and quality from hand thinning. Even on well pruned trees, hand thinning is important, as undersize is a serious problem with Grimes.

Delicious.—About 7 per cent of the trees in Ohio commercial orchards are Delicious.

As with Stayman, this variety is subject to weak crotches and grows many branches in whorls. Corrective cuts to space the most desirable main branches is important. Water sprout bracing can often be used to advantage in bracing up weak crotches. Delicious develops too many medium sized branches, and trees become dense unless considerable removal of medium sized limbs is done with lopping shears and saw. As this variety is most profitable when grown as a large fancy eating apple, it is important that

branch spacing first be secured to admit sunlight, and that this be followed up by well distributed small cuts.

Delicious has a varietal weakness in fruit setting, and detailed pruning with hand shears will greatly improve the set of fruit and secure a yield made up of a high percentage of large, well colored fruits. Hand thinning is also very important with *Delicious*, as this variety is most profitable when a large percentage of the crop is grown fancy. Keep terminals growing 15 inches or more.

McIntosh.—The general habit of growth of the *McIntosh* is quite satisfactory. Adequate limb spacing is important to allow thorough spraying for pest control, especially scab. Fruit is improved more by pruning than thinning, so follow a plan that keeps all fruiting wood vigorous and which favors good sunlight exposure on all fruit spur wood to improve color. Keeping trees well mulched is very helpful in improving size, color, and quality, and gives greatest value to dropped fruit.

Spy.—As a young tree the *Spy* is very dense, with decidedly upright growth habit. Naturally very late coming into bearing, its fruiting often is still further retarded by heavy pruning. Watch closely to prevent forks and narrow angled branches in the framework. Tying down some of the upright branches is often effective in opening the trees, and demonstrations indicate this is an aid to earlier fruiting. As trees get older, considerable detail pruning is required at the ends of the large fruiting branches as described for *Rome*. This will also reduce limb rub injuries to the fruit, so common with *Spy*, and will make conditions better for scab control.

Golden Delicious.—This variety is a very early bearer and training cuts are therefore not as apt to retard fruiting. Special attention is needed to keep forks and narrow angled limbs from developing. As there are so many branches to select from, it is not difficult to develop a strong, well spaced scaffold system. Keep main branches well spaced to encourage large diameter, as leggy branches are very brittle. Modify the leader by pruning away small branches on a side toward prevailing wind. Fruiting will then help pull leader into a side branch.

Transparent.—Summer varieties are becoming relatively less important, and *Transparent* constitutes but 2 per cent of the trees in Ohio commercial orchards. *Transparent* grows too many branches and often becomes too dense. When the main branches are well spaced the weight of fruit spreads the tree quite satisfactorily. Very little topping to outward growing laterals is needed where the right amount of large branches are removed by pruning. Small cuts, well distributed on branches which are left, help considerably in improving size. Increase detail pruning as trees get older.

This variety is greatly benefited in years when it sets a full crop by hand thinning early in the season. It is becoming increasingly difficult to sell small *Transparents*. Both pruning and thinning are needed in a relatively high degree to improve size with this variety.

Wealthy.—*Wealthy* makes up about 2 per cent of the trees in Ohio commercial orchards. As color is important the pruning program should never allow the trees to get thick. If *Wealthy* is allowed to overbear it becomes a

weak grower and a biennial cropper. It is important that pruning be done to promote the most vigorous growth. Long terminal growths on all important branches should be our aim with Wealthy. Hand thinning early in the season greatly reduces the $2\frac{1}{4}$ -inch fruit and vastly improves color.

PRUNING THE PEAR

The young pear tree is trained and pruned to the modified leader system as recommended for the apple. Light pruning is recommended, as blight is more difficult to control on both young and bearing trees where annual growth is softened by heavy pruning. It is particularly important to confine cuts to the thinning-out type, with occasional removals of upright limbs to desirable laterals. Heading-back cuts should be particularly avoided, as these

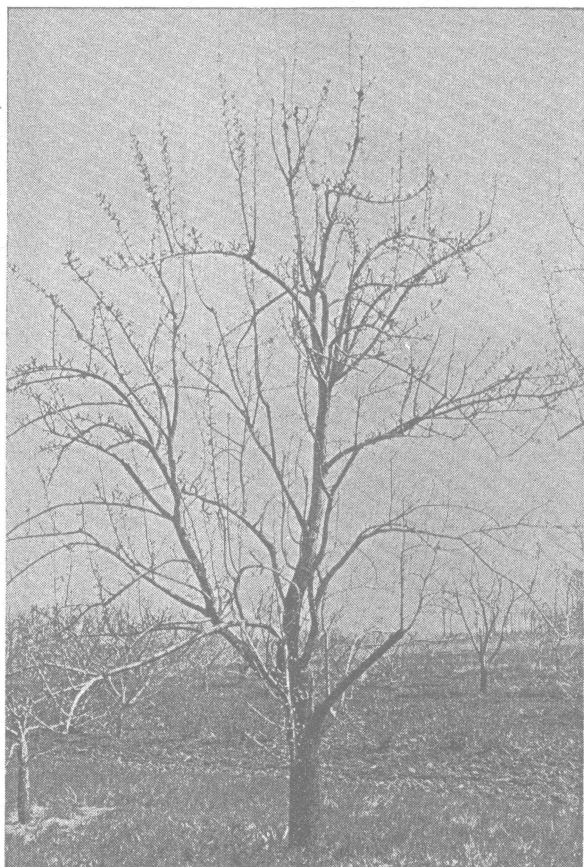


Fig. 22.—Fruiting has given a drooping and spreading habit to this old Bartlett pear tree. Depend on a few well spaced thinning-out cuts and the weight of fruit to spread the branches of pear trees. Heading back upward growing limbs multiplies shoots and increases their susceptibility to blight. When too tall, remove entirely or cut back to strong laterals any objectionable high fruiting wood.

encourage a profusion of soft terminal growths. Tying down can be used occasionally instead of pruning, to spread growth. Depend on fruiting and not pruning to spread the tree (see Fig. 22). When too high to spray and harvest, lower the tree by making thinning-out cuts to desirable outward laterals.

It is important that pruning be confined to the dormant season and that any blighted limbs and blight cankers be cut away or treated as recommended under "Making the Cuts," page 6. If necessary to cut any blighted branches during the growing season to save important limbs, cut a foot or more below the lowest

point where blight is showing and promptly disinfect shears or saw and wound with a solution of 1 to 500 bichloride of mercury (poisonous) and 1 to 500 cyanide of mercury (poisonous) mixed together. To apply disinfectant conveniently put in a bottle and tie sponge over opening. Water sprouts and spurs should be pruned off trunk and lower portions of main limbs to remove this source of direct entrance of blight as a body canker. Blight can be pruned away with least danger of spreading it when the disease is dormant. It is recommended that this work begin about September 1 when blighted twigs contrast easily against normal leaves and growth.

Pears are best grown in sod with mulch. Avoid manure applications and cultivation, as both create a susceptibility to blight. Nitrogen fertilizers should be used sparingly and only when growth becomes too short.

PRUNING THE YOUNG PEACH TREE

Bearing Habit.—Peach trees bear fruit on wood that grew the previous year. Terminal and lateral shoots over the outer surface of the tree are, therefore, important in fruit production. When trees are kept open throughout, a considerable amount of new shoots and short growths or spurs develop each year rather deeply throughout the tree. The pruning program should recognize this fruiting habit. A low, open head, to develop an open-bowl shaped tree, is therefore favored.

Fruit buds are plump and roundish, while leaf or branch buds are small, narrow, and pointed. On vigorous terminals and shoots the buds are often grouped in three's, with a fruit bud on each side and a leaf bud in the center. On shorter growth and spurs, fruit buds are often borne singly. Leaf buds occur without adjacent fruit buds on the ranker growths of 30 inches or more, particularly the lower portion of this growth.

Age of Tree to Plant.—Well grown, 3- to 4-foot, yearling trees of about $\frac{1}{2}$ -inch diameter are preferred for planting. Never plant older trees or small, weak yearlings. Planting in early spring is preferred.

Pruning at Planting.—The usual method of pruning, which can be adapted to any kind of yearling tree, is to select four or five laterals well spaced vertically and around the trunk, with the lowest about 12 and the highest about 24 inches from the ground. Remove all other branches and cut back those selected to short spurs of from 2 to 4 inches, with one or two buds. Head-back the trunk to the upper branch. If no desirable laterals are available, head to a whip at about 24 inches and side branches will develop. Heading lower than recommended will increase the labor of gassing with paradichlorobenzene to remove borers. Leaving lateral spurs helps develop a symmetrical head during the first year's growth (see Fig. 23).

The Second Year's Cuts.—After the first year's growth, select four or five strong, outward growing scaffolds well spaced around the tree to form the head. Remove all other branches originating on the trunk. Try to get 2 to 4 inches of vertical distance along the trunk between scaffolds. Cut out any strong, upright, central shoots and those that cross the head. Train to a

symmetrical, open-bowl type tree. Only head-back lateral scaffolds where growth is excessive without branching. Leave one or two strong secondary laterals on each main scaffold with none closer than 15 inches to the trunk. Secondary lateral limbs are best trained somewhat upright and to the outside.

Where growths are branched and not more than 30 inches, the training is best given with thinning-out cuts and cuts to outward growing laterals to develop an open, spreading tree. Injury to terminals during the growing season from oriental peach moth quite often stimulates considerable lateral branching. Where this injury is excessive and trees become too dense, some of the laterals should be thinned out. Where growth is very dense, some thinning-out pruning during the summer is helpful to direct growth where wanted.



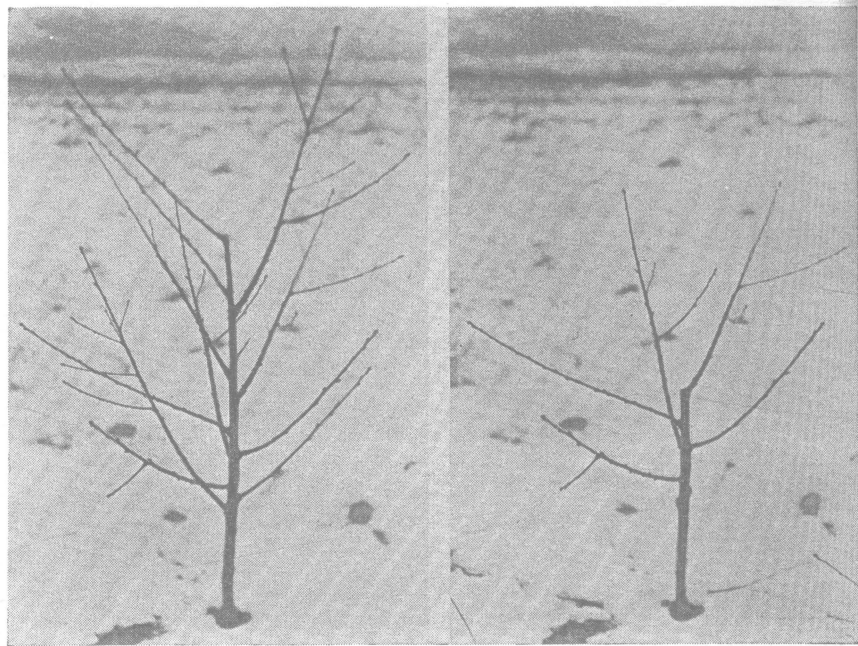
(a)

(b)

Fig. 23.—(a) One-year-old peach tree after planting. (b) Same tree after pruning. The tree was cut back to about 24 inches. Four well distributed side branches were left and cut back to short stubs to assist in developing symmetrical open head.

Special Problems in Starting Head.—Sometimes, particularly if winter injury to wood is serious the first or second winter after planting, the scaffold branches selected are stunted and one or more strong shoots arise from the trunk below the scaffolds selected. In such cases, it is best to prune away the old scaffold and build a new one from the vigorous, low branches. Often the best one of these can be headed and the others removed. Then scaffolds are trained from the new trunk selected.

Modified Debudding Method.—This method has received considerable attention in recent years. To use it, plant a yearling tree of at least $\frac{5}{8}$ inch diameter and height of at least 4 feet. Small trees are unsuitable. The tree



(a)

(b)

Fig. 24.—(a) Peach tree after one year's growth in the orchard. In pruning at planting time, tree was headed too high, which resulted in weak growth of low side branches. (b) Same tree after pruning. Note that central wood has been removed, leaving well spaced scaffold branches to develop an open center peach tree. No cutting of side branches has been made.

is headed at about 36 inches and all branches are removed below 12 to 15 inches from the ground. The rest of the side branches are cut back to stubs of one bud each. When the shoots are about 2 or 3 inches long in early summer, go over the trees and select four or five of the strongest wide angled shoots and try to space them 4 to 8 inches apart, vertically and well distributed around the tree. Sometimes, the shoots are thinned down to leave only the best in early summer, and final selection of the scaffolds is deferred until pruning the following winter or early spring.

At pruning time, select four to six well spaced and distributed branches and see that no one of them is directly over another. The stronger growing

ones are cut back to the length of the short ones and the lower branches left somewhat longer than the upper ones in this pruning. All other branches except the scaffolds selected are removed. Later the training is similar to that described for ordinary training in developing an open-bowl shaped tree. This method has some advantages in reducing crotch injury and the splitting down of scaffold limbs.

During the early summer of the second year go over the trees and rub off undesirable shoots growing from the leader to confine growth from the trunk into the selected scaffolds. The head of the tree is now established and future training will be to develop symmetrical open growth. Some thinning out will be needed and occasional cutting back to outward growing laterals to develop an open type of tree.

The Third Year's Pruning.—The tree should now be well formed, and only very light corrective pruning needed to keep the center open and main branches well spaced. Keep the older small branches arising near the base of the scaffolds on the tree, except for light thinning out where very dense. These small branches are often the first to bear, and too often the first and second crop is thoughtlessly reduced by pruning them off just to make the trees look better. As with apples, the lower branches on peach trees should be fruited as long as the quality is satisfactory.

At this age heavy pruning will reduce yield without improving size of fruit. Some thinning-out summer pruning, to prevent any areas from becoming dense, will help fruit bud formation deep in the tree. Let sunlight reach all the foliage. Fruit buds on peach form in late summer, so keeping trees from becoming dense then helps fruit bud formation.

The advantages of light pruning of young peach trees has been confirmed by experimental work in various states. In Ohio an experiment with light and heavy pruning gave conclusive evidence that heavy pruning seriously reduced the yield during the fourth and fifth years from planting (see Table opposite).

*Effect of Light and Heavy Pruning
on Yield*

Peach Trees Planted 1922		
	Yield per Tree, 1925 Pounds	Yield per Tree, 1926 Pounds
Light pruning	40.0	40.1
Heavy pruning	30.8	22.2

PRUNING THE BEARING PEACH TREE

A well grown peach tree usually begins bearing the fourth year. At this age pruning is light, with a few cuts to keep the center open and bearing wood thinned as necessary to keep it from getting dense. Well grown bearing peach trees seldom fail to make enough fruit buds for a heavy crop. Usually far too many are produced, and pruning is very helpful in thinning the crop as well as in providing conditions for proper renewals of fruiting wood throughout the tree. *It is important that bearing trees be pruned every year.* Otherwise, the tendency is for the fruiting wood to develop farther out and higher up each year, and a thick-topped leggy tree quickly develops, without low fruiting wood.

When and How Severely to Prune.—Pruning practices for bearing peach trees in Ohio are largely determined by the kind and amount of winter killing of fruit buds and wood. Fruit buds killed by low temperatures have dark centers when cross sectioned and do not blossom. Winter injured wood shows browning, and may kill to the pith. Usually about 10° F. below zero is critical for dormant fruit buds and 20° F. below zero is critical for dormant wood, with considerable variation by variety and growth conditions. The last tissue to kill is the cambium (between inner bark and sap wood). Often most cambium injury occurs on trunk and lower portions of scaffold limbs.

It is recommended that pruning be delayed until after danger of winter killing of buds and wood is past. The proper amount of thinning-out pruning

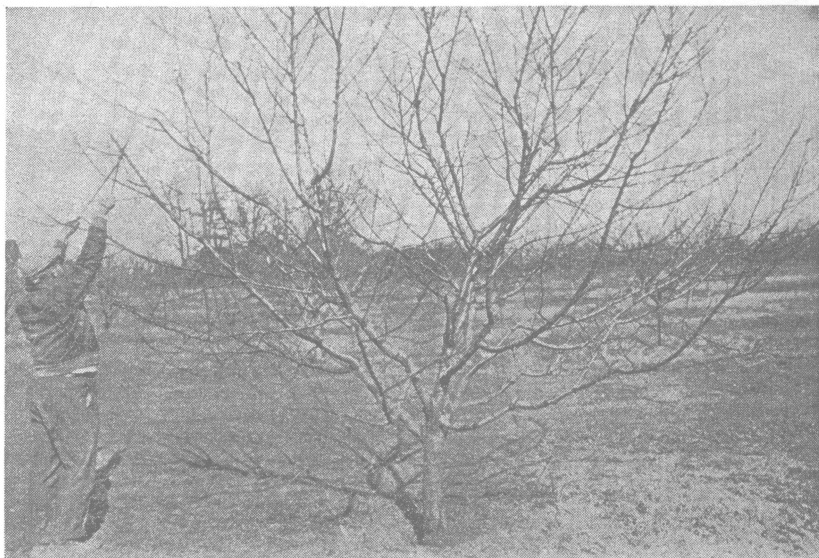


Fig. 25.—Bearing peach tree before pruning. Renewal cuts are being placed at desirable outward growing laterals at height of about 8 feet. Note that lopping shears are very convenient for this work. All fruit buds are alive on this tree and pruning is of the general all-over type. Compare with Fig. 26.

with large cuts as needed can then be given. If no winter injury to fruit buds has occurred, give also a general all-over pruning.

When a portion of the buds are killed, give a very light pruning, because heavy pruning would reduce yield without improving quality. Usually the most live buds are then in the tops of the trees, and pruning should be planned to make the best of the prospect and not cut off too much high wood carrying the live fruit buds.

If all fruit buds appear killed, delay pruning until blossoming time. Then, if no blossoms appear, use the opportunity to thin out and cut back sufficiently to keep tree of desirable size, height, and with proper branch distribution and spacing to get fruiting wood renewals throughout the tree.

In sections where spring frost is as great a risk as winter injury the necessary thinning-out cuts can be made in the dormant season, but the amount of

leading-back is better deferred until after danger of frost injury is over, when the degree needed can be determined.

If crop is lost and wood severely injured there is great temptation to "dehorn" peach trees. Experience has shown that cutting back to stumps of limbs after wood is severely winter injured is often fatal. Such trees should be lightly pruned after growth starts and given a liberal application of a quickly available nitrogen fertilizer as nitrate of soda in early spring, along with good culture, to restore growth conditions. After growth starts, remove dead wood as quickly as possible. If trees recover, place cuts at desirable growing points to lower, thin out, and spread top.



Fig. 26.—Same bearing peach tree as in Fig. 25 after pruning. Note open center and uniform thinning throughout to promote fruiting wood renewals deep in the tree. All upper main branches have received a renewal cut placed at outward lateral of convenient height. A prominent upright branch was removed at each renewal cut.

When uninjured peach trees are dehorned heavily, the resulting growth is too profuse and rank to train easily or to crop heavily for 2 or 3 years. Dehorning, therefore, can never take the place of keeping bearing trees right by well planned annual pruning. Where trees have had some neglect and are leggy and crop has been killed but wood uninjured, a mild dehorning may have a place.

It is best to keep the cuts in wood that is 3 and not over 4 years old, with some of the prominent secondary branches left on the main limbs and these given rather light heading-back. When dehorning, cut out entirely the most objectionable upright branches in the center of the tree. Place cuts to form a low, open, and spreading type of framework.

Types of Pruning.—In maintaining the open-bowl type tree, a general branch thinning, with the shortening of main branches to outward laterals as necessary, must be followed. In general, the pruning is lighter during the

first three or four years of bearing than later. After four or five crops, a heavier heading-back type of pruning is desirable, at least every three or four years, to keep desirable fruiting wood low. Clipping of all the laterals, as occasionally practiced to substitute largely for thinning, is very expensive pruning and reduces yields. "Heading-back-only" pruning has the same objections. It is better to do both moderate thinning and cutting back to outward laterals as necessary. Then depend on hand thinning in heavy crop years to distribute the fruits for proper size and quality development.

Keep the centers of bearing trees open to promote desirable growth of new shoots on main branches and to secure best color on the fruit. Annual terminal growth of 15 to 24 inches maintains desirable fruiting wood. Short slender growths are unproductive and are characteristic of declining trees. Trees that show several annual growths of 50 inches or more are trained with difficulty and the lower areas of these heavy growths are not fruitful. Therefore pruning, fertilizing, and soil management must be carefully inter-related to promote desired growth. In pruning, try to leave desirable length shoots for fruiting well spaced, to keep the lower branches growing and to prevent accumulation of dead twigs in the lower part of trees. When scaffold crotches need bracing, a good method is to run a loop of heavy galvanized wire around the inside of the main branches and attach to each main branch with an ordinary fence staple. If this loop is placed during the dormant season it will prevent overloads splitting the main crotches. The wire should slide in the staples to spread the strain. This is usually placed at a height of 5 to 6 feet from the ground.

Placing Renewal Cuts.—As trees reach a height of about 8 feet it is important to cut the main upward growing branches back to outward laterals. This cut to a lateral will serve as a renewal point for several years. It is handy to make the cut at a height reached easily with lopping shears while standing on the ground (see Fig. 25). Lopping shears are essential in the rapid pruning of bearing peach trees, and as most of the cuts are made from the ground the shears are easily handled to make good cuts. A renewal cut should be placed on every main branch as soon as it reaches sufficient height to require it. The cut is ordinarily made in 2-year-old wood, but sometimes it is necessary to make it in older wood.

Remove the largest upright branch at a prominent crotch at the renewal height. Seldom should the main renewal cut be higher than 8 to 9 feet (see Fig. 26). New shoots are encouraged near the renewal cut and the best of these can be used the next year or two for fruiting. The larger upright branches near the cut are pruned away in succeeding years. In this way the tree is kept within bounds and trained as an open, spreading tree. Often one or two cuts of the heavier upright wood near the renewal cut will be sufficient each year to keep branches in bounds and fruiting wood well renewed.

Pruning Methods Compared.—In parts of northern Ohio there has been a tendency to head-back all branches and use very few thinning-out cuts. In a demonstration in Lake County, heading-back-only pruning was compared with lighter thinning-out pruning and no pruning on a block of Elberta trees planted in 1926. The records for the 1931-1932 crops show that light thin-

ning-out pruning increased the yield over the unpruned trees in these years by an average of 130 bushels to the acre, while the heading-back-only type of pruning reduced the yield 86 bushels per acre as compared with the unpruned trees. Following is the record.

Pruning and Yield—Elberta Peach—Planted 1926
H. L. Mantle, Painesville

Pruning Method	Average yield for crops of 1931 and 1932—Bushels		Gain or loss compared with no pruning—Bushels
	per acre	per tree	per acre
No pruning	248	2.3	
Heading back only	162	1.5	—86
Light thinning out (included cutting back to outward laterals as needed)	378	3.5	+130

The light thinning-out pruning in this demonstration was of the type recommended in this bulletin for bearing peach trees. The advantages of this system over the heading-back-only system are higher yields per tree and per acre, lower bushel costs, less time required for pruning, more open trees, larger trees, better distribution of fruiting wood, and trees which are easier to spray, thin, and harvest.

PRUNING THE SWEET CHERRY

Trees budded on Mazzard stock are preferred to those propagated on Mahaleb. Sturdy 1-year-old whips, 4 to 5 feet, or 2-year-olds of 5 to 7 feet

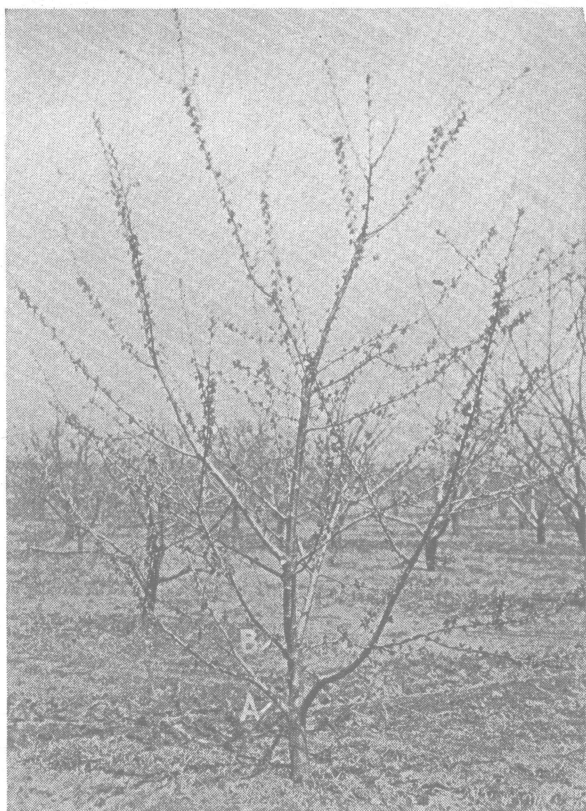


Fig. 27.—Young Seneca sweet cherry trained to modified leader. Note that three important lower scaffolds leave the trunk at rather wide angles and are spaced about a foot apart in vertical distance. The leader is modifying itself with natural branching.

Small low limbs such as A and B will be pruned away when sufficient growth develops on the permanent scaffolds.

and diameter of $\frac{3}{4}$ inch or more, are recommended. Early spring planting is preferred. Plant carefully and firm soil well about roots. Keep from drying out until well started, as sweet cherry trees are difficult to transplant.

The modified leader system of training is followed as advised for the apple, with special attention to keep the leader and upper branches from being choked by opposite or close scaffolds. Use thinning-out cuts or cutting to laterals, as heading-back cuts stunt branch growth and divert growth into limbs not headed back. Three or four lateral scaffolds with about a foot vertical distance between limbs, in addition to the leader which is modified



Fig. 28.—Young Montmorency cherry before pruning. Light thinning-out pruning will keep tree growing well all over.

into an outward limb, will make a very desirable framework for sweet cherry trees (Fig. 27). Special attention to avoid narrow crotches in selecting scaffolds is urged.

PRUNING THE SOUR CHERRY

Fruiting Habit.—Fruit buds are produced on both fruit spurs and, laterally, on 1-year-old wood. Terminal buds of shoots and vigorous spurs are usually leaf buds. Where terminal growth is below 7 or 8 inches, nearly all lateral buds on terminal shoots are fruit buds. This wood becomes bare after fruiting. Where terminal shoots are grown to 12 inches or more some of the

lateral buds will be leaf buds from which spurs will develop. Trees with a good spur system are most productive, and fruit buds are more winter hardy on spurs than on laterals. It is, therefore, important to keep annual growth vigorous, so that a productive fruit spur system will be maintained.

Pruning at Planting.—Sturdy 1-year-old trees, 4 to 5 feet high, or 2-year-old branched trees, 4 to 6 feet, with diameter of $\frac{5}{8}$ inch or more, are preferred for planting either in the fall or very early spring. Where whips are planted, head at about 24 inches and begin selection of scaffolds the second year. Where branched 2-year-olds are planted, select the leader and about



Fig. 29.—Same tree as in Fig. 28. A few branches which shade lower wood were removed. All fruiting branches and spurs now receive ample sunlight and strong terminal growths are encouraged.

three well spaced laterals leaving the trunk at a wide angle, with lowest scaffold about 15 inches above the ground on the southwest. Remove other branches. It is preferable with cherries not to cut back the branches left to form the head, as heading-back cuts stunt branch growth.

Subsequent Training.—The modified leader system of training is preferred to secure well spaced scaffolds. About five or six scaffolds distributed over 3 or 4 feet of trunk above the lowest branch develops a strong framework. The leader is then modified by cutting to an outward lateral. *It is highly important in training cherries that no two scaffolds originate from the*

trunk directly above another—also that no two originate on the trunk at the same height. Development of the leader and branches above is choked if opposite scaffolds, or two scaffolds close together on same side, are permitted to grow.



Fig. 30.—Montmorency cherry which was started with a whorl of five branches at the same height and trained to the open center system. As branches increased in diameter, crowding developed, which split the head apart and ruined the tree. Modified leader training corrects this common fault.

As trees become dense, an increasing amount of thinning-out pruning is necessary to keep tops and outsides open, to prevent inside and lower fruiting wood from dying. Keep the tree growing all over. Annual terminal growth of 12 to 15 inches of plump wood is associated with good fruit production and development of strong spurs on 2-year and older wood (see Figs. 28 and 29).

Many branches develop at odd angles and cross the tree. Such limbs seriously shade lower wood and should

be pruned out before damage occurs. Occasional cutting back of upright wood to outward laterals is necessary on the main branches.

A common fault in sour cherry orchards is to start the tree with a whorl of three or more branches trained to an open head. Such trees are short lived, for the head splits as the branches crowd each other (see Fig. 30).

PRUNING THE PLUM

There are several species of plums. Those best adapted to Ohio are the European plums and prunes (*Prunus Domestica*) and the Damsons (*Prunus Insititia*). The Japanese plums (*Prunus Salicina*) frequently lose crops by spring frosts, and the native plums, while very hardy, lack size, firmness of flesh, and market style, and are seldom planted in Ohio.

The European plums, such as Archduke, Grand Duke, Italian Prune, Bradshaw, Imperial Epineuse, and Stanley are best pruned and trained to the

modified leader as advised for apples. Scaffolds can be placed closer than with apples, and about 6 inches vertical spacing is satisfactory. Lighter pruning may be followed with these and also with the Damson plums such as French and Shropshire. As the trees reach heavy bearing and growth slackens on terminals and fruiting spurs, the amount of pruning should be increased, with detail-pruning throughout the tree and enough thinning-out to keep up desirable growth over the lower branches (see Fig. 31). Open pruning allows most efficient thinning, harvesting, and spraying for control of brown rot.

The Japanese plums such as Abundance, Burbank, and Climax are naturally very spreading growers. A low open head as recommended for the



Fig. 31.—Italian prune trained by the modified leader system. Branches form strong unions with the trunk. Wide spacing of scaffolds has allowed good distribution of fruiting wood.

peach is, therefore, preferred for Japanese plums. Considerable thinning-out pruning, especially of slender branches, is necessary. Some heading back to laterals is needed to keep a stocky, open framework. As the trees get older, shoot and spur growth slacken and rather heavy pruning of the type suggested for bearing peach trees is advisable, as the fruiting habit is rather similar. Considerable fruiting occurs laterally on 1-year-wood and from vigorous spurs on older wood. By maintaining good terminal growth, the development of strong fruit spurs on 2-year and older wood is encouraged, thus increasing the productive capacity of the tree.

PRUNING THE APRICOT

Apricots are only grown as novelties and for limited home use in Ohio as the tree is not hardy and the early habit of blossoming makes spring frost a serious hazard. A protected, well-drained site, such as just southeast of a building, is essential.

One-year-old trees, 3 to 5 feet in height and $\frac{1}{2}$ inch or more in diameter, are preferred for planting in early spring.

Prune and train to open-bowl type tree as recommended for the peach. Long, slender branches need heading back to laterals. Keep trees open with considerable thinning-out pruning, as fruit spurs are rather short lived and must be frequently renewed from rather vigorous terminals.

PRUNING THE NECTARINE

The nectarine is highly prized as a dessert fruit and is worthy of further testing for home use and limited local market on sites where peaches are grown successfully. The tree and fruiting habits are similar to the peach, and the recommendations for peach pruning may be followed with nectarines.

PRUNING THE QUINCE

Two-year-old trees, 4 to 5 feet high, with diameter of $\frac{1}{2}$ inch or more, are suggested for planting.

The fruit is borne terminally on small shoots that arise from terminal or lateral buds of the previous year's growth. For this reason, cuts should be of a thinning-out type to keep trees reasonably open. As blight is a serious pest in Ohio on the quince, trees should be grown rather slowly in sod, as recommended for the pear. Pruning should be very light, as advised for the pear, and blight cankers handled as suggested on page 8.

Quinces are planted only for home use and limited local market, as the ravages of oriental moth prevent successful commercial culture. Since spraying is not effective in controlling oriental moth it is suggested that soon after fruits set enough quinces be bagged to provide for home requirements. Secure bag tightly around fruiting shoot to prevent infestation and leave quince in bag until picked.

Some Pruning Reminders



1. Training cuts during the first three years are especially important in order to secure a strong set of scaffold branches.
2. The modified leader tree is preferred for the apple, pear, cherry, and plum. Train leader into an outward lateral as soon as a sufficient number of scaffolds are secured.
3. The open-center bowl-shaped tree is preferred for the peach. Delay peach pruning until risk of winter injury is over.
4. Properly spaced, wide-angled scaffolds develop strong, long-lived trees; narrow crotches are weak and provoke trouble.
5. Close cuts heal, but stubs are forerunners of decay. Protect large wounds.
6. Light, corrective, annual pruning does not delay bearing.
7. Heavy pruning dwarfs trees and delays bearing. Heading-back cuts should be made only where lateral branching is needed.
8. Depend on cropping to open and spread trees in a natural way.
9. Determine where and how to prune bearing trees by inspecting crop in interior of tree before harvest. Remove wood producing inferior fruit.
10. Prune mature trees from top to bottom and from tip of branches back to their base. Avoid leaving a shell of unpruned branch ends around outside and top of tree.
11. Detail-pruning of small wood increases size, improves color, develops quality, and helps to keep mature trees annual bearing.
12. Adapt pruning skillfully to the needs of the variety.

Bulletins of Interest to Fruit Growers



EXTENSION BULLETINS AND CIRCULARS

APPLE SCAB AND ITS CONTROL—Pierstorff
THE CODLING MOTH AND ITS CONTROL—Cutright and Parks
CONTROL OF GARDEN INSECTS AND DISEASES—Parks and Pierstorff
GRAPE GROWING IN OHIO—Holland, Parks and Pierstorff
HOME STORAGE OF FRUITS AND VEGETABLES—Beach and Tussing
SPRAYING PROGRAM AND PEST CONTROL FOR FRUIT CROPS
PACKAGE BEES FOR HONEY PRODUCTION—Dunham
PEACH LEAF CURL—Pierstorff

The above may be had from your County Agent. If there is no agent in your county, write to the Agricultural Extension Service, The Ohio State University, Columbus, Ohio.



EXPERIMENT STATION BULLETINS

Bul. No.

339 ORCHARD REJUVINATION IN SOUTHEASTERN OHIO—Ballou and Lewis
372 THE APPLE FLEA-WEEVIL—Houser
385 BLOOMING PERIOD AND YIELD OF APPLES—Ellenwood
403 THE TIMING OF APPLE SCAB SPRAYS—Young and May
404 APPLE POLLINATION STUDIES IN OHIO—Howlett
410 RINGING AS APPLIED TO THE COMMERCIAL ORCHARD—Gourley and Howlett
413 SPRAYING FOR THE PREVENTION OF APPLE BLOTCH AND APPLE SCAB—Ballou and Lewis
418 THE APPLE INDUSTRY OF OHIO—Hauck
422 CHERRY POLLINATION STUDIES—Shoemaker
435 WHAT DOES IT COST TO GROW A BUSHEL OF APPLES?—Ballou
456 COST OF DEVELOPING AN APPLE ORCHARD—Ellenwood
464 APPLE APHIDS IN OHIO—Cutright
479 NITRATE FERTILIZATION AND KEEPING QUALITY OF APPLE FRUITS—Hopkins and Gourley
483 FACTORS AFFECTING FRUIT SETTING—I. STAYMAN WINESAP—Howlett
508 APPLE THINNING WITH SPECIAL REFERENCE TO GRIMES GOLDEN AND JONATHAN
510 GRAFTING AND BUDDING FRUIT TREES—Lewis
521 ROADSIDE MARKETING OF AGRICULTURAL PRODUCTS BY OHIO FARMERS—Hauck and Herschler
528 DEPENDABLE FRUITS—Ellenwood and Shoemaker
541 EXPERIMENTS ON THINNING PEACHES—Shoemaker

These Experiment Station Bulletins may be obtained from the Ohio Agricultural Experiment Station, Wooster, Ohio.



BULLETINS OF THE U. S. DEPARTMENT OF AGRICULTURE

F. B. 1160—DISEASES OF APPLES IN STORAGE
F. B. 1264—FARM MANUFACTURE OF UNFERMENTED APPLE JUICE
F. B. 1424—MAKING VINEGAR IN THE HOME AND ON THE FARM
F. B. 1457—PACKING APPLES IN BOXES
F. B. 1558—PREPARATION OF EASTERN GRAPES FOR MARKET
LEAFLET 68—ROADSIDE MARKETS
DEPT. BUL. 1406—RIPENING, STORAGE, AND HANDLING OF APPLES
DEPT. BUL. 1448—PICKING MATURITY OF APPLES IN RELATION TO STORAGE
MISC. PUB. 168—MARKET DISEASES OF FRUITS AND VEGETABLES (Apples, Pears, and Quinces)
colored illustrations, 40c.
F. B. 1588—FROST AND THE PREVENTION OF FROST DAMAGE

Your Congressman may be able to supply any of the above U. S. Department of Agriculture bulletins free. They may also be obtained for 5 cents each (cash, not stamps) from the Superintendent of Documents, Government Printing Office, Washington, D. C.