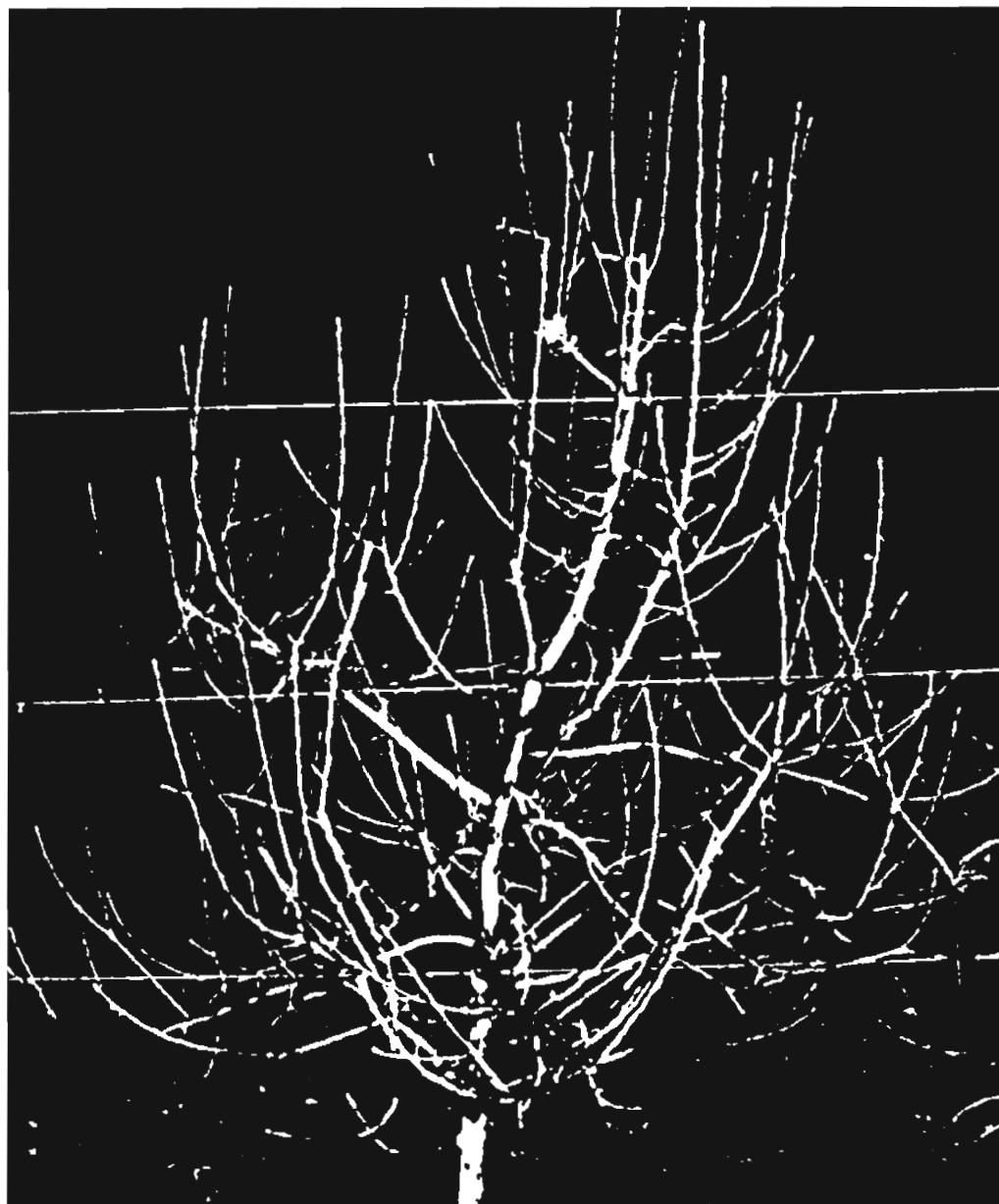

PRUNING MATURE PEAR TREES

IN COMMERCIAL ORCHARDS



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Pruning Mature Pear Trees in Commercial Orchards

R.L. Stebbins

This publication describes the most important concepts in pruning of pear trees. It's intended to help experienced pruners to improve their pruning skills. It provides information about the advantages and disadvantages of various pruning cuts, and it tells how to accomplish certain objectives.

Base your judgments about the kind and number of cuts to make in any particular tree on its current condition relative to your desired objectives.

Tools for pruning

Proper pruning requires use of appropriate tools. Long pruning shears, often called *loppers*, are the most useful. Hand shears are helpful when pruning small trees or when working in close quarters on a ladder. Powered hand shears or loppers may speed the work by reducing worker fatigue. Frequent sharpening of pruning tools makes the work faster and easier.

If you prune your trees from the ground primarily with pole loppers, you won't notice that some regions are nearly inaccessible. Furthermore, pruners with pole loppers often leave stubs, which will lead to water sprouts.

So prune your trees using hand loppers and from the same ladders that you'll use in picking.

You'll need a ladder for the work. Since ladder falls are the most frequent and costly source of injury in orchards, *make sure* that:

- you have a good ladder,
- it's the right size for the tree, and
- you know how to set it properly.

When to prune

Fall or early winter pruning can increase susceptibility of trees to damage in a sudden freeze within 2 weeks after they're pruned.

In districts with mild winters, you may begin pruning as soon as the leaves fall.

In colder districts, wait until after January 1 to reduce the risk of damage to pruned trees from extreme cold. Wounds made during pruning tend to stimulate wound healing activity which may cause the surrounding tissues to lose cold-hardiness.

The glossary (page 11) defines terms used in pruning.

Tree response

You should recognize that there are several ways to prune trees successfully, but they all require an understanding of the characteristics of tree growth. Pruning that ignores these characteristics may result in broken branches, low yield, excessively tall trees, and reduced fruit size and quality.

These basic facts about tree response apply no matter what pruning system you follow:

1. Severe pruning of a young tree reduces the quantity of fruit produced in the early years. In general, it's best to prune young trees lightly and older trees more severely (figure 1).
2. Pruning stimulates growth near the cut; however, the net effect of pruning is to reduce the overall size of the tree and the relative size of the pruned limb. This is used to confine trees to their allotted space and to maintain light distribution throughout the tree during summer.

3. Although pruning stimulates growth primarily near the pruning wound, other parts of the tree may grow more because of improved light distribution.
4. *Apical dominance* is the term used to describe the influence the terminal (or "apical") bud exerts on the growth beneath. It influences the number of shoot-forming vegetative buds, the lengths of the shoots formed, and their angles with the limb they emerge from. A knowledge of apical dominance will help you choose which pruning cuts to use, especially heading vs. thinning.
5. High fruit set and large fruit size depend on adequate exposure to sunlight. Both fruit set and size are reduced when the interior parts of the tree are shaded.

Robert L. Stebbins, Extension horticulture specialist, tree fruit and nut crops, Oregon State University.

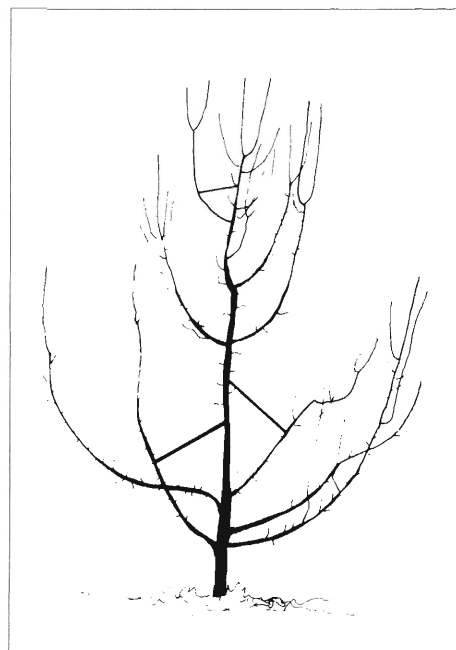


Figure 1.—Training of this central-leader tree is completed after 5 years, and it has begun to produce. To encourage cropping at this stage, pruning should be minimal.



Figure 2.—A tree with overall conical or dome shape has a more even light distribution throughout the canopy than a tree that's broadest in the top, in the shape of an umbrella.

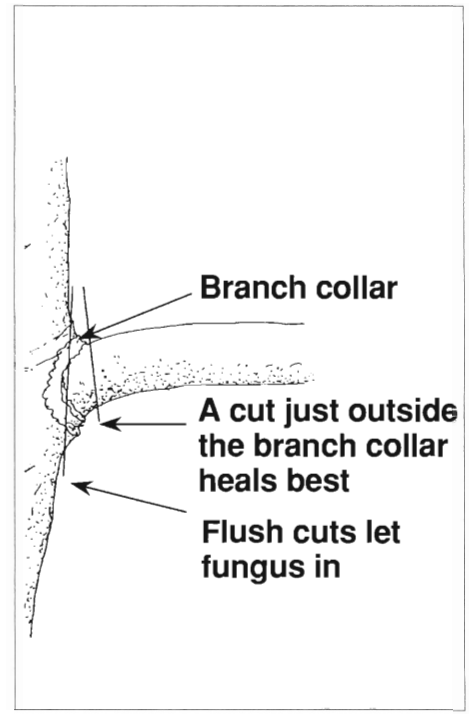


Figure 3.—Cuts made outside the "branch collar" heal more quickly than "flush cuts" or cuts that leave a stub.

6. The overall shape of the tree influences its productive efficiency and fruit quality by affecting the light distribution throughout the tree (figure 2).
7. Since only the leaves and green fruits can fix carbon by photosynthesis, the nonphotosynthetic shoots, scaffold structure, and roots depend on them for "food." Therefore, wood in excess of that needed to support fruit, wastes some of the photosynthates that might otherwise be directed into fruit, rendering the tree less efficient.
8. Cuts made just outside the "branch collar" with the limb heal quickly, but large stubs left don't heal (figure 3). The "branch collar" is at the point of insertion of the limb and has a slightly wider diameter than the limb.
9. Two basic cuts in pruning are heading back and thinning out. Heading means cutting off part of a shoot or branch. Thinning means taking out the entire branch or shoot.
10. Heading stimulates branching, stiffens limbs (allowing them to be extended further), or prevents fruit set on the ends of shoots (figure 4). Long shoots might terminate in

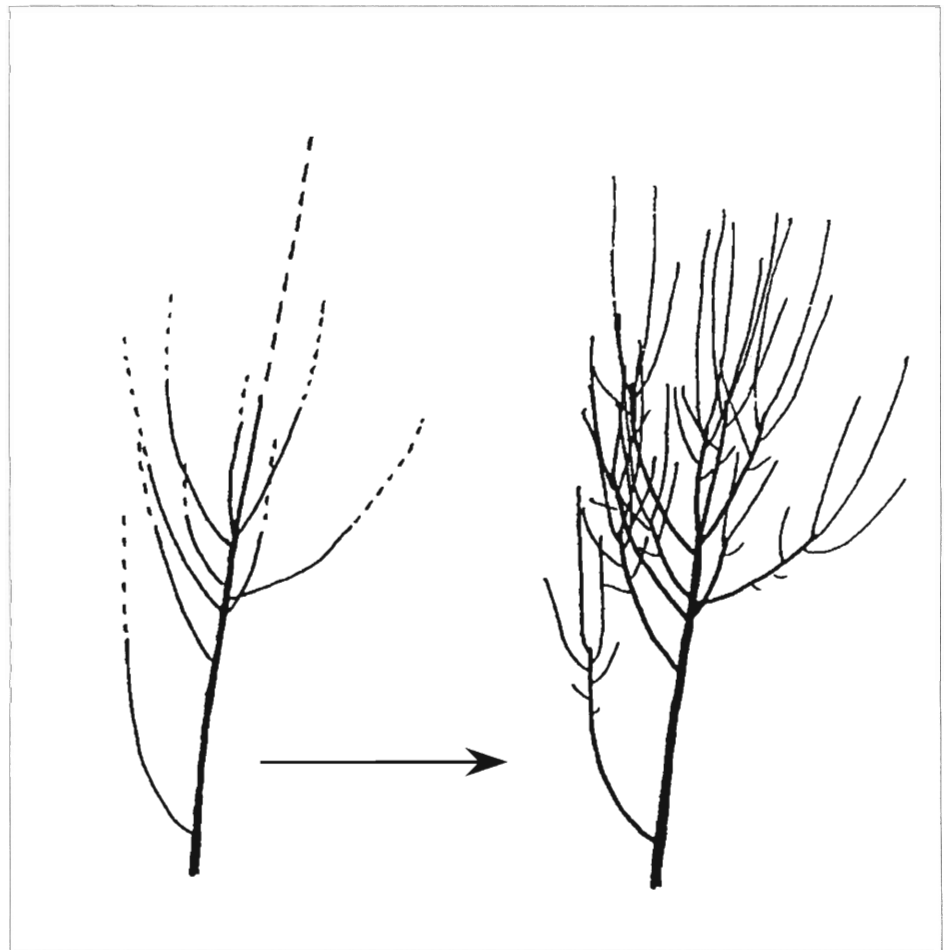


Figure 4.—Heading increases branching.

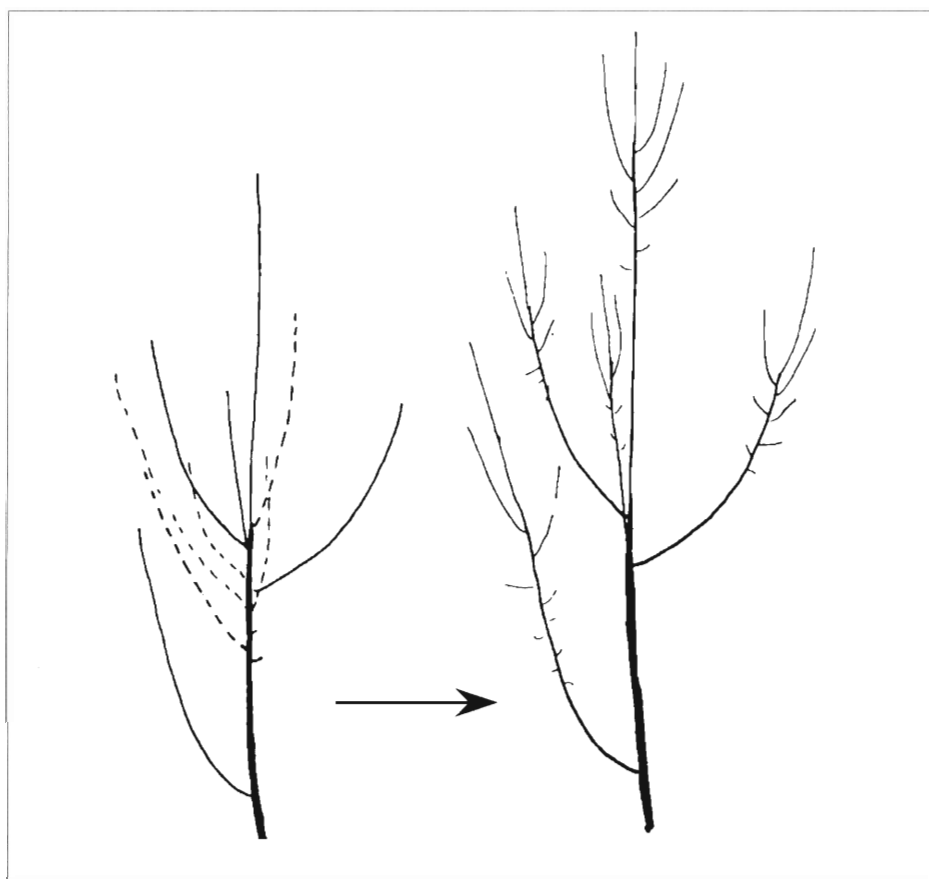


Figure 5.—Thinning favors flower bud formation.

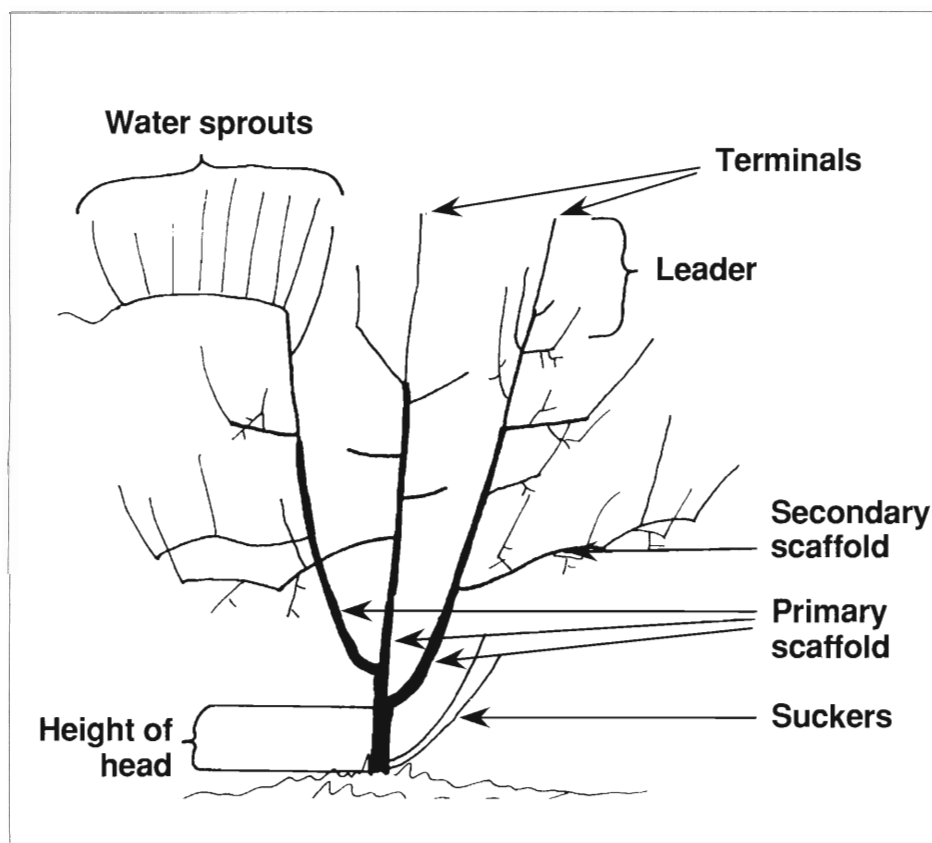


Figure 6.—Certain terms essential to pruning.

late-blooming "rat tail" flower buds that tend to bloom late when weather is warm and conducive to fire blight infestation. Heading them may reduce exposure to fire blight.

11. Heading to a flower bud on 2-year-old wood tends to increase fruit set.
12. When most of the shoots in the bearing tree are headed, production of new shoots is increased and fruit production is reduced. Therefore, long shoots are either left to form part of the limb structure, or removed entirely. Weak shoots are left unheaded.
13. Thinning improves light penetration, preserves more fruiting wood, redirects limbs, and shortens branches (figure 5).

To become a masterful pruner, you must prune and carefully observe the results on the same trees for several years. Figure 6 illustrates certain terms essential to pruning.

Pruning young trees

It may take 5 years to train a tree. Prune young trees to control tree height and spread, to improve fruit quality by reducing limb rub and maintaining exposure to light, and to prevent excessive spreading of limbs under the weight of fruit.

In young trees, the equilibrium between fruiting and growth is easily tipped in the direction of growth by too much pruning. Too much vigor gives excessive growth and small crops of large fruit that are subject to cork (in Anjou).

Obtain greater production through light pruning combined with strapping, wiring, or propping to keep the fruit from breaking limbs—rather than through heavier pruning to further increase limb strength.

Make relatively few cuts on the tree, removing 1-year shoots, if the tree is growing more than is desired or if there are few flower buds because of freeze damage or a heavy crop the previous season.

Do any corrective pruning required on young trees—removing excess limbs, balancing leaning trees, or reducing height—*gradually*, over several seasons, to minimize the stimulatory effect.

Central-leader trees

It's important to control tree height, so that you can reach the top from an 8- or 10-foot ladder. Pruning to control height after it has fruited helps keep the tree balanced toward fruitfulness.

To maintain the vigor and productivity of lower limbs, maintain the overall conical shape of the tree by pruning (figure 7). Don't allow strong lateral limbs to remain in the top $\frac{1}{3}$ of the trees.

Leave only the weaker, more horizontal ones. Leave a space of about 2 feet between limbs. If all the limbs in the top are upright and vigorous, reduce fertilization. Bend or tie the limbs down to get them fruiting.

To keep the vigor of the top in control, limit tree height by pruning to an upright weak lower shoot. This will maintain apical dominance and limit the amount of new shoot growth in the top (figures 8 and 9).

Maintain good light distribution to all limbs by clearing spaces around them, including 2 feet of space above and below them. The longer the limbs, the greater the vertical space required between them for good light penetration (figure 10). The widest vertical spaces between limbs should be at the bottom of the tree, since limbs there are the longest.

Pruning needs of different varieties

The pear varieties most commonly grown in the Pacific Northwest are Bartlett, Bosc, Anjou, and Comice. Among these, Anjou and Comice need more detailed annual pruning than Bartlett and Bosc.

Bartlett trees tend to be narrow and upright. Because their wood is weak, it's difficult to extend the limbs very far from the trunk. Depending on spacing, it can be worthwhile to tie some limbs up in order to extend them (figure 11).

Heading the terminal shoot to about 18 inches long helps to extend the branch. Long shoots often terminate in late-formed, late-blooming flower buds that are likely to get fire blight. Either remove or head such long shoots.



Figure 7.—Note the overall conical shape of this central-leader tree.

Leave unheaded shoots 8 to 12 inches long, well-spaced throughout the tree—these are the most productive. Leave fewer shoots when you're growing large pears for the fresh market than you'd leave for canning.

Bosc trees tend to have long unbranched limbs that break easily. Careful training to develop a strong scaffold system can minimize this problem. If the tree has been developed with too many scaffold limbs, so that no one of them has enough strength, remove some limbs until the tree has only 5 or 6 main limbs at most.

Head shoots over 2 feet long back to about that length, but leave shorter ones unheaded. Adjust the pruning intensity according to the bud set and need for larger fruit.

Anjou and Comice. Although they bloom throughout the tree, Anjou trees tend to set fruit mainly on strong young shoots and spurs well-exposed to light. Fruit set is often lighter than the tree can carry with good size. It can be increased by heading to a flower bud in 2-year-old wood. Save shoots 12 to 18 inches long, unheaded, and plan to head them the next year after they have formed flower buds.



Figure 8.—A renewal point before pruning.



Figure 9.—A renewal point after pruning.

When pruning is completed, the tree should be well-furnished with:

1. unheaded shoots in well-lighted positions,
2. headed 2-year-old shoots, and
3. spurs 3 to 6 years old.



Figure 10.—Note the light channels between limbs in this well-pruned Anjou tree.



Figure 11.—This Bartlett tree is easily held in its 15-foot spacing by keeping limbs upright and strapped together at the top to prevent excessive spread or breakage.

Pruning mature multiple-leader trees

Without instructions to do otherwise, pruners often spend their entire pruning time removing most of last year's new growth. Consequently, because it's not being replaced, the fruiting wood becomes older and less productive each year.

Bartlett pears produce best when the fruiting wood varies from 1 to 4 years old, while Anjou may produce satisfactorily on wood up to about 7 years. When the limbs are "skinned" of new shoots, shoots grow near all those cuts, increasing the number of shoots for the next pruning!

The fruiting wood in trees gradually moves upward and outward as the tree ages. The weight of the crop arches the limbs outward and over lower limbs.

Shade from the tree top weakens lower limbs, making them unproductive. The trees become "umbrella-shaped" and unproductive, and they require much

time annually removing water sprouts. By following a simple set of rules, this situation can be avoided.

Skillful pruning pays dividends

How you think about the costs involved in pruning is important. For many growers, more creative and diligent pruning may be the answer to increasing productivity.

Why not consider pruning as an investment? If we approach the economics of pruning on a marginal cost per bin rather than average cost per acre, we may find that correct pruning, even though more costly, may become a viable alternative.

For illustration, let's define marginal cost as the cost of the last unit produced. Let's assume that we can increase an acre of Anjou's from 30 to 31 bins per acre by pruning.

The planting is square 24 x 26, giving 70 trees per acre. At \$140 net per bin after picking, we could have spent up to \$2 more per tree pruning and still broken even.

If we consider that a bin may contain about 2,000 fruit, at 70 trees per acre, each tree would have to set about 29 more fruit to make that extra bin. To add fruit to a tree, you need to grow more fruiting wood. As we shall see, that's not difficult.

To get the 29 extra fruit per tree, you'd probably need to find suitable locations for about 50 new fruiting points. By shaping the tree to exploit its space more efficiently, you could add many more than 50 fruiting points.

A mature pear orchard averaging 30 bins per acre, with average pruning and average quality, might achieve a 10-bin increase to 40 bins per acre in a 5-year period, with pruning as the only input difference.

How to prune

Emphasize the following four goals:

1. maximum bearing surface;
2. access for light, people, and spray;
3. fruiting wood renewal; and
4. uniform vigor throughout the tree.

Let's discuss how these four objectives are reached.

Maximum bearing surface

Develop limbs into open space to fill it with fruiting wood, but not so close that light to other fruiting wood is cut off. In large trees, leave 2 or 3 feet of open space between trees.

To develop a limb, find a strong shoot in an appropriate position to "take the lead," and head it to stiffen it and hold it in place. Continue to head the lead shoot each year as the branch extends. The branch to be developed should end in a strong, upright shoot, and shouldn't have an overall aspect below horizontal.

It's easier to extend limbs of Anjou than of Bartlett. You may need to tie the limb up to a higher limb for a few years until it gains girth enough to make it on its own.

Of course, when an entire tree is lost, replacement is called for. Bring in as large a replacement tree as is feasible so as not to waste space in the orchard.

Sometimes, space that should be filled with fine fruiting wood is filled instead with excess heavy structural wood. That situation calls for heavy saw cutting.

Access for light, people, and spray

Start the pruning of a tree by clearing out a ladder bay for access to the top center part. However, if saw cuts into old wood are required to form "light channels," you can often do these safely with a pole saw.

Working with a positioning machine, such as a Girette, and a power saw, would be faster. Cut light channels, or ladder bays, with a saw before you begin work on the lighter wood.

If the actual pruning will be done with a large crew of workers, you may want to first mark the places where large cuts are to be made. Use blue latex paint and a corner painter on a pole. This keeps decision making from slowing down the entire saw-pruning crew.

If the tree is too tall to be pruned and picked from 12-foot ladders, it's time to reduce tree height. If more than a few feet of lowering is required, it's best done in two seasons.

If nothing is left but the top layer of limbs in an "umbrella" tree, reducing height may not be a practical option. It would be better not to let the trees get into that condition!

Each year, the light channels we leave tend to fill with new growth. Much, but not all, of this must be removed. Prune to keep the limbs coming out straight from the trunk, like the spokes on a wheel. Don't let side limbs cross over the light channels, closing access to inner wood.



Figure 12.—Young, vigorous shoots well-exposed to light, such as this one, which was left unheaded the previous year, tend to produce large pears.

Wood renewal

What you leave on a tree is important; what you cut off is not. Remove all the vertical shoots unless they're at a "renewal point" (a point where the growth in height of the limb will be stopped each year).

Leave shoots that tend toward horizontal, and that are of moderate length, less than 18 inches. If they're needed for fruiting wood, longer shoots may be left headed to 18 inches (figure 12).

Leave shoots for fruiting wood far enough apart, 12–18 inches, to allow for their fruiting. In their second year, cut these back to a flower bud. *Don't head shoots that are less than 18 inches long.*

Cut back to an upright spur or cut off the old fruiting wood (which is

usually located under the limbs). Get a rotation started. After 4 or 5 years—when they're an inch or two in diameter, downward-hanging, and require some pruning for control—cut them out and replace with others.

Following these practices, there will always be some of last summer's shoots and fruiting wood aged 2 to 6 or 7 years in the tree after pruning. If you need to increase fruit size more than overall yield, remove more of the old fruiting wood. The best quality fruits are born on 2- and 3-year-old spurs (figure 13).

Renewing secondary limbs, which usually means removing part of the framework limbs in the upper half of the tree, is also part of wood renewal. Remove the ends of limbs that have moved below horizontal.

Limbs should be left with an overall upright aspect, with tips pointing up. This will help reduce suckering by preserving apical dominance. Growing shoot tips suppress the growth of shoots below them and cause them to start out more horizontally.

This phenomenon, called *apical dominance* (see page 6), can be used to help control how the tree grows. Limbs in the bottom of the tree can be more horizontal than higher up because there's nothing below them to be shaded. However, if they're allowed to hang downward too much, they'll lose vigor and become unproductive.



Figure 13.—Old, downward-hanging fruiting wood sets few pears, which tend to be small.



Figure 14.—These branches have been renewed to more upright wood regularly.

Because the well-lighted parts of the tree grow the most rapidly, more limb renewal must be done in the upper, outer parts. In the lower and central parts of the tree, soft, horizontal (where available) water sprouts are left to replace fruiting wood. Vertical shoots can be bent down and tucked under other wood to provide replacement fruiting wood.

Remember: A fruit tree is only as old as its fruiting wood. The rate at which you replace old fruiting wood with new, and the amount of wood you leave on the tree, are ways that you can affect both yield and fruit size.

Uniform vigor

Pear trees tend to grow more strongly in the tops than lower down. Horticulturists call this an *acrotonic* tendency.

Only if a tree has fruiting wood from close to the ground up to the tops, can it reach its full productive potential. This requires a pruning strategy *that favors maintenance of vigor in lower limbs.*

This means that upper limbs must be shortened until they don't extend out over the lower ones. After pruning, the tree's overall shape should tend toward the conical or "dome-shaped."

One of your tasks as pruner is to form as nearly a dome-shaped tree as the tree on which you're working will

allow. In some cases, that may mean just not letting an umbrella tree get any worse.

The "pruner's dilemma" is that you must remove some of the strongest, potentially most productive fruiting wood in the top of the tree just to maintain some vigor lower down. However, the tree overall will be much more productive if you do maintain even vigor from top to bottom, to the greatest extent practical.

Keep lower limbs spaced enough so that they don't crowd each other. Shorten side branches to avoid excessive bending and twisting under a crop load, and to prevent side branches from becoming as large as the main branches.

Don't let the branches develop equal forks. If the lowest limbs still have only very short terminal shoots, thin off more of the fruiting wood to allow more photosynthates to go into new growth.

Controlling suckers or water sprouts

Strong vertical shoots located in any part of the tree are called *water sprouts*. Removing these annually is necessary—they don't contribute new fruiting wood, and they may not contribute much to fruit sizing, yet they must be removed to allow light passage to fruiting wood that's left.

When you remove water sprouts, cut them as close to the limb as possible. If you leave stubs, more than one new water sprout will appear in place of the one you removed.

Maintaining an overall aspect of the limb above horizontal will also help to minimize formation of water sprouts. Allowing water sprouts to become fruiting wood, by leaving some which are going out to the side unheaded, also minimizes regrowth.

Leaving a "renewal point" at the end of the branch, as well as at certain other high places on the branch, also minimizes the reappearance of water sprouts. In other words, a limb could appear to have from one to three "false ends," consisting of headed vertical shoots at high points, before the actual end.

To create a renewal point, leave one vertical water sprout, and head it at about 18 inches. Each year, two or three lopper cuts are required to

restore this point to the one vertical headed shoot, plus a few weak lower fruiting shoots. Initial thinning to the vertical replacement shoot can start higher or lower, but the final heading cut is made at the same point each year.

This system uses apical dominance to reduce water sprout formation near the renewal point, which is located at a point where many would normally form (figure 14).

Thin out the shoots, leaving those of medium length, and leave the end of the limb moderately upright.

A basic plan

Here are some typical instructions for pruning a mature pear tree:

Part A. Maintain a productive limb structure

1. Remove limbs, usually in the tree top, that block light channels and ladder bays.
2. Fill available spaces (if any) by selecting a vigorous lead shoot going into the space, heading it, and removing (if required) parts of the branch not growing in the right direction.
3. Remove the ends of upper limbs that have gone below horizontal, by cutting to a weak upright shoot, to restore an overall conical or dome shape to the tree, and to maintain apical dominance.

Part B. Control regrowth and rotate fruiting wood

4. Restore renewal points on the ends of branches and at other high points in the tree top by thinning to a single strong shoot that's headed at about 18 inches. Remove all other vertical shoots entirely, cutting close to the limb. Don't leave stubs!
5. Leave nonvertical shoots, usually less than 18 inches long, unheaded, spaced 12 to 18 inches apart where more new fruiting wood is needed. Head to a flower bud on the ones left the previous year.
6. Remove or shorten fruiting wood left in previous years, especially if it's weak and hanging downward.



Figure 15.—Mechanical side hedging was used to create space between these old Anjou trees that had grown together. With followup hand pruning, such treatment can increase yields in the second year after pruning.

It's a good practice to prune demonstration trees yourself of each variety and age or problem group. Try to communicate why certain cuts are made rather than having pruners just cut by imitation. Prune a limb and explain as you prune.

Employing the same people for pruning, thinning, and picking, to as great as extent as possible, reinforces skills in all three areas. Pruning is the single most important cultural operation in the orchard. Almost anything required to do it correctly is worth the effort. Try to impart a sense of importance and enthusiasm to the pruners.

Pruning neglected mature trees

Trees that haven't been pruned for several years are overgrown and bushy. Restore the balance of vigor and fruitfulness in trees by making many thinning cuts throughout the tree with emphasis on the upper, outer portions. Cut into wood that's several years old at an upward-growing branch or shoot.

Do this for several years. Remove no more than one or two large limbs per year. Too much pruning at one time may cause the tree to stop producing. It may be helpful to use spreaders to bend upright shoots toward the horizontal.

The tops of adjacent trees in an overgrown orchard tend to close together, reducing light to lower limbs. Prune to allow several feet of space between branches in the tops of adjacent trees.

Excessive suckering may be caused by the loss of apical dominance on nearly horizontal limbs, excessive pruning, and/or excessive use of fertilizer. Suckers or water sprouts may be removed in summer.

The "umbrella-shaped tree" has two causes: failure to cut into older wood, and always pruning to outside wood. New growth consists primarily of suckers in the tree top. Lower limbs are weak and shaded.

There's little new growth in the weak, devitalized spur systems. Much time and effort is expended annually in removing suckers and placing props.

Mechanical pruning

Mechanical topping and/or hedging is sometimes used to maintain a certain tree height and reduce labor costs. When it's applied to trees that are overgrown in the tops and sides, and followed with hand pruning, it's been shown to increase yields (figure 15).

Unless it's followed by hand pruning, it can *reduce* yield and fruit quality so that a serious net loss occurs even though some savings were made in pruning costs.

Masses of new shoots form along the plane of cutting, and lower, inner wood is weakened or dies because of shading. Mechanical pruning best confines the tree to its allotted height and spread before hand pruning commences.

Don't reduce the height or spread of trees with mechanical pruning more than about 2 feet in a single season. Always thin out the excess shoots formed by the previous season's mechanical pruning. Prune by hand throughout the tree to stimulate growth away from the area that was affected by topping or hedging.

Selective cutting, with chain saws or pole saws, is a better way of reducing the height of tall trees because the cuts can be made at branch points, where they're more likely to heal. Some fine wood in the tops of trees can be preserved. Growth in the trees can be balanced because apical dominance is maintained.

Glossary

Apex

The end of a shoot most distant from its base.

Apical dominance

In which the growing shoot tip produces hormones which move toward the roots, influences the number of buds forming shoots, the lengths of the shoots formed, and their angles with the limb they emerge from.

Central leader

The central limb in the tree from which all other limbs arise and which also forms the highest part of the tree, also "central axis."

Flower bud

In pear, buds that contain flower primordia also contain leaf primordia and could also produce up to two shoots.

Heading

Cutting off part of a shoot or branch not at a branching point.

Pruning

Cutting off parts of the tree.

Scaffold limbs

The woody parts of pear trees can be divided into two kinds of wood: fruiting wood and structural or "scaffold" wood. Fruiting wood is replaced periodically by pruning, but scaffold wood is more or less permanent.

Shoot versus spur

The term *shoot* refers to the past season's growth in winter or a current season's growth in summer.

Spur

A very short shoot that usually terminates in a flower bud.

Spur system

A cluster of spurs that originated from a single shoot.

Sucker

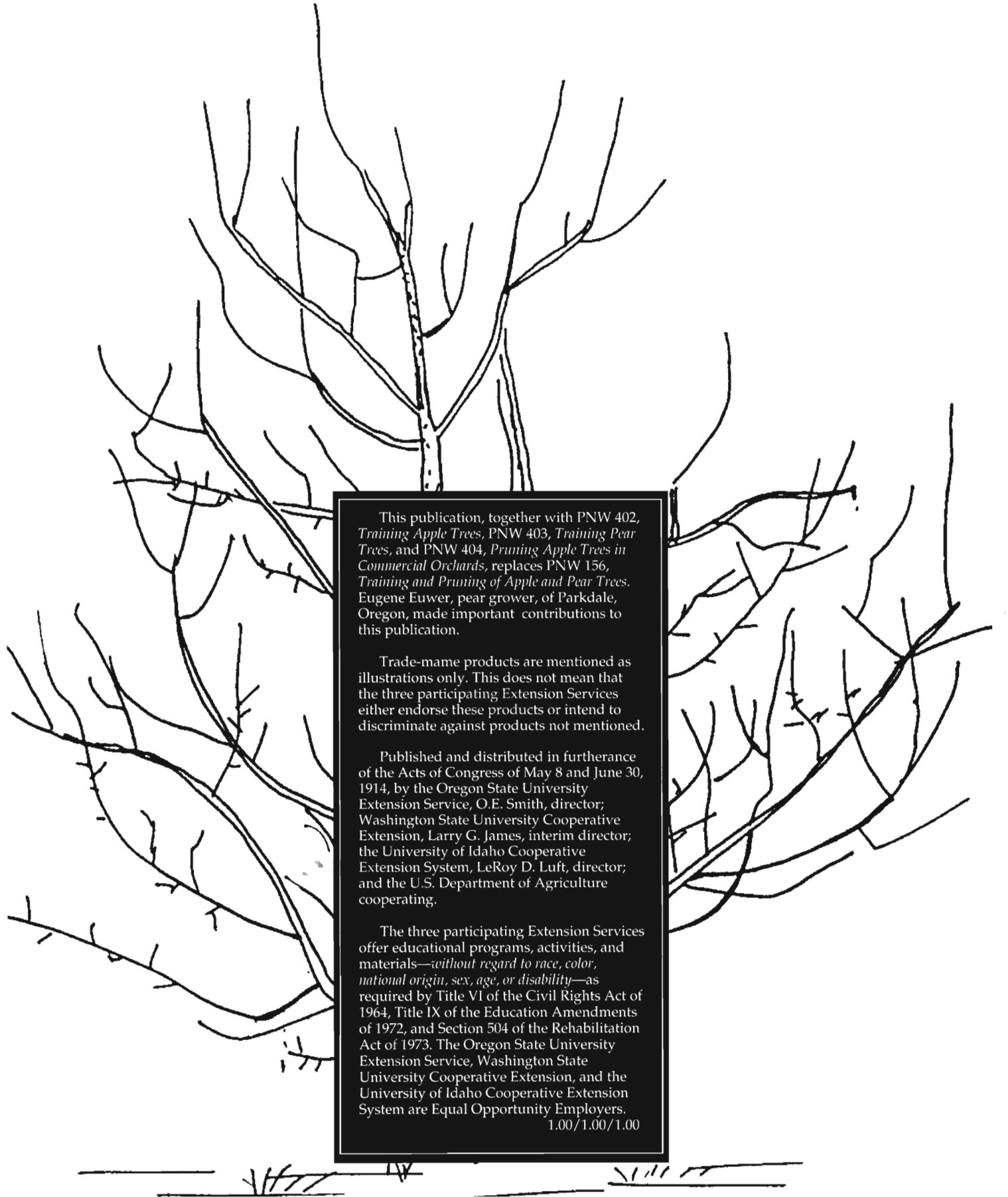
A vigorous, usually vertical shoot, usually arising from the roots, trunk, or main scaffold branches (used interchangeably with **water sprout**).

Thinning

Taking out the entire branch or shoot back to a larger branch or to the trunk.

Water sprout

The same as a sucker, but always arising from trunk or main scaffold branch.



This publication, together with PNW 402, *Training Apple Trees*, PNW 403, *Training Pear Trees*, and PNW 404, *Pruning Apple Trees in Commercial Orchards*, replaces PNW 156, *Training and Pruning of Apple and Pear Trees*. Eugene Euwer, pear grower, of Parkdale, Oregon, made important contributions to this publication.

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