



Tree Pruning Essentials

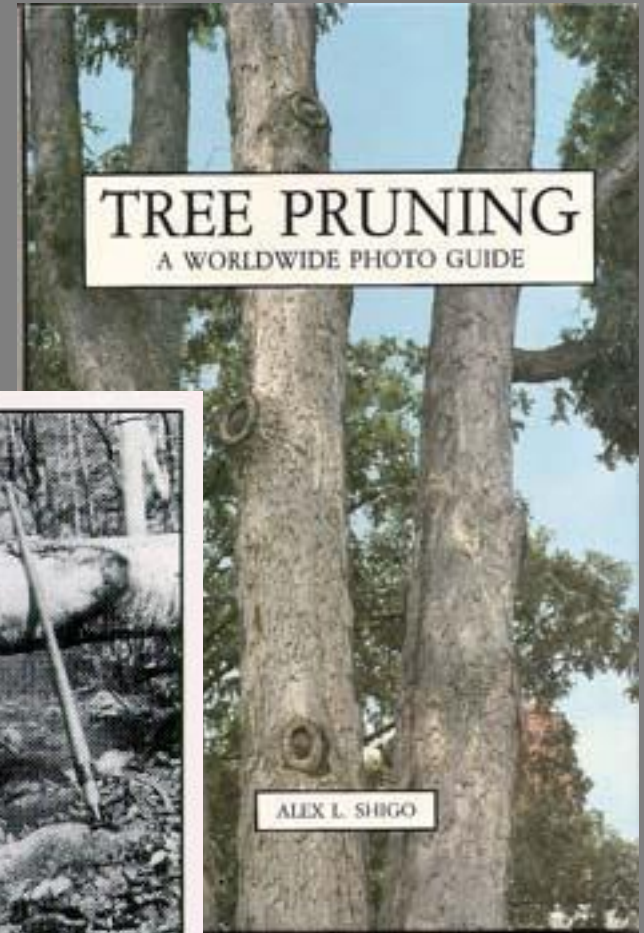
Overview

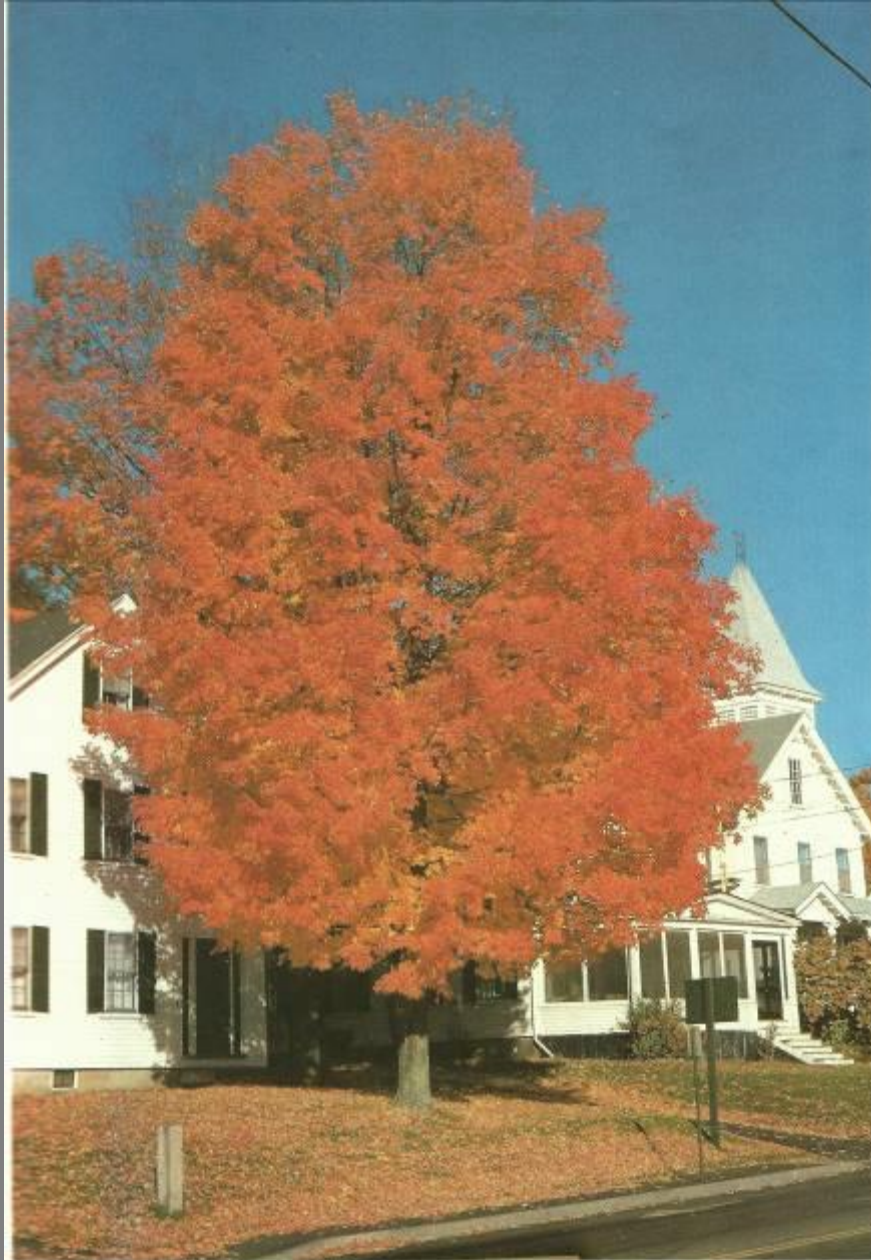
- WHY
- WHEN
- TREE STRUCTURE & ANATOMY
- TREE DEFENSE SYSTEMS & WOUNDWOOD
- IMPROPER CUTS
- PROPER CUTS
- QUESTIONS TO ASK
- PRUNE TREES

Tree Pruning

A Worldwide Photo Guide

By Alex L. Shigo





And the fox said to the little prince: "Men have forgotten this truth. But you must not forget it. You become responsible, forever, for what you have tamed."

The Little Prince
Antoine de Saint Exupery



PROPER PRUNING

Respects Tree Beauty
Respects Tree Defense Systems
Respects Tree Dignity



IMPROPER PRUNING

Destroys Tree Beauty

Destroys Tree Defense Systems

Destroys Tree Dignity

Why Prune?

- Helps develop strong tree canopy
- Increase light penetration
- Increase air flow through canopy
- Increase fruiting potential
- Aesthetically pleasing
- Tree size control

When to Prune

- Temperate fruits are best pruned when they are dormant in the winter
- Tropical fruit trees should be pruned immediately following harvest OR following flowering. (None during Oct–Jan)
 - Non–Fruit Bearing – pruned for structure at any time of the year (Small wood, not a big deal; large wood stimulate growth)



Australia

1. WRONG TREE, WRONG PLACE

The tree is later mutilated.

Know what size and shape of tree you want. Little trees grow to become big trees.

Know your planting site.

Select trees that will grow best on your site.

Get advice from professionals.



Tree Structure & Anatomy



New Hampshire

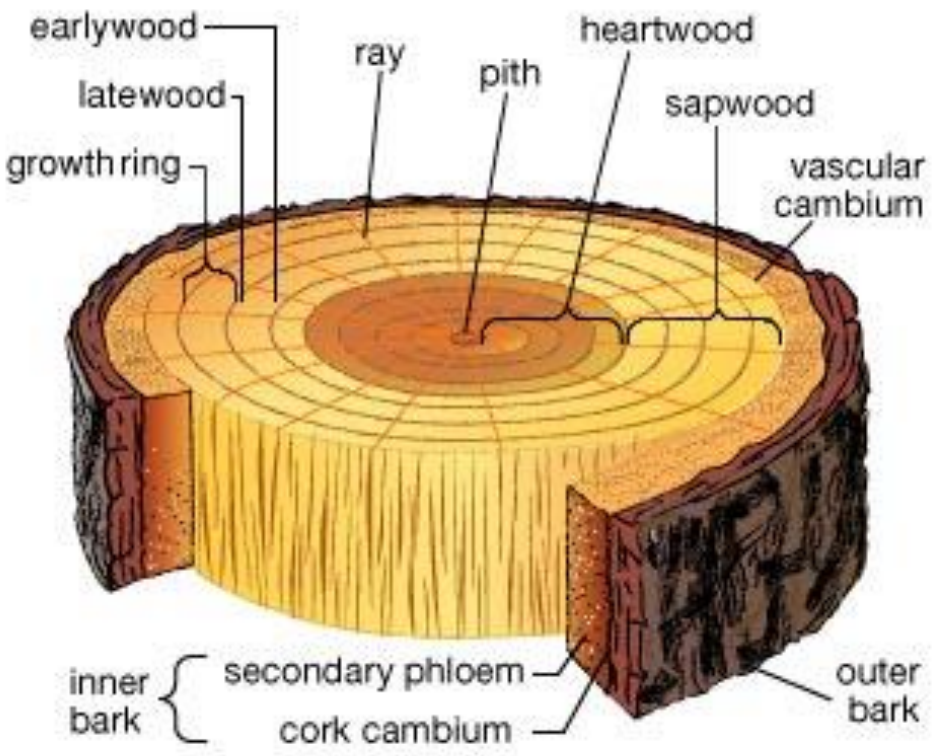
WOOD IS NOT DEAD!

Wood is a tissue made up of living, dying, and dead cells in a highly ordered arrangement. The cell walls consist of cellulose and lignin.

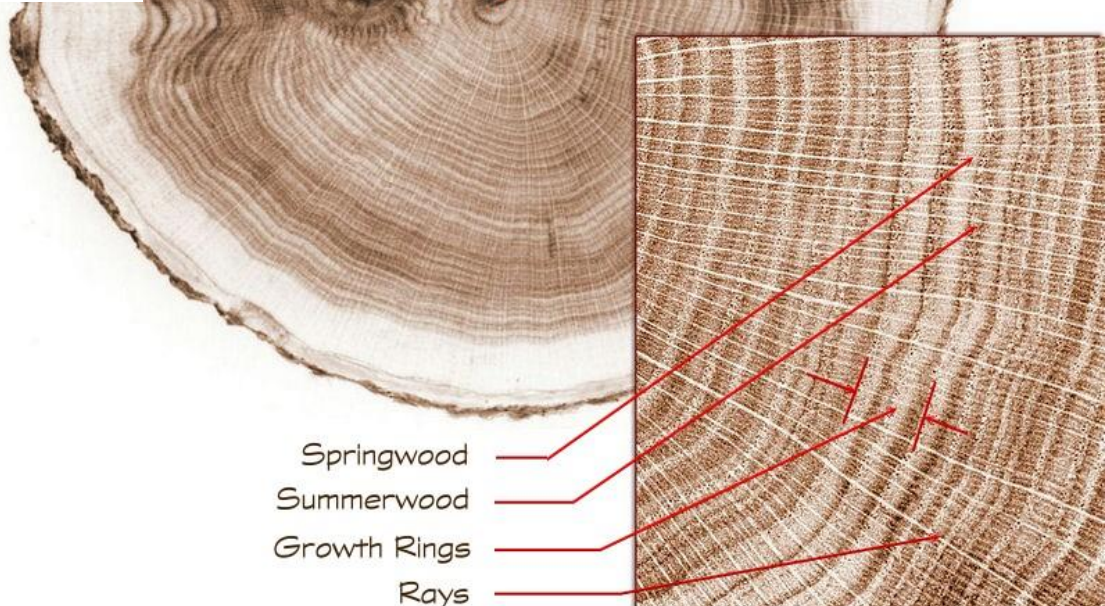
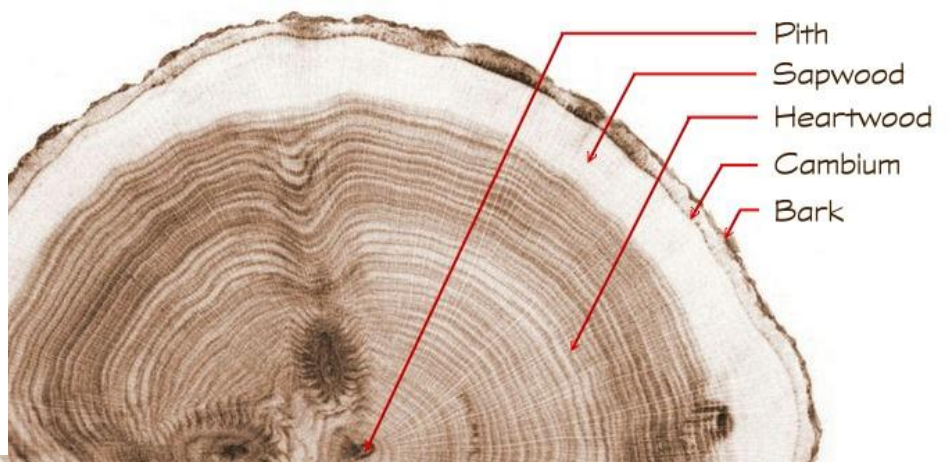
Sapwood in trunks, branches, and roots have more living cells than dead cells. The living cells are small. The dead fibers and transport cells are large.

Above is a stained section of living cells in wood. Living cells store energy reserves for many tree processes, especially defense.

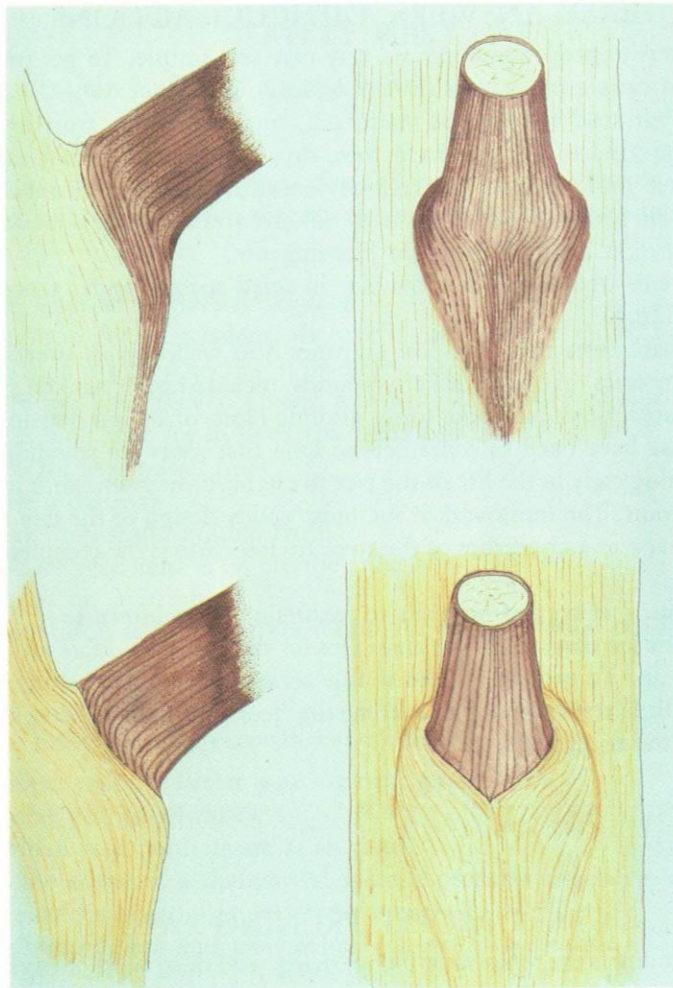
When pruning removes wood that has living cells, the energy storage system of the tree is affected. When energy storage is affected, growth and defense are affected.



© 2006 Merriam-Webster, Inc.



ACTIVITY



New Hampshire

HOW BRANCHES ARE ATTACHED TO TRUNKS

Branch tissues (red) start growth before trunk tissues.

Branch tissues turn abruptly at the branch base to form a collar.

Trunk Tissues (yellow) grow later and form a trunk collar over the branch collar.



New Hampshire

PROTECTION ZONES

Protection zones form within the bases of branches. The zones are made up of chemicals that come from stored energy reserves — starch, oil — in living wood cells. The zones resist spread of organisms from the branch into the trunk. The chemicals are phenol-based in hardwoods and terpene-based in conifers.



Maine

BRANCH COLLARS

Branch collars are rings of wood with living cells about the bases of branches. Great care must be taken not to injure or remove the collars on young and old trees when pruning. All branches on woody plants have branch collars.



New Hampshire

COLLARS ON TREES

Branch collars and trunk collars can be seen when trunks are split as shown here. The trunk collars and branch collars are called collectively the branch collar.

The collar is a place where bark and wood of branch and trunk come together. The collar is like a tissue "switching zone".

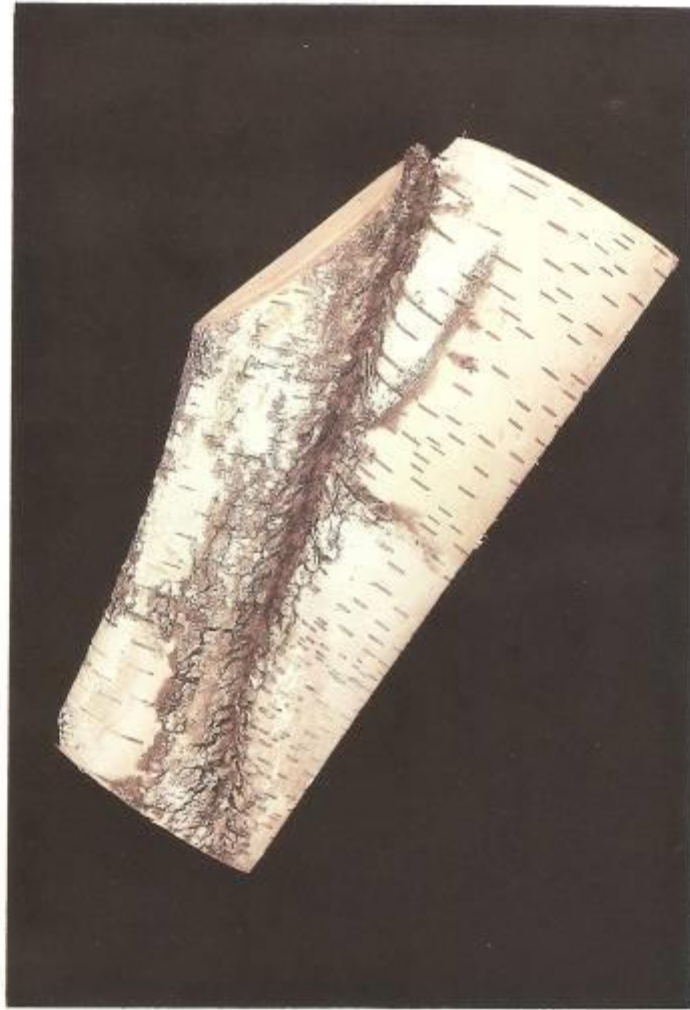


Australia

DO NOT INJURE OR REMOVE COLLARS

Branch collars on some trees are very large, as shown here. There is great variation in size of the branch collars on the same tree.

The collar that remains after proper pruning is not a branch stub. A proper pruning cut is based on the collar and not on a set angle of cut.



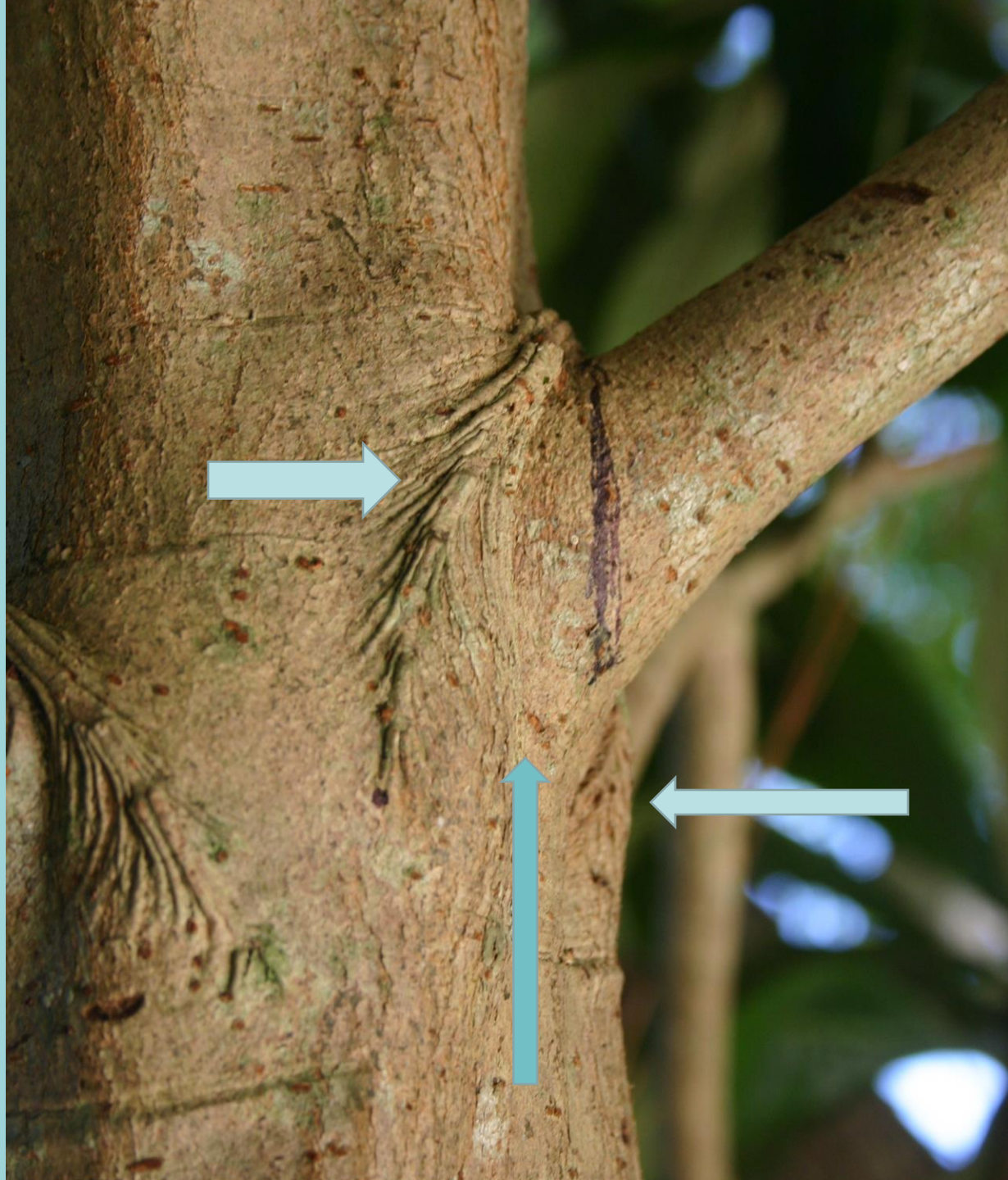
New Hampshire

BRANCH BARK RIDGE

The branch bark ridge (BBR) is raised bark that forms within the branch crotch. It remains on the trunk as the tree grows. The BBR is the black ridge on the white birch. The BBR is the key to proper pruning.

The BBR shows the angle of the branch core in the tree. On some trees—London plane and smooth-barked eucalypts—the BBR is shed with the outer bark. Still, an indentation remains on the trunk where the BBR formed.

ACTIVITY





Tree Defense Systems & Woundwood

ACTIVITY

ANIMAL

VS

TREE



ACTIVITY

ANIMAL

VS

TREE



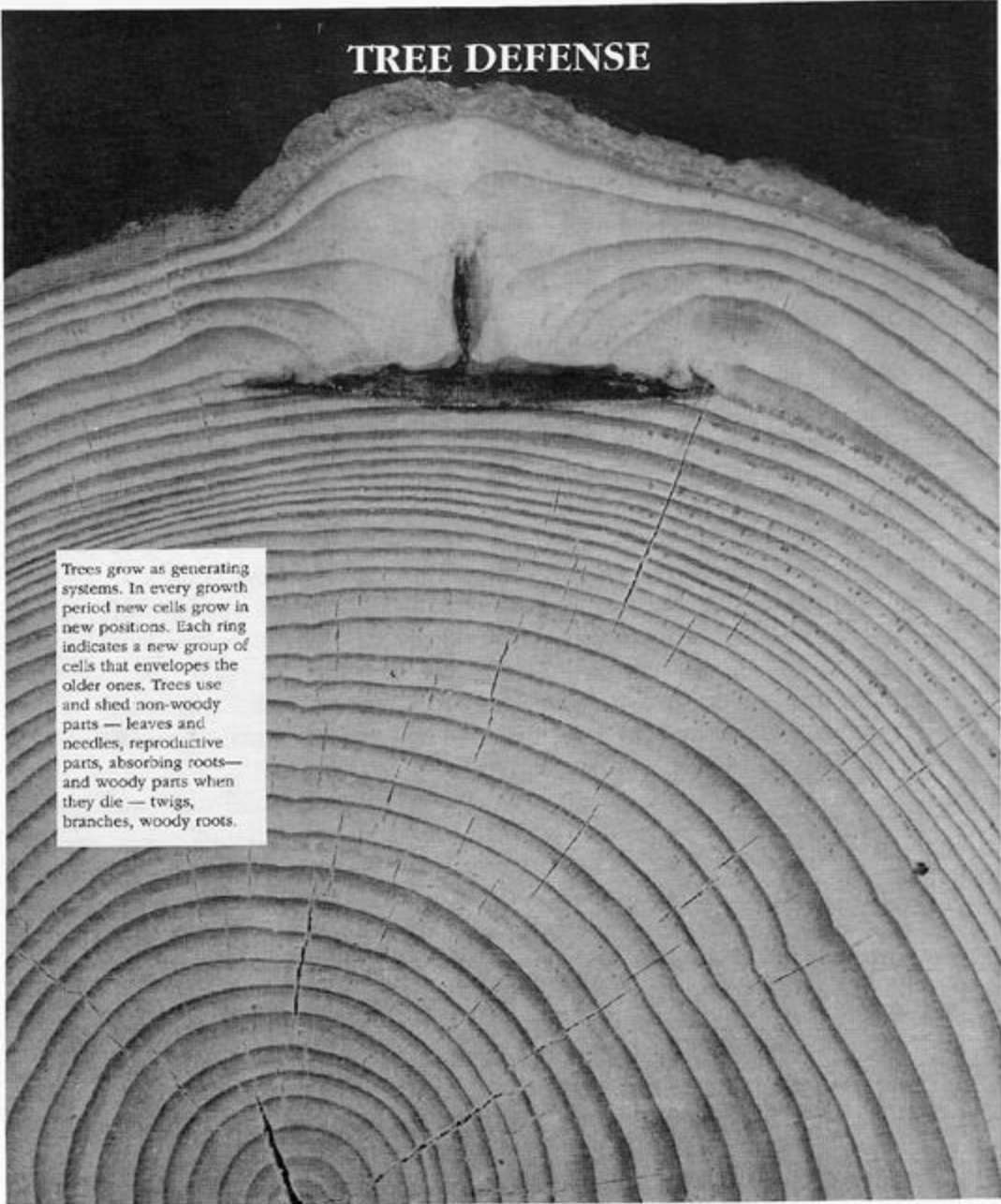
New Hampshire

WOUNDWOOD, SEALING, AND BOUNDARIES

When woundwood seals wounds and when internal protection boundaries are strong, rot, if it develops, will be walled off—compartmentalized.

People heal. Trees compartmentalize. People can rid themselves of infections. Every injury and infection a tree receives will be in the tree for the life of the tree.

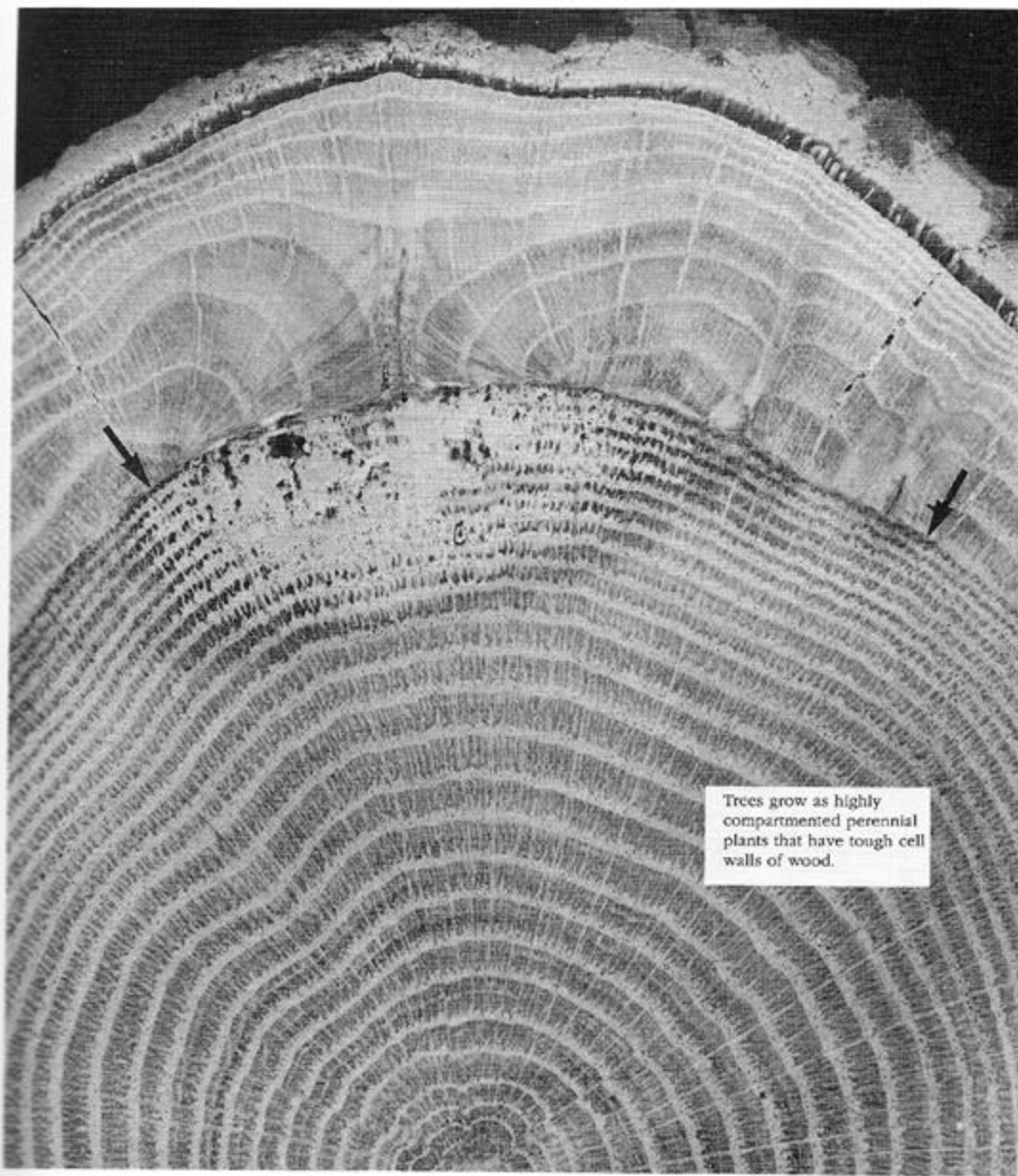
TREE DEFENSE



Trees grow as generating systems. In every growth period new cells grow in new positions. Each ring indicates a new group of cells that envelopes the older ones. Trees use and shed non-woody parts — leaves and needles, reproductive parts, absorbing roots — and woody parts when they die — twigs, branches, woody roots.

A small 6-year-old wound in a red spruce, *Picea rubra*. The wound was compartmentalized, or walled off within the wood. The wound would always be in the tree. New cells would not replace or restore the wounded wood. In this sense, the wound would never heal. The wound was sealed.

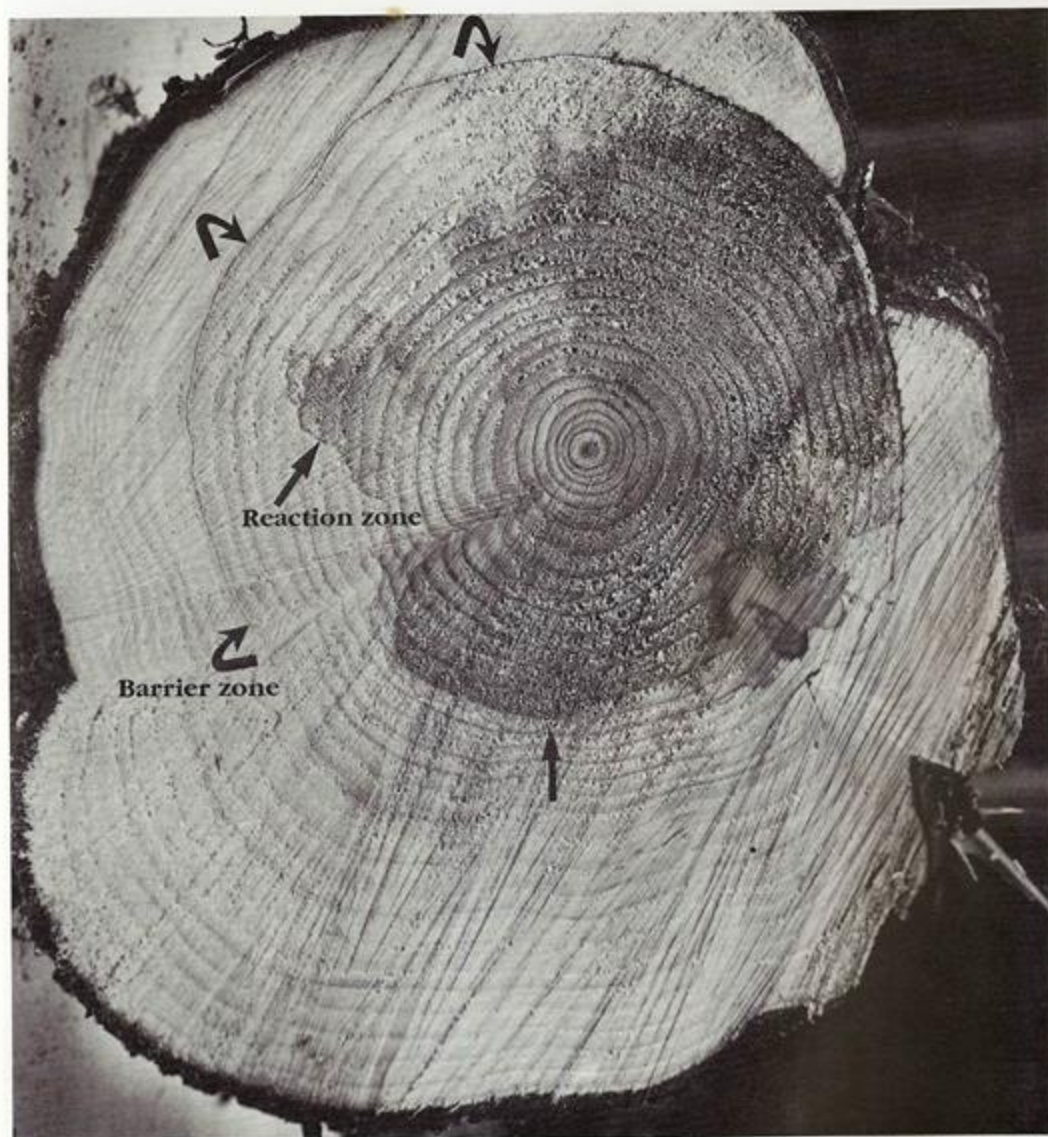
BOUNDARIES RESIST SPREAD OF DECAY



Trees grow as highly compartmented perennial plants that have tough cell walls of wood.

A 9-year-old buckshot wound in a red oak, *Quercus rubra*. A dark protection boundary of chemically-altered wood surrounds the decayed wood. The boundary resists, not stops, the spread of decay. Decay could spread inward and to the sides, but not outward into the wood that formed after the tree was wounded (arrows).

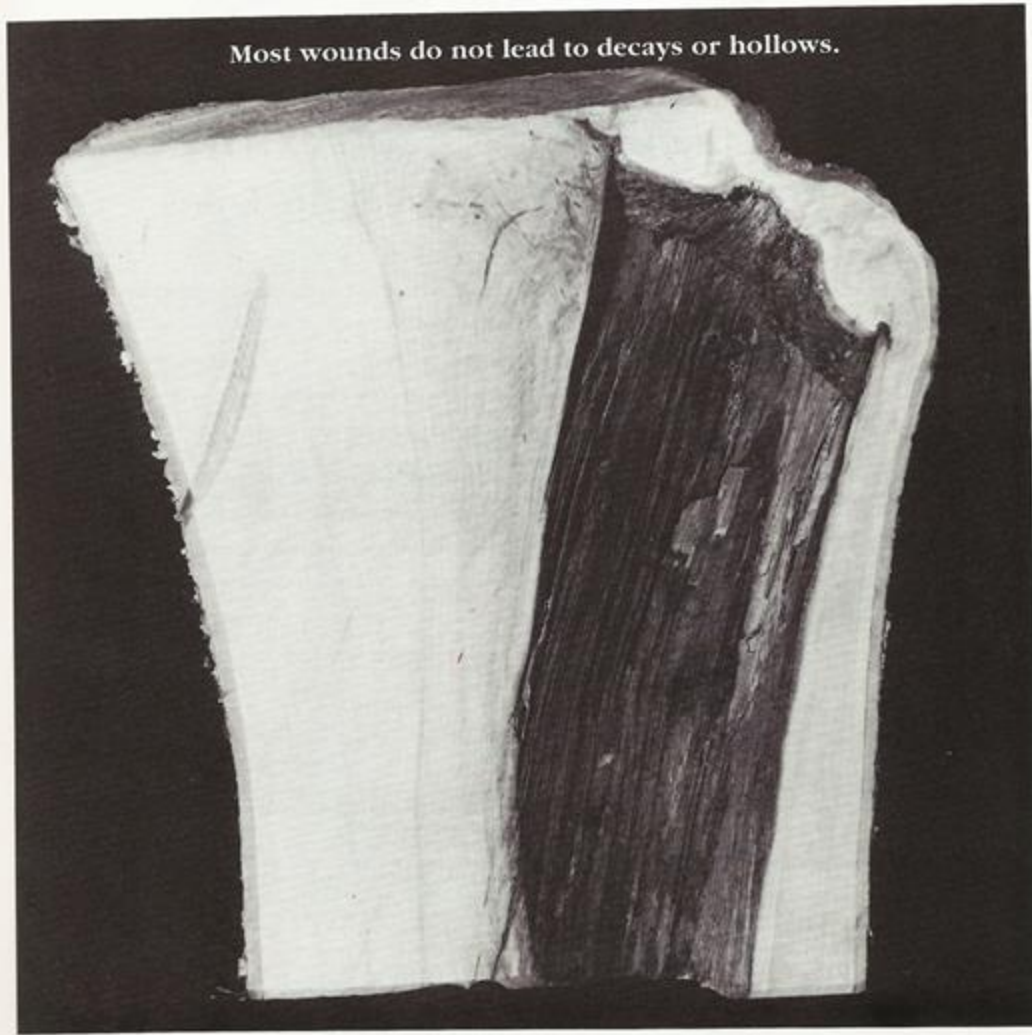
BOUNDARIES CALLED REACTION ZONES AND BARRIER ZONES FORM AFTER WOUNDING



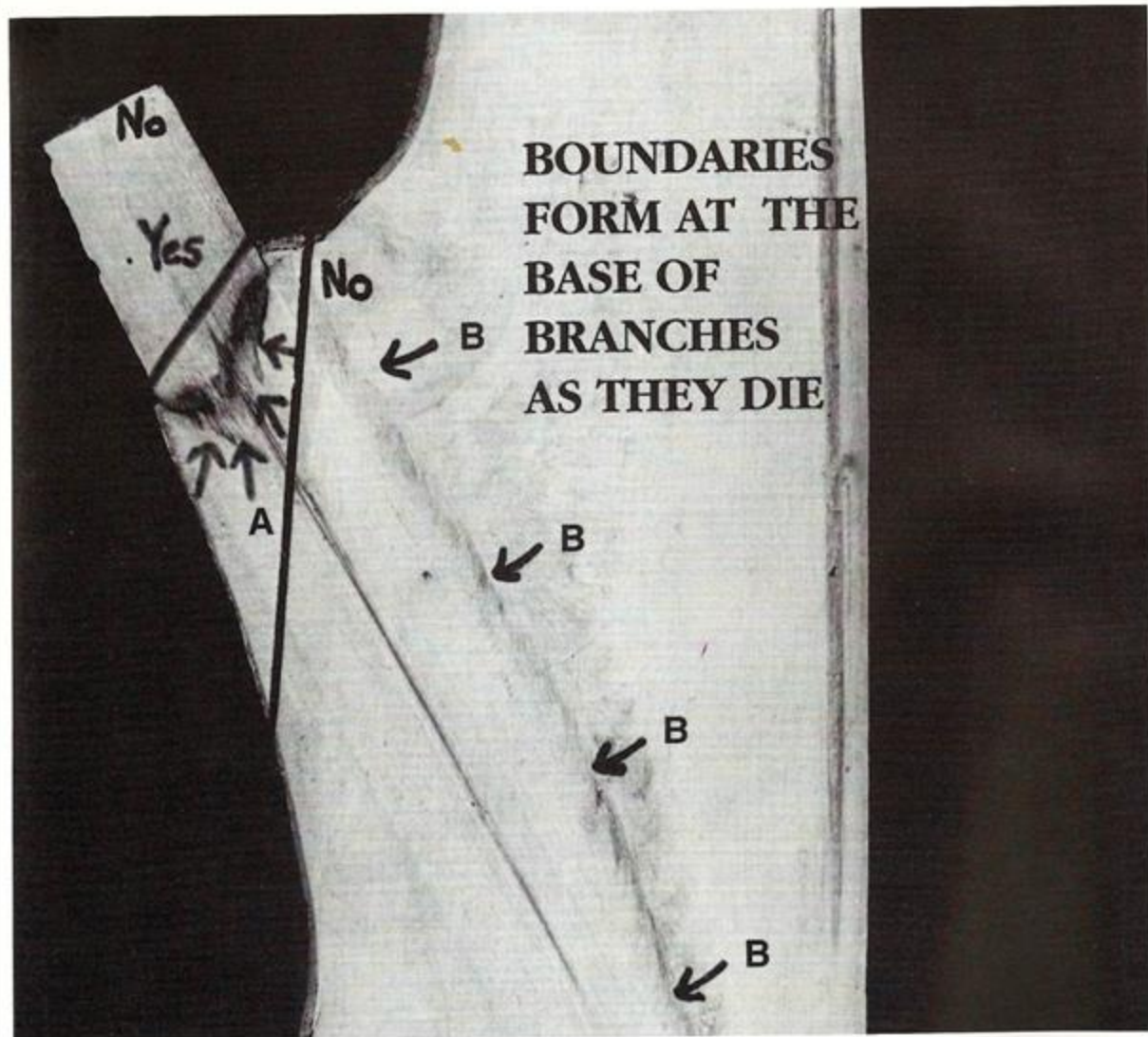
A 12-year-old wound on a western hemlock, *Tsuga heterophylla*, caused by a black bear that chewed the bark. The dark boundary about the infected wood is called a reaction zone (straight arrows). It resists the spread of infections within the wood present at the time of wounding. The curved arrows show the size of the tree at the time of wounding. A strong boundary called a barrier zone formed around the tree the year after wounding (curved arrows). If decay would spread outward, it would stop at the barrier zone. A hollow would then develop in the tree.

THE DIAMETER OF A HOLLOW IS USUALLY THE DIAMETER OF THE TRUNK AT THE TIME OF WOUNDING

Most wounds do not lead to decays or hollows.



The diameter of the hollow in this yellow birch, *Betula alleghaniensis*, is the diameter of what was the main stem that died 60 years before the tree was cut. In 60 years the decay did not spread into the wood that formed after the main stem died. A branch then became the new leader stem. The greatest diameter of a hollow or of a decayed column of wood will be the diameter of the tree at the time of wounding or of the death of roots, stems, or branches. The infected wood is walled off or compartmentalized. Mature trees may live in a healthy state while having thousands of compartmentalized infections. Compartmentalization in a generating system gives trees a much longer survival time after injuries and infections than animals that have healing in a regenerating system.



Boundaries also form at the base of branches as they die. The boundaries resist the spread of infections into the tree from organisms in the dead branch. Because the dead branch is mostly cellulose, which is made up of glucose — sugar — fungi can use the dead branch as a source of food while they "press" against the boundary within the branch base. Arrows A show the boundary. When pruning, do not leave stubs as food for fungi, and do not cut branches flush with the stem — flush cuts — thus removing the tissues that form the boundary. Do cut as close as possible to the swollen base or collar of the branch, but do not injure or remove the swollen base or collar. Arrows B show where the trunk tissues grew around the branch tissues.



Missouri

WOUNDWOOD RINGS

A ring of woundwood forms about proper cuts. The woundwood forms above and below the cut. Make pruning cuts that result in rings of woundwood.

Callus is undifferentiated tissue with little or no lignin.

Woundwood is highly ordered wood with lignin.

After wounding, some callus forms about the margins of the wound. Then large woody ribs form that begin to close the wound. The woody ribs are woundwood.



Denmark

WOUNDWOOD AND IMPROPER CUTS

Woundwood forms only to the sides of improper cuts. The living tissues above and below the cuts die back. Woundwood usually forms later under the bark. Even minor pruning mistakes made at the time of leaf formation or leaf shedding may result in major injuries to the tree.



Denmark

CALLUS CONFUSION

A large pocket of rot was behind the large ring of woundwood in the horse chestnut. *Callus is undifferentiated tissue with very little lignin. Woundwood is differentiated tissue with lignin.*

Confusion over woundwood (callus) as a sign of healing has been a major problem with pruning for centuries. People thought large "callus" meant strong healing.

This is why pruning cuts were made through the branch collar; a large "callus" formed. People knew about the branch protection zone for centuries. But, they still thought that "callus" as healing was more important. They also knew that rot developed rapidly when such a treatment was done. But, they felt that some magic wound dressing would stop the rot. That magic material has not yet come. And what has been called callus is really woundwood. Confusion indeed! (Niels Hvass)



Illinois

IMPROPER CUTS AND PROBLEMS

Wounds made by improper cuts may close, but rot and cracks often develop. Cracks and rot ruin wood for high quality wood products. Cracks and rot weaken the tree and lead to hazardous trees.



Improper Pruning Cuts

FLUSH CUTS – Not Good



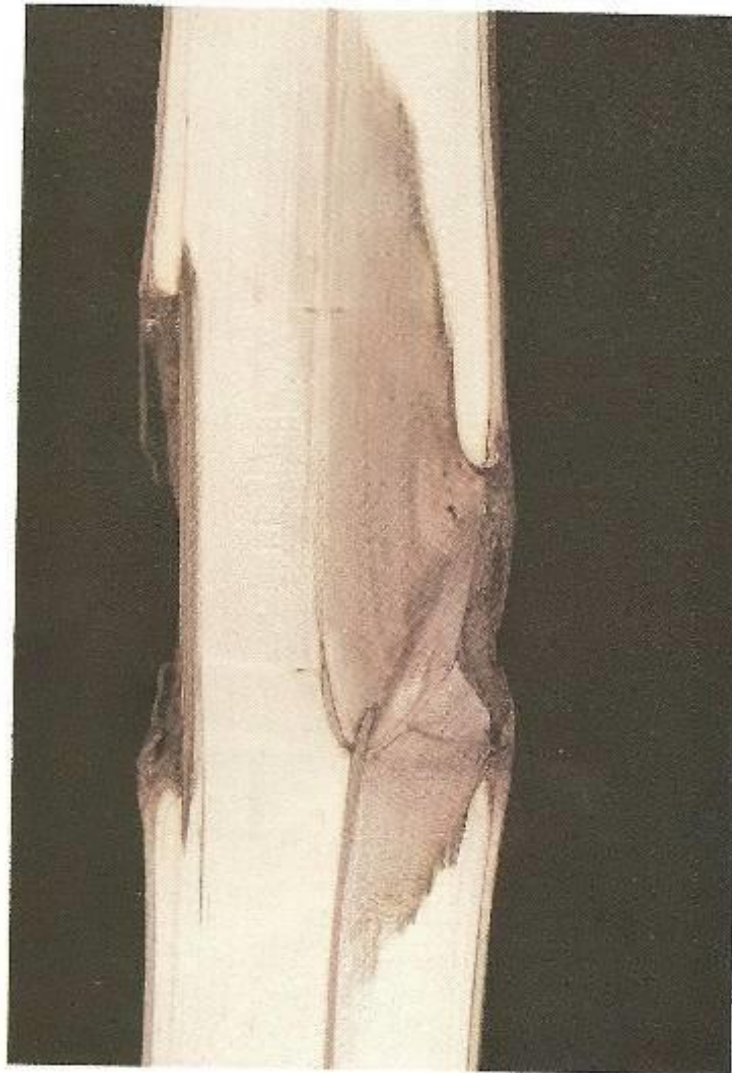
California

2. FLUSH CUTS

A major tree defense system is destroyed.

Make pruning cuts as close as possible to the collar at the branch base.

Do not injure or remove the collar.



Maine

WHY FLUSH CUTS INJURE TREES

Flush cuts are improper pruning cuts that remove the branch collar and the wood where the branch protection zone forms. Flush cuts expose the trunk wood to infections. The experimentally inflicted trunk wound at left is much larger in area than the flush cut at right. Flush cuts destroy a major tree defense system.



Missouri

INSIDE VIEW OF IMPROPER CUT

Improper cuts remove the branch collar and the branch protection zone, and the cuts wound the trunk.

Trees, during their hundreds of millions of years on this earth, never experienced this type of injury until man came along with pruning tools and a poor understanding of trees.

STUB CUTS – Not Good

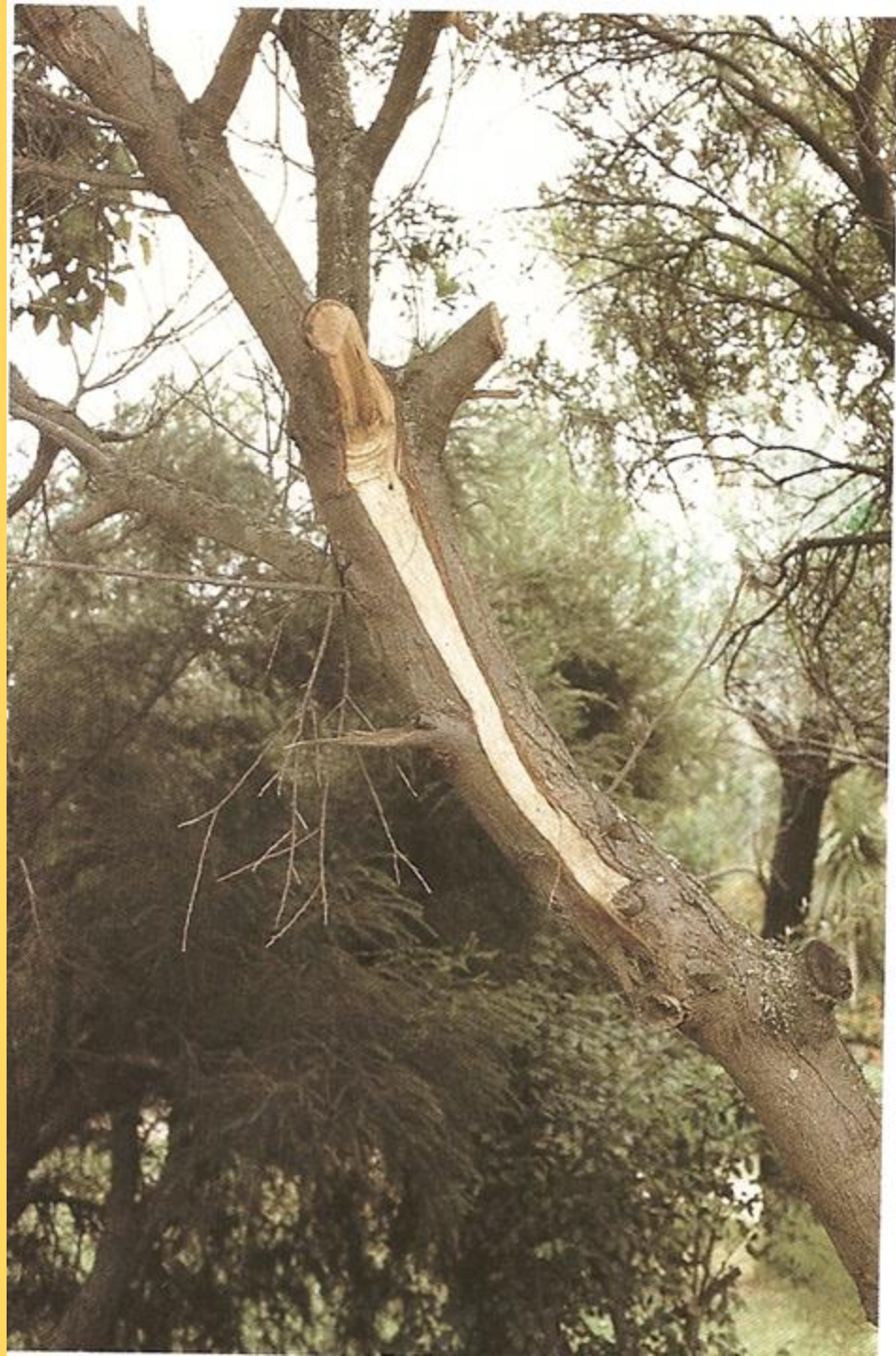


New Hampshire

DO NOT LEAVE DEAD STUBS

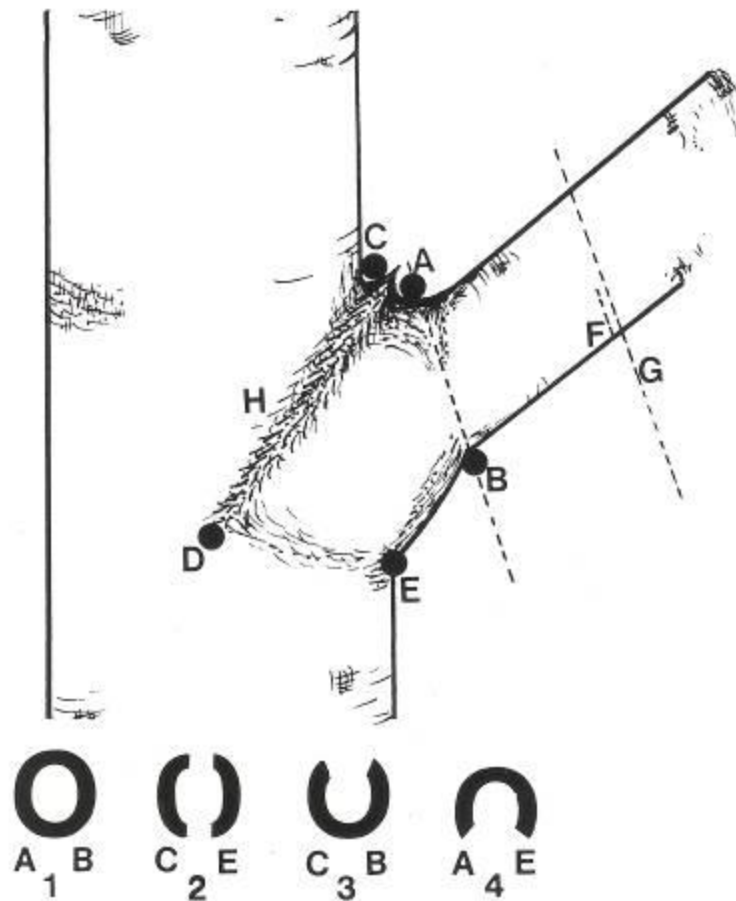
Dead stubs provide food and shelter for microorganisms and insects that could spread into the tree. If dead stubs are on trees, remove them by making cuts as close as possible to the ring of living wood at the base of the stub.

In the natural forest most twigs and branches die slowly when they are small. There is time for the branch protection zone to form. When large living branches are cut and stubs are left, the branch protection zone begins to form at the same time as organisms are spreading inward from the stub. Proper pruning leaves no stubs, and gives the branch protection zone time to form. The branch collar is not a stub.





Proper Pruning Cuts



NATURAL TARGET PRUNING

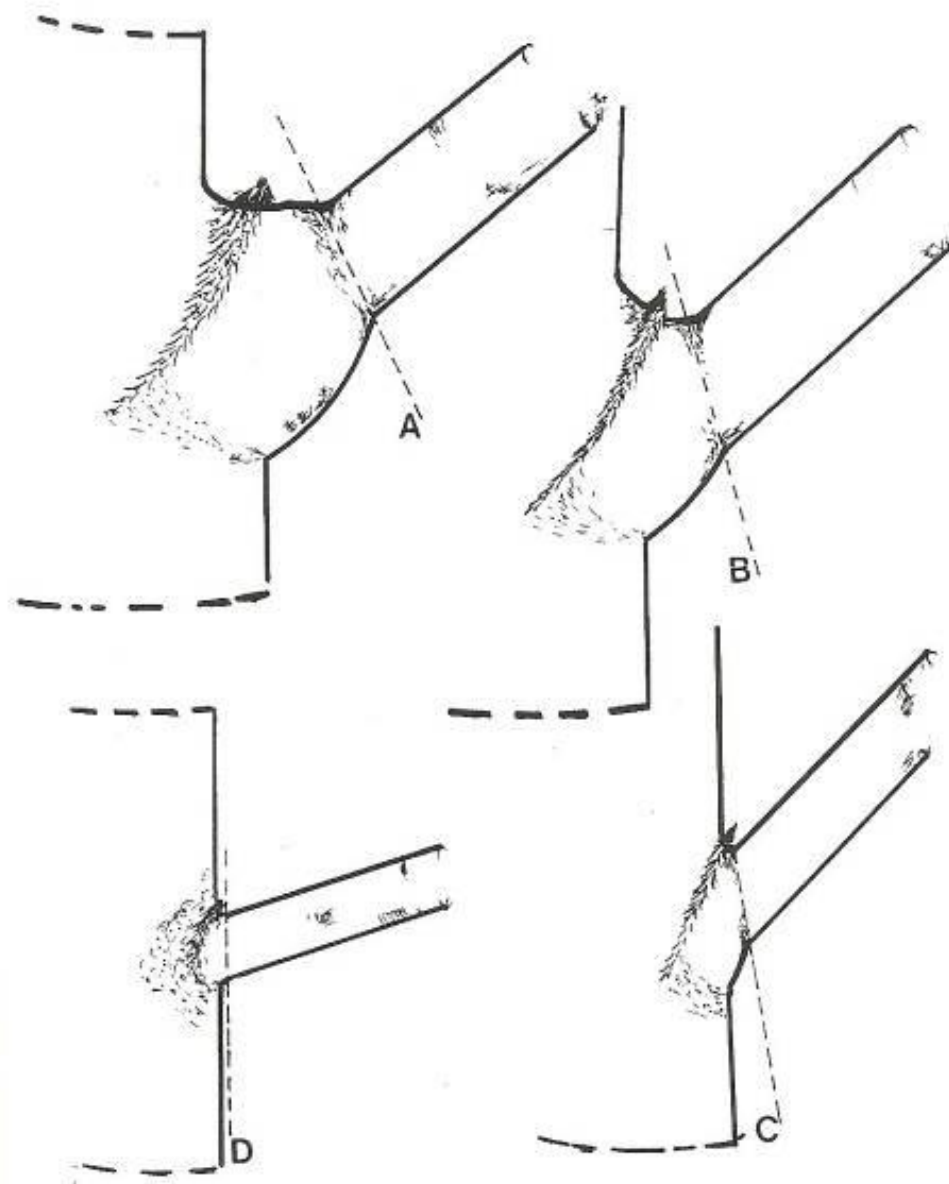
- Locate the branch bark ridge (H) and the branch collar (E to B).
- Stub cut the branch (up F, down G).
- Locate points A and B where the branch meets the branch collar.
- Cut from A to B, or from B to A with care.
- If position of B is uncertain, draw a line in your mind from A to E.
- Angle EAD is approximately the same as angle EAB.
- Point D is the beginning of the branch bark ridge (H).
- A proper cut will result in woundwood pattern 1.
- Improper cuts will result in patterns 2, 3, and 4.
- Do not leave stubs.
- Do not make flush cuts.
- Do not paint the wounds.



Washington

INSIDE VIEW OF PROPER CUT

A proper cut after nine years in a deodar cedar. The colored central core was the diameter of the tree at the time of pruning. The wound closed and compartmentalized the pathogens and no rot or cracks developed. Natural target pruning is effective for large branches and small branches. (Michael Schnad)



BRANCH COLLARS AND ANGLES OF CUTS

Proper pruning of a living branch is a cut as close as possible to the branch collar. There is no set angle for a proper cut.

Cuts A, B, C, and D are proper cuts.



Maine

DO NOT PLACE PRUNING TOOLS BEHIND THE BBR

Do not leave branch stubs. Cut along the red line, as shown here.

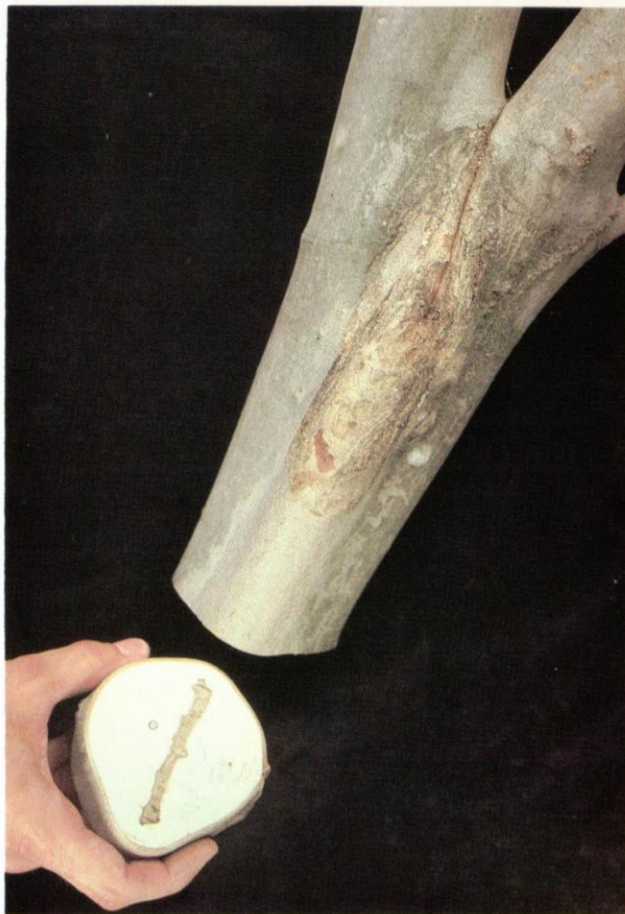
A cut behind the BBR in the crotch destroys the protection zone within the branch collar.



Washington

CODOMINANT STEMS

Codominant stems are stems growing at the same rate from the same position on another stem: forked stems. Codominant stems, unlike branches, do not have collars that form protection zones. A stem bark ridge forms between the stems. When the stem bark ridge turns upward as shown here, there is a strong union between the stems regardless of the angle of the stems.



Maine

CODOMINANT STEMS AND INCLUDED BARK

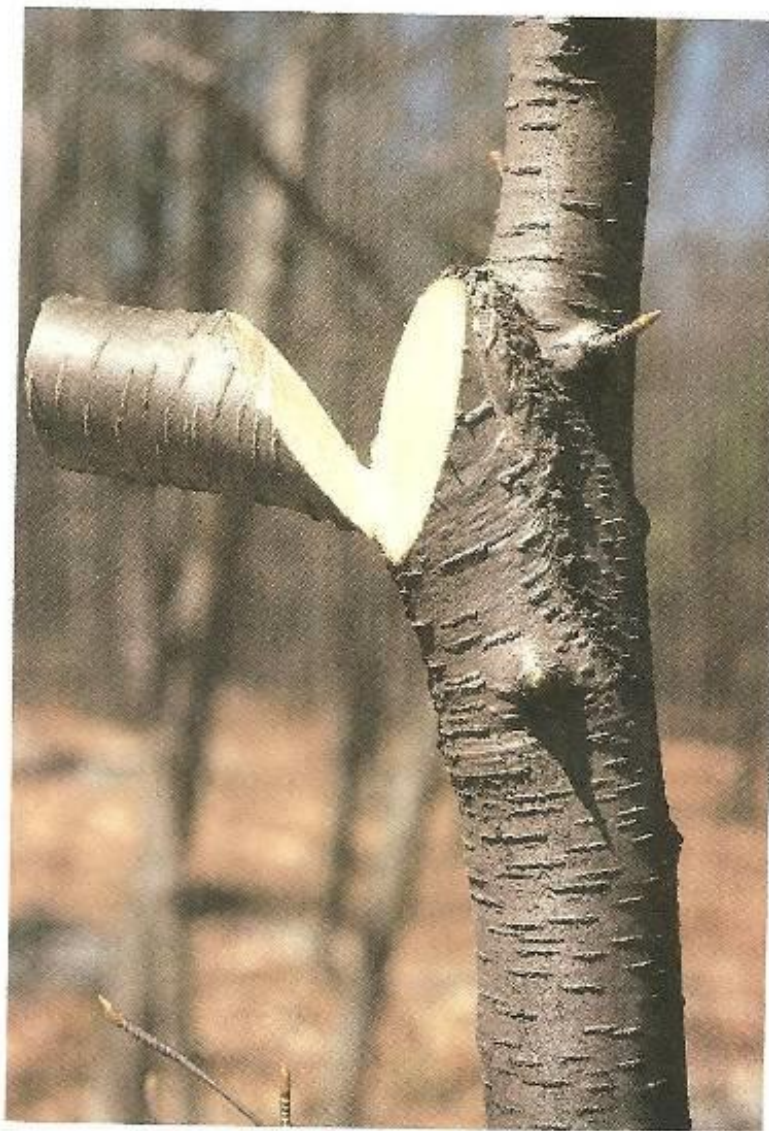
Included bark is bark that is squeezed between stems. Included bark leads to weak unions. If a tree has a few branches with included bark, remove them as soon as possible.



Florida

INCLUDED BARK AND HAZARDS

Be on guard for large trunks or branches with included bark that are growing away from the main trunk. They are extreme hazards. (Robert Kyle)



New Hampshire

PROPER PRUNING OF A CODOMINANT STEM

The stem bark ridge is the key to proper pruning of *codominant stems*. Do not leave stem stubs. They will be alive without a defense system.

PROPER PRUNING OF CODOMINANT STEMS

1. To remove stem L, cut from C to D or from D to C with care.

To remove stem M, cut from A to B or from B to A with care.

Always stub cut the stem to be removed, and then make the final cut with care.

Points D and B are opposite point E.

Point E is the beginning of the stem bark ridge (J).

Point C is to the left of the stem bark ridge and point A is to the right of the stem bark ridge.

Never remove both stems.

2. When the bark plates on the stem bark ridge turn upward as shown in figure 1, the union of the stems is strong. When the bark between the stems turns inward as shown by K in figure 2, the union of the stems is weak. It is the union of the stems more than the angle that determines whether a stem is weak or strong. Strong unions usually have a U-shaped crotch.

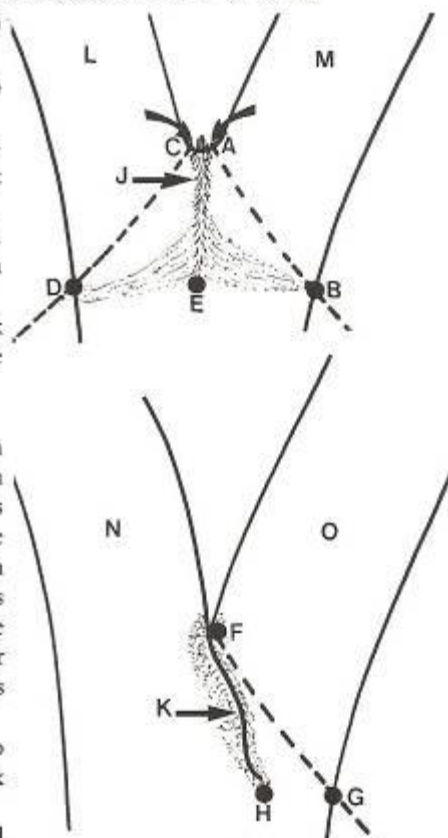
In figure 2, stem N is beginning to envelop stem O. The stems have bark between them at position K.

The bark between the stems is called included bark.

There are three ways to remedy this situation: remove O, prune living wood from O and not from N, or put a cable between N and O.

To remove O, stub cut the stem first and then cut from G to F with care. Point G is opposite point H, which is the beginning of the stem bark ridge, or the point where the bark begins to turn inward.

To slow the growth of O, remove approximately a third of the living branches. Do not prune stem N. Stem N will begin to form a trunk collar about



stem O. This can be done only on young trees.

To strengthen stem O on older trees, a cable can be attached by professionals. The cable should be placed at a point approximately two-thirds of the distance from the crotch to the top of the tree.

Proper placement of cables requires a great amount of skill. When a cable is used to strengthen stems, the cable must be checked regularly. When the risk of stem fracture becomes high, the stem should be removed by professionals.

PROPER TRAINING CUT TO REMOVE A LEADER ON A YOUNG TREE

To remove the leader stem on a young, small tree, cut from A to B.

Always stub cut the stem H first.

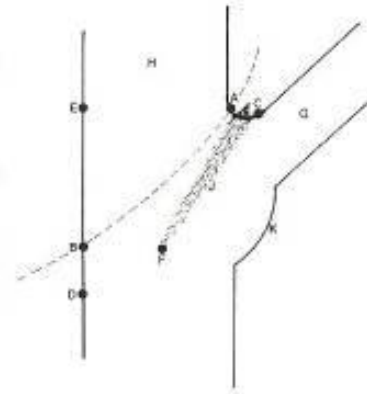
Point A is to the inside of the branch bark ridge (J) within the branch crotch.

Point B is opposite point F.

Point F is the beginning of the branch bark ridge.

Point K is the branch collar, and G is the branch that will become the new leader.

Improper cuts are A to E, A to D, C to E, C to B, and C to D.



TRAINING YOUNG, SMALL TREES

Most young, small trees can be trained to grow in many different shapes. Start with a tree that has the basic framework and growth pattern to give you what you want.

All cuts should be made properly at nodes.

To have a tree with a long trunk, start early in the life of the tree to remove branches at positions 1, 2, and 3. Do not remove more than a third of the living branches.

For a more compact tree, remove C's.

For a more upright tree, remove A's.

For a more open tree, remove B's.

To regulate height, remove D at position 6.

If a tree with a strong central leader is wanted, remove other upright stems at position 6 that may be competing with D.

If a large portion of the top must be removed, make the cut at a node where there is a strong side branch.

These training cuts are only for young, small trees.





Australia

TOPPING AND SPROUTS

Topping stimulates excessive sprouting. The sprouts are unsightly and hazardous. Topping trees under power lines causes more sprouts to grow back into the lines faster.

Excessive sprouting is a sign of low energy reserves.

Conclusion

Questions to Ask Before Pruning

- What are you trying to accomplish with pruning and what is your long term goal? (size control, increased fruiting, tree health, architecture)
- How and where does it fruit? (inside the canopy on branch spurs, terminal bearing, on the trunk, fruit on 1st or 2nd year wood)
- What is the function of the branch you are thinking of cutting?
- Make sure you know when to **STOP**.



*And the Lord God took the man,
and put him into the garden of Eden
to dress it and to keep it.*

Genesis 2:15

STILL OUR RESPONSIBILITY!

Outside Time

5
8

- Trees to Look at
 - Oaks in RF
- Tree to Prune
 - Atemoya in Arb.