TARGETS FOR PROPER TREE CARE[1]

by Alex L. Shigo

Abstract. Proper tree care starts with a thorough understanding of trees and the many treatments used to help trees stay attractive, safe, and healthy. In the real working world of trees, it is almost impossible to do all the needed treatments perfectly all the time. A professional arborist must know what proper tree care is. Each part of each procedure for proper tree care becomes a target. I believe that the degree of professionalism of an arborist centers about knowing where the targets are, and how to hit them. The clearer the targets are to you, the better your chances of hitting them more often. I try here to clarify further some of the targets for proper tree care.

A new expanded concept of tree decay, a model of the concept, and new electrical equipment and methodology have served as the basis for reexamining trees, tree diseases, and many tree treatments.

Some adjustments in tree care practices have been made. Many more adjustments are needed. There are still many points about some of the adjustments I have been discussing that need further clarification. Many questions have come to me about these points. At the same time that I am trying to help clarify many tree care treatments, I am keeping in mind how difficult it is to do all the necessary treatments out there in the real working world of trees. Yet, we must constantly try to understand what is best for the trees, and to do the best we can as often as possible. In a sense, the proper parts of the treatments become target points. We must know where the targets are. The more clearly they are defined, the better our chances of hitting them.

This paper is primarily for the person who has a fair to good understanding of the expanded concept of tree decay, compartmentalization, CODIT, the Shigometer, and the adjustments in some tree care practices that I am proposing. This paper is a collection of brief notes and comments on recurring questions. Additional details can be obtained from the author. (Background information on these subjects is in many papers published in this journal, other journals, and in U.S. Government publications.)

Tree basics. Trees have no wound healing process in wood. If you use the word heal, then you must know the difference between animal-type and tree-type healing. Heal does not mean to restore to a previous healthy state. The restoration is by repair or replacement of cells in the same spatial position.

Callus forms after wounding. Callus does close wounds. Callus formation is closely associated with the growth rate of the tree. Callus formation also appears to be under moderate to strong genetic control.

Inaccuracies about roots are probably at the top of the list of tree misunderstandings. What are feeder roots? What are they feeding on?

Heartwood may be many things, but it is not dead; heartwood will react in an orderly way when it is wounded. It is a reactive tissue.

Heartwood does not go deep into roots. Most tree roots are shallow, or within the top 20 inches. Of course, there are many exceptions to this. The absorbing roots of a tree are those fine, nonwoody roots that are associated with fungi, the mycorrhizae. They absorb water and essential elements from the soil.

Is wood living or dead? The answer is yes. Wood is a highly ordered arrangement of cells, with walls of cellulose and lignin mostly, that are in all gradations of aging. Every wood cell was cambium first. Some wood cells live a very short time while some others may live for over a hundred years.

Trees are generating systems. They are con-

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stantly producing new cells in new spatial positions. Even the vascular cambium changes position every growing season.

Trees set firm boundaries between woody parts and nonwoody parts, after the nonwoody parts have aged to a genetically controlled point. Then the boundaried part either falls away or it is digested away. But, trees do not actively cast off leaves or reproductive parts, or other parts. Some trees do shed not only nonwoody parts, but some woody parts, such as small twigs, and even branches. After support roots and large branches begin to die, the tree also begins to form firmer boundaries between the dying part and the still-healthy woody part of the tree.

Compartmentalization. Compartmentalization is a boundary-setting process that resists the spread of infection. It is often confused with either localization or restoration. Restoration is primarily an animal process. Localization is primarily a process of nonwoody plants. Localization means to restrict to one locale, or to limit to one place. The confusion starts when this concept is used for compartmentalization, because columns of defect do indeed get bigger and bigger in trees. If something is increasing in size, how can it be localized? It is not! Yet, does not the barrier zone that is formed after wounding wall off the infections within the wood present at the time of wounding? Is this not localization? Indeed it is.

Compartmentalization is the word we need for the boundary-setting process because the other words do not accurately describe what happens in a tree after wounding. At the time of wounding, the next season's wood is not present, and the infection cannot spread into wood that has not formed yet. The tree responds to the injury and infection by setting firmer chemical boundaries about the infected cells. The tree resists the spread, and the microorganisms grow to increase the spread. There is a tree-microorganism interaction. If the tree is very fast and effective with its boundary-setting defense system, the infection will not spread; it may be localized. If the tree is not so fast and effective, and the microorganisms are, then rapid spread will occur. If the cambium is killed during the spread, then that part of the tree dies — cambial dieback. When spread is so far and fast, the entire tree may die, as it does with some wilt diseases. In this case there is no localization. But there can be all gradations of interactions between these extremes. The interactions cannot be called localization, nor can they be called killing reactions. Again, compartmentalisation speaks to the gradations from localization on to the quick kill, which really means no localization, no compartmentalization, no real interaction, because the tree was overwhelmed. Natural systems usually come in gradations.

Barrier zone. While an interaction between tree and microorganisms is proceeding in the wood present at the time of wounding, the barrier zone is being formed as the cambium continues or resumes its growth. The barrier zone does set a firm boundary between infected wood and healthy wood that will continue to form after the barrier zone is completed. The barrier zone does localize, in a sense, the infection from the newly forming cells. But, the infection may continue to spread within the tissues present at the time of infection. If the microorganisms are able to break through the barrier zone, the cambium will be killed. This type of breaking through will only happen once, because the cambium will be dead in that spot and no wood will be formed after that. Yes, the barrier zone may be penetrated, but only once at any one spot. If a large portion of the barrier zone is penetrated, then a large portion of the tree's cambium will be killed, and in some cases, the entire tree may be killed, as in Dutch elm disease.

Limits of compartmentalization. Some microorganisms have developed unique ways to "get around" the barrier zone. Some canker rot fungi get established first in the wood and then form wedges of hard masses of fungus material from the wood deep into the bark. The wedge may kill the cambium from the bark side inward, and thus enlarge the wound. Every time the cambium is killed from the bark side inward, a new barrier zone forms in the wood where the cambium is still alive. Other types of microorganisms get established first in the bark and then move inward and kill the cambium from the bark side. The microorganisms then grow slightly into the wood. Later they grow as a wedge out into the bark and repeat the inward cambial killing, and thus enlarge the wound. Compartmentalization does function most of the time to the advantage of the tree, *but not all of the time.*

Energy reserves. Compartmentalization can be very beneficial in small amounts, especially when the tree has time to produce enough new cells in new positions after an injury and infection. But, when repeated injuries or infections start too much compartmentalization, the results may be harmful for the tree. Every time the tree walls off wood that would normally be used to store energy, the tree is reducing the size of its "fuel tanks." This means that there is less volume in which to store energy. And, when energy reserves are so reduced that normal tree functions cannot continue, then the tree and its remaining energy reserves are easy prey to the microorganisms.

CODIT — Compartmentalization Of Decay In Trees, is a model. The terms used in the model are meant to show the anatomical and biochemical boundaries set by the tree after injury and infection.

There are two parts to CODIT. Part I, with Walls 1, 2, and 3, takes place where there is still living cambium. Wall 4 *does not* form over the surface of the wound, because there is no living cambium there.

When the genetics of compartmentalization are discussed, it is Part I, Walls 1, 2, and 3, that are involved; not Part II, or Wall 4. Part I determines the size of the columns. Wall 4 separates Walls 1, 2, and 3 from the still-living cambium.

Some *individual* trees of a species have such a strong Part I that the column size of defects is very small. How effective Part I is appears to be under moderate to strong genetic control.

CODIT, Part I, takes place in heartwood. Part II cannot take place in heartwood because it requires living cambium, and the living cambium is between the inner bark — phloem — and the most recently formed sapwood. A wound must pass through bark, cambium, and sapwood before heartwood is penetrated. Wall 4 may later be included in heartwood, as the tree grows.

After a wound or an injury, microorganisms will infect. The tree has no system to prevent infection of wounded cells. The tree can only resist the spread of infections. As the microorganisms spread, the tree continues to respond to their presence. In many ways it is the spread of microorganisms that elicits the strongest response by the tree.

Shigometer method. The Shigometer is a meter that sends a pulsed electric current and shows the resistance to this current in thousands of ohms on its ohmmeter. The resistance is dependent on the type of electrodes used and the three major factors that affect resistance: moisture, temperature, and concentration of cations, or positively charged ions. In living trees, moisture content will be above the fiber-saturation point, or 28%. Temperatures above 40°F have little affect on resistance. It is primarily the concentration of cations that affects resistance in trees.

The meter can be used for two basic types of measurements: detection of decay and determination of relative vitality. Sudden decreases may signal defects in wood. Low resistance in inner bark means high vitality. When the needle electrodes that are used for bark measurements are pushed into dead tissues in the bark and wood, the electrodes will be giving readings for dead, defective wood, and not for vitality. For a vitality measurement, the electrodes must be pushed into living tissues.

An understanding of trees and CODIT are absolutely essential for proper use of the meter and method. The meter alone, without the other two ingredients, is not very valuable. The Shigometer will not make a decision for you. We cannot make a devise or a method that will have a red light and a green light. There will always be an orange light in between. The professional is a person who understands the orange zone.

The meter takes *skill and practice.* Without these two ingredients, the meter will confuse more than clarify or help.

Wound dressings. Results of several studies with many materials over a 13-year period (details soon to be published in this journal) show that no materials stopped decay. The tree was more important than the treatment. Some individual trees of a species closed and compartmentalized wounds very rapidly, regardless of treatments. Other individuals of the same species did not close or compartmentalize wounds effectively, regardless of treatment.

Many materials reduce discoloration, but discoloration is not decay. Some discolored wood is essential for the tree's defense system. It may be that early disruption of the discoloration process may actually speed decay. Many materials will stimulate callus formation, but callus formation is not associated with the decay process. Large wounds seldom close completely; even when they appear closed, they have very fine hairline cracks. Such a situation favors the growth of decay-causing fungi.

When insects infest wounds, they usually bore into the dying tissue around the wound, so dressings would be of no benefit.

Many investigators have considered putting fungicides in dressings, but the decay-causing fungi are seldom the first to infect wood behind wounds.

Cavity filling. Great care should be taken when cleaning a cavity before filling, so as not to break the boundary that separates the decayed wood from the sound wood. A cavity can be filled for costmetic reasons with any type of materials that will not rub against the living tissues. I know of no data that show added strength due to filling; although hardware inserted during filling may add strength.

The small hole made by the drill bit during the use of the Shigometer causes little injury; the tree can usually wall off the injury very rapidly. But when large sections of boundary are broken during cleaning of cavities, then the injury overwhelms the defense system.

Injections and implants. Injections properly done may be beneficial. Injections improperly done will be harmful to the tree.

Holes should be shallow and small, at the tree base, not into the roots. No holes should be directly above or below other holes or wounds, and if possible, holes should not be drilled every year. Great care must be taken not to get the injected chemicals on the cambium.

Discolored wood is dead wood. The living cells in the wood are killed. Long streaks of discolored wood are not so harmful. But when the discolored columns begin to develop laterally, then they can be very harmful. The tree has room for many long discolored streaks, but the tree has only so much circumference. Any treatment that reduces the living circumference of a tree will be harmful. Always check your injection sites for lateral cambial dieback. If you see that the injection wounds are not closing within one growing season, be on the alert for cambial dieback, especially when material begins to flow from the injection holes. Injection sites should be checked the next season after application. If the holes are open and if materials are flowing from the holes, it would be very unwise to continue to inject. Never plug injection holes. The same precautions given for injections are applicable for implants.

You can do almost anything to a tree once or twice, or even four or five times, but as such treatments are repeated, the chance for internal injuries increases.

Cabling and bracing. Proper use of hardware can be of great value for trees. Proper cabling and bracing does take a great amount of skill, and it is hard work.

Screw lags can be used safely in sound wood. Even in sound wood, it will be the wood that forms after the lag is put in that provides the long-term holding power.

Hardware in trees can start some problems, but they must be weighed against the potential losses if no hardware is put in.

Bolts or rods will break through walls 4, but the columns of new decay will usually be the diameter of the hole drilled for the bolt or rod. The holding power will come from the washers seated on both sides of the stem. It is best to use washers on both sides of a bolt or rod. Sharp-pointed washers should be avoided. There is no need to throw away all your diamond-shaped washers — grind the tips off to round the ends; this will help to reduce bark and wood cracking that is often associated with sharp-pointed washers.

Seat washers *on* the wood, not in the wood or on the bark. This can be very difficult with thick-barked trees. It is a good idea to carry a large curved wood chisel to make the rounded margins, especially on the vertical ends.

The weakest part of most trees is the trunk section from approximately 4 to 12 feet above the ground. On many short-trunked trees, the trunk section below the forking large branches is a weak spot.

Scribing or tracing. If possible, try to avoid scribing or tracing wounds in such a way that the vertical ends are sharply pointed. It is best to round them off. There is no need to scribe in the form of a vertical ellipse. Try to follow the natural contour of the wound and cut away as little healthy cambium as possible. When in doubt about the margins of a wound, and when time is not limiting, allow the tree to show you the limits by the formation of callus during the current or next growth season. Then remove, carefully, the dead bark up to the living callus. On lightning wounds this may be the best procedure, because it is often very difficult to determine the margins of the wound.

Be very careful tracing wounds on large, thick-barked trees. Car-wounded street trees are good examples: Many times only the outer thick bark is removed by the car, and the tree is not wounded until someone with a chainsaw begins to scribe the bark injury.

Cracks. Three events must occur in sequence to fire a gun: First, it must be loaded, then cocked, and finally the trigger must be pulled. In the same way, three events must happen in sequence before a large vertical crack develops in a tree. A wound, or a dying branch or root, opens the tree to infection. The charge on the "gun" depends on the microorganisms. If microorganisms spread deep into the tree very quickly, the charge is high. The tree responds to the injury AND the infection by setting boundaries, CODIT Part I and later Part II. The boundary-setting "cocks the gun." Any number of events may pull the trigger: natural growth stresses, sudden heat, sudden cold, abrupt movement by wind, sudden weight loading by snow, ice, or fruit, and when the tree is cut, the impact of felling. Even after the log is cut and drying, pressures and weight loading will set off "the gun."

There are three basic types of cracks in living trees. Shallow bark cracks usually start from the outside and spread inward. They usually stop at the wood, but some may spread slightly into the wood. This type of crack is common on young trees, and on older trees of some species, such as Norway maple. The second type of crack is the one along the barrier zone or Wall 4. Wall 4 is a very strong protective boundary but a very weak structural boundary because it often lacks lignin and the type of wood cells that give strength to the wood. It has fewer vessels and fibers, and more thin-walled living cells that convert their cell contents into inhibitory materials. The common term given to the separation of Wall 4 is ring shake. This circumferential separation, or shake, is the start of many tree problems. The third type of crack is the radial crack, or radial shake, or ray shake. What all of this means is that the position for a crack in the radial direction is set, but not necessarily opened yet. Before a radial separation starts, a circumferential separation comes first.

The formation of Wall 4 is all-important to understanding wood cracks. When a tree is wounded, or when a root or branch dies, a Wall 4 will form. Then radial weaknesses begin.

A common starting point for basal vertical cracks in recently planted young trees is dying roots. Roots are either wounded or killed during planting, or roots are injured and they die in a few months to a few years. Then the cracks form upward on the trunk. Even worse is the death of two roots that join together at the base of the trunk. The crack begins to form between the two dying roots and spreads upward on the trunk. Wounds at the base of young trees are also common starting points of cracks. The wounds are commonly inflicted during planting.

Shallow cracks or bark cracks may often form near some branch stub or shallow bark wound. With dead or dying branches, the trunk crack seldom will be in direct vertical alignment with the branch. The crack will usually be to the side of the branch because of the way a branch is set in the tree trunk. Because the crack is off to the side, it does not seem to be associated with the dying or dead branch.

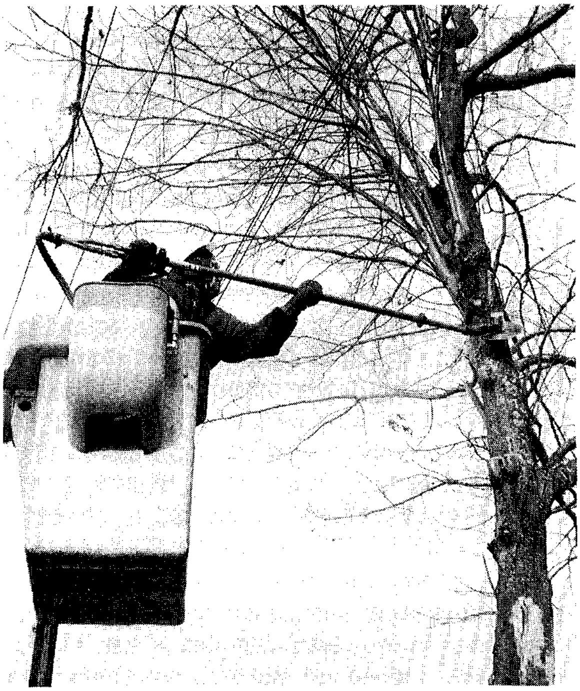

Figure 1. Line clearing is a difficult job. New tools and realistic targets are needed to improve this type of pruning.

Figure 2. Proper cuts can be made with this tool and others, but only when the operator is at right angles to the branch, and when the final cut is made on the upstroke. No cuts should be made behind the branch bark ridge (arrows). No stubs should be left. A circular saw with a rotating head would greatly improve this job.

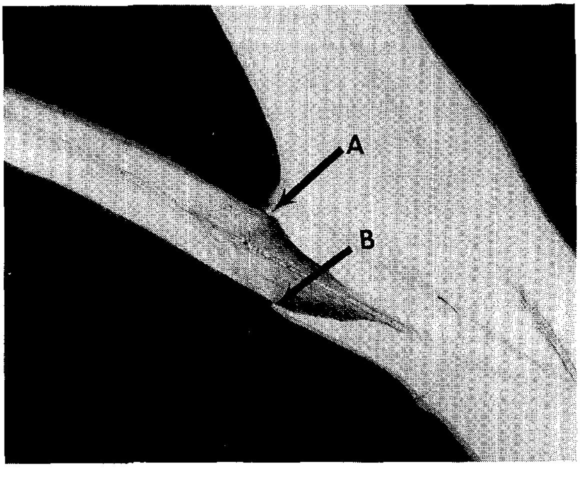

Figure 3. Dissection of a young red maple tree one year after the branch was cut 15 inches out from the trunk. Note where the tree set boundaries to wall off the dead branch (arrows A and B). This is the natural line for proper pruning. Note also the discolored wood within the branch collar. This type of discolored wood is very beneficial because it is a strong boundary to inward spread of decay-causing fungi. Pruning cuts behind the branch bark ridge will remove this boundary, and decay will spread rapidly above and below the cut.

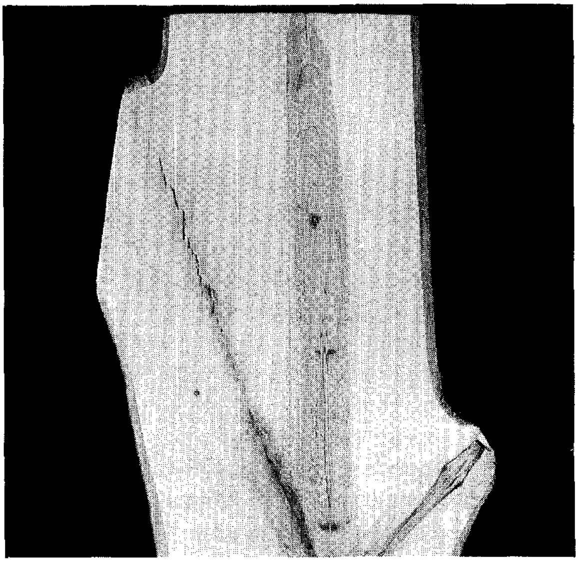

Figure 4. Proper pruning cut of a living branch on a red maple. The angle of the cut line is opposite the angle of the branch bark ridge as shown on the inside. The same angle of the branch bark ridge will be in the bark, and easily visible from the outside. Note the well-compartmentalized small dead stub at lower right.

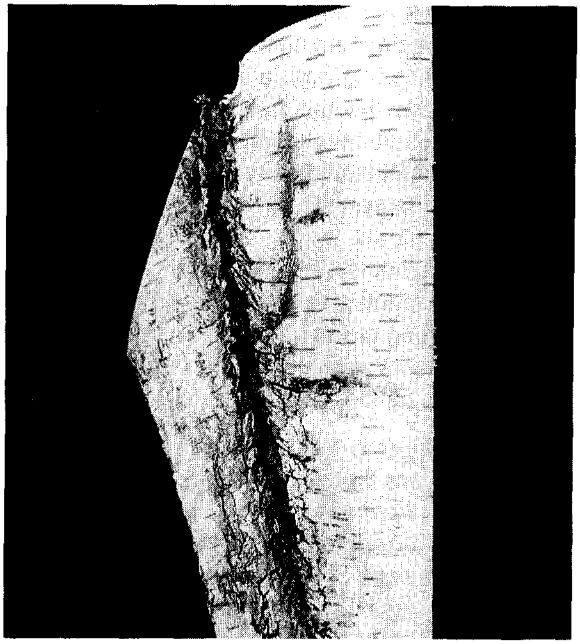

Figure 5. Proper cut of a living branch on a paper birch. The branch ridge is very obvious. The angle of the cut is opposite the angle of the branch bark ridge. Do not make cuts behind the branch bark ridge. *Do not leave stubs.*

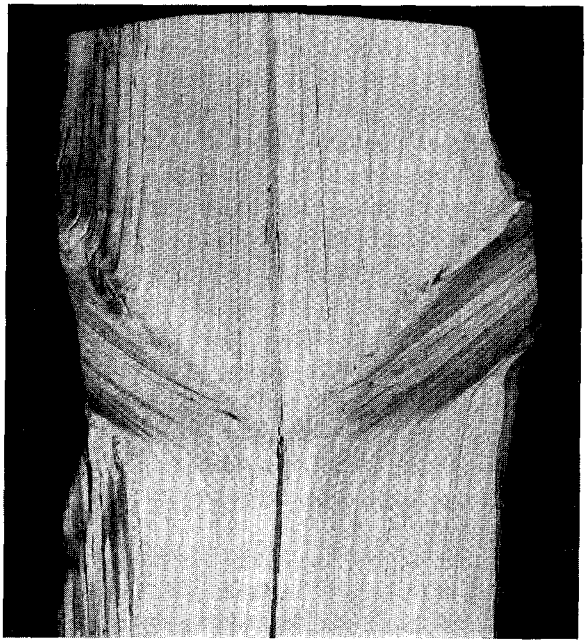

Figure 6. Flush cut, left, and proper cut, right, on a conifer after 8 months. Flush cuts lead to resin pockets, blue stain, *and rapid decay.*

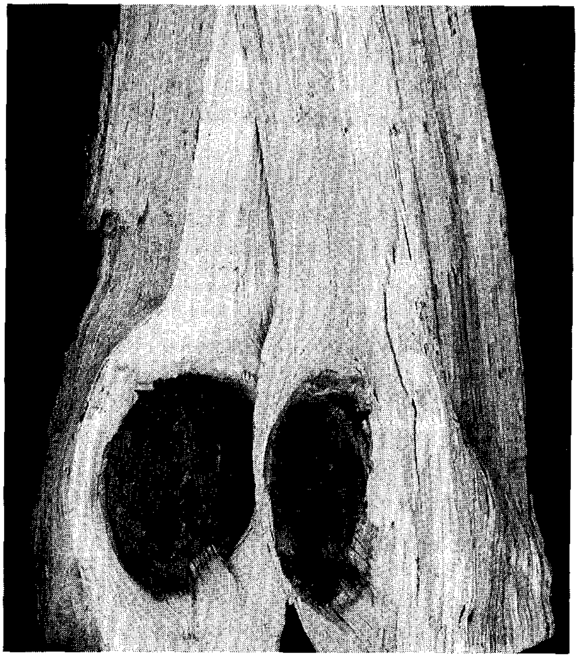

***Figure 7. Proper pruning cut on a red oak after 40 years.* Note the closure and the clear sound wood.**

Figure 8. Improper flush cut on the same tree as shown in Figure 7. The cut was made 30 years ago. Note the advanced decay above and below the cut. The wound appeared closed, but there was space between the long crack. *The space provided enough of an opening to make* conditions perfect for the decay-causing fungi.

Sunscald. There are two basic types of tree injury that are called *sunscald*. One type is the altered outer bark that is common on trees suddenly exposed to the sun. This is shallow bark roughening that seldom injures the cambium. The sun may, indeed, start this after the bark is exposed suddenly. But the type of sunscald that results in long dead spots on the trunk is seldom *started* by the sun. Root death, wounds, and especially improper pruning are the major starting points. Prune a branch flush on the south to southwestern side of a tree and you will likely get serious sunscald. To really make the situation serious, prune flush two or more branches that are above and below each other. The sunscald may spread to the roots on young trees, and even start root rot.

Sunscald is often said to start after trees are suddenly exposed to the heat of the sun. But to expose the trees usually requires some pruning and pruning by old standards means flush cuts, or cuts made as close as possible to the main stem. Or the trees may be exposed during thinning, and some of the residual trees are wounded during the thinning. The major point, again, is that the killing of cambium called sunscald is usually associated with some injury, and flush cuts are at the top of the list. Next to flush cuts are the flat-top cuts where leaders have been removed. This is very common on fruit trees because the vital vertical leaders are commonly removed.

Pruning. Pruning properly done is still one of the best things you can do to help trees stay healthy. Pruning improperly done is still the worst thing you can do to a tree. Proper pruning means removing dead, dying, or living branches in such a way that the branch collar is not injured or removed. The branch bark ridge is the key to proper pruning. No cuts should start behind the branch bark ridge.

The slightly swollen branch collar that will be present on some branches *is not a stub.* A stub is a projection of the branch; a proper cut does not leave any projection of the branch.

The most common question about pruning is whether it is better to err on the side of leaving a small stub, or on the side of cutting too close to the trunk. I have never answered that question because either answer will start more problems than we have now. I am calling the type of pruning I am recommending *natural target pruning.* It is natural because the cut lines are those that the tree forms for natural shedding. I am pointing out where the natural cut line should start and where it should end. These points are target points. We should try to hit the targets the best we can with the tools we have. It is impossible to hit the targets all the time. So my answer to the question about whether too long or too short is better, is not to be concerned with the size of the stub, but with the targets. Try your best to hit the targets.

The first target is the outer side of the branch bark ridge where the branch meets the main stem. The second target is where the lower part of the branch meets the branch collar. These target points are obvious on most branches. They are even more obvious on dying and dead branches, because as a branch begins to die, the branch collar usually begins to swell, to form a "doughnut" around the base of the branch.

If you cannot find the second target point, then the cut line is a line at an angle opposite to the angle of the branch bark ridge. Such a cut will never leave a stub.

With dead branches, do not injure or remove the living ring of callus that surrounds the base of the branch. A major problem we have with pruning is that most tools are made for flush cuts. It is easy to place the bar of a small chainsaw behind the branch bark ridge. It is almost impossible to make a proper cut with pole pruners or with small hand cutters. We need some new pruning tools. The line-clearing arborists are especially in need of new tools. They need some tools that have a rotating head, such as a ball joint on a rotating saw. Then they will be able to make proper cuts from any angle from the bucket of an aerial lift. Such tools will not only help the trees, but will surely increase safety and take much less time to make the proper cuts.

Until some new tools are made it will be impossible to make proper cuts on the downstroke. With existing tools the branch should be stubbed on the downstroke, and the proper cut should be made on the upstroke. This pattern should be used when small chainsaws are used for pruning.

Topping. No matter how you top a tree, it is going to cause the tree moderate to serious injury. The aim of topping is to cause the tree as little injury as possible. Flat-top cuts must be avoided. A proper cut of a vertical stem or leader starts with finding the branch bark ridge again. This time the first target point is on the inside of the branch bark ridge where the lateral branch meets the vertical stem. The cut line should be at an angle downward that is approximately the same as the angle of the branch bark ridge. As with branch pruning, it is always best to stub the stem first. The final cut, with most tools, must be on the upstroke, unless the lateral branch to be left is at an angle that will allow the blade of the saw to start in the crotch without touching the lateral branch that is to remain.

Improper topping cuts may start long streaks of dead cambium. Improper topping cuts on cherry and peach trees may result in serious injuries. Wound dressings will not help.

Hazard trees. Many factors must be considered when trying to determine the potential hazard condition of a tree. Tree hazards center about three major breaking points: 1) a tree falls over because its support roots decayed, 2) branches fall as they die and decay, and 3) trunks break, usually at the 4 to 12-foot level above ground.

Decay of support roots is a very common problem in warmer climates; the Southeast and Southwest mostly. In the Southeast, decay of support roots is commonly associated with root injuries resulting from expanding roadways and sidewalks. Some of the most "sneaky" fungi infect roots of oaks and other species. These root-rotting fungi digest the roots but seldom move far up into the trunk. The lush grass and vines at the tree base hide the fruiting bodies of the fungi. Learn to look for the fruiting bodies of the fungi below the vines and other plants at the tree base. Some of the trees with decaying support roots will not appear unhealthy in their crowns because the absorbing roots are still able to get moisture, and in some cases, a rich supply of essential elements applied as fertilizers to the lawns. Moderate winds may cause such a tree to fall.

A similar root condition exists in the Southwest. Trees that normally survive in very dry soils suddenly are surrounded by houses. Lawns are started. The lawns are watered and fertilized. The support roots begin to decay, but the absorbing roots are able to get all the water they require, plus an extra bonus of essential elements from the fertilizers. The crown may look better than ever. A moderate wind may cause the tree to fall, and the roots — all rotted — come up with the tree.

In other cases, the roots are decayed and the crown also begins to appear unhealthy. The major point remains the same. The sudden change of soil conditions is just too much for the root system. Be especially on guard with large-crowned trees 5 to 10 years after they are included in some housing or industrial development.

Learn to recognize the often flat fruiting bodies of the fungi that rot roots. Learn to use the Shigometer on suspect roots. If such high-hazard-potential trees are under your care, indicate *in writing* that you consider them hazard trees and they should be braced, pruned, or removed.

Branch breakage is the most common type of tree hazard. Even small branches can cause serious injury when they fall on a person. Proper pruning is the best answer to the problem.

Limb drop or branch drop is a problem in some areas, especially southern California. I have examined such broken branches in California and also species of Eucalypts in Australia. I have examined many branches, and I have yet to find a branch that did not fit one of the three basic patterns for limb drop. Branches fall 3 ways: 1) breakage at a distance out from the base. A long stub is left. 2) breakage within the branch collar at the base of the branch, and 3) breakage along the trunk where the falling branch pulls away a small to large portion of the trunk above and below the branch. Each situation is different. It is the clumping of all these breakages that confuses the problem.

First, the long stub breakage. This starts with branches that have large side branches that die or are cut improperly. When the side branches on the main branch die or are cut, the branch responds by forming several barrier zones; one for each dead branch. The barrier zones are weak spots. Add wind or rain and the branch breaks.

Type two is the branch that breaks within the branch collar. This is the normal shedding position for branches. I have found brownrot in the base of such branches. Brownrot is very difficult to see if you don't understand this type of rot. The rot will be very limited. Within an inch the appearance of the wood will change from brown-rotted to completely sound. Brownrot in heartwood that is normally brown makes finding this type of rot all the more difficult. Rot in the branch collar is essential for normal branch shedding. Branches cannot be shed unless the rot spreads into the protective zone, the zone within the branch collar.

The third type of breakage is not of the branch but of the trunk tissues that support the branch. A long elliptical trunk section is commonly attached to the fallen branch. This type of breakage is most common on large open-grown trees where lower branches have become very large and are horizontal. I believe this type of breakage comes about because we let the tree grow into an impossible condition or configuration.

Why some branches fall during quiet hot periods needs more attention. But before sound answers come, the basics of branching and branch shedding must be clearly understood. Few things just happen in nature.

The third type of tree failure is the breakage of the upper trunk, usually 4 to 12 feet above ground. First, this portion of the trunk is usually the most defective portion because that is the position of the largest branches. When the large branches die, microorganisms have access to the tree. Any additional injury to the tree at this trunk position will start serious hazard problems.

Be on the alert for vertical cracks. Be on the alert for cracks that are on opposite sides of the tree. This is one of the most critical indicators of a hazard tree. Such a crack pattern starts with a wound or the death of a large support root. The first internal crack is still a circumferential ring shake, and then radial cracks begin to form. When two radial cracks form at 180° to each other, the tree is a high hazard risk. A moderate wind may cause the tree to move as two separate trees, and breakage will result as a shearing failure. The tree will break, not at the base where the rot is most advanced, but above, where the spreading cracks meet sound wood.

The proper use of the Shigometer can help greatly in hazard tree assessment. Check suspect roots. Check for fruiting bodies, and vertical cracks. Use the Shigometer to check the width of sound wood 1 foot above obvious injuries, and on the opposite side of the trunk from the injury. When in doubt about the tree, put your recommendations in writing.

The real working world of trees. In the end we must do the best we can with the information and tools that we have, and under the constantly changing regulations and the pressures of uninformed people with strong emotions. The real working world of trees is both a wonderful place and a very difficult place.

Everybody wants a red light — don't do it — and a green light — do it. But natural systems always have an orange light in between the two. Everybody wants a generalization, and the best you can ever do with a generalization about natural systems is to be correct about 80% of the time. There will always be exceptions.

I believe that the professional understands the "orange light" or the constantly changing exceptions. I never lose sight of the difficulties of the real working world.

The targets are many. The trees' needs are great.

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