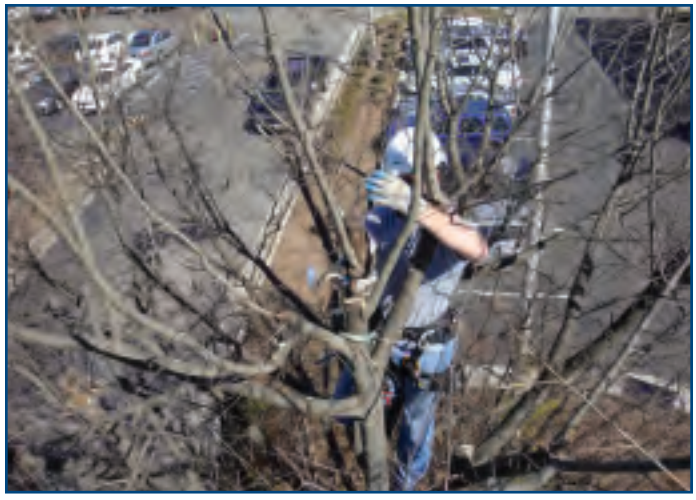
RESTORING TREES

ONE BRANCH AT A TIME

By Guy Meilleur

Damage to dominant trees, whether by topping or storms or strength loss, can quickly alter our attitudes toward these green giants. Decay, unstable regrowth, loss of vitality, and brutal ugliness can be the depressing results. Arborists often react by rapidly recommending removal and replacement, preferring "death with dignity" to the uncertain task of restoring the tree's health, stability, and value. This article will review the art and science of restoration pruning, while addressing some traditional notions about it. It does not include work with the bottom half of the tree, the rootzone, which is an essential component of restoration. With more experience and a better understanding of the techniques and timing involved, arborists may be more inclined to choose conservation over condemnation.

Alex Shigo's *A New Tree Biology* (1986) introduced many new concepts about tree pruning that we are still struggling to understand and apply. For every general rule we make there are exceptions, many confirmed by new research. Pruning branches back to the branch protection zone (BPZ) at their origins is generally good, unless too much heartwood is exposed to decay. Removing codominant branches also invites decay, because they have no BPZ. What are our options? Reduction of stems and scaffolds is sometimes considered, like topping, inadvisable because BPZs are not present. However, the same kind of chemicals and anatomical structures exist at other nodes—"enlarged portions of stems where leaves and buds arise"—especially those where the terminal bud was set. "Topping is done internodal…" according to Shigo, and the ANSI (2008) standards agree. As Shigo goes on to say, "…proper crown reduction is done at nodes, or at crotches." To clarify the difference between reduction and topping, let's look at some oak trees.



ISA Certified Arborist Brock Holtzclaw removes the rotten end of the central leader of this willow oak (*Quercus phellos*). The first sprout was attached to decayed wood, so he went back to the next. His cut is sloping away from the sun, to avoid cracking and decay.

Restoring Topped Trees

In 2006, 45 oaks were topped at a car dealership, and the City threatened a $77,000 fine, plus other penalties. Lawyers negotiated the case for more than two years, running up a huge bill as the trees decayed and sprouted. Finally a settlement was signed, which mandated restoration pruning by ISA Certified Arborists. We wrote our assignment, including the research-based criteria for making restoration cuts.

Observations: The trees' response to internodal pruning cuts was extremely instructive. A few sprouts from the stubs emerged at odd locations from newly formed adventitious buds, but did not thrive. Stronger sprouting was clustered further back at nodes, many from dormant buds that lay waiting. (These dormant buds are carried out in the cambium as the branch expands, but remain connected to the core by pith trails, or "bud traces." Held fast by compacted xylem in the core of the tree, these bud traces are thin, but they still may provide significant structural attachment for the new sprout. Every climber knows better than to underestimate the strength of tree fibers!)

Decay spread downward through the internodal stubs,

until it met barriers at the nodes. The trees drew the chemical lines there with phenols and other natural sealants, and decay was walled off. Buttresses thickened at the base of new sprouts, guarding against breakage by strengthening the attachments.

Energy reserves are restored when the trees' sprouting slows down, so that's a good sign that it's time to restore the trees' form, by pruning. But our schedule was driven by politics, not biology, and we had to work while the trees were still weakened. We timed the pruning just before budbreak, when the trees would respond aggressively. (Late summer is a better time for heavily sprouting trees, because removing more resources slows growth.) Common guidelines are to remove no more than 5 percent to 30 percent of the vegetative buds at a time from a mature tree. Removing all of the codominant and crowded sprouts would have been excessive, risking sunscald and starvation and instability. We reduced or "subordinated" many sprouts into side branches by cutting them back to small laterals that had room to grow.

Conclusion: Had the original pruning been to the nodes, with regard for the trees' health and structural integrity per ANSI, it might have been defendable. Decay would be much better compartmentalized, and regrowth more stable. But as is often the case, arborists come in to clean up someone else's mess, following ISA Best Management Practices by the Best Means Possible. When sprouting from these restoration cuts slows down, pruning again would be ideal, but not necessary. One dose of pruning probably restored sufficient structure to sustain many trees indefinitely. The City inspector was satisfied with the work, and the car dealer was spared the heavy penalties that were originally proposed.

Criteria for Locating Reduction Cuts

1. Size of wound. Generally, smaller wounds close faster and decay less.
2. Sunlight, and space to grow into and mature.
3. Foundation. Leaving some decay is tolerable if it is being walled off on the inside by natural wood preservative. This Compartmentalization Wall 4 is visible as a black line, walling off the discolored tissue.
4. Health. Color, brightness and quality of buds and foliage where present, demonstrate the tree's overall health.
5. Thickness of collar-type tissues at the node. The more meristematic tissue there is, the sooner the wound will close.
6. Angle of attachment. A lateral growing at a 90 degree angle may develop an unstable "hollow elbow", so cutting at the next node distal, to the outside, may be advisable.
7. Angle of cut. Sloping cuts may capture less moisture and spores, but they offer more surface area. Arborists will apply their experience with the species to know whether the wound is likely to die back to a slope, and look and feel for swelling as a pruning target.
8. Orientation of cut. Shaded cuts may crack and decay less when exposed to the sun.
9. Size of remaining lateral branch. One-third the diameter of the parent branch is a common guideline, sometimes exaggerated into "The One-Third Rule". But sometimes, cuts are best made at nodes where laterals have been shed, but BPZs remain. An overriding need for just one lateral to carry on a terminal role is not clear; three dukes can replace one king.

After 75 percent crown loss, damaged limbs were headed back to small laterals or buds.

Restoring Storm-Damaged Trees

Restoration pruning principles are much the same after damage by ice, rain, snow, or wind, as after topping. Storm damage is seldom as symmetrical as topping damage, so the immediate risks of uprooting and branch breakage are greater concerns, and restoration pruning is even more critical. After ice storms, selective heading cuts to nodes are simply part of crown cleaning, as defined in ANSI and described in *Arborist News* (August 2004). After hurricanes, the University of Florida (2006) advocates the same practice: "Storm damaged trees may not have a lateral branch present for making a good reduction cut. In that case, a heading cut may be preferred over removing the limb. Removing an entire limb could reduce energy reserves in the tree, create a large trunk wound, and lead to decay… A heading cut is made at a node along the stem, leaving a stub."

Regrowth from dormant buds can be vigorous and crowded, so restoration pruning should follow. However, if arborists think that highly technical pruning treatments must be repeated to restore a stable form, they may not recommend retention. When removals are paid for by FEMA (Federal Emergency Management Agency), for example, but repair is not, that further directs the decision toward removal. But when arborists advocate for retention, FEMA may cover the cost of pruning. City Arborist Norm Brown saved money and trees in Richmond, Virginia, U.S., after Hurricane Isabel, by educating FEMA and city officials. Specifying careful cuts reduced tree risk to an acceptable level without undue pruning expense later on. Future maintenance needs depend on severity of damage, species, condition, and other factors. All mature trees typically need "deadwooding" every five years or so—an acceptable cycle for restoration pruning as well.

Retaining large diameter lower branch stubs is particularly difficult, because the buds are slower to break dormancy. But even if a full year goes by, not all hope is lost. One restoration treatment five years later can restore it if it responds well enough to stay, or remove it back to an enhanced collar if it declines.

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Six years after heading, the 6-inch wound on this central leader is fully closed. One of the six large sprouts were removed, and two subordinated. The less dominant leaders were slower to close their wounds.

Six years after heading, form is restored. Pruning was conservative out of concern for biomechanical stability, resource loss, and sunscald. One more treatment is scheduled five years later.

Restoring Trees After Strength Loss

Older trees can lose strength for many reasons—repeated attack by insect or microbial pests, construction damage by human pests, restricted root space, environmental factors, or simply transition to a later stage of life. Strength loss is often due to a combination of stressors, straining tree condition into a downward spiral. Practitioners like "Dr. Treevorkian," introduced in this issue's Detective Dendro tale, characterize this trend as a "mortality spiral" for which they offer proactive euthanasia. Before such a prescription is considered, signs of strength gain such as reaction wood and compensatory growth must be assessed, as well as the potential of arboriculture. That spiral can spin both ways—timely Plant Health Care treatments to the entire tree system can be synergistic, pulling trees upward to a reasonably stable state of health. Pruning is the most obvious need to the non-arborist, but pest management and root invigoration are essential as well.

Reduction of tree crowns is largely misunderstood, due in large part to confusion with reckless and internodal topping. Reduction does remove some photosynthetic potential, but the remaining leaves can increase their energy production, and new leaves are formed per need. Formal research on crown reduction is almost impossible due to the large number of variables, so one trend has been to repeat simple criteria, like the one-third rules applied to stem walls and branch diameter ratios. Research on structural pruning shows the removal of a large codominant stem will introduce decay into the other, so subordination is preferred. Reduction slows its growth rate, subordinating the stem into a branch. Discoloration and decay is farther from the fork, protecting the remaining stem. Compartmentalization also depends on species, the activity of the parenchyma cells, and the availability of stored material. Late summer crown reduction may elicit both a favorable wound response and more manageable regrowth.

Retrenchment first referred to soldiers who retreated back to a line they could defend, where landforms and supplies allowed them to dig in and fight anew. This concept relates very well to declining trees, so before cutting any branches to reduce the size of the canopy, visualize the new canopy outline. The objective is to make reduction cuts so that branch tips are left intact on the new, smaller canopy. For trees with strength loss at the base, as little as a 10 percent reduction

Reduced in 2001, this 10-foot (3 m) stub did not sprout until 2004. Coring done in 2009 showed no decay spread past the two new terminal branches.

in height often adds a great amount of stability. This effect is reported in Tree Statics tests and calculations on many trees in Europe that have been slightly reduced and successfully retained. Older trees die back when sufficient water cannot reach their periphery. Retrenchment makes more water available and redirects growth to a lower, consolidated crown. This pruning also redirects hormonal growth regulation, often resulting in reiteration and rejuvenation. This process has been likened by Claus Mattheck to a king being overthrown, allowing the rise of several dukes and earls.

Reiteration is any shoot that repeats the basic form of the tree. Like new stems arising from stumps, reiterations in the crown are often extremely vigorous, so they make logical targets to cut a branch back to. However, when they arise perpendicular to the parent branch, their structural stability may be compromised. Cuts at right angles can also result in a "hollow elbow" type of decay. Smaller cuts further outward may be difficult to make perfectly without an aerial lift, but it may be better for the tree to have an imperfect smaller wound than a more precise larger wound after unnecessary crown loss. A slight swelling or a reduction in diameter indicating a node can be felt more than seen, so running both hands along the branch can be a vital step in understanding what to do with it. Shigo's mantra, "Trees must be touched to be understood," is too often forgotten today. Trees are living entities. We can feel for more than form with our manual examination.

Repairing internal function is the goal of our work with damaged trees; restored shape is just a sign of renewed health. Form follows function, as other artists know. What other signs of tree health can we sense, to guide our work? Vitality is evident in twig extension,

Laterals over one-third branch diameter are within handsaw reach, but they are at right angles, and would remove too much of the crown. A telescoping polesaw reaches out to smaller laterals with better angles and location on this compromised sweetgum (*Liquidambar styraciflua*).

leaf size and color and number, and particularly in signs such as bands of orange tissue forming reaction wood and reinforcing the structure. Thermal images show concentrations of heat in trees, which may indicate internal functioning.

Rejuvenation of a tree's physiology slows down its aging clock. This is best seen in trees that grow on stressful environments, like mountaintops. Among trees, some adversity can promote longevity. Recovery from damage enhances dignity in veteran trees, as they demonstrate endurance. As noted by Peter del Tredici of Harvard University (Cambridge, MA), "Pruning does it by inducing the growth of younger meristems, shortening the internal transport path, and balancing shoot load and activity with limited root activity and support. In trees, physiological and developmental aging operate independently. They can be simultaneously embryonic and senile, resulting in a form of ecological immortality. It is this potential for immortality that makes trees so fascinating to work with."

In his 2008 keynote talk at ISA's international convention, canopy researcher Steve Sillett issued a challenge to arborists around the world. (The 2010 conference will be keynoted by another electrifying canopy researcher, Nalini Nadkarni.) Sillett's assignment to us, echoed by most tree owners, is to apply arboricultural approaches to maintain stability, sustain contributions, and extend longevity. Restoration pruning follows trees' tendencies to optimally harvest sunlight, which along with soil improvement can produce upward spirals of recovery. Trees are resilient; after all, they grow in urban soils and air, surviving damage from saws, storms, and the strains and insults of aging and living with people. By discovering and collaborating with trees' abilities to sustain themselves, we can meet Sillett's challenge, and further our facilitation of the coexistence of people and trees, one branch at a time.

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