Learning from

Old Trees, Artists, & Dead Poets

By Neville Fay

Conservation arboriculture, while being informed by the natural sciences, also draws from cultural traditions, the humanities, arts, and other sciences, to develop a holistic approach to tree management.

Fifteen years ago, I was asked to carry out a conventional arboricultural assessment of an ancient population of English oak trees in a thousand acre historic parkland. This led to a salutary lesson. Intervention was intended to improve the amount of light reaching important old trees and to manage the trees' stability. By intervening too intensely, a small, though significant number of the veteran trees declined. Strangely, I owe a debt of gratitude to those trees who suffered despite my good intentions.

The experience unexpectedly led to a new development between arborists and specialists involved in invertebrate, lichen, and fungal communities associated with deadwood (saproxylic) habitat. These conversations opened up the interrelationships between trees and wildlife as a complex ecosystem, and also served to consolidate the formation of the Ancient Tree Forum (ATF) as a 'knowledge community' engaged in furthering awareness, science, and good conservation practices for ancient trees. The ATF collaboration has always punched above its weight, influencing national (UK) policy, publishing standards for veteran tree surveying (Fay and de Berker 1997), and guidance on good management (Read 2000).

I had been taught that trees have a natural life cycle: they set seed, and they grow old.

From these early beginnings, the arboricultural paradigm began shifting from the planning, planting, and maintaining of trees in safe and amenable conditions, to considering trees as ecosystems operating within ecosystems, as keystone species for dependent wildlife. Britain's ancient trees support 2,000 invertebrate species that are dependent on their deadwood habitat for some stage of their life cycle. When an old tree is lost, so are the colonizing species.

These events and exchanges were consciousness-changing experiences. I had been taught about pests and diseases, to protect trees from biological harm. The perspective now rather focused on health, what might constitute a functioning above- and belowground ecosystem, and about what might tip the balance toward disease. Theoretically, given favorable circumstances, trees through their vegetative capacity, could live forever. Given that ancient trees are by definition natural survivors living for hundreds and even thousands of years, immersed and infused with microorganisms, the question arises, What creates the grounds for pathogenicity or a spiral of decline? To integrate these implications, theorists and practitioners need a conceptual framework that draws on an understanding of natural processes as a basis for developing mature tree management strategies and enhancing ancient tree longevity.

Ancient English oak population in a well-visited historic deer park: some specimens are more than 500-years-old, mostly with extensive trunk decay and vertically drawn from overtopping young vigorous trees. Intervention was needed to maintain structure and increase light. Too rapid, intensive intervention risks inducing tree decline or loss.

Ancient and Veteran – Tree Time

Sometimes the modern world has to reinvent things before we can believe in their veracity, which in times past had been taken for granted. After a century of adding fertilizers to soil to increase agricultural productivity, the organic movement emerged as an alternative. Even it was before fossil fuels were chemically processed that this was all anyone knew to do, and therefore did not even need to give the process a name.

Washington Irving, a nineteenth century American author, was moved by the trees of Sherwood Forest (England), describing "…mighty trunks of veteran oaks, the patriarchs of Sherwood Forest… shattered, hollow and moss grown… noble and picturesque in their decay… ruins of their ancient grandeur" (Irving 1835).

Had the ATF existed when Irving visited Sherwood, he would without a doubt have been a member. His colloquial observations should not be lightly dismissed. They show arboricultural and ecological imagination, aware that trunk diameter (mighty trunks) reflects age, how shattered broken branches, decay, and hollowness suggest veteran qualities, and that these being associated with grown moss (having colonizing epiphytes) are all pointers to the trees' ancientness.

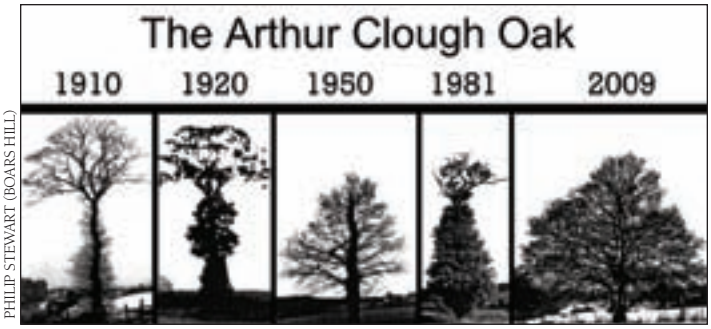
Travel and the comments of travelers open our eyes to things we may take for granted. More than 175 years ago, Irving clearly found the ancient trees of Sherwood remarkable for their antiquity, preferring "veteran" and "ancient" as descriptive terms. In describing the features of decay and age, he applies terms more recently used to understand the trees' habitat qualities.

Still surviving ancient trees at Sherwood Forest that writer Washington Irving would likely have seen when visiting from America. The ancient tree on the left is the 1,000-year-old Major Oak. The tree on the right is deceptively of similar age, and rejuvenating.

Getting a sense of time is a difficult but important aspect of the "arboricultural imagination." This includes observing trees through their life cycle, which allows arborists a glimpse of evolutionary time and natural processes that support their everyday management decisions. The life cycle is key to understanding the aging process, and what is meant by "veteran" and "ancient."

An ancient tree is one that is old for its species. The term ancient describes an age class where chronological age of the individual is considered in light of the species' life cycle and typical life expectancy. A veteran tree has woody (saproxylic) habitat derived from wounding and the aging process, through which the tree becomes host to wildlife. In this sense a veteran might be thought of as a battle scarred survivor, who having been through the wars has tales of experience and wounding. The physiological effects of damage, shading, drought, and storms initiate veteran habitat and can occur "pre-maturely" in a non-ancient tree. Whereas all ancient trees are veterans, not all veterans are ancient.

We seldom witness the long-term effects of our actions. Developing the faculty to comprehend tree-time, to imagine how a tree will respond to influences, requires close observation of natural processes to appreciate that when we intervene (e.g., pruning), growth responses occur slowly and probably not how we would have imagined. The Arthur Clough Oak is a rare 100-year-old tree with a photographic record (sequence), which illustrates in ways most tree specialists would not imagine the rejuvenation responses or the long-term self-pruning and shaping by the tree.



PHILIP STEWART (BOARS HILL)

The Arthur Clough Oak (one hundred years of aging). It is hard to imagine this is one and the same tree. We are limited in interpreting how trees will respond over 'tree time' unless we harness our arboricultural imagination. Probably most of us would not have imagined even the next stage of growth and the tree's rejuvenation response. By developing this faculty, working with the principles of conservation arboriculture and observing natural processes, we can build up techniques for reversing the age clock when attempting to enhance tree longevity.

Crown Retrenchment and Retrenchment Pruning

We think of an ancient as having the wisdom of their ancestors. So it is with ancient trees, which being true survivors, communicate through their body language (morphology)—their physiological encounters with history. It is for us to develop the skills necessary to interpret their form to understand how we can enhance their longevity and support today's trees becoming tomorrow's ancients.

A crucial stage of aging is when the crown of a fully mature tree begins to retrench (when nutrient and water supply lines from root to crown periphery begin to reduce). This is prompted naturally when the roots are unable to finance new peripheral extension, being limited by the canopy having developed to its maximum capacity. Crown retrenchment defines the onset of the ancient phase (often the longest phase). Retrenchment can occur many times during a tree's lifespan (Fay 2002).

Crown retrenchment is a valuable point of observation regarding the ways the arborists can mimic the natural process of conservation management for important heritage trees.

Habitats confer importance to veteran trees, both as individuals in their own right with iconic heritage qualities and as host to colonizing organisms, through veteran features, wounds, and decaying wood.

Natural crown retrenchment [l-r: English oak (*Quercus robur*), sweet chestnut (*Castanea sativa*), Holm oak (*Quercus ilex*)]. The crowns of trees naturally retrench as they enter and proceed through the ancient phase. This process can be biologically mimicked by fine, staged, peripheral crown pruning influencing, bonsai-like root growth and crown hormone regulation to promote rejuvenated lower, internal crown growth (see diagram on guidance).

The poet John Dryden touched on how tree-time compares with human-time, describing the oak as the patriarch of trees, with "shoots rising up and spreads by slow degrees"…

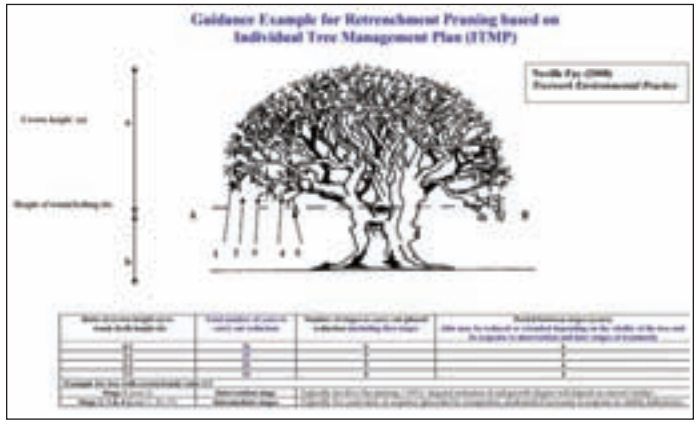
> "Three centuries he grows / and three he stays supreme in state / and in three more decays" (Dryden 1700)

Dryden had an arboricultural imagination, perceiving the English oak as having a natural longevity greater than 13 human life spans, of 900+ years. He understood natural aging, that oak was in its developmental phase for 300 years, in the mature phase from 300-600 years, beyond which was the prolonged ancient phase (these phases are tree age classes).

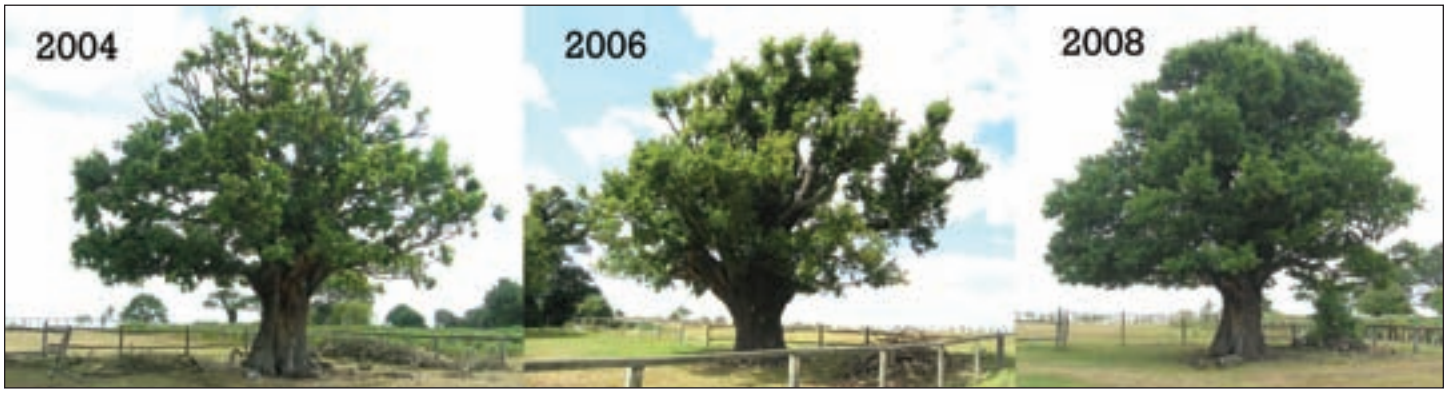
Because the human life span is so short by comparison, it is not surprising that we hone in on functionality and amenity rather than values associated with the tree's potential lifespan, and in so doing this inevitably leads to cutting short the aging process, removing trees at highest mature use-value before their veteran qualities begin to flourish.

Working Toward a Holistic Approach

The British landscape holds a large proportion of northern Europe's ancient trees, many being pollards (trees that are cut for wood products while being out of the reach of grazing animals). These ancient pollards in savannah-type wood-pasture have taught us that decay has little to do with disease and often much to do longevity. The oldest trees in many European landscapes have been lost or harmed through wars and "civilizing" influences, and in recent years from



Guidance on retrenchment pruning based on Individual Tree Management Plans for high value trees. This approach takes account of likelihood of losing the tree from structural failure and/or declining vitality within a management plan period, typically of 30 years. The diagram shows staged, fine peripheral pruning, and is not to be confused with functional "roundover pruning." The technique is used to good advantage in restoring old and mature trees under stress. The time of year for pruning is important.



Crown retrenchment pruning to ancient pedunculate oak pollard at Richmond Park, England, carried out on a declining tree with a hollow, fragmenting trunk (one of 830 ancient pollards currently studied). Pruning is designed to promote rejuvenated external and lower internal crown growth.

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more mechanized work approaches. Failing to comprehend our own relatively short existence pushes us in the direction of mechanistic intervention rather than that of patient observation.

Britain has also lost many ancient trees in recent decades; trees that are no longer considered "safe" or "useful"—this has raised passionate discourse between tree people, nature conservationists, and property owners, increasing the momentum of conservation arboriculture. Neither have tree professionals escaped a tendency toward modernization, to a safer and more sanitized environment, free from the risks of aging trees. Tree managers have played their part in cleansing environments of dead wood, impoverishing biodiversity, and unwittingly deconstructing the younger generation's experience of living processes. All of which suggests a responsibility to reassess arboricultural principles, to review assumptions that imply some tree care practices are entirely unchallengeable.

Deadwood: A Hidden Resource

"Life and death are one thread, two faces of the same sinew." (Lao Tzu)

Despite 300 million years of co-evolution between trees and fungi (and the late arrival of man on the scene), the view that "deadwood removal is good for the health of the tree" (Shigo 1989), as a scientifically valid and intuitively self-evident principle, has in large measure driven arboricultural practice to the present time. This perspective is based on the assumption that dead and decaying wood are food sources for invasive or harmful fungi.

Inspired by Shigo's dictum that "education starts when you doubt something" (1989), seeing trees in their later stages of life prompts questions about how thousand-year-old trees survive with copious dead, decaying, and advanced-rotting wood. The view that deadwood is harmful is challenged by mycologists exploring tree-fungi interrelationships, fungal colonization, nutrient recycling, and decomposition (Cooke and Rayner 1984; Rayner and Boddy 1988). Despite wide acceptance of mutualistic mycorrhizal associations between fungi and tree roots, a new emerging appreciation of endophytic fungi as latent organisms within live tissue has challenged accepted wisdom and practice about dead wood and fungi (Rayner 1993). This new research demands reconsideration of the view that fungi operate inherently as invasive pathogenic organisms (Shigo 1989).

The Tree - Fungi Water System

Modern research highlights the significance of tree hydrology. Investigations into endophytes demonstrate that tree-related fungi are capable of several modes of behavior and that the macroscopic expression (i.e., when fruiting) arises under fairly uncommon conditions, influenced by the tree's hydrology—a hydrodynamic model of the tree and its fungal communities.

The tree, having evolved to move water great vertical distances, requires a strategy to maintain this water, conducting pipe integrity'. This cohesion-tension theory requires the exclusion of air for the hydraulic system to function. Endophytic fungi are already present in this system in quiescent form in hydrated vessels (circumstances that prevail for many years). When sapwood hydration significantly reduces (through pruning and wounding) water molecule cohesion is disrupted, causing the chain of vessel-borne water to 'snap' (air embolism). Under these circumstances, endophytes flourish and forage, benefiting from available oxygen, changing their mode of behavior, and eventually expressing their macroscopic presence emerging as fruiting bodies on exposed wood.

Rayner shows that, once freed from dormancy, fungi are greedy for territory and highly antagonistic to other fungal communities. Given that endophytes compete strongly between one another and against opportunistic colonization from other outside fungi, there is a case for characterizing the relationship between endophytes and the tree as an immune system.

Conclusion

The tree is clearly a far more complex organism than can be understood by an oversimplified biological model. Conservation arboriculture explores the tree as an ecosystem and through the lens of co-evolution develops holistic approaches to management. The internal topography of an aging woody structure, infused with a network of fungal hyphae—progressively hosting communities of invertebrates and other organisms—together express the web of life that is the ancient tree – a web that is certainly worth conserving.

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Six hundred-year-old ancient pollard beech (*Fagus sylvatica*) in southern England, cut for its produce. For the past century, the tree shows high vitality and is completely hollow. The pollard re-growth (now multiple small trees) at one time would have been cut on a cycle depending on the type of use for which the wood was required. Such rejuvenation cutting has contributed to the tree's longevity.

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For more information regarding The Ancient Tree Forum, visit their official website (www.woodland-trust.org.uk/ancient-tree-forum).

WHAT'S THE SOLUTION?

I concluded my discussion with Miss Fanny about the odd form of her lilacs. "And so, although strange, I hope my explanation has reassured you that your lilacs are in no danger. While unusual, they will continue to be healthy and provide bountiful blooms for years to come."

"Yes, I'm much relieved," Miss Fanny sighed, fanning her dewy brow.

We approached Codit, who was speaking with Christa as she twirled lazily in the tire swing. She shook out her blonde curls and gave Codit a coy smile. I chuckled. Codit was in full savior mode, trying to disguise his nervousness.

"And remember I was saying how tree and shrub branches typically grow? Not like those strange lilac fans, but how the living tissue called cambium is right under the bark. It expands outward every year to increase branch size and create annual rings, and lengthwise to make branches longer so that growth is like an expanding cylinder," Codit went on, blushing and looking anywhere but at Christa as he dug his boots nervously into the dirt.

"Mmm-hmm," Christa said dreamily.

"Thank you, detective, for today's most interesting botany lesson!" Miss Fanny proclaimed. "Knowing that the problem with my lilac is not so terrible is reassuring, even if it is still a bit of a mystery in its details. And maybe I will leave these mysterious branches. They do look rather intriguing now that I know nothing sinister is afoot!"

I thanked Miss Fanny for her hospitality. In turn, she thanked me again, both her elegant hands wrapped around mine.

"So how was your conversation with the lovely Miss Christa?" I prodded when we pulled out of the drive.

"Well, when I saw the cockscomb Christa was holding, I remembered from botany class that this strange form of popular annual flower is caused by a mutation called fasciation. And right then I put two and two together." Codit put his arms behind his head, looking smug. "Now, in the case of the cockscomb, its unusual flower form comes from true seeds, so this mutation is a separate cultivar. But in the case of other plants, such as these lilacs, fasciation arises for a variety of possible reasons, and we don't always know why. The apical meristem tissue at the shoot end, which should elongate, fails to develop in the normal lengthwise dimension. Instead, it grows outward—perpendicular to normal growth. Sometimes adjacent growing points fuse together and make a broad, flat limb instead of a cylindrical one."

"You have done well with the 'what,' Codit. Now what about the 'why'?" I asked. I reminded him to dig through the scenarios he explored earlier at Miss Fanny's.

Codit concentrated for awhile. "A-ha! My weather damage scenario fits. Damage to buds could induce fasciated growth! And bad pruning could, too, like internodal cuts or cuts too close to the buds. Of course, not in Miss Fanny's lilac's case," Codit hastily added.

"Very good, Codit. You were aiming pretty close with your idea about chemicals, too. Growth hormones have been used to induce fasciation experimentally. Some researchers have implicated fertilizer overdose and, in other instances, mineral deficiencies may be to blame. You also grazed the answer with your gall theory. Insects and mites have been implicated in a few cases of fasciation. And, I'll add more. Viruses or diseases are other possible biotic causes."

"Wow. There are a lot of possible reasons," Codit surmised. "I guess we may never know the cause of each instance, but at least knowing that fasciation seldom harms a plant makes finding the cause less pressing."

Codit unwrapped a sandwich he had brought along and took a bite. I asked, "So, it's not dangerous then?"

"No. Fasciations are not necessarily bad, and they aren't poisonous or infectious. Why are you asking?" Codit squinted at me.

"Good thing then, looking at that crenellated beefsteak tomato sticking out of your sandwich. Wouldn't want you to get sick now that you're becoming such a font of knowledge!" I laughed.

"This tomato is a …?" Codit looked at it suspiciously for awhile before popping the last of it in his mouth.

NORA BRYAN

Fasciation can be induced by any number of sources, hormone treatments, viruses, diseases, or even weather conditions.

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