

Arboriculture in the 21st Century

By Dr. Alex Shigo

Arboriculture in the beginning of the 21st century will begin to split into art-only and art-and-science professions. By the middle of the next century, the two professions will be well separated. The purpose of my discussion is to give information in support of this prediction.

To know where you are going, you must first know where you are and then know how you got there. The future can be thought of as an extrapolation of points along a curve. The past defines undulations of the curve before the present. History is

the actual occurrence of events over time. The recording of past events is often clouded by the person who tries to explain why some of the events happened. The occurrence of the events cannot be denied, but any more than that becomes very subjective.

Just as I base my discussion on a single prediction, I believe there was one driving belief that set the stage for the growth of arboriculture in the United States. That belief is now over three centuries old, and it has moved as a wave. When a wave hits a shoreline, the crash back into the water

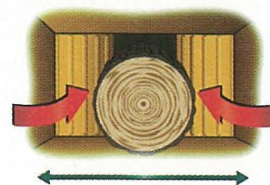
is much more intense than the inward rush of water. The belief that grew after our country was colonized in 1620 was that the trees were endless and they were the enemy. Trees were in the way of farms, homes, towns and roads. Yes, they did have some value for buildings and for fires, but their size and abundance made them more of a problem than a benefit. Over time, the value of trees did increase, but the belief in endless forests continued.

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crash of the wave signaled the end of the belief that the forests were endless. By this time, the many values of trees had gained public attention. A city without trees is not worth living in. Trees as a means for enhancing property has become common sense. As the value of trees continues to gain momentum, educated clients will demand better treatments, better decisions and better trained and educated people to look after their trees. The art-science arboriculturist will be called.

Correct pollarding, as done on these London plane trees in Spain, will slowly become more common.

Why have myths and misunderstandings plagued arboriculture? The problem started in the mid-19th century when several important events happened about the same time. The repeated failure of the potato crop in Ireland caused by the fungus *Phytophthora infestans*, set off a large scale famine and migration. At this time, Anton De Bary proved that a fungus caused the disease rather than the well-accepted belief that the disease caused the fungus. At the same time as Louis Pasteur was winning the battle of the germ theory, Robert Hartig showed that fungi cause decay rather than the long held belief that decay causes fungi. For his work, De Bary is recognized as the father of plant pathology. Hartig is recognized as the father of forest pathology. Hartig's great work set off a rushing stream of research on decay.

In a world covered with trees, however, there was no incentive to learn about how to grow more of them. What was needed was to find better ways to deal with decay and better and faster ways to get the wood out of the forest. Pathology studies centered on pathological rotation schemes to deal with decay in living trees and better ways to prevent decays in wood products.

Now comes the problem of the heartrot concept. Heartrot was defined as the decay of the heartwood. Heartwood was defined as the central, darkly colored dead core of all trees. Since decay developed in dead heartwood, decay was not considered a disease. At the same time, textbooks and teachers—even to the present day—state that the only living part of a tree trunk is the single layer of green cambium that produces wood on its inside. And that is all wrong! Sapwood has more living cells than dead cells. The cambium is not a single layer, nor is it green. (The cortex is green). The cambial zone produces xylem. When it is lignified, it is then correctly called wood. The dead heartwood decay concept has been the major myth that has led to many injurious tree treatments. If the wood is dead, then put a wound dressing on wounds. If decay develops, dig it out until healthy clear wood is exposed. Cut branches as flush as possible to the trunk to stimulate faster "healing" to cover the core of dead, decay-susceptible wood. The heartrot concept treated the tree as a dead cylinder of wood. The heartrot concept is, at best, a wood decomposition concept. The tree as a living, big, beautiful organism was left out of the concept! Say what you will about compartmentalization, but it is built on the belief that a tree is a living, dynamic, organism. The tree does not lie there and just "let" decay-causing organisms run through it at will!

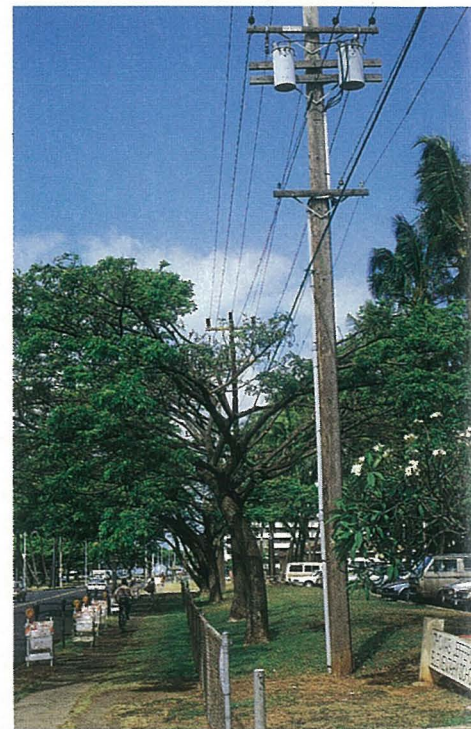
If you believe that the tree is a living, dynamic, organism, then to treat it is essential to understand the basic principles of all living things. This means an understanding of biology and, yes, chemistry. Now we know there is still more, as we see the need to understand the tree also as a magnificent mechanical structure. The science part of arboriculture will be expanded in the 21st century. The past has given us the endless enemy and the dead heartwood decay concept. The present gives us great concerns for the conservation of trees and for the best ways to treat the living tree and its many living associates—the tree system.

Guns, Shadows, Targets

You can have the best rifle in the world. You could be the world's best sharpshooter. However, if you don't know the difference between shadows and animals, you won't put



Soil is alive with many organisms. Decisions and treatments must be made to keep not only trees healthy, but also the soil inhabitants. They are all part of the grand living system.



Proper pruning of trees near electric utility lines will become more common. Here are monkey pod trees, pruned correctly, in Honolulu.

Cover Story

much wild game on the table. To shoot a deer you must aim at the deer as the target not its shadow. Silly, you say. Think about it. Plato did 2,300 years ago. He said in *The Republic* that many people have great difficulty telling the difference between reality and shadows as perceived reality. Plato tells a story about people born in a

cave. They are chained to their chairs and can only see the wall in front of them. There is a fire in back of them. People with various-shaped objects march behind the fire and the shadows of the objects show on the wall. Great societies of shadow watchers are formed. High honors and awards are given to the best shadow watchers. One day, a brave soul breaks from his chains and runs out of the cave. The light at first blinds him and the pain is intense. In a short time, he begins to see again and the pain begins to subside. Then it happens!

He is overwhelmed at what he is seeing and touching. He is now seeing and touching real things, not looking at shadows. He becomes so overjoyed that he wants to share his discoveries with his cave friends. He rushes back into the cave. They kill him!

I predict that many cave people will escape in the 21st century. I believe the word is out in the cave that real things of great wonder are outside, just waiting to be understood and enjoyed. This does not mean that the cave shadow watchers will go away. They will strengthen their forces and let escapees know the dangers that face them. They will come up with even better recipes for bigger, and more wonderful shadows.

Guns, Tools, Principles

Back to guns again. Consider if you will what a gun and shooting is all about: a tube, a projectile and some force-providing substance to move the projectile so rapidly through the tube that it extends its path far beyond the tube. Think for a moment about this. From a historical view, tubes were used by early humans and are still used today by some jungle people as a tool for directing some projectile in a straight path beyond the tube. So, tubes are not new. Think about the many kinds of projectiles used to strike a target. Projectiles are not new. How about some force to move the projectile. You could blow a dart through a tube. You could whip a small stone through a tube. Or, you could use some material such as black powder that explodes and blows the projectile through the tube. Again, nothing new. However when you connect the tube with a lead projectile and use a force-providing substance, now the rifle became a new thing made up of many old things. That is the way most so-called new theories, principles or concepts come about. Remember, the Old Testament states that nothing is new, yet it is followed by a New Testament!

New theories, concepts and principles are usually built on many old, well known other truths. The act of connecting makes the product new. Not so different from much that is said about modern arboriculture. The concept is not new in one sense, because much has been discovered about tree biology, tree associates, soils, chemistry, biophysics and many other subjects. My point is that key aspects have not been connected. You would not

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go hunting with only a tube, or with some lead or rock projectiles, or with a handful of black powder. These are all old things. You do hunt with a rifle. It is new in the sense of connecting the most important parts of well-known items. Nothing new, but a connection of more refined items.

This will be the same procedure with many tools and machines used by arborists in the 21st century. Just as guns are connections of simple basic parts, so are many of the tools and machines used to prune, plant, fertilize, spray, inject, chip, dig stumps, cut wood, lift to greater heights and record data. There is no doubt that computers and new electrical tools will enter the tree care profession. I predicted many years ago that small electrical devices will be placed in select trees and signals will be sent to receiving computers miles away. A flush cut on Mrs. Jones' tree will start a red light blinking. Don't laugh. In summary, tools and machines will change to

be more accurate, lighter and user-friendly. However, just like the modern rifle, how you use them will depend on skills and distinguishing shadows from the real targets.

Of Steel and Trees

It is always fascinating to see the common threads that connect subjects far removed from each other. What can the steel industry tell us about the tree industry? Plenty!

In 1901, United States Steel was formed as the first and mightiest conglomerate in the world. The conglomerate brought together oil, railroads, coal, telegraph cables, steel and people. The good news is that the steel conglomerate was a major factor in the growth of our country. The bad news is that the people who worked in the mills and coal mines and on the railroads were paid very little for extremely hard, long work. They were the people who came to the New World after the potato famine. The leaders of the conglomerate all became multi-millionaires. By our standards today, they would be billionaires. The power of the conglomerate lasted almost a century. After the second world war, the conglom-

erate began to weaken as other countries got into the steel business, oil was imported and air travel took over from rail.

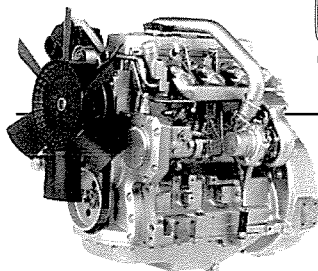
Long before the steel conglomerate, nature "understood" the power of synergy, where two or more connected groups yield much more than the sum of the groups taken as individuals. A classic case of synergy is the connection of trees and fungi to produce a new organ called a mycorrhiza. Many synergistic associates exist within the rhizosphere of trees. My point is that much more can be done at a lower cost if the right groups are connected. The steel groups waited until 1901 to understand that. Trees "knew" it long before that. A major difference between the steel conglomerate and the tree "conglomerate" or system is that the tree system did "demand" much from every associate, but the associates were "assured" high-quality survival. The fall of the steel conglomerate can also teach us a tree system lesson: When connected parts begin to fall away, in a short time the entire system will begin to decline.

In preparation for this discussion, I looked at many old photographs of houses of the first ultra-rich people in the United

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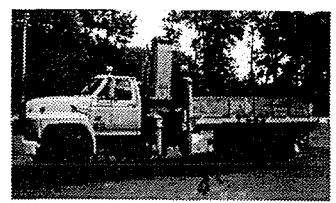
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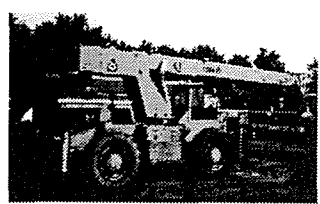
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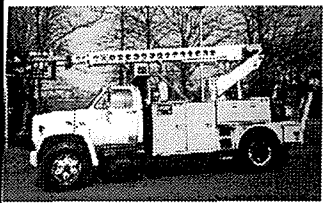
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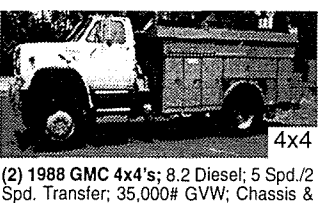
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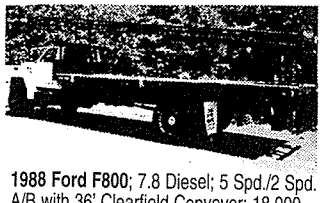
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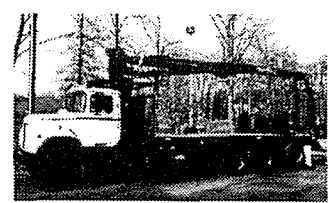
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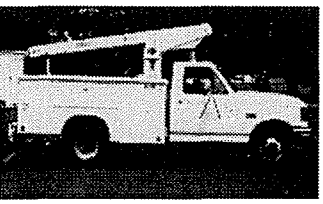
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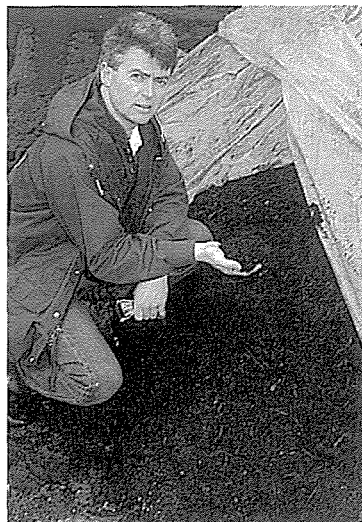


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States. Their mansions or castles were built on land scraped of all living things. Photos showed that new trees and new gardens were the first additions to the landscape. Many of the new trees were small, less than six inches caliper. It was not long after this that arborists were called to prune and care for the trees. This was the beginning of commercial arboriculture. Some may argue that arboriculture started long before this, when trees were cleared for telegraph lines. I hope we never consider that arboriculture, since trees were mutilated to make room for the lines. Further, some people may say that line clearing is still with us today. I am an eternal optimist, because I believe that line clearing of the past is changing to pruning trees near electric utility lines.



Ron Carter of Victoria, B.C., shows some excellent composted mulch from wood chips and leaves. Mulch is food for many soil inhabitants. More composted mulch will be used in the future.

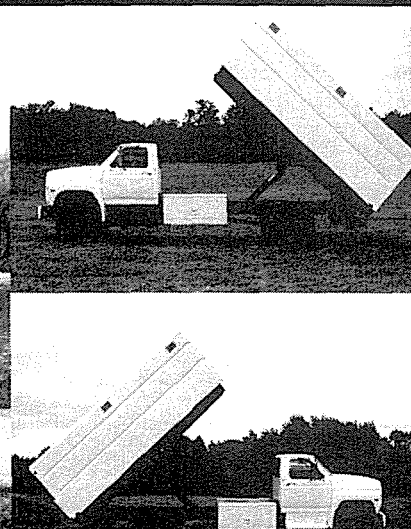
Hard Work Will Not Change

A major difference between a tomato plant and a tree is that you cannot fall out of a tomato plant. Tomato plants cannot fall on you and kill you. To be an arborist, you must not be afraid of hard work. This is a major reason why I am very proud to be associated with arborists. I like people who work hard and have a strong feeling for our living world. This part

of arboriculture will never change. Here I need some further explanation of my terms old and modern arboriculture. By old arboriculture I mean tree care based on old recipes and myths—plant deep, cut flush, paint wounds, dig into cavities, over prune, over water, over fertilize, inject anything that stands still, top trees, add lots of fresh chips as mulch, plant the wrong tree in the wrong place and most important, don't read or learn anything new!

Modern arboriculture will still mean lots of hard physical work. But it will also mean making decisions, predictions and treatments based on an understanding of the whole tree system—hard work and education, mind and muscles, training and education. Not to belabor my point, but modern arboriculture must be more than just muscles without the mind. I know that many people became arborists because they ran from school. I know this has no reflection on their intelligence. In fact, I think some were so intelligent they saw the futility of some of the school courses! I regard some of the school dropouts as my close friends, and I know they not only understand arboriculture, they understand the ways of the business world. In the future, I hope our education systems will change and reduce the number of dropouts.

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Changes and Adjustments

As arboriculture grows in the 21st century, the art and science will slowly come together. New and altered tools, machines and products will bring with them the need to understand correct use and dose where products are concerned. There will still be saws, and other tools will be developed for rapid, correct pruning and for cutting trees. The biggest changes will come in tools and machines used for detection of potential problems and diagnoses of existing problems. Electronic devices will be used for sensing early symptoms of declines and of diseases. Electromagnetic devices will be used to confuse insects and fungi. Many new products will flood the marketplace. The careful arborist will really need to know what may be helpful from what could be harmful, at least to the wallet and purse.

To keep pace with the new products, the science side of arboriculture will have to increase greatly.

Today the number of Ph.D. arborists is low compared to the number with only a high school education. There will be dramatic changes in these percentages as demands increase for decisions on larger tracts of land. Bright students will begin to consider not only salaries, but, as always, the life the job brings. This last feature has always been a beneficial part of arboriculture. As the "outside" shrinks, the chance to be outside and still make a living will have greater appeal to young people. Training and education leading to careers in arboriculture will start at an earlier age. More and better educational programs through schools, television and environmental-based groups will inform not only prospective arborists but the clients who will hire them. Awareness of the whole green system will come to all people from many different sources. The image of a professional modern arboriculturist will increase greatly. In time, the present organizations such as the ISA, NAA, The National Arbor Day Foundation and others will begin to have many sub groups. I

use for my predictions here the patterns of some of our large organizations today.

I do not want to lose sight of the fact that the hard, physical parts of arboriculture will not go away. Even if more powerful, lightweight tools and machines come, it will still take a lot of muscle to do many tree jobs. The ability to move bigger and bigger trees with bigger and bigger equipment will still tax the body after a long day. However, the modern arborist will have to use his or her mind to decrease the burden of heavy loads and dangerous jobs. The size of the patient will never let arboriculture become an easy profession.

A difficult subject to discuss, but it must be discussed, is how will the existing green groups grow in the next century? Will they grow together, apart or remain as they are now? Some of the major groups are arborists, nursery people, landscape architects, foresters, and lawn care people. These groups have insulated themselves from others very well during this century. Competition in business may force some melting and blending. The educational requirements of landscape architects have kept them at a higher wage level than other groups. The shrinking forest and the chip-



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The image displays a variety of arboriculture tools and equipment. At the top center is a large coil of silver-colored rope. To its right are several pulleys and a hand saw. Below these are more ropes, some coiled and some hanging straight. In the bottom left, there is a motorized device, possibly a winch or a pump, with a red handle and a white body. Next to it is a coiled white rope. In the bottom center, there is a large pair of pliers or shears. To the right of the pliers is a long, thin, red-handled tool, possibly a pole saw or a trimmer. The background is a plain white surface.

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ping industries will continue to reduce the needs for the "classical" forester. Small woodlot forestry will remain a steady market for many foresters.

The desire to abandon people, machines and headaches usually means a try as a consultant. We are overrun with consultants now, and the flow will continue to increase. What will happen is that those with the best credentials will dominate the market, and they will slowly grow back into what they tried to leave as they hire assistants, secretaries and all sorts of others. There is no doubt that the marketplace will be the ultimate driving force when it comes to which groups will stay as they are now, or melt into hybrid groups. I predict that more hybrid groups will develop and establish a hierarchy at positions from CEO to the person who will drag the brush. The rush of paperwork and regulations will continue to make small and medium-sized companies think about their economic survival. The wave of downsizing will not crash for many decades.

In October 1957, an event took place that gave all Americans a wake-up call. Sputnik went off! Were we to be outpaced by another country? Were we not the leader? In October 1957, there was little doubt about who was now in control. No way



Workshops will give people opportunities to touch all parts of the tree.

were we as a country going to let it happen. Anybody who could spell scientist became one!

What nobody knows is when or if another wake up call will come. On the environment, it has been tried with the book *Silent Spring*, and with warnings on acid rain, global warming, the decline of our forests, ozone depletion and the possibility of comets striking earth. But none of them really has stuck to the wall. The theme of gloom and doom was used so much that it was similar to the repeated warning of wolf, wolf! The scary part of this is that the wolf may come some day and people will say, not again! If it does happen, I believe there is a good chance that the wake-up call will affect something in our green world that has a direct bearing on our survival. One such possibility would be famine due to several events happening at the same time. Or it could be drought, dead soils, insect infestation, a new, powerful, disease-causing mutant bacterium or fungus. Not that I am looking for gloom and doom, as so many others

are to give our profession a boost, but I do believe we work in an area critical for the health of the world.

That point has never come through, mainly because we are just ending the period of the endless enemy. People usually respond only to crises, which is sad but true. As the endless enemy wave hits the shore, the back splash may signal the need to begin learning something about our trees. Remember, there was no need to know how trees grow or how to grow trees when it was thought that the forests were endless. Consider the same situation

with AIDS. Until it came along, little was known about our human immune system. Why study something that has no immediate value or connection? Now, researchers must go back to some basics that were left unstudied. The journals are now full of articles about our immune system. Why not take the same approach with trees? Look in any textbook on biology or botany and see how much space is given to the entire field of trees. What more do you need to learn about them? They are big, tall and some grow for a long time. They have three organs (WOW!), leaves, stem, roots. The core of wood is covered by bark and they have seeds. Next lesson. How sad!

Just as medical people somehow left out the human immune system, tree people left out the entire response system of a tree. How could a dead cylinder of wood respond anyway. Wound it, paint it, and when it decays, dig out the rot! Enter compartmentalization again. In 1959, when I first started dissecting thousands of large trees in a longitudinal radial direction with a chain saw, I saw things in the trees that



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Cover Story

were different from what I saw in the textbooks. One day I decided to escape from the cave and I stood up in front of my peers and said the tree is correct and the textbooks have some shadows in them. Since that day, the shadow watchers have been out to get me.

In the next century, I believe we will go back to learn more about many subjects that were left along the way. Many people have asked for more advanced stuff. It is interesting that while some want more advanced information, others are saying enough, we do not need it. My answer is, if you are satisfied with your wages and job—and satisfied knowing they will not change during your life—then fine, you do not need more stuff. I must say that the other group asking for more drives me. I repeat, I accept the group who doesn't want more and I respect them and their position, but they should not interfere with those who do want more.

What more is there, really? There is more about biology, laced with a good dose of chemistry. The next level of tree biology cannot be approached without the language of chemistry. To hear and read the same old studies on fertilization, pruning, etc. must make you as disturbed as it does me. The next level of biology and chemistry will give us new opportunities to really talk about fertilization, rhizoplanes, bicarbonate ions, redox potentials in soil, ion size and charge, and a new, wonderfully long list of topics that will clarify years of confusion.

I cannot see how we can discuss the tree without discussing associates, and the soil and the ribbon of chemical changes that runs through the whole grand connected system. I am not saying that every arborist must be a biologist or chemist. I do believe that every arborist should at least be aware of the major scientific principles of life. It is awareness that I am after, not a complete detailed understanding of biology and chemistry. Now, I am very sympathetic with arborists who ran from biology and chemistry in school. It is no wonder they did, judging from the way the textbooks are written and the way they were taught. I have been wading through large chemistry texts now, and I know the problem.



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Changing Education

Now I come to another big adjustment that will take place in the next century. The curricula for two- and four-year programs will and must be adjusted. It is impossible to cover all the material needed in that time to prepare a person for a job. Yet, many people just cannot afford to continue going to college. What is the answer? Textbooks and courses must change to awareness-type material. The material must be in a form that makes you aware of the principles, but does not demand that you understand all the details. Chemistry courses are designed to make you a chemist. What if you do not want to be a chemist, but you do want to be aware of enough chemistry to help you make sound decisions about treatments for the tree system? The first part removed from awareness chemistry will be the mathematics. I am not down on mathematics, but it is usually the main problem when it comes to chemistry. The next item to go must be the demand to memorize long formulae. It will not be easy to write and teach awareness-type books and courses. Yet, it must be done. I know the subject is hot now within many universities. As this happens, the mix of art and science of arboriculture will come about without a stir. It will be a natural thing.

Now, let me go back to a potential problem I presented earlier about insulated green groups. As more students graduate with more awareness information about many principles, the insulation among the green groups will begin to decrease. Why? Because of the marketplace again. Clients will only want one group to do the job for reasons of economics.

Another big change in the next century will be the expanding world market for modern arboriculturists. The Pacific rim is

already beginning to show its economic strength. If the past is prologue, developing cities will want trees and parks. Rebuilding old and decaying parts of cities will require decisions about trees and parks. In some of the Pacific rim countries, the reverence for trees is high, while in other countries trees have little value. This will change as people pressures demand someplace to walk and sit. What this means is that young, trained and educated people from the United States may see great opportunities in other countries. As travel time shrinks, the possibilities of working in other parts of the world will become more desirable.

Where Will Research Go?

The role of electromagnetic fields will be hot for all life sciences from humans to trees to microorganisms. For a long time, some researchers have believed that termites communicate by way of magnetic fields, and that insects first find their target by magnetic fields and then go on with volatiles or pheromones. This research may clarify why insects seem "to know" a declining tree from a healthy one or a tree that has no defense system. Once these subjects are understood, they open up a whole new approach to pest control.

The use of genetic information has been slow to come to practical means with trees. Most genetics research has been directed toward more showy individuals. Super tough trees that could resist invasion after wounding have been known about since 1976. That information has never been used. In time genetics will play a greater role in selecting trees for different soil types and sites.

The use of growth regulators will increase. The bottle-neck for their use now is the lack of understanding of the physiology of movement in the tree. Materials can be put in, but they may or may not move throughout the tree. Here again is an example of a forgotten basic area that must be researched. Many effective materials are available now, but getting to their target sites in the tree is the problem.

Research on electrical-based sensors will come in several decades, not soon. The sensors are available now, and have been for at least two decades. The problem is knowing what all the signals mean! This is the problem the Shigometer has and will continue to have. The machine or meter only gives numbers, the important thing is to know what they mean. The numbers cannot be "wrong" because they are only an indication of some electrical signal.

Over and over again, I make the same plea for understanding the basics of the tree system. When this finally happens, many wonderful pieces will fall into place.

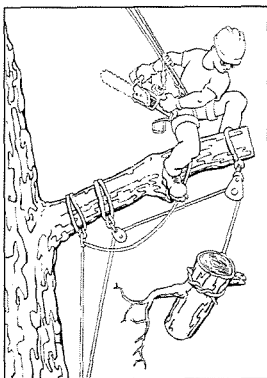
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By Mark E. Battersby

Leasing Benefits Galore

Buy or lease? That is a question that faces every tree care and landscape business owner. While virtually everyone understands the simplicity of buying, leasing is more complicated. Deciding which is the best strategy is a tough move for anyone.

The lease is a very old legal device. It was employed extensively centuries ago by noblemen and landed gentry to permit others to use parts of their real estate. The lease is still used extensively in connection with real estate—often because property has not been available on any other basis.

Another important factor in the decision of whether to lease or not is flexibility. Ownership, after all, has become incidental in today's business climate. So long as tree care companies are free to use equipment, it is not really necessary for them to own it.

This is practical because under a lease, all of the risks and uncertainties that go with owning equipment are transferred to the lessor. If the equipment becomes obsolete, the tree care business can simply turn it in or have it upgraded. This is especially beneficial with computer systems that are changing so rapidly.

Leasing of property permits the use of property without balance sheet recognition of either the property or the obligation to pay for it. This so-called "off-balance-sheet" financing has become

important to many contractors, since it doesn't usually affect the operation's ability to borrow in the future.

Some businesses have sold a major part of their property and leased it back. Others have induced developers to build special-purpose property in return for a promise to lease this property for a long period of time.

The U.S. Department of Commerce reported that of the \$379 billion spent by business on productive assets in 1992, \$121 billion or 32 percent was acquired through leasing. In 1993 (the latest figures available), \$125 billion out of \$390 billion of all equipment investment was estimated to have been acquired through leasing. Although these figures are up dramatically from the 27 percent figure reported in 1985, there is still a great deal of confusion over leases.

There are two basic types of leases: The operating lease is a shorter-term lease and runs for a fraction of the useful life of the equipment. Services such as maintenance and insurance may be offered with operating leases because the lessee tends to want to use the equipment, which is often high-tech and quickly becomes obsolete, for a short period of time.

With an operating lease, the lessor owns the equipment, takes the depreciation deduction and the lessee/tree care business has no liability. For tax purposes, operat-

ing lease payments are treated as an operating expense, not a capital investment, and are deducted from operating revenues.

A so-called "finance lease" on the other hand, is a lease that has an option at the end where the user can purchase the equipment. The finance or capital lease is a full-payment or closed-end lease. It requires a lessee to purchase the equipment at the end of the lease period at a percentage of the original value or for a nominal amount. The capital lease is usually designed for longer periods than an operating lease. It's similar to an installment sales contract.

Under the finance or capital lease, equipment is capitalized on the balance sheet. The capital lease actually represents a type of loan in which ownership eventually passes to the lessee.

It should be mentioned that many lease terms for trucks, chippers and lifts include insurance, maintenance, taxes and a variety of asset management services usually available only to Fortune 500 companies. As far as service on leased equipment, there is no standard way to handle this. Some lessors automatically include service, with others the desired level of service to be provided must be negotiated.

Many experts feel that high interest rates help boost the leasing industry. When interest rates go up, tree care companies start looking for options other than a bank loan.

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