Branching out: trees in and beyond the forest. Special section, [Vol. 13, No. 5] [October 1989]

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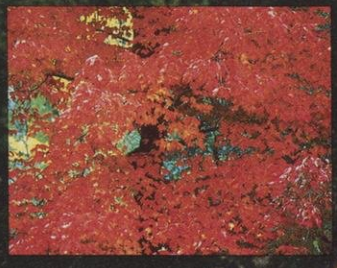
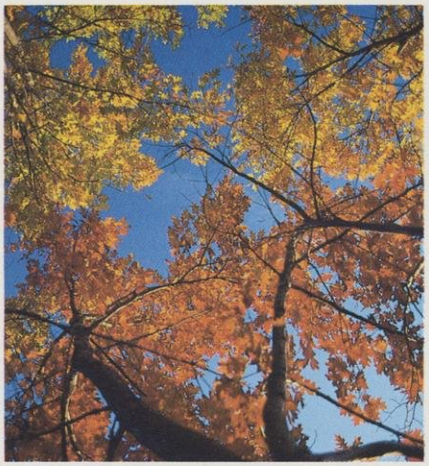
Branching out: Trees in and beyond the forest



What's a tree to you?



BARBARA MULVANEY

Depending on your viewpoint, it could be: an air conditioner, a gene storehouse, a 50-foot matchstick, a means of transportation, a raw material, a source of community pride, a dog's best friend, a people magnet. A frame for a perfect sky. An investment. A vote of confidence in the future.

Perspective is the key. The following articles were written to bring together a number of views and ideas about trees and forests in the modern world. Perhaps your image of what a tree is will change by the time you've finished reading.

CONTENTS

FRONT COVER: Towering pine, Arvid Widvey; tree planters, Pat Skiera; autumn leaves, Chris Mattison; wood truss construction, USDA Forest Service Forest Products Laboratory

Produced by the DNR Bureau of Forestry
Edited by Maureen Mecozzi

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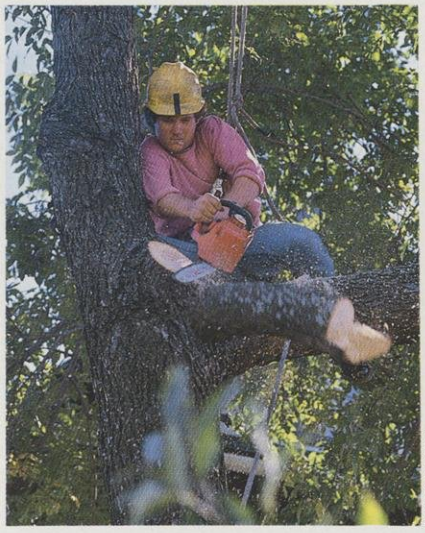
It isn't easy being green

Trees are vanishing from the landscape of urban America faster than free parking stalls. We ignore their departure at our own peril.



ROBERT QUEEN

Holly Kuusinen

Millions of people around the country waited anxiously to hear: Would the mighty 500-year-old Treaty Oak of Austin, Texas survive the deliberate poisoning that threatened to end its long, historic life? Could professional foresters counteract the chemicals streaming through its xylem?

Gifts and bouquets of flowers were placed at the base of the tree by Aus-

Tending to trees in the city requires skilled workers and heavy-duty equipment. Municipalities allotting funds and time for tree maintenance are likely to have healthy, thriving specimens shading boulevards and side streets.

ROBERT QUEEN

JEAN B. MEYER

Don't cross that line! Overhanging branches become a hazard when they're allowed to grow over telephone and power lines. The cardinal rule of street-tree planting: Fit the tree to the space available. Check with an arborist to find out how high and how wide the species will be at maturity before ground is broken.

tin residents, young and old. Get-well cards came in from all over the country . . . for a tree. A tree in the city.

Foresters went to extraordinary lengths to save the beloved oak. Right now, there's hope; the tree is responding favorably to treatment. But it isn't out of the woods yet. No one knows if the Treaty Oak will live to bear silent witness to another half-millennium of Texas history.

The outpouring of human affection for the Treaty Oak may come as a surprise to anyone strolling the streets of America's cities. Even a casual observer can see that urban trees endure abuse seldom experienced by their forest counterparts:

Trees in the city absorb carbon dioxide and some vehicle emissions; the roots take in road salt and oil that filters through the soil in spring runoff. Root systems suffocated by cement sidewalks and asphalt driveways are further threatened by routine applications of herbicides and other lawn chemicals.

Cars back into delicate tree trunks. Lawn mowers gouge bark. Kids on swings stress limbs meant to hold squirrels. Signs nailed into trunks give access to insects and disease. Vandals tear saplings out by their roots and storms rip limbs and branches away in the wind.

It isn't easy being green in the city. Although we stand in awe of the majestic pines and graceful hardwoods in our forests, we tend to ignore the trees shading our homes, boulevards and parks.

We aren't completely blind to the advantages trees bring to our cities or to the care those trees need, however. There's a movement afoot dubbed "urban forestry" offering city dwellers a chance to turn over a new leaf.

The concept of urban forestry is simple: Focus the same attention, concern, research and money on trees in the city as we do on trees in the forest. Why? Because the value of a single pine in an urban park may be different, but not less, than a stand of popple.

As you'll see in the following boxes, a healthy tree in the city does much more than provide a place to tack up a "No Parking" sign. Read on and you'll be convinced that every urban tree should receive the affection and respect given Austin's Treaty Oak. ■

Public information officer Holly Kuusinen follows forestry issues for the Department of Natural Resources.

Nature's quality control experts

Trees play an especially important role in regulating the urban environment:

— they deflect icy winter winds, reducing heating costs by 50 percent.

— they provide shade, which can reduce air conditioning costs from 20 to 50 percent.

ROBERT QUEEN

— people breathe in oxygen and exhale carbon dioxide; trees "breathe in" carbon dioxide and tons of man-made airborne pollutants and "exhale" oxygen, which people like to breathe.

— trees, especially evergreens, are excellent noise buffers, absorbing sound from traffic and playgrounds.

— their roots hold soil, reducing runoff and allowing the ground to absorb rainfall to recharge aquifers.

— they're natural humidifiers, releasing water absorbed as rainfall back into the air through the leaves.

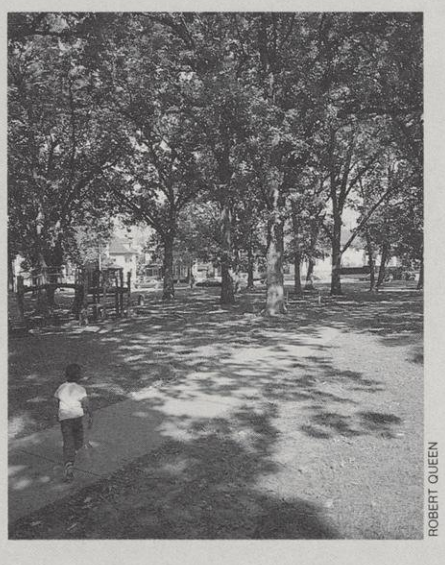
— they protect watersheds by controlling erosion.

— they serve as filters for pollutants that would otherwise leach into groundwater.

How valuable are your trees?

If you could bank the bucks the average 50-year-old tree has contributed to the environment during the course of its lifetime, you'd never have to play the lottery:

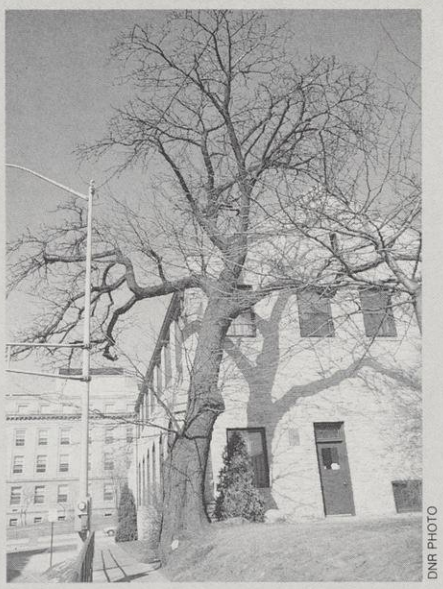
$31,250 in oxygen
$62,500 in pollution control
$31,250 in soil fertility
$33,750 in recycling water as a humidifier



ROBERT QUEEN

Budgeting for trees

A well-managed urban forest represents a sizeable investment portfolio for a Wisconsin community. For instance, Milwaukee's 1986 forestry budget for maintaining 324,000 existing street trees, planting 7,657 new trees and maintaining 117 miles of landscaped boulevards and vest-pocket parks was $8.5 million.



DNR PHOTO

Mean streets

An oak or maple capable of living 200 to 400 years in a forest survives . . .

. . . 40-80 years in a sheltered corner of a college campus

. . . 25-30 years in heavily used city parks

. . . 12-18 years along suburban street rights-of-way

. . . 3-4 years in downtown "planting pits"

Return on your investment

A U.S. Forest Service study shows that real estate values could increase as much as 20 percent with the addition of well-managed trees. The Council of Tree and Landscape Appraisers, in cooperation with the International Society of Arboriculture, roughly places the dollar value of a healthy, mature tree on a well-landscaped lot at:

10-inch diameter: $1,729
14-inch diameter: $3,388
18-inch diameter: $5,588
26-inch diameter: $11,682
30-inch diameter: $15,554

Think before your dig

Almost any tree species growing in a Wisconsin forest can grow in an urban environment if it is properly planted on a suitable site and given sufficient room to grow, if the roots are never disturbed and if it is regularly watered, fertilized, pruned and inspected for insects and disease. For an urban tree to survive, it needs routine care and maintenance.

When choosing a tree for an urban environment, talk to an arborist about the site you have in mind. Some areas of your yard may retain moisture better, get more sunlight or be more exposed to the wind than others; these are factors you'll want to consider before you start to dig. Certain species, such as the ginkgo, can tolerate urban pollution well — a point to consider if you're planting on a heavily-traveled road. Saplings of species that are shade-tolerant can be planted under older trees and eventually succeed them. Will the tree produce fruit or nuts that you can eat, or wildlife will eat? Will it shed seeds or pods you'll have to rake up? A little thought beforehand will save disappointment later.

PAT SKIERA

Starting an urban forestry program

You don't need city-owned walkways and greenways in boulevards to have an urban forest. All homeowners with trees in their yards contribute to a community's urban forest, and everyone can work together to make informed decisions that will affect the community's environmental health and property values in the future.

AL STENSTRUP

Education is essential to the success of any urban forestry program. At Milwaukee's Havenwoods State Forest, kids learn how roots anchor a tree to the ground and how root hairs supply the tree with nutrients drawn from the soil. Later, the striplings gather 'round for a portrait with a sapling.

Whether you live in the City of Milwaukee or the Village of Gresham, you can promote and protect your urban forest resources through activities ranging from public policy and decision making to education to hands-on planting and tree maintenance.

Where to start

First, contact your mayor, village president or town chairperson to determine what formal activities may already exist. Many Wisconsin communities don't have a forestry committee overseeing the maintenance and planting of trees. You may get the chance to start a program. You may also contribute time to an existing program.

Then, drive through town some afternoon and take a mental inventory of the trees in your community.

Chances are the majority of them are large, mature trees nearing the end of their natural lifetimes. As a tree ages it becomes more susceptible to storm damage, insects and disease,

AL STENSTRUP

and because of its size, may be more difficult to trim correctly. Because no tree lives forever, it's important to plan for the day when that tree has to be removed and replaced.

How many young trees do you see during your drive through town? Not many, probably. If most of the trees in the community are roughly the same age, there's a very good chance many may have to be replaced at about the same time, especially if they are of the same species — an expensive prospect.

Whether you're a homeowner or the city planner, careful planning now and regular plantings will make the transition less painful aesthetically as well as financially. Periodic tree maintenance will extend the life of your urban forest.

Share your impressions with others and begin to develop some allies interested in starting a tree program. You need to create an awareness and appreciation for your urban forest. Work with your local newspaper to heighten awareness and recruit other concerned citizens.

Form a team of interested and knowledgeable people. Contact representatives from the Department of Natural Resources forestry program, local nursery or university forestry or horticulture program to serve as specialists on your team.

Together you can work with your local government to evaluate your community's situation and establish a management plan.

For a step-by-step guide, contact the American Forestry Association and ask for "Save Our Urban Trees." Call AFA at (202) 667-3300 or write them at 1516 P Street NW, Washington, D.C. 20005.

— H.K.

Think globally, plant locally

An ambitious program to combat the greenhouse effect has its roots in your own backyard.

James Bartelt

When Wisconsinites take on a project, they like to do it up big. Nobody knows that better than Donald Thompson, a DNR forester and state coordinator of Global ReLeaf — the national effort to plant 100 million trees in urban areas by 1992. Not one, not 10, but 100 million trees.

By Thompson's reckoning, Wisconsin residents and communities planted over 25 million seedlings and saplings in the spring of 1989 — four million during Forest Products Week in April alone! Initial projections were for a modest one million, hence the campaign slogan, "Be one of a million."

"We'll emphasize planting again next year," said Thompson. "We need to keep up public awareness of the value of trees."

Global ReLeaf, part of a multi-faceted approach to combat global warming, was launched in the fall of 1988 by the American Forestry Association (AFA). While legislation designed to reduce air pollution and international initiatives to protect tropical rain forests are included in the AFA's strategy, the organization recognized the need for direct public involvement.

"The right niche for any particular organization and citizen is something they can do, not just something they hope someone else will do," read the association's official introduction of the program in American Forests magazine. "Tree-planting has the virtue of being an action that moves in the right direction and that educates about the fundamental nature of the global issue at the same time."

BOB WALLEN

Digging in for the planet: A pine takes root with the help of a few friends on Arbor Day. Trees ease the greenhouse effect by absorbing carbon dioxide and releasing oxygen.

The "fundamental nature of the global issue" is simple: There's too much carbon dioxide in the atmosphere. It's there because human beings are burning excessive quantities of carbon-based fuels, like coal, gasoline and wood. When the sun's rays hit the earth under normal conditions, they bounce back to the atmosphere as longer-wave heat and the heat dissipates into space. But heavy concentrations of carbon dioxide in the air trap heat and reflect it back toward earth. Cities — where acres of concrete buildings and miles of asphalt pavement soak up heat like marathon sunbathers, creating "heat islands" — are especially vulnerable to a rise in the mercury.

Higher global temperatures could turn once-fertile lands into deserts and cause ocean levels to rise, flooding coastal cities and contaminating groundwater aquifers with salt water.

Trees help stave off the sizzle because they use CO_2 in photosynthesis, the process by which cells in green plants convert light to energy and make carbohydrates from carbon dioxide and water. Oxygen is released into the air during photosynthesis, restoring the atmospheric balance and making breathing a little easier for Earthlings. Plus, trees provide much-needed shade to cool roasting cities, decreasing the amount of energy needed to run air conditioners, refrigerators and other appliances.

One hundred million trees planted in U.S. urban areas would add the equivalent carbon dioxide-absorbing capacity of a forest the size of Connecticut, notes the AFA. An estimated 40 billion kilowatt hours of energy could be saved as well.

Rooted in the community

"We can act by planting trees in an urban environment," says Robert Skiera, Milwaukee city forester and chair of an AFA urban forests task force. "Global ReLeaf is really a tree awareness program on how trees function in the environment. It's a sort of 'take care of your tree and it will take care of you' message."

PAT SKIERA

Eight thousand trees were planted in Milwaukee in 1989. In 1988, the total was 5,300. "The drought of '88 was a good lesson in what trees can do," Skiera observes. "Shade trees can reduce the heat island effect by as much as 10 degrees."

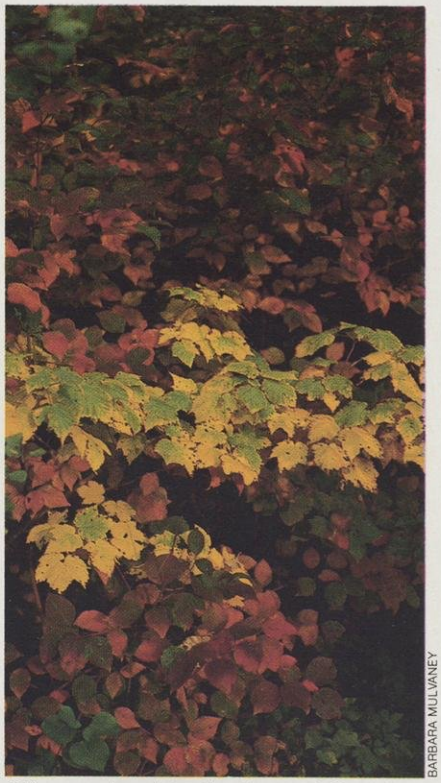
Milwaukee's progressive forestry program encompasses the whole city, not just the tonier boulevards. "We've made a special effort to include industrial areas of the city in our tree-planting program," says Skiera. "We're planting trees in the industrial Menomonee River Valley. It was a railroad yard with literally no trees. We want to reforest it, make it attractive to people."

Milwaukee isn't the only Wisconsin city to go out on a limb for the planet. Twenty-six Wisconsin municipalities received "Tree City" awards from the Arbor Day Foundation in 1989. To be eligible, cities must have an agency dealing with forestry and a budget of $2 per resident for forestry. Individual effort was recognized when the governor's office presented 18 champion tree planters with

GLOBAL RELEAF

The American Forestry Association

AL STENSTRUP



BARBARA MULVANEY

Gifts growing into the future: Milwaukee schoolchildren leave behind something the class of 2040 can look up to (top); leafy beauty renewed each season for years to come (middle); a special living memorial to Dr. Martin Luther King Jr. is ready to grow at Havenwoods State Forest (bottom).

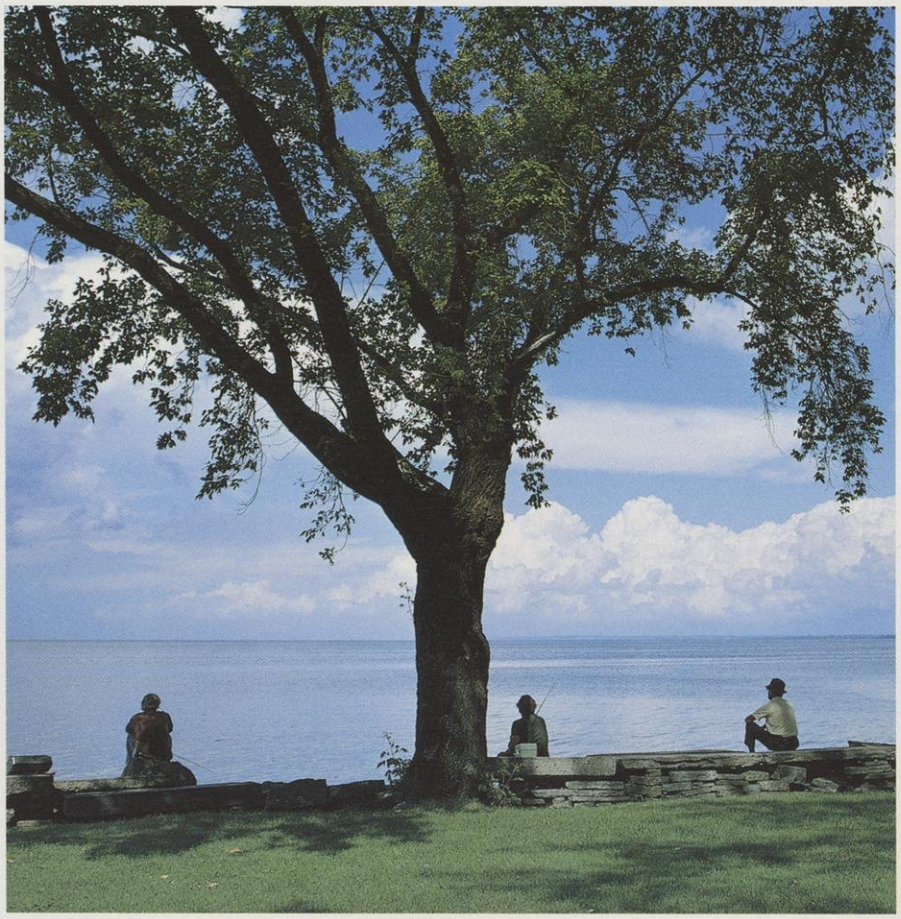
awards after the "one of a million" campaign.

AFA foresters would like Global ReLeaf to become an on-going program. "We don't want it to stop in 1992," says one. "The problem demands continuity."

His thoughts are echoed by naturalist and author James R. Udall, who wrote in a recent issue of Sierra magazine: "Devising a strategy to combat global warming is not like finding a cure for cancer. The ailment's causes are known. Coming up with a prescription for a cure is child's play; filling it, though, is a Herculean task. Any attempt to halt climatic change must be global in scope and must persist for decades, even centuries. In one fashion or another, these efforts will affect the lives of everyone on the planet."

If the 25 million trees planted here in 1989 are any indication, people in Wisconsin are prepared to take on that task. ■

James Bartelt, former Capitol correspondent for the Green Bay Press Gazette, frequently covered environmental stories for the paper; he continues to write about nature and politics in retirement.



DEAN TVEDT

Framing the gathering clouds above Lake Winnebago, trees define urban space in this Fond du Lac park, lending grace to the shoreline landscape.

PAUL PEETERS

Besides making city neighborhoods more habitable for humans, urban trees provide habitat for nesting orioles and other bird and wildlife species.

Green acres

What better legacy could you leave to future generations than a clean, green Earth?

Here's what you can do to make a difference:

1. Plant and care for trees in your yard and in your community. A greener life is more beautiful, more healthful and more energy efficient.

2. Support public policy for reforestation, energy conservation, and pollution emission controls.

3. Recycle and practice energy conservation at home.

For information, write: Global ReLeaf, P.O. Box 2000, Washington, D.C. 20013.

Plastod and wetal

No, they're not Saturday-morning cartoon heroes. Try two valuable forest products created with new wood-processing techniques.

David L. Sperling

Innovation. It's as important to foresters as to car makers. It may not be especially thrilling to consumers, who are often less concerned about added safety features or extra-efficient engines and more interested in the latest colors on new car models. Yet these behind-the-scenes changes are important; they ultimately bring better products at cheaper cost.

Forestry innovations are much the same. Some are marketed as jazzy new wood products and others are root-deep techniques for growing trees better, stronger and faster. All contribute to the growth of the industry. Here's an overview:

A field guide that sees the future — This new field guide for northern forests predicts what a forest will look like 30, 40 even 70 years hence. By inventorying soil types and the varieties and numbers of small seedlings and shrubs, foresters can better gauge the mix of hardwoods and softwoods a tree stand will naturally contain. Forest plans can then complement rather than buck natural succession.

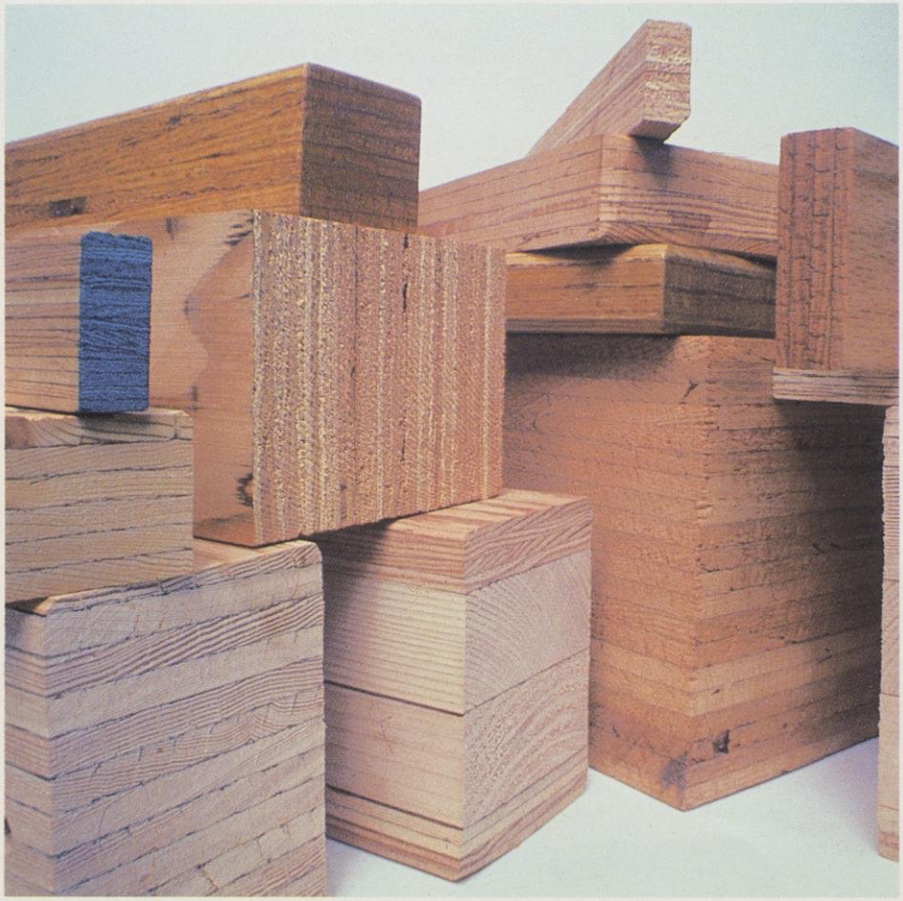
Waferboard and nonveneered panels — The most important new wood product in the last decade is plywood and paneling formed from flaked or chipped wood. Chipping and gluing methods enable manufacturers to form durable, strong wood panels from cheap, abundant hardwoods from the Upper Midwest and Canada. The next generation of these conglomerations, called oriented strandboard, will be shaped and curved at the factory to form elegant but sturdy construction materials.

USDA FOREST SERVICE FOREST PRODUCTS LABORATORY

A new wrinkle: Resin-coated wood chips and flakes are injected with steam and quickly molded to form sturdy particle board and flakeboard. Instant pressure and blistering 280-315° F heat cure the adhesives, turning loose chips into solid board in less than two minutes.

More board feet for the buck — Computer technology is at work in the sawmill. Laser devices automatically measure logs and set saw cuts to get the most and the strongest lumber from each log, the most plywood from each plank.

Strong lumber from "weaker" trees — Despite the name, it's hard to get durable, straight lumber from many hardwoods. New sawing methods called "saw, dry and rip" are producing quality lumber from hardwoods that formerly warped and twisted when dried. Green logs are sawed into 1 3/4-inch strips called flitches. These are dried at hotter than 212° F to less than 12 percent moisture. Like a sauna, the hot temperature relaxes lignin (the glue holding the wood fibers together), loosens stresses and allows wood fibers to slip past each other while cooling. This



PHOTOS ON PAGES 10-11 COURTESY USDA FOREST SERVICE FOREST PRODUCTS LABORATORY

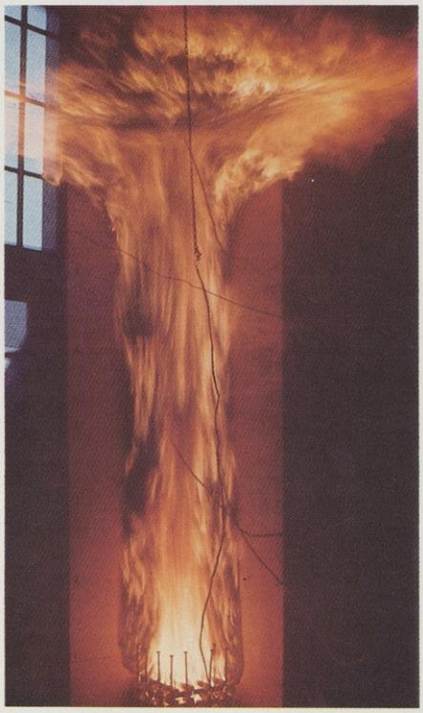
Laminating, or slicing thin strips of wood and gluing them into layers, creates a wood product with characteristics similar to plastic and metal. Wood products can be molded, bonded and shaped to be structurally strong in every direction. The opportunities for meeting the needs of business and industry with the renewable resource of trees is wide open for those willing to invest in change and innovation.

Testing the tensile strength of various types of wood and new wood products is a key to comparing product quality.

produces straighter boards that can be rip-sawed into studs. Using this technique, tests show lumber could be cut from yellow poplar, aspen, blackgum, eastern cottonwood, sycamore, red alder, paper birch, black willow, basswood, soft maple, sweetgum and black cottonwood.

Laminated veneer lumber — Thick slabs of veneer are glued and cut to form strong, durable lumber. It doesn't warp, split or check because the veneers are dried before they are glued together and the laminated layers disperse the wood's weak points. As high-quality sawn lumber becomes more scarce and more expensive, laminated lumber is increasingly used for building trusses, I-beams, door and window headers, bench seats, scaffolding, ladders and bridge stringers.

No fuel like an old fuel — Wood, especially hardwood, can be ground and distilled to release a variety of solvents and fuels. One oldtimer that could be blended with gasoline is wood alcohol. In the early 70's, energy research predicted corn and trees could provide a significant share of our energy needs, but this



Judging wood by its cover: Wood preservatives, stains and paints get a trial by fire to prove their resistance to heat and flame.

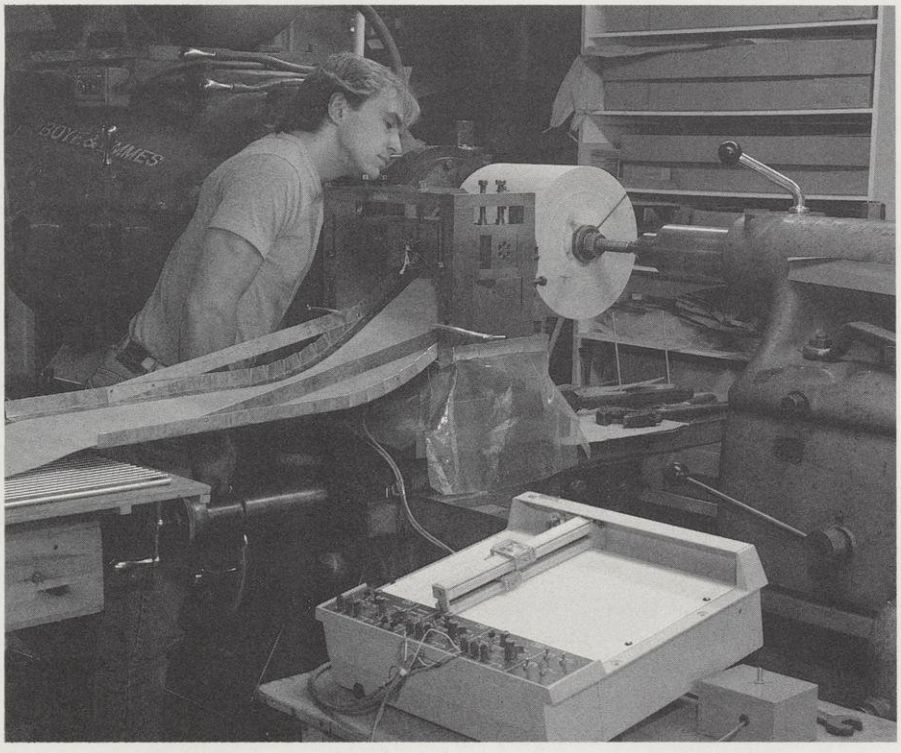
biomass research was put on the back burner as oil dropped in price on the world market.

Plastod and wetal — Growing interest in bonding wood to other materials has shaken up foresters accustomed to seeing solid wood products. Plastic/wood fiber composites are being tested in auto body parts, metal/wood composites could form building materials and even glass/wood combinations will be tested in the near future.

Corrugated fiberboard — Soft fibers are molded in a waffle-like pattern and then glued together; two sheets can be sandwiched together to form lightweight corrugated boxes 30 to 200 percent stronger than conventional corrugated boxes. Several layers can be glued to form thick layers that are strong in every direction, providing new, lightweight building materials sturdy enough for walls.

Corrugated paper from hardwoods — Corrugated paper is traditionally made from long, easily bonded softwood pulp. Newer processes can produce strong, smooth paper from shorter, stiff hardwood fibers by applying heat and pressure as the pulp is formed. As the technology improves, recycled paper could be added to the mix.

I want some steam heat! — Steam injected pressing is a new technique in which a large box that looks like a pants presser injects steam into wood chips and flakes that have been coated with sticky resins. Under tremendous pressure, steam raises the temperature in the middle of the wood to 280-315° F. High temperature and pressure can cure the adhesives in flakeboard and particle board in less than 90 seconds; otherwise composites must be pressed for four to five minutes.



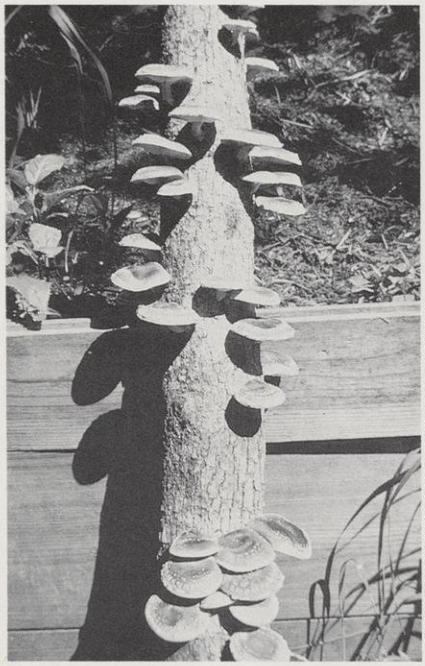
Take it all off: Beautifully grained wood is carefully peeled in thin sheets of veneer that are glued onto cheaper woods or composites to mimic the luster and warmth of solid wood. Quality veneer logs of red oak, white oak and black walnut can be worth $60-$100 apiece.

Better protection and finishes to protect wood — Wood and water just don't mix. In fact, wood's biggest drawback as a building material is that it swells in humid weather and shrinks when dried out. An old-time wax-like coating, called PEG (polyethylene glycol-1000) is coming back into favor among carvers and hobbyists as a effective dip to combat humidity. The waxy chemical dissolves in warm water, is noncorrosive and nontoxic. Green wood like new gun stocks, wood carvings and furniture parts can be protected safely and at low cost using this preservative.

Truss-frames for homes — Premade trusses are used to frame sturdy, durable homes with 30-40 percent less wood than is needed to build conventional "stick" framed homes. The prefab floor-to-roof trusses are joined by regular wall studs every 24 inches using 2x4-inch lumber. Since the trusses span the entire width of most homes, basement supports are not needed and load-bearing walls need not be constructed on the first floor. The building technique allows more open, airy construction with the strength of wood framing. Since framing takes less time on the building site, homes built using premade truss-frames cost about 10 percent less than traditionally-built homes.

Biopulping — Twelve paper companies plus public partners have formed a consortium to examine new methods of making paper products with fewer chemicals. Currently, wood is ground, mixed and treated several times to separate wood fibers. The consortium is examining if nature's methods of decomposing wood can be used to break down lignin. By examining the fungi that make wood rot and understanding the biochemical reactions that release wood fibers, the group believes paper products could be manufactured with fewer pollutants at less cost. The linchpin in the process is biotechnology, a technique for artificially manufacturing large quantities of these natural decomposers.

One spin-off industry from biopulping is the Shiitake mushroom business. Scientists took an interest in this gourmet tree mushroom that also breaks down lignin. The technology for cultivating the mushroom spawned a new food industry as well as capturing the interest of paper researchers.



USDA FOREST SERVICE FOREST PRODUCTS LABORATORY

Shiitake mushrooms — a sidelight of the search for fungi able to break down wood into paper fibers. Raising these delectable tree mushrooms is a growing business in Wisconsin. More than 15 commercial growers and 1,150 hobbyists produce an estimated 33,500 pounds of the meaty-tasting mushroom that fetches $5-9 per pound in gourmet shops.

Whiter whites in waste — Paper we write on and read is crisp and white, but it doesn't start that way. Even chemicals, bleaches and fancy filtration equipment don't remove most of the brown lignin colors from pulp and pulping wastes. Most bugs and bacteria in waste treatment systems can't remove them either. A technique pioneered by the USDA Forest Products Lab and North Carolina State University uses the decaying properties of the white-rot wood fungus to naturally digest the color in pulping wastes. In tests, an enzyme in the fungus removed more than 80 percent of the dark color from pulping waste in one day. Since the fungus completely breaks down lignin, it also degrades organic wastes in pulp. If the fungus can be produced economically in large quantities (perhaps through biotechnology) and its residues prove benign, the process could reduce or eliminate the need for chemicals to removing color from paper effluent.

New uses for lignin — Equally exciting is the prospect that lignin, wood fiber's natural cement, could be used to form new wood products. Wood is 25-30 percent lignin; the substance binds cellulose fibers and gives wood its rigid yet flexible structure. As technology improves for separating and purifying lignin with enzymes, this once-potent waste could become an important component in papermaking and a new feed stock for natural adhesives and solvents.

Separating stickies — Wastepaper recycled into pulp contains adhesives that can't be wetted and readily separated from paper fibers. Papermakers call these globs of contaminants "stickies" because they stick to the rollers and presses, gumming up papermaking equipment and leaving unsightly blobs on the final product. Removing stickies has slowed the paper industry's enthusiasm for recycling paper.

A new technique developed at the Forest Products Lab and the University of Wisconsin separates stickies by slowly pouring recycled paper slurry over a wide, metal disk spinning at high speeds. Stickies and pulp fibers are about the same weight and density but the spinning wheel separates the wet pulp from the stickier adhesives, paving the way for higher-quality paper and more recycling.

They stay crunchy, even in milk — Cardboard boxes are light, sturdy containers, but they can fall apart or get flimsy if they get wet. Researchers are developing processes to keep paper and corrugated boxes stiff even after they're exposed to moisture. Using the SOFORM process, wet wood fibers are treated with formaldehyde in presence of sulfur dioxide. When these treated materials are dried at high temperatures, cellulose fibers form strong chemical links that lock the molecules together. Corrugated paper made from this process doesn't swell or lose strength in humid weather or when wet. ■

David L. Sperling edits Wisconsin Natural Resources and serves as president of the Plastod Fan Club.

Bridging the gap

New techniques for wood bridge construction may revive an old standby on Wisconsin roads.

Jim Bishop

"Over the river and through the woods to Grandmother's house we go . . ." Getting to Granny's years ago usually meant traversing rivers on wooden bridges. A few of those sturdy, swiftly built (the construction material was on hand right in the forest) spans remain. But most are gone, replaced by structures of concrete and steel.

There's a movement underway in Wisconsin to bring back the wood bridge. Of the more than 13,000 bridges in the state over 20 feet in length, 300 to 400 are repaired or replaced annually. Lew McCreery, a timber bridge specialist with the Resource Conservation and Development office in Medford, notes that many of these bridges are between 20 to 60 feet long — ideally suited for replacement by a modern wood structure.

In the summer of 1988, an innovative wooden bridge was constructed over the Iron River in Ashland County within the Chequamegon National Forest. Built with timbers

and federal funds, the 34-foot bridge on Forest Road 183 is the first of its kind in the state.

Strength from stress

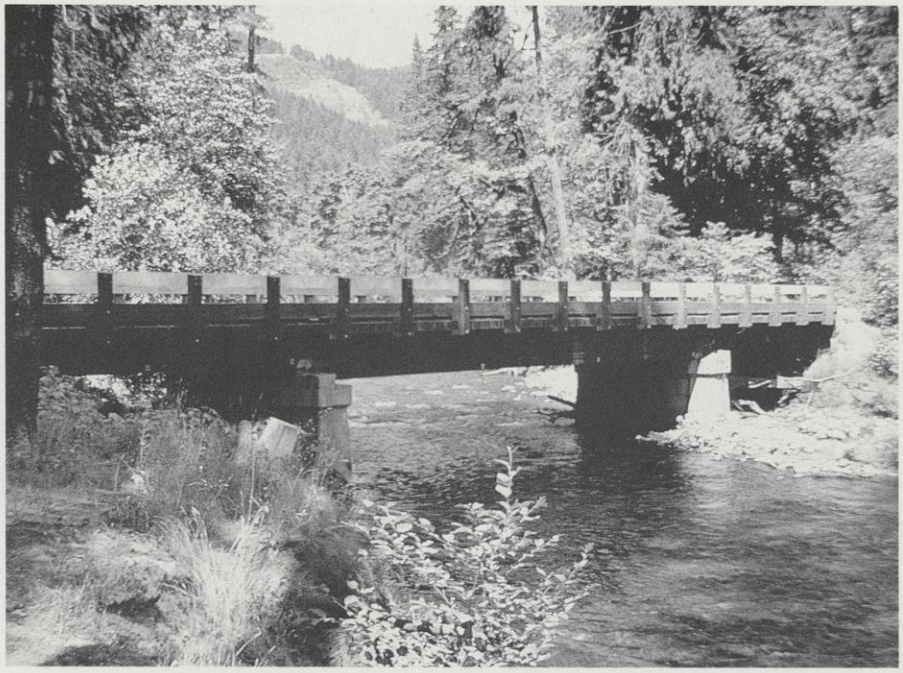
To give added strength to their new structure, the designers and engineers used a stress-lamination method developed in Canada. No nails are driven or spikes pounded in this method of bridge construction; only steel rods and unique joinery are used to create the tension that holds the timber members together. Periodic tension adjustments keep the bridge deck a solid mass.

Prior to construction, all the wood was pressure-treated with preservative, creating a lasting barrier to moisture and insects. Southern pine was chosen as the decking wood because of its strength, ease of treatment and price. The species has been used successfully in bridge construction elsewhere. Wisconsin's hardwoods and softwoods have not yet been tested on modern bridgework. "As timber bridges become more popular here," says Ken Hujanen, timber marketing specialist for the Department of Natural Resources, "more local wood will be treated, tested and used."

Eighty-one 4 by 8-inch timbers 34 feet long were pre-assembled into four six-foot wide sections and trucked to the site. A center pier was added for stability. Rob Fallon, U.S. Forest Service engineer and head of the bridge-building project, said no center pier would have been needed if 12-inch beams had been used.

The bridge was built inside of a month. Most of the construction time was spent improving the abutments and driving in the pilings; it took only four hours to lay the four sections of deck. A large crane lifted the sections off a truck and set them in place. They were bolted in and the bridge was ready for use. A layer of asphalt was applied for a smoother ride and to provide more protection from the elements.

Against the backdrop of the forest, the bridge looks like part of the landscape. After a year of use, mostly by logging trucks and recreational vehicles, the structure has sustained no damage. "We run regular tests for moisture content and stress loading," says Fallon. "This bridge was designed to last 50 years." He added that another bridge to be built with oak, red pine and Southern yellow pine using a glue-laminating process (strips of wood are glued together to form beams) is being planned for the Teal River in Sawyer County.



USDA FOREST SERVICE FOREST PRODUCTS LABORATORY

Wood bridges blend gracefully into rural landscapes. Modern construction methods, strength and low cost make wood bridges a good choice for spans up to 60 feet long.

A bridge too far?

McCreery, Hujanen and other wood-bridge proponents believe they've got a good alternative to metal and concrete spans, especially for rural roads. They cite esthetics, high strength-to-weight ratio, cost, local wood availability, jobs and ease of construction by local highway crews as a few of the many positive attributes of timber bridges. And wood is not affected by road salt, the annual winter plague upon concrete and steel.

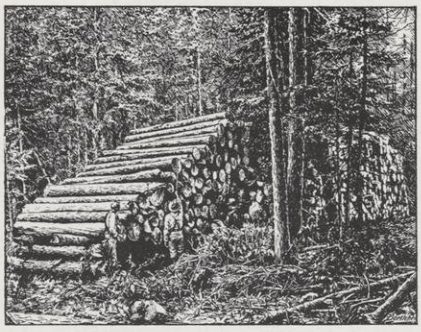
Another wood bridge advocate is Mike Oliva, professor of civil engineering at the University of Wisconsin-Madison. Oliva and other researchers see a bright future for modern, stress-laminated timber bridges on all roadways. "Wood can take tremendous stress," he says. "It's proven its use on airplane propellers and railroad bridges."

Stan Woods, state bridge engineer, takes a different view of timber spans. Although Wisconsin has 542 standard wooden bridges and 12 to 25 more are constructed per year, Woods isn't impressed. "By their very nature, timber bridges are applicable only to low-volume roads," he says. "They just cannot take the constant pounding of high-volume traffic."

According to Woods, state contractors and engineers are familiar with concrete and steel bridges and can replace or repair them in a relatively short time. "To replace an 80-foot bridge would take about six weeks maximum," he claims.

It's uncertain if the modern, laminated timber bridge will have a place in Wisconsin's transportation future. Should it ever become more predominant in the rural landscape, getting to grandma's house will be just like old times. ■

Jim Bishop is a public information officer in DNR's Northwest District.



Forest on the fast track

Advances in biotechnology may speed the growth of tomorrow's forests.

Trent Marty and Maureen Mecozzi

The road of scientific progress seldom follows a simple or straight route. Hypotheses become lengthy, convoluted detours. Limited funding brings the best of experiments to an abrupt halt. Morality sets up roadblocks to inquiry.

Occasionally, a discipline makes a bold leap beyond all the theoretical, financial and ethical traffic jams blocking the way. Brent McCown, professor of horticulture at the University of Wisconsin-Madison, has led such a leap in the fledgling field of forest biotechnology.

"To seriously suggest that one could genetically alter a forest tree and then produce thousands of exact copies of that new plant was heresy five years ago," he says. Today, McCown can point to genetically manipulated poplar trees able to resist the effects of herbicides, enabling them to grow unhampered while weeds are suppressed. He's also experimenting with splicing the bacterium *Bacillus thuringiensis* into poplars to make their leaves a deadly dinner for tent caterpillars and gypsy moths.

McCown's trees are still in the greenhouse — he plans to apply for permits from state and federal officials to plant them outdoors for a field test after further lab experimentation. "It's a sensitive issue," McCown allows, acknowledging public concern about the release of genetically engineered plants into the environment. "Any field test should be carefully controlled to guard against unwanted ecological effects."

Mass production

Due to their longevity, trees have long posed a problem for plant breeders. Fifteen to 25 years may pass before a species fully matures and breeders can begin propagating a strain with desirable traits.

Biotechnology has put the forest on the fast track by allowing researchers to produce trees in the lab in a shorter amount of time than a conventional breeding program.

Let's say there's a certain white spruce with outstanding form and vigor growing on a hill just outside of Wausau. This tree is so special the Wausau city council wants to plant 500 exactly like it all around town.

The council could have the Boy Scouts collect the cones and let local 4-H clubs raise the trees from seed. Or, they could choose to have this extraordinary spruce *micropropagated* by a biotech lab.

Methods of tree propagation — grafting, root layering — have been around for centuries. Today's biotechnicians have refined and accelerated the propagation process. They start by placing tree tissue, organs (a bud, a leaf) or individual tree cells in a growing medium — usually agar, the brown gel on which you grew bacteria in your high-school biology class. By altering the hormones in the growing medium, researchers can mass-produce shoots, callus tissue or single tree cells.

Shoots are clones — exact copies — of the micropropagated tree. "There's seldom a chance of mutation with shoots," McCown says. Aspen, poplar and more recently, white and Norway spruce, have been cloned in this way. Many of the rhododendrons, dogwoods and other ornamental shrubs sold at garden centers are produced using the shoot-culture method.

Blasted trees!

Quantities of cloned callus tissue or single cells are useful for genetic engineering experiments, the vanguard of biotech.

Let's say the goal is to develop Norway spruce resistant to bark beetles. By transferring the right gene (a tiny section of DNA) from a donor organism to the tree, researchers can alter the tree's reaction to the insects. The donor organism can be a fungus, bacteria, virus, another plant or any other living thing.

While there are a number of ways to transfer genes in plants, a new technique called biolistics shows the most promise.

"Blasting, or biolistics, works on a much wider variety of organisms than traditional methods of gene transfer," says McCown. "Basically, we're shooting or blasting the genes into tree cells at a high rate of speed." Blasting, notes McCown, makes it easier to put in several specific traits without disrupting the genetic changes made in the past. The method is being refined at the UW in conjunction with Agracetus, a private biotech firm; spruce and poplar are the species under study.

Gene transfer and micropropagation will complement, not replace,

The micropropagation of white birch: A piece of tree tissue is placed in agar, a jellylike extract of seaweed. Nutrients and hormones are added to the goo, and within several weeks, shoots begin to form.

PHOTOS COURTESY OF THE UNIVERSITY OF WISCONSIN-MADISON HORTICULTURE DEPARTMENT

The shoots, or treelets, are separated and replanted in a new growing medium. The treelets that form roots are transplanted to a greenhouse.

Treelets are raised in soil under the greenhouse glass for about six months, gradually becoming acclimated to seasonal cycles.

Then, it's out to the nursery bed and the real world of wind and rain, snow and sun. The young birch trees are exact genetic copies, or clones, of the tree whose tissue first was used to begin the culture.

conventional tree breeding programs. Although researchers can adjust certain genetic attributes, it's doubtful they will ever be able to create a tree from scratch. Superior trees for Wisconsin's future forests will begin by using the best tree material available and then applying biotechniques to build in other desirable qualities like disease resistance.

Biotechnology is a short-cut on the road of progress in forestry, but short-cuts have their drawbacks. Micropropagation, at this writing, is expensive and time consuming. The consequences of raising altered trees in the natural environment are unknown. Genetic engineering of trees (and animals and humans) poses difficult ethical questions; the answers we accept could change the way we perceive life itself.

All of which means it would be wise for forestry researchers and the public to follow the rules of the road and proceed with caution. ■

Trent Marty is DNR's tree improvement specialist and nursery coordinator; Maureen Mecozzi edits supplements for Wisconsin Natural Resources.

Protecting your forest home

A country home set amid a pine grove preserves your peace of mind and privacy, but what preserves your home during a forest fire? Some communities limit house building on the fringes of densely forested areas because these homes are particularly vulnerable when an inferno rages through the woods. Rural volunteer fire departments are responsible for dousing fires at isolated homes and buildings nestled among the trees. They respond as quickly as they can, attempting to outrace the fire and protect the home.

DNR foresters battle "wildland fires" — fires in forests and undeveloped areas. Rural firehouses, police departments and ranger stations are linked with communications equipment provided through government grants, allowing volunteers and emergency staff to coordinate a fast, efficient response to remote fire sites.

Homes in the forest require an extra measure of preparedness against the threat of fire and DNR staff are available to meet with rural property owners to discuss safety measures. Your best defense is to protect your home and outbuildings by following these recommendations of the National Fire Protection Association and your state forester:

1. Check with local officials to see what fire protection is available, and how to summon help in the event of a fire.

2. Clearly mark your driveway location and address so emergency vehicles can find your home.

3. Make sure your driveway is at least 18 feet wide, to accommodate a fire truck. Remove overhanging limbs and other obstructions.

4. Use fireproof materials in building construction. Nationwide, the number-one cause of home loss from wildfires is from untreated wood shake roofs, which catch wind-blown sparks. When building or remodeling, check with your architect, builder or fire inspector about fireproof walls and window protection.

5. Don't stack firewood or debris near the house. Obtain a permit from your local fire warden before burning debris such as yard waste or construction materials.

6. When landscaping your forested lot, remember to plant trees at least 30 feet away from the house or other buildings. If you live in a pine forest (pine is notoriously flammable), keep trees 100 feet or more from the house.

7. Clean gutters, eaves and roof regularly, especially during the fire season, to prevent accumulation of leaves, twigs, pine needles and other flammable materials.

8. Provide an adequate water supply to assist in fighting fires. Your well should have enough pressure to douse the house with a garden hose. Firefighters will also need to know the location of nearby creeks, ponds and other water from which they can draw water while fighting a fire.

9. Install a spark arrester in the chimney to prevent the escape of sparks and burning materials. Have your chimney cleaned at least once a year to prevent buildup of soot or creosote.

10. Use only Underwriters Laboratory-approved woodburning stoves and heaters in your home. Install them according to manufacturer's recommendations. Dispose of ashes and partially burned coals from fireplaces, woodstoves and barbecues by wetting them thoroughly and dumping them into an earthen pit.

For more information, contact your nearest DNR office or local fire department. ■

DNR PHOTOS

Forest fires claim more than trees: Engulfed by flames, this cabin near Manitowish Waters was reduced to a heap of ashes in a matter of minutes. Structures in isolated areas of the forest are especially vulnerable; fire precautions should be considered before any home or building is constructed in the woods.

In a pine forest, allow at least 100 feet of cleared area around homes, cabins or outbuildings. The margin of open space gives firefighters room to maneuver trucks and equipment during a blaze.

A home built smack dab in the middle of a piney grove may be nice, but presents a serious safety problem should fire break out.