Modern Forests

Critics of genetic engineering usually focus on the modification of humans, domesticated food crops, and farm animals. This should surprise no one given our anthropocentric culture. To the degree that anyone worries about wild species, they worry about ecological consequences of genetically modified crops; but until recently this has been a minor concern. Then Cornell entomologist John E. Losey published a letter in the May 20 issue of *Nature* on monarch butterflies. Losey reported the death of monarch larvae that ingested milkweed leaves dusted with pollen from corn that had been genetically modified with the addition of *Bacillus thuringiensis* (Bt), a toxin that kills insects.

This raised obvious questions. How many other insects might be killed by genetically modified corn pollen? What about the pollen from other genetically modified plants, especially the genetically modified trees that are now the subject of research and development at prominent western universities?

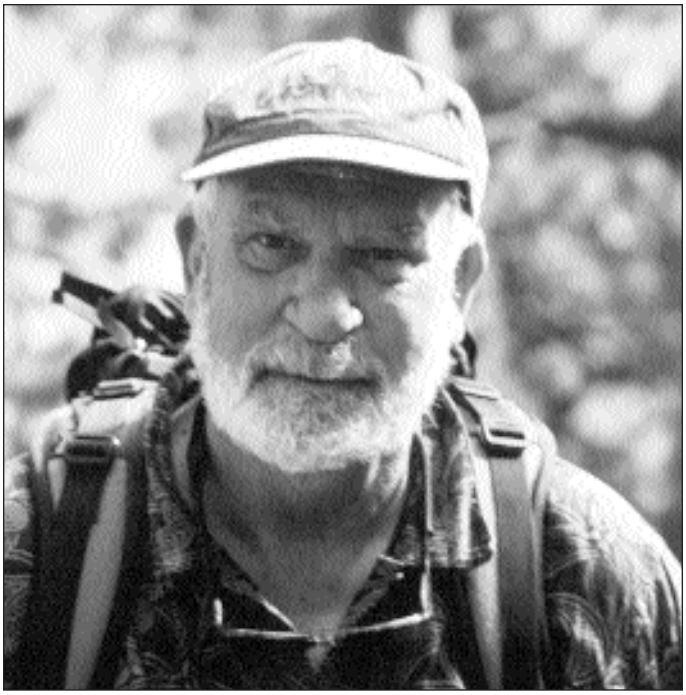
Crops tend to be around other crops, but forests are where the wild things are, or supposed to be, or were. Have you ever seen the conifer pollen blow in western forests? It drifts in sheets of yellowish-green clouds, hundreds, sometimes thousands of feet high. It coats the lakes, deer, your truck, your barbecue grill. It floats down rivers. You inhale it, lots of beings inhale it.

Lots of critters live in the air, not just birds. According to a recent article in *Orion* (Spring, 1999) by David Lukas, the "atmosphere over a single square mile of the earth's surface contains twenty-five million airborne insects"–everything from aerial plankton to flying spiders. What will be the consequences of Bt-laced pollen on all these insects? With transgenic forests, it is hard to see how wild beings can avoid eating Bt-bearing beings and transgenic beings. What will happen to overall trophic patterns of an ecosystem? No one knows.

Indeed, how many transgenic viruses, bacteria, mollusks, insects, birds, fish, and mammals have we created so far? No one knows, and further, no one is keeping track. What is documented is usually buried in arcane technical journals and there is no "search engine" to collate the results of what graduate students are creating in the recesses of universities or what scientists are manufacturing in the secrecy of their corporate laboratories. How are we to get a handle on what genetic engineering is going to do to wild nature? After all, it is happening right now, and it will shape the future of ecosystems in the American West.

Consider one small area of research: common trees in western forests. Projects conducted at the University of Washington's Poplar Molecular Genetics Cooperative, Oregon State University's Tree Genetic Engineering Research Cooperative, the University of California at Davis' Dendrome Project, and at the Institute of Forest Genetics in Placerville, CA (a unit of United States Department of Agriculture, National Forest Service) have or soon will have manufactured transgenic versions of cottonwood (50 transgenic lines!), aspen, willow, loblolly pine, Douglas fir, and western white pine. The goal of this research is stated clearly by the Institute of Forest Genetics: "To develop molecular and evolutionary genetics knowledge critical to maintaining viable populations of healthy, improved, genetically diverse forest species in sustainable western ecosystems. . ."

This is to the point, but it veils what is really at stake: more efficient forests. One of those new transgenic cottonwoods grows ten feet a year. This in turn veils the ways in which our ideas of 'health,' 'disease,' 'improvement,' and 'diversity' are being modified by the concept of efficiency



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Of The Abstract Wild*, Peter Matthiessen writes, "*The Abstract Wild *is a cry in the dark, passionate and provocative, and it must be heard, for it is urgent and insightful and based on broad and thoughtful study as well as a deep experience of the wild–the real wild, not the "abstract" one which, even as we watch, eats like rust at the shining nature of existence."*

for the sake of greater profits. Transgenic forests are not about health, they are about money.

To produce "healthy, improved" species for our western ecosystems, research has focused on the same two areas that produced more efficient crops: herbicide resistance and resistance to insects and disease.

The herbicide is glyphosate, usually Monsanto's Roundup. Farmers spray Roundup on crops because it kills everything but the crop. Critics claim there are problems with Roundup, of course, though Monsanto denies it. According to an article from *Seedling* (March 97), "Roundup Ready or Not," posted on the Genetically Manipulated Food News website, Roundup is the third most commonly reported cause of illness among agricultural workers in California, the top cause of complaint among landscape workers, and the most frequent cause of pesticide-related casualties in Britain. Roundup also blocks nitrogen fixation in plants, harms fungi, reduces winter hardiness in trees, and retards the development of earthworms. Do we want this stuff sprayed on western ecosystems?

Why spray a forest with Roundup and kill everything but the trees? What eats ground worms? How will this alter the phenology of the American robin? Since none of those trees will die from beetles and rust, there will be less material for wildfires. How will that alter wildfire regimes, landscape architecture? No one knows.

Now the resistance to diseases and insects. They vary: cottonwood leaf beetle, tent caterpillar, and the fungal "pathogen" responsible for white pine blister rust. Resistance to disease is achieved in two ways. First, by a genetic transfer from another species; for example, by transferring a resistant gene from a sugar pine into a white pine. Second, by transferring a biological pesticide to the tree. The choice in most cases–how did you guess?–is Bt, the same pesticide genetically engineered into Monsanto's corn, potatoes, cotton, etc., to kill Colorado potato beetles, bollworms, budworms, and corn borers, and the same pesticide that the corn pollen carried beyond the corn fields, dusting the milkweed leaves and killing the monarch larvae.

Aren't all those beetles, butterflies, caterpillars, fungi, rusts, borers, and worms somebody's lunch? Weren't genetic engineers required to study ecology at some point in their education?

Is anyone worried? Yes, the success of transgenic trees has created a new area of forestry: genetic risk assessment. It attacks the problem on two fronts. Oregon State is working on a computer model they hope will predict the extent transgenes "will spread from transgenic plantations and what their impacts might be." Will spread. Might be. Does the computer model have a variable for robin survival and wildfire regimes? Why did they plant the trees before they had the computer model?

The other line of attack is this: sterile forests. If plain old transgenic forests are too dangerous, then we will have sterile transgenic forests–forests where everything is either dead or incapable of producing life, but very efficient at producing wood. This is a reductio ad absurdum of "forest."

Among the institutions supporting research on genetic engineering are Alberta Pacific Forest Industries, Boise Cascade Corporation, Champion International Corporation, Electric Power Research Institute, Fort James Corporation, Georgia-Pacific West, Inc., Inland Empire Paper Company, McMillian Bloedel Timberlands, Inc., Potlatch Corporation, Scott Paper Ltd., Shell, Westvaco Corporation, Weyerhaeuser Company, United States Department of Energy Biofuels Feedstock Development Program, British Columbia Ministry of Forests Research Branch, and, of course, the National Forest Service–the outfit that services our forests.

In short, the folks responsible for cutting down western forests now intend to replant them with either healthier, improved, more efficient transgenic goofies, or healthier, improved, more efficient, sterile, transgenic goofies.

Welcome to the modern forest.

As usual in forestry, the fusion of public and private interests is ubiquitous. In 1995, Potlatch and Boise Cascade were putting 20,000 ha (about 50,000 acres) of transgenic poplars "into production" under drip irrigation in eastern Oregon. At the Institute of Forest Genetics' Conifer Geonomics Research Program, half of the collaborators are from the Weyerhaeuser Forestry Research Center. When Oregon State planted several acres of transgenic trees on land near Boardman and Clatskanie, Oregon in 1996, Fort James Corporation and Potlatch Corporation provided the land. It was, the university reported, "a shining example of university-private industry collaboration."

Unfortunately, there is nothing unique about genetic engineering for western forests. In New Zealand they have successfully altered *Pinus radiata*, *Pinus taeda*, *Pinus elliotii*, and *Pseudotsuga menziesii* in "a high-tech quest to create forests of superior trees." In Brazil it is wild rice. In Australia, eucalyptus. In Chile, *Nothofagus alpina*–a hardwood endemic to subantarctic forests in Patagonia. India? Teak, Moringa (a nut tree on the Malabar Coast), Casuarina (a wood once preferred by cannibals on Fiji for making forks), and bamboo. Indeed, the Institute of Forest Genetics boasts that last year the Institute hosted visitors from Finland, Germany, France, Spain, Hungary, Japan, Malaysia, China, South Africa, Australia, and Mexico. Soon we will have genetically engineered forests all over the world. How long will it take?

An article entitled "Poison Plants?" on the *Scientific American* website notes, "The percentage of genetically modified seed, some experts estimate, is now approaching 40 to 60 percent of all U.S. plantings." This took only five years. How long will it take for half the world's forests to be genetically modified? No one knows.

And should we be surprised by this endeavor? If we are ready to accept healthier, improved, efficient food and healthier, improved, efficient children, then what could possibly keep us from accepting healthier, improved, efficient trees, trout, elk–you name it.

If there is little doubt we will proceed to manufacture new forms of life in the face of ignorance, a veritable eruption of that most ancient malady, hubris, there is also little doubt that the gods will make us pay.

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