Environment

Tree planting: The 'greenhouse' effects

Increasing global reforestation between now and the year 2000 by an area nearly twice the size of Texas could not only return the world's supply of wood for fuel and industry to a sustainable level, but also help stabilize watersheds and highly erodable, wind-prone areas, according to Sandra Postel and Lori Heise of the Washington, D.C.-based Worldwatch Institute. A less obvious benefit would be the capture and storage of considerable carbon, which could reduce the rate of global warming. Carbon emitted by fossil-fuel burning and deforestation—largely as carbon dioxide (CO_2)—has been accumulating in earth's atmosphere. A "greenhouse" gas, atmospheric carbon dioxide can contribute to climate warming. But in "Reforesting the Earth," a report published last week, Postel and Heise present "rough calculations" that suggest that preserving tropical forests and planting new trees could play "a significant role" in slowing the CO_2 buildup.

During photosynthesis, trees absorb carbon. Cutting trees down begins a cycle that will lead to the release of that carbon. Adding 120 million hectares of forest cover would store about 780 million tons of carbon annually, the Worldwatch analysts estimate. Halving deforestation in Brazil, Indonesia, Colombia and Côte d'Ivoire — the leading contributors of deforestation-related carbon dioxide—would cut net annual carbon releases from tropical forests more than 20 percent. Postel and Heise calculate that these measures, taken together, could remove two-thirds of the annual carbon emissions attributable to deforestation, or 17 percent of the carbon emissions from all sources, including fossil fuels.

Such measures could buy the world time to wean itself from an addiction to fossil fuels. And that's important, Postel and Heise believe, arguing that "Boosting energy efficiency and shifting to alternative energy sources will buy the greatest degree of climate insurance for the dollar."

Forest declines: Is mighty moss to blame?

Something has been killing forests across industrial Europe and the northeastern United States. Though acid rain and ozone have been the primary suspects, research by University of Colorado geographer Lee Klinger now suggests that the actual assassin is probably a cool, springy carpet of moss.

Klinger, who works at the university's Institute for Arctic and Alpine Research in Boulder, began his studies in arctic Alaska, where mosses are the dominant plants. Later, when he turned his attention to why forests were dying—there and elsewhere—he assumed he'd be tracking a deadly pollutant. Instead, he found himself on the trail of mosses. To date he has looked at 100 regions in some 30 states experiencing forest dieback. "And I have not yet found one," he says, "that does not fit the pattern" —dead, very fine "feeder" roots directly underlying a carpet of mosses. He has observed that even a few inches outside the edge of the moss, tree roots are healthy.

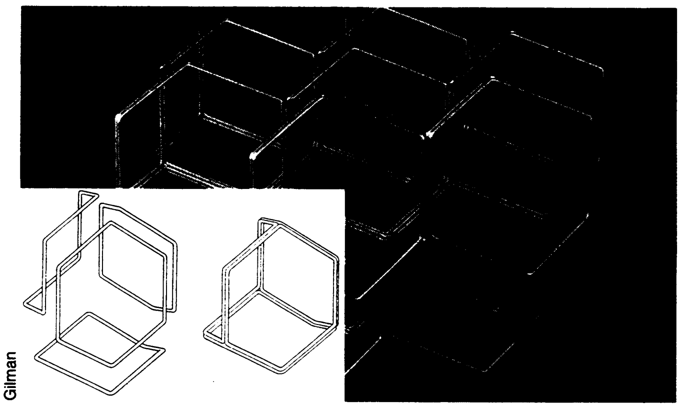
Calling mosses "terrestrial sponges," Klinger says they can hold enough water to "saturate the surface soils right beneath them, making that zone anaerobic (free of oxygen)." As feeder roots — the ones that take in nutrients but have the smallest oxygen storage — grow into that zone, they die. But additional factors may play important roles. For example, Klinger says mosses can kill mycorrhiza — symbiotic fungi that help tree roots absorb nutrients. Moreover, mosses acidify water passing through them. Once the water reaches a critical acidity, toxic aluminum in the soil becomes soluble and available to the tree, says Klinger.

This acidification, Klinger says, explains why his work does not exonerate acid rain's role in forest declines. Since mosses love acidic conditions, acid rain may actually foster moss growth, accelerating this natural process of forest death.

Technology

Ring around a tetrahedron

The diamond crystal structure, in which each carbon atom is bonded to four other carbon atoms to create a tetrahedral framework, is one of the strongest and most rigid structures known in nature. A similar geometry lies at the heart of a novel method for constructing strong, stiff, lightweight frames that could be used for applications ranging from stable platforms for large telescopes and other optical systems to frameworks for large boats, storage tanks, buildings and space stations. The method, invented by John J. Gilman of the Lawrence Berkeley (Calif.) Laboratory, depends on the use of puckered, six-sided rings that can be easily joined together to create a tetrahedral framework (see illustration).



Gilman

Four struts come together at each node in a tetrahedral structure. The problem that confronted Gilman was finding a way to join the struts without having to weld them together or having to use an elaborate coupling device into which the struts could be inserted. After building some models of tetrahedral frames, Gilman noticed that his frames contained bent rings, each consisting of six struts attached together so that the angle between each pair of struts is the tetrahedral angle, or roughly 109.5°. He discovered that he could assemble a complete tetrahedral framework just by fastening such rings together.

"This ring scheme solves several problems at once," says Gilman. His method is particularly useful when the framework is made from a composite material, such as a fiber-reinforced polymer, which can't be welded together at corners. Casting the rings as units and then fitting and gluing them together avoids the need for welding or special joints. The casting process works most easily when the rings have a triangular cross section. Gilman has also developed a way of creating his tetrahedral structures using sheet material.

"I have trouble trying to get people interested because they find it hard to understand the diagrams on a piece of paper," says Gilman. "They have to see the models to see how it works—that it's not just a crazy jumble of materials. It's going to take a while to really get it into the practical sphere."

Bugs in the cracks

Bacteria appear to play an important role in the breakdown of pavement made from asphalt, according to a report released by the Federal Highway Administration. The culprits are usually bacteria that belong to the genus *Pseudomonas*, says K. Ramamurti, who conducted the study for the Kansas Department of Transportation in Topeka. The bacteria migrate from the soil into moisture-laden cracks, where they feed on the hydrocarbon-rich asphalt. The result is the gradual deterioration of the pavement into rubble. As the practice of recycling asphalt for road use increases, engineers may have to start paying attention to the deleterious effects of microbial attack on the strength and life span of recycled asphalt.