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Climate Change

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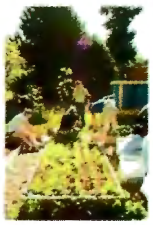

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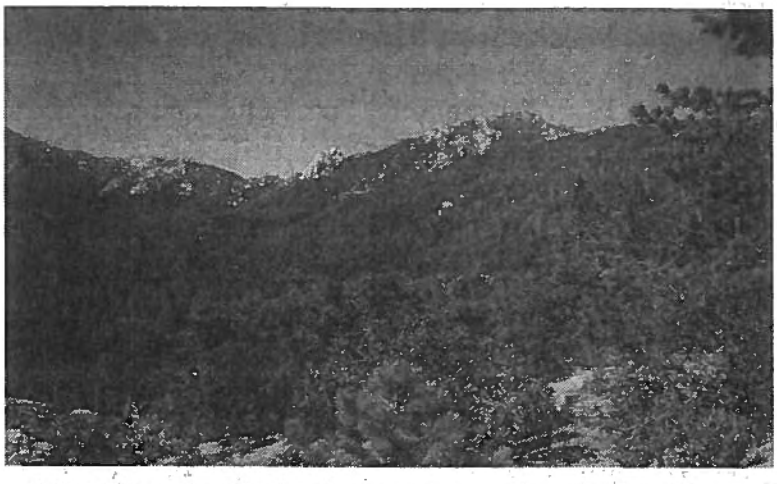
Editor's Edge

Seeing the Climate Through the Trees

Scott Horton

IN 2006 SIR RICHARD BRANSON of Virgin mega-corporation fame and Al Gore announced a $25 million prize to anyone who could invent a way to remove greenhouse gasses from the atmosphere. My first thought, besides "that's an awful lot of money," was "Duh! It's a forest!" Now that I'd solved global warming and bested two of the most active and vocal proponents of immediate human interventions to solve the crisis, I could get back to tending my garden, editing the magazine, and wait for my $25 million check to arrive.



A $25 million prize-winning design or just a yellow pine forest?

As I worked on this issue I was reminded of the permaculture principle of succession. Natural systems follow their own patterns and timelines to achieve dynamic homeostasis. So it seems do ideas. I had thought climate would be a rich and topical theme for the magazine and had hoped for submissions about creating home and garden microclimates, desert restoration, olive groves thriving in northern latitudes due to ingenious permaculture planning and thermal mass—that sort of thing. Instead, I got a watershed of material about trees and forests. We recently did an issue on trees and tree crops *(May 2005, #56)* so I was a bit disappointed and thought readers had missed the point.

Reading the submissions and thinking further about the theme, I realized—thanks readers!—that planting trees, and restoring and preserving forests should be a primary strategy for slowing and reversing the upward trend of greenhouse gasses. Forests are huge sinks of carbon. The Amazon is estimated to hold 77 billion tons of it, about 9% of what is in the atmosphere now. The Indonesian forest fires of 1998 dumped a billion tons of carbon into the atmosphere in a few weeks, about a quarter of the annual increase. The trick is to get trees to grow and to keep them from burning. This approach is perhaps the single best option open to us for stabilizing climate (not just emissions)...at least until someone, somewhere wins the Branson/Gore prize.

Permaculturists are clearly ahead of the curve in considering solutions. We instinctively turn to trees and forests as the indispensable tools in a race to put the brakes on climate change. Though soilbuilding, modified microclimates, reduced consumption, more aquatic habitat, renewable energy sources, and other strategies are vitally important, permaculture forestry, including food forestry, would give the most bang for that 25 million bucks, I reckon. Still, it might be kind of fun to see the science-fair displays of contraptions invented to sequester carbon and garner riches.

Sequestering carbon from power plant emissions may help us keep the lights on while limiting climate impacts, but all such technological approaches carry high and often unforeseen costs. Permaculture has taken a justly critical view of high technology as inseparable from our high energy economy now beginning its irreversible decline.

Even if carbon emissions stabilized immediately, atmospheric carbon would continue to rise: we need more sinks. And even if emissions fell to levels that could be absorbed by existing sinks, there's more warming "in the pipeline" due to feedback lags in the atmosphere and the oceans. We have to beyond conservation and contraction toward active removal. Branson and Gore got that right. But it isn't likely that humans will ever exceed the energy efficiencies of photosynthesis on a scale sufficient to reverse current climate trends. Betting on forests is not only more likely to get the job done, but provides enormous extra benefit: We store up fuel and fiber for future generations, we build soil, clean up air and water, improve our health, and shelter wildlife.

The articles in this issue offer a range of views and information about climate, what's affecting it, and, significantly, how we might mitigate human impacts on it. We've nothing to lose and everything to gain from restoring and protecting forests. Δ

Scott Horton is Editor of Permaculture Activist *and lives in the San Jacinto Mountains of southern California.* We welcome your articles, news items, photos, and other materials of interest. Please contact the Editor in advance of your submissions at to request writers guidelines and present your ideas *(editor@permacultureactivist.net).*

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Permaculture is a holistic system of DESIGN, based on direct observation of nature, learning from traditional knowledge, and the findings of modern science. Embodying a philosophy of positive action and grassroots education, Permaculture aims to restructure society by returning control of resources for living: food, water, shelter, and the means of livelihood, to ordinary people in their communities, as the only antidote to centralized power. For 25 years Pc has combined top-down thinking with bottom-up action to make a world of difference in over 60 countries. We are everywhere.

Why We're More Scared of Gay Marriage and Terrorism Than a Much Deadlier Threat

If Only Gay Sex Caused Global Warming

Daniel Gilbert

NO ONE SEEMS TO CARE about the upcoming attack on the World Trade Center site. Why? Because it won't involve villains with box cutters. Instead, it will involve melting ice sheets that swell the oceans and turn that particular block of lower Manhattan into an aquarium.

The odds of this happening in the next few decades are better than the odds that a disgruntled Saudi will sneak onto an airplane and detonate a shoe bomb. And yet our government will spend billions of dollars this year to prevent global terrorism and, well…essentially nothing to prevent global warming. Why are we less worried about the more likely disaster? Because the human brain evolved to respond to threats that have four features: features that terrorism has and that global warming lacks.

No facial hair, no threat

First, global warming lacks a mustache. No, really. We are social mammals whose brains are highly specialized for thinking about others. Understanding what others are up to—what they know and want, what they are doing and planning—has been so crucial to the survival of our species that our brains have developed an obsession with all things human. We think about people and their intentions; talk about them; look for and remember them.

That's why we worry more about anthrax (with an annual death toll of roughly zero) than influenza (with an annual death toll of a quarter-million to a half-million people). Influenza is a natural accident, anthrax is an intentional action, and the smallest action captures our attention in a way that the largest accident doesn't. If two airplanes had been hit by lightning and crashed into a New York skyscraper, few of us would be able to name the date on which it happened.

Global warming isn't trying to kill us, and that's a shame. If climate change had been visited on us by a brutal dictator or an evil empire, the war on warming would be this nation's top priority.

Moral sensibilities

The second reason why global warming doesn't put our brains on orange alert is that it doesn't violate our moral sensibilities. It doesn't cause our blood to boil (at least not figuratively) because it doesn't force us to entertain thoughts that we find indecent, impious, or repulsive. When people feel insulted or disgusted, they generally do something about it, such as whacking each other over the head, or voting. Moral emotions are the brain's call to action.

Although all human societies have moral rules about food and sex, none has a moral rule about atmospheric chemistry. And so we are outraged about every breach of protocol except Kyoto. Yes, global warming is bad, but it doesn't make us feel nauseated or angry or disgraced, and thus we don't feel compelled to rail against it as we do against other momentous threats to our species, such as flag burning. The fact is that if climate change were caused by gay sex, or by the practice of eating kittens, millions of protesters would be massing in the streets.

The brain is a beautifully engineered get-out-of-the-way machine that constantly scans the environment for things out of whose way it should right now get.

The third reason why global warming doesn't trigger our concern is that we see it as a threat to our futures—not our afternoons. Like all animals, people are quick to respond to clear and present danger, which is why it takes us just a few milliseconds to duck when a wayward baseball comes speeding toward our eyes.

The brain is a beautifully engineered get-out-of-the-way machine which constantly scans the environment for things out of whose way it should right now get. That's what brains did for several hundred million years, and then, just a few million years ago, the mammalian brain learned a new trick: to predict the timing and location of dangers before they actually happened. Our ability to duck that which is not yet coming is one of the brain's most stunning innovations, and we wouldn't have dental floss or 401(k) plans without it. But this innovation is in the early stages of development. The application that allows us to respond to visible baseballs is ancient and reliable, but the add-on utility that allows us to respond to threats that loom in an unseen future is still in beta testing.

We haven't quite gotten the knack of treating the future like the present it will soon become, because we've only been practicing for a few million years. If global warming took out an eye every now and then, OSHA would regulate it into nonexistence. There is a fourth reason why we just can't seem to get worked up about global warming. The human brain is exquisitely sensitive to changes in light, sound, temperature, pressure, size, weight, and just about everything else. But if the rate of change is slow enough, that change will go undetected. If the low hum of a refrigerator were to increase in pitch over the course of several weeks, the appliance could be singing soprano by the end of the month and no one would be the wiser.

Environmentalists despair that global warming is happening so fast. In fact, it isn't happening fast enough.

Because we barely notice changes that happen gradually, we accept gradual changes that we would reject if they happened abruptly. The density of Los Angeles traffic has increased dramatically in the last few decades, and citizens have tolerated it with only the obligatory grumbling. Had that change happened on a single day last summer, Angelenos would have shut down the city, called in the National Guard, and lynched every politician they could get their hands on.

Environmentalists despair that global warming is happening so fast. In fact, it isn't happening fast enough. If President Bush could jump in a time machine and experience a single day in 2056, he'd return to the present shocked and awed, prepared to do anything it took to solve the problem.

The human brain is a remarkable device that was designed to rise to special occasions. We are the progeny of people who hunted and gathered, whose lives were brief, and whose greatest threat was a man with a stick. When terrorists attack, we respond with crushing force and firm resolve, just as our ancestors would have. Global warming is a deadly threat precisely because it fails to trip the brain's alarm, leaving us soundly asleep in a burning bed.

It remains to be seen whether we can learn to rise to new occasions. Δ

Daniel Gilbert is a professor of psychology at Harvard University and the author of *Stumbling on Happiness*, published in May by Alfred A. Knopf. This article originally appeared in *Forest Voice, www.nativeforestcouncil.org.*

Heating Up the Planet's Waters

Disappearing Lakes, Shrinking Seas

Janet Larsen

WEST AFRICA'S LAKE CHAD HAS SHRUNK to a mere five percent of its former size. Central Asia's Aral Sea is shrinking, gradually turning into desert. In Israel, the receding shores of Lake Tiberias—also known as the Sea of Galilee—sometimes allow mere mortals to walk where the water once was. Thousands of lakes in China have disappeared entirely. The diversion of river water in India and Pakistan that allowed for a doubling of irrigated area over the last four decades has depleted many lakes. All told, more than half of the world's five million lakes are endangered.

For more than 4,000 years, farmers have diverted river water for crops in dry areas and dry seasons, reducing the flow into nearby lakes and seas. Over the last half-century world water use has tripled, expanding faster than population. Today irrigation accounts for two-thirds of global water use. With the advent of diesel and electrically driven pumps, groundwater extraction in some areas has exceeded recharge from precipitation, also causing water tables and lake levels to fall.

Nestled among deserts, the five-million-year-old Aral Sea is one of the world's most ancient lakes. As recently as the early 1960s, it covered some 66,000 square kilometers (25,483 square miles) and held 1,000 cubic kilometers (264 trillion gallons) of water. Two rivers, the Amu Darya and Syr Darya, fed the lake with some 65 cubic kilometers of water each year. Today, however, irrigation of vast fields of cotton has drained the rivers, reducing the annual inflow to only 1.5 cubic kilometers. As a result the Aral has lost four fifths of its volume and is now split into two sections. The shoreline of the Aral Sea has receded by up to 250 kilometers, leaving behind a salty desert. The United Nations estimates that every day 200,000 tons of salt and sand containing residual agricultural chemicals and heavy metals from the uncovered seabed are carried by the wind and dumped on farmland within a 300-kilometer radius, destroying pastures and arable land. The pollution of air, land, and water has left a legacy of diseases such as cancer, cholera, and typhus. The once-prolific fishery has been destroyed.

Cycles of Flood and Drought

Growing water demands are causing other lakes around the globe to vanish. Irrigation withdrawals from the waters that feed Africa's Lake Chad quadrupled between 1983 and 1994. Water consumption, combined with low rainfall levels since the 1960s, has shrunk the lake by 95 percent, from 25,000 square kilometers to 1,350 square kilometers, over the past 35 years. Overpumping groundwater in China's Hebei province has lowered the water table, resulting in the loss of 969 of the province's 1,052 lakes. Madoi County in northwest China's Qinhai province, the first through which the main stream of the Yellow River flows, once had 4,077 lakes. Over the past 20 years, more than half have disappeared.

In 1998, China's largest river, the Yangtze, experienced devastating floods, taking the lives of 3,600 people and wreaking more than $30 billion in damages. The floods were largely attributed to the cutting of forests and the loss of more than 13,000 square kilometers of lake area along the Yangtze's middle and lower reaches. Prior to the flooding, some 800 lakes had disappeared entirely, depriving the basin of needed water storage capacity and flood protection. Following the floods the Chinese government pledged action to restore both forests and lakes. Tonle Sap in Cambodia, Southeast Asia's largest freshwater lake, supports one of the world's largest inland fisheries. Like many lakes it has long provided flood protection, fluctuating in volume according to rainfall and climate. Now, however, eroding deforested and farmed land is silting up the lake and reducing its storage capacity, ultimately increasing the region's vulnerability to the opposing extremes of flooding and water scarcity. The Hamoun Lakes and nearby wetlands in Iran and Afghanistan's Sistan Basin are similarly losing their ability to mitigate floods as they are drying from the damming of the Helmand River and years of drought. Mono Lake, North America's oldest, dating back some 760,000 years, is an important feeding stop for migrating birds, especially as southern California has lost over 90 percent of its wetlands. Since the first diversions of its tributaries to quench the thirst of growing Los Angeles in 1941, the lake has contracted dramatically, with water level dropping by 11 meters

Over the last half-century world water use has tripled, expanding faster than population.

(37 feet) and volume down 40 percent. As a result, its salinity has jumped to three times that of the ocean—far too salty to sustain most fish. The lake likely would have died completely had locals not intervened and defeated Los Angeles in a legal battle over keeping water for the lake.

Mexico's largest lake, Chapala, is the primary source of water for Guadalajara's growing population of five million. This lake's long-term decline began in the 1970s, corresponding with increased agricultural development in the Rio Lerma watershed. Since then, the lake has lost more than 80 percent of its water. Between 1986 and 2001, Chapala shrank in size from 1,048 to 812 square kilometers. Climbing municipal and industrial water demands now exceed the sustainable supply by 40 percent. The lake's contraction has come at the expense of several fish species and potentially presages a change in the mild climate that the water supported. Lakes are not only being drained dry; they also are dying from contamination. Farm wastes, sewage, and nitrogen fallout from fossil fuel burning fertilize lakes, causing excess algal and plant growth that depletes water oxygen levels and kills aquatic animal life. Such eutrophication plagues more than half the lakes in Europe and Asia, 41 percent of those in South America,
and 28 percent in North America.

Acid precipitation, largely from fossil fuel burning emissions, is killing thousand of lakes. An estimated 12,000 square kilometers of lakes in Norway are acidified to the point where fish stocks have crashed. Sweden has some 4,000 acidified lakes. In Canada, some 14,000 lakes are severely acidified. The US Environmental Protection Agency estimates that some 70 percent of sensitive lakes in New York's Adirondack Mountains are at risk of periodic acidification, and that without further reductions in sulfur dioxide emissions the rate of acidification will increase by half or more. A survey of remote mountain lakes throughout Europe found that even lakes far from human development were acidified by sulfur and nitrogen deposition and that virtually all were contaminated by heavy metals (such as mercury, lead, and cadmium) and fly ash particles. The sediments and fish in these lakes also contained a wide range of persistent organic pollutants. Rising global temperatures are predicted to increase average lake temperatures by 2-3° Celsius (3.6-5.4°F) over the next 50 years. Unfortunately, as water warms, its natural purification processes can slow down. Climate-related changes in water chemistry and stratification can lead to fish losses, as is already being seen in East Africa's Lake Tanganyika. More than two billion people live in countries with chronic water stress. Many of the world's people, especially in developing countries, depend on fish for protein. Lakes are not only reservoirs of fresh water and a source of food, but also important habitats for aquatic organisms and waterfowl. Lakes reduce flood damage, moderate climate, and recharge groundwater supplies. They also offer transportation and recreational opportunities and income from tourism. With all the benefits that we derive from healthy lakes, we cannot afford to let them disappear.

Food Security: Temperature Trends and Effects

De-Stabilizing Climate

Lester R. Brown

SINCE 1970, THE EARTH'S AVERAGE temperature has risen by 0.7° Celsius, or nearly 1.3° Fahrenheit. Each decade the rise in temperature has been greater than in the preceding one. Four of the six warmest years since recordkeeping began in 1880 have come in the last six years. Two of these, 2002 and 2003, were years in which, as just described, the major food-producing regions saw their crops wither in the presence of record or near-record temperatures.

As atmospheric concentrations of carbon dioxide rise, so does the earth's temperature. Since atmospheric CO_2 permits sunlight to freely penetrate the earth's atmosphere but restricts the radiation of heat back into space, it creates a "greenhouse effect." Atmospheric concentrations of CO_2, estimated at 280 parts per million when the Industrial Revolution began, have been rising ever since people in Europe began burning coal. They have risen every year since precise measurements began in 1959, making this one of the world's most predictable environmental trends. Atmospheric CO_2 concentrations turned sharply upward around 1960. Roughly a decade later, around 1970, the temperature too began to climb; the rise since then is quite noticeable. Projections by the Intergovernmental Panel on Climate Change (IPCC) show temperatures rising during this century by 1.4-5.8°C. The accelerating rise in temperature in recent years appears to have the world headed toward the upper end of that projected range of increase.

Developing patterns of desolation

Perhaps even more important than the average temperature rise is where the increase is likely to be concentrated. The warming will be greater over land than over the oceans, in the higher latitudes than in the equatorial regions, and in the interior of continents than in the coastal regions. One of the higher increases is expected to be in the interior of North America—an area that includes the grain-growing Great Plains of the United States and Canada and the US Corn Belt, the very region that makes this continent the world's breadbasket. (1)

The earth's rising temperature affects food security in many ways. Much of the world's fresh water is stored in ice and snow in mountainous regions. These "reservoirs in the sky" supply water for irrigation. But the reservoirs are now shrinking. A modest rise in temperature of one degree Celsius in mountainous regions can substantially alter the precipitation mix between rain and snow, increasing rainfall and decreasing snowfall. This leads to more runoff during the rainy season and less snowmelt to feed rivers during the dry season, when farmers need irrigation water. (2)

The melting glaciers and shrinking snowfields of the Himalayas are a concern to countries throughout Asia because this is where virtually all the major rivers in the region originate—the Indus, Ganges, Mekong, Yangtze, and Yellow. In Asia, where half the world's people live and where irrigated agriculture looms large, any reduction in river flow during the summer directly affects food security. The prospect of diminished river flows during the dry season at a time when water tables are already falling in most Asian countries raises basic questions about food security in the region. (3)

In addition to the direct effects of temperature on yield, higher temperatures mean more evaporation and thus more rainfall. Elevated temperatures can lead both to more extreme drought and to more severe flooding. Drought can be caused by below-normal rainfall or above-normal temperatures. Most often the two combine to create crop-withering droughts. Increased temperatures also mean more powerful, more destructive storms. (4)

One of the higher increases is expected to be in the interior of North America. . . the very region that makes this continent the world's breadbasket.

Higher temperatures can worsen or create new crop disease and insect problems. The combination of heat and humidity, which makes an ideal environment for many plant diseases, makes it almost impossible to produce wheat profitably in the tropics. Higher temperatures would simply expand the region that is inhospitable to wheat from the equator toward the higher latitudes. (5)

One of the most serious long-term effects of climate change is rising sea level, which is driven both by the thermal expansion of the oceans as temperatures rise and by the melting of glaciers. The last IPCC report projected that sea level could rise by up to one meter during the current century, but papers published since then indicate that the melting is proceeding much

faster than IPCC scientists had estimated. One study of glaciers in Alaska and western Canada, for example, suggests that ice melting there is now raising sea level by 0.32 millimeters per year, more than double the 0.14 millimeters per year assumed by IPCC. (6)

Melting ice and rising seas

One of the major concerns among scientists today is the accelerated melting of the Greenland ice sheet. If the ice sheet on Greenland—an island three times the size of Texas—were to melt entirely, sea level would rise 7 meters (23 feet), inundating not only Asia's rice-growing river deltas and floodplains but most of the world's coastal cities as well. This kind of massive melting, even in the case of the most rapid warming scenario, would occur over centuries, however, not years. (7)

The World Bank has published a map of Bangladesh, which shows that a 1-meter rise in sea level would inundate half of the country's rice land. It would also displace some 40 million Bangladeshis. Where would these people go? Which countries would be willing to accept even a million refugees fleeing the effects of rising sea level? (8)

A warmer earth means that agricultural zones in the northern hemisphere would move northward within Canada and Russia, for example, as the growing season lengthens.

A warmer earth means that agricultural zones in the northern hemisphere would move northward within Canada and Russia, for example, as the growing season lengthens. This assumes, of course, that there are high-quality soils that could sustain a productive agriculture in these regions. In Canada, however, the glaciated soils north of the Great Lakes cannot begin to match the productivity of the deep, fertile US Corn Belt soils south of the Great Lakes. (9)

One advantage of a longer growing season would be that the winter wheat belt could move northward, replacing the lower-yielding spring wheat now grown in the northernmost agricultural regions. This would affect primarily Canada and Russia, the leading producers of spring wheat.

On balance, however, agriculture would be a heavy loser if temperature continues to rise. The notion that the world's farmers would be better off with more atmospheric CO_2 and higher temperatures is a view based more on wishful thinking than on science. It may soon become apparent that the costs of climate change are unacceptably high.

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Lester R. Brown has been a leading thinker in the environmental movement for more than four decades. He has authored and co-authored more than 50 books and innumerable articles and papers, He founded the Earth Policy Institute in 2001.

From *Outgrowing the Earth: The Food Security Challenge in an Age of Falling Water Tables and Rising Temperatures* (W.W. Norton & Co., NY: 2005).

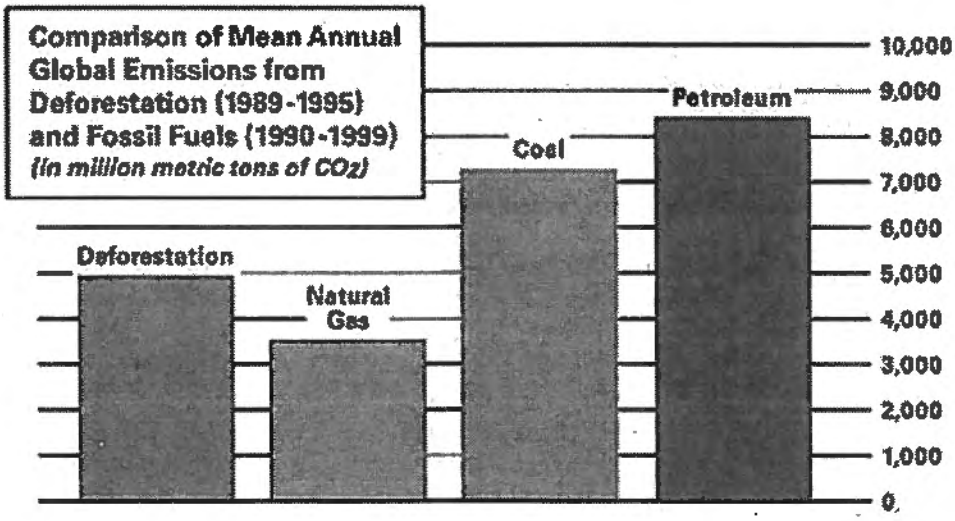
Recognizing Forests' Role in Climate

Union of Concerned Scientists

THE WORLD'S FORESTS PROVIDE many important benefits: Home to more than half of all species living on land, forests also help slow global warming by storing and sequestering carbon. Forests are sources of wood products. They help regulate local and regional rainfall. And forests are crucial sources of food, medicine, clean drinking water, and immense recreational, aesthetic, and spiritual benefits for millions of people.

As globally important storehouses of carbon, forests play a critical role in influencing the Earth's climate. Forest plants and soils drive the global carbon cycle by sequestering carbon dioxide through photosynthesis and releasing it through respiration. Although carbon uptake by photosynthesis eventually declines as trees age, many mature forests continue to sequester carbon in their soils.

Yet, in many parts of the world, forests are being rapidly cleared for agriculture or pasture, destructively logged and mined, and degraded by human-set fires. When forests are degraded or cleared, their stored carbon is released back to the atmosphere during harvest and through respiration, thus these forests are net contributors of carbon to the atmosphere. Tropical deforestation is responsible for approximately 20% of total human-caused carbon dioxide emissions each year, and is a primary driver of extinction of forest species (see graph).(4)



Source: IPCC; US Department of Energy

In the US, forests are currently net carbon "sinks," sequestering more carbon than they emit. A key reason for this is that forests in the Northeast and elsewhere, cleared previously for agriculture, are now re-establishing on abandoned lands. Other reasons include suppression of wildfires, changes in timber harvesting practices, and increased growth of trees through fertilization from elevated atmospheric concentrations of CO2. Although highly uncertain, the net terrestrial sink of North America appears to have increased on average from the 1980s to the 1990s. However, sinks of today's magnitude cannot be counted on in the future, as many of the key processes are likely to diminish or otherwise change. (5) In the tropics, a survey of recent science finds a net carbon flux of approximately zero, that is, tropical land areas are in balance with respect to carbon exchange. This suggests that the carbon sink there is large enough to offset carbon emissions associated with deforestation.

Due to sparse atmospheric and ecological data for the tropics, however, the uncertainty around this result is significant. (6) Forest and land-use measures have the potential to reduce net carbon emissions by the equivalent of 10-20% of projected fossil fuel emissions through 2050. Efforts to increase carbon storage in US forests could sequester an additional 40 to 80 million metric tons of carbon annually, (7) equivalent to about 3-5% of current annual US fossil fuel emissions. (8) Worldwide, the greatest potential for carbon sequestration by forests exists in tropical and subtropical regions. (9)

Carbon sequestration in forests

Measures to protect, restore, and sustainably manage forests offer significant climate change mitigation potential. Furthermore, forest-based measures can be an effective complement to abatement options focused on fossil fuel emissions. Forest-based mitigation of global warming can occur by three strategies:

- Conservation of existing forests—to avoid emissions associated with forest degradation or clearing.
- Sequestration by increasing forest carbon absorption capacity—occurring primarily by planting trees or facilitating the natural regeneration of forests, especially on marginal land and by making changes in forest management to increase biomass. (10)
- Substitution of sustainably produced biological products—substituting wood products for materials requiring energy-intensive production, such as aluminum or concrete, and substituting woody biomass for fossil fuels as an energy source.

(11) Properly designed and implemented, forest and land-use measures to mitigate climate change can result in other social and environmental benefits (e.g., protecting biodiversity and watersheds, promoting rural employment).

However, poorly designed measures may result in significant negative social and environmental impacts. (12) For example, by allowing credit for reforestation without first establishing a reasonable baseline, measures that fail to provide for carbon sequestration that is truly additional to what would have taken place otherwise (i.e., under a "business-as-usual" scenario) may actually encourage forest clearing.

Forest and land-use measures have the potential to reduce net carbon emissions by the equivalent of 10-20% of projected fossil fuel emissions through 2050.

Markets and forest-based climate mitigation

A major obstacle to slowing forest loss is that markets generally fail to capture the values of biodiversity, carbon storage, water purification, and other "ecosystem services" that forests provide. Effective approaches to addressing the "market failure" for forest goods and services should address the fact that financial incentives to clear or destructively log forests are generally stronger than those to conserve, restore, and use them sustainably. UCS generally supports the use of market-based approaches to promote forest-based climate mitigation options, provided that they achieve the following:

1. Ensure real, verifiable, and lasting greenhouse gas reductions by designing policies that account for the potential reversibility of forest-based emissions reductions. For example, a change in land management or a natural disturbance can re-release carbon stored under a forest-based program into the atmosphere.

2. Create incentives for activities that are environmentally and socially beneficial. Natural forests must not be cleared to establish plantations, for example, nor should historical fire regimes be altered to promote biomass accumulation. Policies to conserve or enhance forests for carbon storage must also consider other benefits that forests provide. In general, managing forests for carbon conservation by increasing forest area, forest age, and tree size can have beneficial effects on biodiversity and forest ecosystem function.

3. Complement rather than replace activities that reduce fossil-fuel emissions, as both are essential for long-term climate protection. The timing, magnitude, and scope of actions implemented to address climate change through forestry projects should take into consideration a suite of factors—relative cost-effectiveness, quantity and permanence of carbon offset, and environmental, social, and economic co-benefits all should figure importantly into decision-making on best policies for greenhouse gas reductions. Bearing in mind the advantages and limitations of market-based approaches, UCS endorses the following set of specific actions and measures for achieving forest-based mitigation of climate change.

Slow deforestation internationally through the Clean Development Mechanism (CDM) and other international investments in forest conservation

The CDM, which is part of the Kyoto Protocol agreement, allows industrialized countries to invest in emission reduction projects taking place in developing countries, where emissions abatement is often the most economically efficient option. Under the CDM, developed countries will be able to apply the certified emission reductions achieved by such projects (including forestry projects) to meet their emissions reductions target. At the June 2001 climate policy negotiations in Bonn, Germany, governments decided to grant CDM credits to projects that grow trees in developing countries but not those that protect existing forests from being cleared or degraded. This decision applies only to the Kyoto Protocol's "first commitment period" of 2008-2012. As such, the current agreement leaves open whether other forest and land-use projects, including those designed to slow deforestation, will be eligible for CDM credits beyond 2012. The decision to limit CDM credits to afforestation and reforestation (A&R) perversely eliminates CDM financing for the most important measure that forest-rich developing countries can take to slow emissions and protect biodiversity—protecting threatened natural forests (i.e., forest conservation). CDM credits for forest conservation would provide significant new funding for climate mitigation and conservation activities in these countries. UCS is committed to working with scientists, NGOs, and policymakers to ensure that sound measures to protect threatened forests are eligible for CDM carbon offset financing in future commitment periods. The U.S. Congress is also considering legislation to provide US firms with tax credits to invest in international forest-based projects which mitigate climate change and protect biodiversity. (14) The passage of such legislation could generate useful projects that build experience and confidence in forest-based climate mitigation in developing countries.

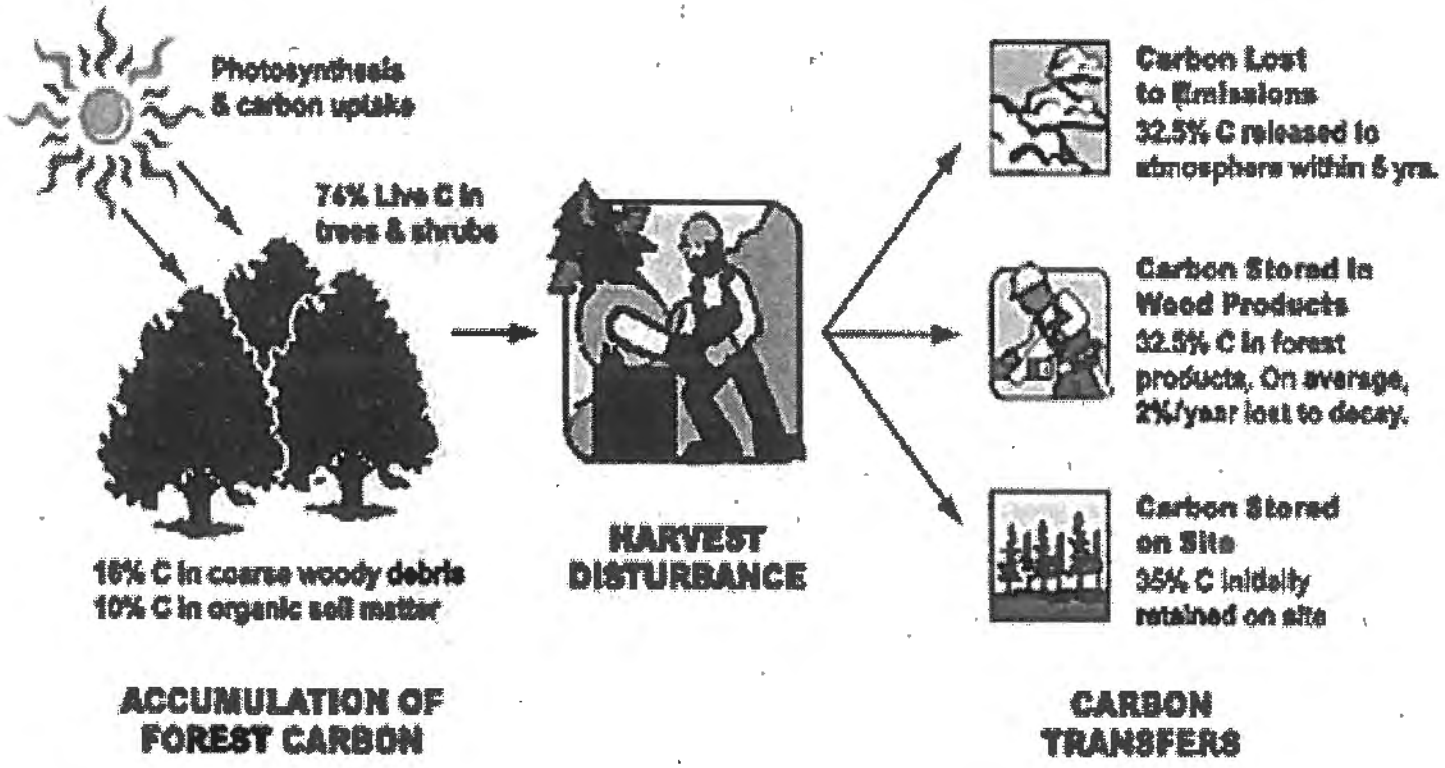
Create a carbon market that recognizes domestic forest carbon values and creates strong incentives for reducing emissions in the US by protecting and restoring natural forests.

Regardless of whether the U.S. Government ratifies the Kyoto Protocol, it should implement mandatory limits (or caps) on carbon emissions and create an economy-wide domestic carbon market equivalent to that stipulated by the Protocol. Such a "cap-and-trade" approach allows the marketplace great flexibility in finding the most economically efficient and innovative ways of meeting mandatory emission limits. Voluntary actions rewarded by tax credits or other government incentives may serve as an interim measure towards developing tradable credits for forest-based emissions reductions. Similar to other federal programs that provide payment for private conservation projects (such as the Conservation Reserve Program) (15), several legislative proposals under consideration provide incentives for voluntary CO_2 sequestration or emission reduction projects on private lands. (16) Potential measures include reforestation and changes in agricultural practices that lead to increased soil carbon storage. Incentives include tax credits, subsidies, and funding for carbon registries and demonstration projects to establish standards for key carbon performance metrics such as carbon accounting, verification, additionality, and permanence.

Unfortunately, the eligibility of projects that reduce carbon emissions by protecting US forests from destructive logging practices remains uncertain. Measures to promote voluntary carbon sequestration on private forest and agricultural lands could be an effective means to increase participation and learning by farmers and forest landowners in mitigating climate change. In addition, voluntary measures will serve to galvanize greater recognition of the role of land use in climate change. Building confidence in this approach requires that rules be sufficiently rigorous to ensure that voluntary actions result in both measurable net reductions in atmospheric carbon as well as other environmental benefits. Without a true economy-wide cap on carbon emissions, however, such interim voluntary measures are not likely to ameliorate the failure of the market for forest products and services—i.e., the untapped potential of forests in mitigating climate change.

Manage timber production forests for carbon and other environmental values

Forests that have been managed primarily for timber production should also be managed for climate mitigation and other environmental values. Expanding forest area by promoting regeneration of native trees, allowing trees to grow larger, employing harvesting methods that reduce damage and waste, and establishing conservation set-aside within production forests can all increase the average long-term quantity of stored carbon. These management options also tend to have beneficial effects on biodiversity, and on other key ecosystem services such as maintaining watersheds. Restoring forests also tends to improve habitat quality, especially for wide-ranging forest birds and mammals. Allowing trees to grow larger before harvesting



generally increases a forest's structural diversity and provides habitat for a broader range of forest species. Healthy forests, i.e. those that retain their natural complexity and diversity in age and habitat structure, generally have greater stability and resilience to disturbances associated with climate change. (16)

Trees grow quickly when they are young, but growth slows as they mature. To increase average carbon storage over time, harvests should occur after the annual growth rate falls below the average growth rate. Because timber companies have a strong economic incentive to harvest when prices are most favorable, however, many forests are harvested well before this optimal age. Lengthening the time between harvests or retaining older trees through successive harvests could significantly increase the carbon stores in the Pacific Northwest and Southeast. (17) Establishing a carbon market and a sound regulatory framework could provide financial incentive to lengthen harvest cycles. Reducing damage to non-harvested trees and disturbance of forest soils during logging operations can also substantially reduce CO_2 emissions. (18) Advantages of reduced-impact forestry include immediate carbon benefits at modest cost as well as a decrease in the risk of fire. (19)

Preserve the integrity of mature forests when managing for timber or biomass

There is a widespread and misguided belief that logging or clearing mature forests and replacing them with fast-growing younger trees will benefit the climate by sequestering atmospheric CO_2. While younger trees grow and sequester carbon quickly, the fate of stored carbon when mature forests are logged must also be considered. When a forest is logged, some of its carbon may be stored for years or decades in wood products. But large quantities of CO_2 are also released to the atmosphere—immediately through the disturbance of forest soils, and over time through the decomposition of leaves, branches, and other detritus of timber production. One study found that even when storage of carbon in timber products is considered, the conversion of five million hectares of mature forest to plantations in the Pacific Northwest over the last 100 years resulted in a net increase of over 1.5 billion tons of carbon to the atmosphere. (20) Using forest products as a source of biomass energy can present a conflict between climate mitigation and other environmental objectives. This is because a trade-off exists between leaving carbon in standing forest and producing a sustainable flow of renewable woody biomass that can be used to produce energy (instead of fossil fuels) or building materials (instead of energy-intensive steel or aluminum). While increased forest carbon storage yields climate benefits, greater mitigation may be possible over time by managing forests for the long-term production and use of biofuels. Managing for biomass and fuel production should only be an option if deleterious effects on biodiversity can be avoided (i.e., is fully compatible with the Forest Stewardship Council's guidelines for biomass management). Mature forests and other forest areas with recognized high conservation value should be fully protected. Even careful commercial forestry operations in high conservation value forests impose substantial costs to other forest ecosystem services such as biodiversity conservation, watershed maintenance, recreation, and other forest amenities. These forests should not be managed for timber or biomass.

Maintain historical fire regimes

Historical forest fire regimes should not be altered to increase carbon storage. Forest fires release large quantities of CO_2 to the atmosphere and are estimated to contribute 10-20% of annual global emissions of methane and nitrogen oxide, both potent greenhouse gases. Fire, however, is a natural disturbance factor upon which many forest processes depend. Suppressing fires to protect either carbon, timber resources, or private property thus leads to fuel accumulation, exacerbating the risk of future catastrophic wildfire and associated "boom/bust" cycles of unpredictable carbon storage and release. Most forests and their biological features developed in balance with a natural fire regime. These natural patterns are thus a critical ecosystem process. Fire is often a primary determinant of a forest's species composition. In fire-prone regions, for example, fire-tolerant species dominate. For these species, infrequent hot fires are important for seed germination and suppression of faster-growing but fire-susceptible species. By suppressing natural fires, fire-tolerant species become competitively disadvantaged. Western forests are especially vulnerable to catastrophic fire, due to suppression of wildfires and destructive logging practices, both of which have allowed these areas to grow unnaturally dense with young trees. The U.S. Forest Service recently reported that about 17 million hectares of National Forest in the western United States are at "...high risk of catastrophic wildfire, a fragility brought on by years of efforts to quell natural fires." (21) Not only can a catastrophic 'crown' fire kill an entire stand but soil damage, nutrient depletion, and watershed damage may also occur. Moreover, these catastrophic fires can so degrade a site that forest recovery may be delayed or a very different ecosystem (such as grassland) may replace the forest. (22)

While increased forest carbon storage yields climate benefits, greater mitigation may be possible. . .

Maintain environmental safeguards on US public forest lands

Forty-two percent of all US forests and the vast majority of old-growth forests are located on public lands. (23) Numerous

federal and state policies affect the conservation and use of these forests. These policies, and proposed changes to them, must consider the full range of possible environmental and social impacts, including forests' influence on climate through carbon emissions. Much public debate surrounds the Roadless Area Conservation Rule, finalized by the U.S. Forest Service in January 2001. This rule calls for ending nearly all logging, road building, and new coal, gas, oil and other mineral leasing in 58.5 million acres of the wildest remaining national forest lands. (24) Bush Administration efforts to weaken the Rule would threaten land that serves as habitat for threatened and endangered species, provides quality recreational opportunities, protects against invasion of non-native species, protects watersheds, and stores significant quantities of carbon.

There is a substantial disconnect between Congressional proposals to provide incentives for private landowners to sequester carbon (e.g., tax credits) and other, countervailing measures that may increase carbon emissions from public lands (such as weakening of the Roadless Area Conservation Rule). (24) Meaningful benefits to the climate require consistent measures to protect, restore, and sustainably manage forests for the carbon and other environmental values on both public and private lands. Δ

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The Simple Act of Planting a Tree:

The Urban Forest Possible

Andy and Katie Lipkis

WHAT IS A FOREST? A forest is made up of trees, of course, but it's also the plants—including fungi and microflora such as lichen—that grow under and around the trees. It's the birds and animals; the bugs and microorganisms; the air; the streams, rivers, and lakes; the rain, fog, and snow; the soil, the rocks, the mountains, and the minerals. It is the products of the forest: the fresh air, clean water, protected soil, recreation, fish, game, edible seeds and nuts, and of course fiber, both timber and pulp.

The forest creates less tangible products as well, which are rarely valued and hard to quantify. These include wilderness and wildness; solitude, emotional and physical restoration, beauty, nature, and a reconnection with one's spirit and spirituality as well as one's sense of adventure.

It's right before dawn. You slip out of bed, pull on your sweats, and go for a walk through the forest. The birds get up just before you to herald the sunrise. It's hard to see them, but they're everywhere in the lacy and varied canopy overhead. The cacophony of sound is bracing. The air too is crisp, fresh, and clear. You take a deep sniff. Is that wet pine leaves or eucalyptus? There's a rustle in the tree above. A squirrel leaps three feet, clutching an acorn in its teeth. How peaceful and calm it is here! You feel nurtured and relaxed, yet delightfully exhilarated. What a way to start the day! There's a new smell—of bacon frying and coffee brewing. It's feeding time for the dominant animal species of this, the urban forest.

What is the urban forest?

Many agencies have spent years trying to define it. Most differ somewhat in their opinions, but they generally agree on what constitutes an urban forest: trees and vegetation in and around a town or city environment. In the city, the only part of the forest managed by public agencies is that which grows on public land such as streets, highways, parks, and public buildings. But like the natural forest, the urban forest is actually an entire ecosystem. All areas—private homes, condos, apartments, roof gardens, commercial and retail property (including their parking lots and landscaped areas), flood-control channels, hillsides, utility rights of way, abandoned rail lines and the edges of active lines, airports, and spandrels (the no-man's-land open spaces covered by trees, weeds, or trash)—are parts of the urban forest. It is a whole system. If a disease infects the trees on your street, it will likely spread to the vegetation around your home, and vice versa. You can't effectively help the urban forest without dealing with the whole, including factors outside your city and somewhat outside your control. If your water is imported, weather patterns hundreds of miles away might have an impact on you. Likewise, laws and public policies legislated thousands of miles away can affect your forest.

Integrating forests, cities, and people will reduce the heat island effect, increase local food supply and diversity, and make urban environments more livable.

An urban forest would function like a rural forest if it weren't for the rather inconvenient (for the trees) existence of the city and its human activity. Because the natural cycles that guarantee its functioning have been broken, the urban forest needs us in order to survive. For example, new trees are always being planted in natural forests through the process of natural seeding. There is a mix of ages of trees. When older trees die, the maturing younger ones are right there to fill in. Since concrete and the lack of a natural ecosystem prevent trees from reseeding themselves in most parts of the urban forest, it becomes our constant job to plant new trees. We must interplant along our streets and in our parks to guarantee that there's a generation ready to succeed our old beauties. It's the same story with nutrients, water, and pest control; we must provide that which does not occur naturally in cities.

Elm Action

When Dutch Elm Disease hit Minneapolis, Don Willeke, lawyer and cofounder of the Twin Cities Tree Trust, mobilized a massive citizen lobby that resulted in a state matching fund of $60 million to help cities organize a war against the disease. Most other stricken cities lost nearly all their trees, but by acting quickly, the people of Minneapolis slowed the spread of the disease and saved nearly half of their old elms. They have also planted nearly 1 million large trees in the past 15 years to ensure a dense urban forest canopy. According to Don, the key was to involve politicians: "People underestimate their power to move government to action. They think as long as they're doing tree work, they don't need to get their hands dirty with politics." During the effort, citizens visited their representatives to plead for the trees. Now 100,000 mature elms lining the streets of Minneapolis stand as testimony that their strategy worked.

Take a Peek

Perhaps the best way to view your urban forest is to look at it from above. If you're afraid of taking off or landing, checking out your forest is a great airplane activity for those tense sixty seconds! For a longer, more studied view, find the tallest building in town, a good hillside, or a detailed aerial photo. Notice the elements that we label city: the buildings, streets, parking lots, cars, and freeways. Now look at the forest instead of the city. The trees are probably obvious, but what about the meadows and clearings? Lawns, gardens, parks, parkways, golf courses, and cemeteries play a major role in the city forest, along with the wildlife, birds, bugs, and bees.

Now that you've mentally checked it out, what have you found? Was your city carved out of the forest, or was the forest planted into your city? If you don't have much of a forest at all, then your role is clear. You need to help create it wisely and establish it firmly. If your city or community is blessed with heavy forest cover, your job is just as magical, only different. How old are the trees? How well have they been maintained? Is there an inventory on them? What's the replacement plan? What's the ratio of trees lost to trees planted each year? (The national average is four trees lost for every tree planted.) Trees grow old and die. Disaster strikes communities who've become complacent about tree cover and have dropped planting from their list of priorities. Can a tiny sapling adequately replace a 100-year-old elm? Foresight will keep your community shaded in the manner to which it has become accustomed. Who is taking care of your forest? Who's the guardian of the whole ecosystem? Who's monitoring what's happening? Who's reporting what to whom, and when? Where do government agencies, landscape professionals, and gardeners go for reliable information on what to do? How and where do lay people plug themselves in? Are there gaps between what the agencies are able to manage well and that which is clearly the jurisdiction of private individuals? If you've not seen the forest from this perspective before, you've probably not clearly been able to see your stewardship role.

Trees Release Me

Trees can't be used as the scapegoat for unrepentant polluters. For instance, although many studies have shown trees to be valuable as sinks for trace contaminants—trees lining freeways are especially valuable in absorbing lead and exhaust fumes—we need to consider what happens to the leaves after they've taken up particulate matter from the air. If leaves are removed and burnt, the contaminants end up back in the atmosphere. If they're buried in landfills, the pollutants may leach into soil or ground water. If the leaves are used for mulch or compost (in the case of evergreens; leaves stay on the tree but are cleaned by rainfall), the soil eventually gets the pollutants back again. What's more, some trees cannot withstand air pollution and will die or suffer chronic stress. The message? Give trees a break. Don't ask them to clean a mess that was avoidable in the first place.

Was your city carved out of the forest, or was the forest planted into your city?

The urban forest possible

Already the forests in our cities contribute a lot to our lives, physically, aesthetically, emotionally, and spiritually. Everybody has a tree story in their past. If we now contribute a little extra energy to them, they'll give us even more.

Trees shade and cool our streets and buildings, creating beautiful green towers to soften the harsh urban environment. A big tree can provide a day's oxygen for up to four people. Trees contribute to a community's sense of place. They increase property value. They provide fruit. They give us beautiful shapes, flowers, fall colors, and scents, and they provide homes for birds (who sweeten the air with their voices), butterflies, squirrels, and other wildlife. Their flowers are a food source for bees, and their branches hold many a tree house. In colder climates, trees can help insulate homes from cold winds as well. Trees catch rainfall, slow storm runoff, and prevent soil erosion. (See Chapter 2 for a complete list of the benefits of trees.) Not so obvious are the emotional and healing benefits to people. A study at a hospital in Pennsylvania revealed that surgical patients whose rooms had a view of trees and greenery took fewer painkillers and recovered quicker than those whose windows faced a brick wall. Is there any doubt that an abundance of trees in the city makes it a saner place and keeps its residents a little more balanced?

How trees cool our cities and our planet

The entire urban forest canopy plays a leading role in cooling our cities and keeping our energy costs down by breaking up heat islands, thereby lowering peak summer temperatures by five to nine degrees. A heat island, primarily an urban phenomenon, is an area of exposed, heat-absorbing surfaces, such as tarmac and concrete, that without tree cover absorb the sun's energy and radiate it back as tremendous heat. They can be found all over the city—in our parking lots, streets, and buildings.

Mental Tarzan

As you begin to know trees by name, you'll almost unconsciously start labeling them as you walk or drive through the city. Your attention will be drawn to them rather than to the urban hardscape. Ultimately, you may find yourself mentally swinging from tree to tree like Tarzan in the urban jungle. According to research conducted since 1988 at Lawrence Berkeley Laboratory (LBL), proper planting and shading of these urban surfaces can achieve an energy saving of up to 50 percent of the electricity used for summer air conditioning. Used in this way, an urban tree becomes an effective tool for combating global warming and cutting utility costs. Hashem Akbari and Arthur Rosenfeld, researchers at LBL, report that one urban tree does the job of between ten and fifteen rural forest trees in keeping greenhouse gases from the air.

Just as global warming and the hole in the ozone layer are linked by human causes, so are trees central to countering both environmental ills. The shade produced by trees on city streets and campuses can help shield us from harmful ultraviolet rays, which are more prevalent without the protective ozone layer.

Exploiter vs. Exploited

"You're from Los Angeles, huh? (Sympathetic sigh.) Oh, they really need you down there. You know, our son went down there; he built three shopping centers, and we were ready to go down and see the job he'd done. Suddenly we had a call from him saying he was coming back to Spokane; said there were no trees down there and too much traffic and congestion and people and buildings and...well, the trouble is, you lose hope in a city like that. It doesn't seem like anyone can affect anything at all. . . . Now he's building houses in Spokane."

Pop eco-psychology: completing the broken cycles

Imagine the earth is a ball you're holding in the palm of your hand. Look at its precious resources: clean air, clean water, energy, abundant food, animal life. Notice that all the elements on the earth seem to coexist in a state of balance. This rule applies not just to the whole but to its parts. The forest ecosystem in its natural state is a perfect example of nature in balance. This state of balance is actually a dynamic set of processes that make up cycles. In natural ecosystems, everything—energy, information, nutrients, water—flows in a cycle.

Let's follow an energy cycle. Plants grow using energy from the sun, carbon dioxide from the air, and nutrients from the soil. During photosynthesis, plants transform the sun's energy into biomass: leaves, stems, and wood. Anything that falls to the ground, be it leaves, broken branches, or the plant or tree itself when its life is through, decomposes and returns the energy to the soil, making it available for the growth of other plants. One simple and complete cycle. The cycle expands to include the animal kingdom, which consumes the food the earth produces. Animals—humans included—are a part of the bigger cycle. We eat plants, convert and use some of the plant energy, and then, through elimination or death, pass the remainder of that energy back to the earth to be used as fertilizer for the growth of more plants. Another complete cycle.

If a cycle is broken, the energy is diffused. For instance, during a forest fire, heat, carbon dioxide, and smoke are produced as waste products. That waste, or diffusion, is what scientists define as pollution.

For millions of years, humans were able to live on the earth as a part of natural cycles and systems. Whatever damage or disruptions people caused could be handled by nature. As technology advanced, people learned how to manipulate the environment and to disrupt cycles permanently. Instead of recycling the energy we use back into nature, we break the cycle and think we can throw away that energy. Our waste becomes pollution: sewage fouling rivers, lakes, and oceans; litter making

Current Emissions of CO_2 by Source

- Fossil fuel combustion
- Deforestation
- Cement production

Top Three Sources

Fossil fuel combustion

1. United States
2. China
3. Russia

Deforestation

1. Brazil
2. Indonesia
3. Colombia

Cement production

1. China
2. USSR
3. Japan

our common land look like a trash can; and garbage filling our canyons and turning them into ever increasing and harder-to-reach landfills. The level of pollution—poison—has risen to the point where it is affecting our health and killing off forests and animals. Human energy has more than just a physical presence. We also express and recycle our energy in the form of love, service, art, dance, prayer, and so on. Likewise, wasted human energy is represented by more than just physical pollution. We feel boredom, frustration, anger, alienation, depression, and pain. Until recently, our physical pollution has been out of sight and therefore out of mind—flushed or buried from view. On the nonphysical plane, ridding ourselves of our deep boredom, anger, or pain has required sophisticated distractions, such as harmless spectator sports or, more drastically, gang activity and drug abuse. No wonder we're an addicted society!

Planning and planting urban forests is a great way for kids to learn about nature and the environment without leaving city limits.

Our role in the breaking of cycles began when technological advances made it possible for humans to manipulate the environment. It gained new proportions when we moved beyond villages into large cities, where a degree of anonymity could be translated into not being accountable and not counting. Aside from breaking the energy cycle on a massive scale, urban dwellers broke the negative feedback loops. As long as we could put our waste somewhere else, we didn't have to face the damage it was causing and so didn't change our behavior.

Now that we see a crisis before us, both environmentally and socially, we have a chance to get back in touch with our personal power and responsibility to change our ways. Imagine what can happen when that human energy is focused! The answer doesn't lie out there. There will never be enough money to hire teams to clean up the planet for us, any more than there will be enough money to rid us of the scourge of drugs. The answer lies in mobilizing every single one of us to heal—not as a punishment, but as a powerful gift to ourselves. Tending our own mess, like tending our own trees, is a continuing discipline. As with most messes, once we get involved in cleaning up, we can appreciate the need for prevention. Humans are the only creatures capable of comprehending and relinking the earth's cycles. From an ecological perspective, we do have a role to play beyond enjoying ourselves, consuming the earth's resources, and destroying its life-support systems. Consequently, the three Rs many of us remember from childhood have become the four Rs for the 21st Century: reduce, reuse, recycle, and replant.

The Players

Look at the number of possible players in the urban forestry game! Just trying to find who's responsible can be a massive undertaking. Here's a starting point: individual citizens, youth, politicians, organizations such as churches, clubs, and homeowner groups, government agencies such as city or urban foresters; the public works department; street tree, roads, or highway departments; parks departments; fire departments; county, state, and federal forestry agencies; environmental quality departments; planning, building and safety, or engineering departments; and agriculture commissioners, citizens' commissions on trees, public works, and parks; urban forestry professionals such as arborists, landscape architects, landscape maintenance firms, and home gardeners; telephone and electric utilities (for line clearance), businesses, environmental organizations, and the nursery industry. Whew!

Lines of authority differ in every town. There are often major gaps in coverage, and many opportunities to enhance the urban forest are missed. With the rise of professional urban foresters, some cities are now making an effort to coordinate diverse agencies and activities. A city will benefit by having an urban-forest management system planned or in place before it takes on a major planting effort. However, take heed of Marcia Bansley of Trees Atlanta who said their planned-management system fell apart because no one could agree on a species selection list! Trying to coordinate efforts can be very hard work. There's no rule on what a system should look like, but there are a number of ideal components.

City forester: Overall program manager whose role is to integrate the work of public agencies and the private sector.

City or government agency: Has planting, management, and maintenance responsibility, and funding to do it.

Ordinances: Some ordinances protect trees or prescribe minimum legal tree cover in, for instance, commercial parking lots. Others may mandate certain densities of plantings with development projects or percentage of sun required on city streets. Some city ordinances even mandate tree-pruning standards and require certification of tree care professionals. (Contact the American Forestry Association, TreeNet, or the International Society of Arboriculture for information. See Resources.)

Citizen tree commission: Holds the vision of a city forest, provides community input, and contributes to the planning and management process. Can be set up in a policy-making or advisory capacity.

Citizen action component: Includes youth involvement in planning, planting, light pruning, and care; advocacy; and the contributions of citizens through environmental or community-service private nonprofit groups.

Public education: Handled by public or private sector. Neighborhood-level outreach, organizing, training, and action: Best handled by a private organization.

Tree inventory: Organized list of all trees on public lands. Should include maintenance history and prescribed policy and schedule for maintenance and replacement.

Tree or forest master plan: A planning document that guides selection of species, planting styles, sizes, and formats. Could include special neighborhood identities. The creation of this document can be a profound process for building community involvement and commitment. Just how these components come together can be tailored to the needs, resources, size, and spirit of a given community. Depending on the players, much can be the responsibility of local government or a local nonprofit.

The greenhouse effect and global warming

Carbon dioxide (CO_2) and other gases form a natural shield in the earth's atmosphere and behave in a similar way to the glass in a greenhouse. The sun's rays penetrate the shield, hit the earth, and are reflected as longer-wave heat. The shield then traps some of the reflected heat that would otherwise radiate into space.

This process is a natural phenomenon. Without this greenhouse effect, global temperatures would be sixty degrees (Fahrenheit) cooler—unlivable for us. However, with the overabundance of greenhouse gases, which include water vapor, methane, and nitrous oxide, as well as carbon dioxide, the natural blanket surrounding the earth is thickening and, as a consequence, global temperatures are rising slowly but dangerously. We are losing tropical rain forests—the lungs of the earth, which, along with other plants, absorb carbon dioxide and release oxygen—at an alarming rate. An area roughly the size of a football field is cut down and burned every second; an area the size of a city block is cut down every minute. We're not only losing the forests' ability to absorb and store carbon but are also releasing more carbon dioxide into the atmosphere during the slash-and-burn process.

World energy use is the main contributor to increased atmospheric CO_2. Conservative estimates say that each year we burn enough fuel to release nearly six billion tons of carbon dioxide into the air. The United States, with only 5% of the world's population, produces nearly one-quarter of the annual global CO_2 from burning fossil fuels. The 1980s witnessed the four hottest years this century, with 1988 being the warmest year on record. (Ed. note: Until 1998 and 2003…). Present global temperatures are the highest since mankind has been keeping records. The rate of global warming in the past two decades is higher than at any earlier recorded time. Moreover, in addition to destroying the ozone layer, which protects the earth from the sun's ultraviolet rays, chlorofluorocarbons (CFCs)—widely used in aerosols, refrigerators, air conditioners, and foam packaging—are responsible for 15 to 20 percent of the global warming phenomenon.

. . . several families gather to harvest peaches, plums, and apricots from the trees they planted in the community orchard at their church.

Picture this

Thousands line a major boulevard in teams of four to ten people, removing concrete from neatly trimmed, square holes cut in the sidewalk. They dig, measure, determine the sun's direction to enable them to orient the tree's limbs, and mix soil amendments and nutrients into the native dirt. When the preparation is done, they assemble around a waiting tree. They move it toward a hole, and while some support its branches, others quickly and gently remove the pot from the tree's rootball. All help lower the tree into its new home, steadying it while the hole is filled. The soil is packed in, and stakes are pounded into position on either side. The people use special rubber ties to secure the tree between the stakes—loose enough to allow the tree to sway in the wind and build its own trunk strength, but tight enough to provide protection from a host of urban stresses it will encounter in its first, most vulnerable years. Then the final touches. While some sweep and clean up the surrounding area, others fashion a basin around the tree's base using surplus soil from the hole. The team gathers to inspect the work for quality. They take turns pouring buckets of water into the basin. To complete their work, they dedicate the tree by giving it a name, which they write on a small strip of bumper sticker material. They sign their names to another sticker, then affix both stickers

to the stakes. Before moving on to the next tree, they commit to plans for watching over and caring for this one. Stepping back, one can see the boulevard in the midst of a profound transformation. As teams complete their planting, they polish the job by collecting and recycling litter, and sweeping the sidewalks. Tomorrow they'll be back to paint out the graffiti.

Down the road at the shoe warehouse, on company time before the lunch break, employees are pruning and weeding the trees they planted around their parking lot 18 months ago. Some of the faster-growing species they selected are already beginning to shade the building and reduce air-conditioning needs and every day the early birds get the pick of the cool, shaded parking spaces. The employees then sit down to enjoy lunch in the scented herb-and-fern-garden picnic area they created next to the lot.

The bell rings. It's the end of another school day. Students flow out of the classroom doors. While most leave, a couple go to the bicycle compound. Mounted on specially engineered forest-care bikes, they ride to the boulevards and business districts in their assigned territory. One student checks with a local shopkeeper before hooking up a hose and filling the water tank on his bike. He adds some nutrient concentrate and pedals up the sidewalk to feed and water the trees. Another loosens tree ties that are beginning to strangle their charges and prunes suckers that have sprouted. She then rides to the neighborhood compost station to deposit the prunings before riding home. On another day, students are making preparations for future forests which will shelter their schools and surrounding communities. Working with neighbors and local businesspeople, they survey streets, parking lots, and open spaces to determine the number and species of trees required to form a green canopy. They receive guidance from city foresters and planners and will ultimately gather the whole community to shape their collective dreams into action plans.

They plan to collect funds, materials, and supplies to plant seeds, transplant seedlings, and then raise thousands of trees in nurseries built in school yards. Students will spend a portion of every day working in the nursery and caring for the larger trees they've planted around their campuses and communities.

Street trees bear fruit

It's not common, but in Coral Gables, Florida, the avocados that line some streets are tended by civic and church groups who glean and distribute the fruit to the needy. The trees are well mulched to prevent the avocados from splattering when they fall. From 1980 to 1985, Massachusetts had a state-mandated fruition program that also relied on gleaning groups to keep the trees clean. However, a city in California just removed its fruit-bearing street trees because citizens (adjacent owners) weren't harvesting or cleaning up the fruit that had dropped and become a hazard. If you can provide solutions to the problems your city might face, this fruity idea bears thinking about!

On Sunday after the service, several families gather to harvest peaches, plums, and apricots from the trees they planted in the community orchard at their church. They each take their share, then deliver the remainder to a local food bank for distribution. Just a month before, this part of town held its annual Jacaranda Festival to celebrate the brilliant display of the purple-flowered theme tree planted by residents along the length of the streets in a square-mile block. The festival attracts tourists from around the country, drawn to the town not only by the beautiful floral display but also by the general aesthetic quality and high standard of care of its well-planted streets. This is not Ecotopia nor even a futuristic community-living complex in Scandinavia. It's what is possible in cities throughout the United States and the world as citizens take back their power and begin to take responsibility for the urban environment. The sky's the limit in this urban forest. The number of trees lining highways and freeways, in parks, parking lots, streets, school yards, and private homes can be increased dramatically.

It takes a village—or a neighborhood, the city's equivalent—to transform streets into forest alleys.

Trees For Life

Balbir Mathur says he is simply an observer of miracles. Since 1983, his organization, Trees For Life, has planted more than 1.5 million trees in India. "Trees For Life is not really about planting trees but about regenerating the spirit of people," he says. Trees For Life was the result of a childhood promise Mathur made to the generous lemon tree in his back yard: to plant thousands more like it so that others could enjoy its fruit.

Although its focus is India, Trees For Life is based in Wichita, Kansas, where its Grow-A-Tree kit provides school children with fruit-tree seeds and the instructions to plant and care for them.

City harvests

We know urban trees grow old and eventually die, just like rural forest trees. But why do they end up in our landfills, or simply sold as firewood, instead of being used to provide the more typical forest products we know? There are inspiring examples in Northeastern cities where tree trimmings are recycled as mulch. And now with the advent of portable, mini sawmills, urban trees can be turned into usable wood and lumber. A mill can be pulled with a pickup truck right to the site of a cut or fallen tree, or can be used in a municipal equipment yard where trunks and debris are hauled. Lumber from these mills, some of which are almost fully automated, can be used for furniture, crafts, toys, and small construction projects.

The lumber from a city-owned mill could be made available to inner-city high-school and junior-college wood shops and carpentry-training programs. In Los Angeles city schools, students must pay for the wood they use for projects in shop classes. One inner-city wood-shop teacher at Jordan High School, upon receiving an award for his outstanding work with students, commented that if he could only be given enough wood for student projects, he could keep them all out of gangs and off the streets! This wood could help develop carpentry and job skills, as well as supporting cottage industries for small crafts.

Recycling urban wood is not just an opportunistic idea. Can you imagine growing trees on abandoned urban land parcels with the specific intent of selectively harvesting the wood and replanting the crop? Think of the places, such as along highways and freeways, where trees could be doing double duty!
In Oslo, Norway, some of the parks are also well-managed, lumber-producing forests. People play and ski in them, but the city foresters also harvest mature trees and sell them for lumber. The true value of this program lies not with the wood harvested but the example of sustainable forestry that's set and the reminder to urban dwellers that we should be able to protect far off, unseen tropical hardwoods.

Holding the rain

As our cities continue to sprawl, the increase in paved areas causes enormous runoff, erosion, and stormwater problems. Instead of rainwater being caught and slowed by trees and shrubs and slowly percolating into the ground, rainwater hits asphalt, concrete, or bare, compacted ground with full impact and rushes off wherever gravity takes it. Most cities have developed complex and expensive flood-control systems to carry away the resulting runoff. Continued urbanization now threatens to outstrip the ability of the flood-control system to handle the runoff. In Los Angeles, the Army Corps of Engineers is in the midst of planning an emergency project to raise by ten feet the walls of the Los Angeles River and the bridges that cross it. The Corps has determined that, because of increased paving and construction, major portions of the city will be threatened during a one-hundred-year flood, because the Los Angeles River at its current capacity would surely overflow its banks.

What's more, the runoff from urban areas carries with it toxic substances, such as oil from the streets, which go on to pollute our waterways and lakes and the bays and oceans into which they flow. The polluting of our water in this way is as tragic as the loss of the urban watershed to development. In areas like Los Angeles, where water must be imported, it's folly to send valuable rainwater to the ocean when it could be captured and used where it falls, channeled into tanks or swales (mini-dams) for irrigating the local urban forest. Forestry is also known as watershed management. It therefore follows that urban forestry can be used as urban watershed management, saving on imported water and protecting waterways downstream. Proper planting and design of parking lots and sidewalks, along with the installation of devices to trap and store rainwater, can help solve the problem.

Along with the forest and water came a changed climate, a healthy agriculture, and a new, energetic population.

The man who planted hope

Jean Giono writes of a humble shepherd named Elzeard Bouffier who lived alone in a deserted and barren region of the southern French Alps in the early part of this century. It was his opinion that the land was dying for want of trees. Confessing to no pressing business of his own, he had resolved to remedy this state of affairs. Every day, while tending his sheep, he planted acorns. When the author met him, he was growing beech trees in a nursery near his cottage and was considering birches for the valleys. Ten years later, the oaks and birches had formed a young forest. Formerly dry streams now ran with water. The wind scattered seeds and, with the water, willows, rushes, meadows, gardens, and flowers reappeared. The transformation took place so gradually it caused no astonishment other than the delight of discovery by the local administration of what appeared to be a natural forest. Thirty years later, the earlier barren landscape was unrecognizable. Along with the forest and water came a changed climate, a healthy agriculture, and a new, energetic population. One unlearned peasant, armed with a greatness of spirit and the tenacity of benevolence, had completed a work worthy of God.

Australia suffers the effects of drought regularly on a countrywide basis. Not coincidentally, it's also badly devoid of

tree cover. Coastal and inland areas have been largely deforested to make pastureland for the wool and cattle industries. Water is a precious commodity. In most semirural areas, mains water is too expensive for anything but drinking. In extreme circumstances it has to be trucked in. Many households—even in the suburbs—collect rainwater for their own use.

The citizen forester

Whether you put a ficus in a pot in your living room or launch a grassroots action group in your city, your energy, inspiration, love, creativity, time, talent, resources, and your concern for this earth are crucial right now. The need is clear. The way forward is simple but certainly not easy.

In Los Angeles, a Citizen Forester is a person who has taken very specific TreePeople training. Citizen Forester is a term trademarked by TreePeople. It is used to represent an individual citizen who is volunteering to serve the community. The term is specific and is in no way meant to imply possession of professional forestry skills or license to practice professional forestry. TreePeople expects its graduates to join in the task of fostering environmental stewardship in the community, and the organization is committed to that task. Reading this essay is a different matter. We don't have your name and address, and no one is there to cajole you to pick up a shovel. Here the term citizen forester is used in a broader sense. Here are a few examples, from the simplest to the most gung-ho, of what might happen to you as a result of reading this.

The backyard forester

People in glass houses shouldn't throw stones. And people in any sort of house with land around it should start their planting right outside their door. It's the simplest way to start. It will involve you in the wonderful discovery of your favorite trees, and you won't have to deal with permits, volunteers, fund raising, publicity, or any of the other things that can sometimes stump even the most fervent planter. But you will learn what it takes both to plant and care for trees.

Your own home, or a nearby vacant lot, can provide you with tons of opportunity to create a highly diversified and intensive urban forest microenvironment. You can turn your yard into a wildlife or bird refuge—the National Wildlife Federation has a special program to encourage exactly that—or create an orchard that produces a surplus to share with food banks.

Don't discount this idea if you're a renter. Not all landlords will pay for your garden improvements, but many will welcome your work. They may ultimately benefit, but you're the first beneficiary, and approaching life with a giving spirit invariably sets you up to receive at least as much as you give.

The multiunit forester

Whether it's patios, common areas, window boxes, terraces, rooftops, outside the parking garages, or around the building itself, there are plenty of areas with landscape potential around apartments and condominiums. With the permission of the owners, it's possible to cut concrete to make room for planting. Obviously a little less satisfying, but also less threatening, is to use containers, such as pots, boxes, and large planters.

The neighborhood forester

Once you've done the work for yourself and your family, think about moving beyond your own property to take on the role of creating community around tree planting. Having learned the basics, you can help get your neighbors started in planning, planting, or in taking extra care of the trees around their homes. It will depend on the layout of your properties, but you might want to coordinate the planting of a particular species right inside the property line, all the way along the street. Whether you aim to line your street with trees, or populate your neighborhood with a tree species that will attract specific birds, there are many opportunities for action.

. . . people in any sort of house with land around it should start their planting right outside their door.

The scout

At some point, it's a good idea to inventory the needs and resources that exist in your area. Look out for vacant lots, parking lots, graffiti-covered walls, traffic islands—neighborhood eyesores. City hall likely has no clue about the specific blights or needs of your community. Scouts love merit badges. It's only logical that when a scout learns the terms and principles of urban forestry and carries out a tree-planting-and-care project, he or she should be honored with a badge. In the early 1980s TreePeople worked with the Angelus Girl Scout Council to develop Urban Forestry Merit Badges. Hundreds of girls participated in an educational program with TreePeople, then went on to work with the Los Angeles County Forester and Fire Warden to plant a special grove in an inner city regional park. Completion of both phases of the program earned each scout a special urban forestry badge. Senior scouts, too, commonly take on special projects with TreePeople to earn their final title of Eagle Scout.

The citizen pruner

In New York, Citizen Pruners are trained by the Street Tree Consortium and certified by the city to carry an ID card that authorizes them to prune trees whenever and wherever needed

and to liberate trees girdled by tight support wires.

Perhaps you can create something similar. Bone up on pruning techniques and begin with your trees and with your neighbors' trees—with permission, of course, or on request. Carry with you wire cutters and pruning shears. Where you can't assist a needy tree, or if you don't feel your work would be appreciated, carry a notepad so that you can mail in problem reports to the proper authority. We don't encourage vigilante action. However, if your local agency is overburdened, it may welcome responsible maintenance action on the part of trained citizens.

The citizen activist

Get involved in local politics. Sit on a tree board, work with your city to create or enhance a professional urban-forestry management program, be a guardian of your forest by watching out for inappropriate tree removal or bad pruning techniques. Help organize a way to protect them. One long-time TreePeople volunteer digs through the city's capital-improvement plans, discovers where street widening (and tree removal) is proposed, and notifies neighbors so that they can respond accordingly. He also pays close attention to notices of public hearings, spreads the word about them, and attends to speak on behalf of the trees. He is one man operating alone. In Seattle, one woman has formed an organization called Plant Amnesty "to end the senseless torture and mutilation of trees and shrubs that many people incorrectly refer to as pruning." With a sense of humor—but a serious mission, Plant Amnesty delights in telling bad horticultural jokes and tales of hope and horror. Remember, angels can fly because they take themselves lightly!

Tree huggers

When commercial loggers began large scale felling of trees near Reni in northern India, their chainsaws were slicing through the very roots of local society and threatening the livelihoods of local communities. In an astonishing display of courage and determination, the women of Reni wrapped their arms around the trees to protect them from felling, sparking off the Chipko Andolan movement (the "movement to hug"). Eventually, following an inquiry, the government declared 12,000 square kilometers of the sensitive watershed region of the Alakananda basin off-limits to loggers. Today, the Chipko movement runs reforestation programs in other villages where livelihoods are threatened.

The ReLeaf Coordinator

Once you've been doing this for a while, you may be ready for the big league. New groups are popping up all the time, responding to their founders' inner calls and to the growing need for citizen involvement in urban environmental healing. The American Forestry Association is running a campaign called Global ReLeaf and provides guidelines for new local groups. There's a lot of support out there. There are also many other people with great ideas.

Sooner or later you'll bump into someone in your city who's in the same situation or, maybe even better, has already got something together on a bigger scale. Perhaps your city already has a tree-planting organization, or an urban forester. Try not to act too much like the newly converted around the old salts. Your role may be as facilitator or problem solver. Perhaps you'll be a leader or simply a planter. Maybe the most important thing you can do will be to put forth your ideas and get out of the way. Look to nature for guidance. There's room for a wide variety of ideas. They don't have to compete. Diversity is the strength of the forest. Cooperation is the key. Have fun!

Global ReLeaf

In the summer of 1988 the American Forestry Association and TreePeople sat around a conference table in Washington, DC, to discuss how the American people could be moved to take a stand against the growing gloom of global warming. The result of that meeting (and an inordinate amount of research, coordination, and fund raising on the part of Neil Sampson and Gary Moll) was the launch of Global ReLeaf, a national campaign to encourage the planting of 100 million trees in US cities by 1992. Recognizing the essential role of community groups in the realization of the goal, AFA has built a network of local and regional organizations under the ReLeaf banner, providing fledgling groups with information on how to get started and acting as a clearinghouse to link individuals with their nearest organization. Δ

Changing the Climate and Creating Livelihood

Making Trees Pay

Albert Bates

ONE OF MY FAVORITE ANIMATED SHORTS, and one we often show visitors to the Ecovillage Training Center, is *The Man Who Planted Trees*, Frederic Back's adaptation of the story by Jean Giorno referred to by Andy and Katie Lipkis in the previous article. *The Man Who Planted Trees* is the story of an old mountain shepherd who, acorn by acorn, single-handedly converts his arid, war-battered surroundings into a thriving, productive ecosystem. (1)

Many permaculturists are doing this, and we see splendid examples on every continent—food-and-fiber polycultures magically transforming barren lands into rich and diverse forests that make their own climates. If we consider how carbon and other greenhouse gases are actually removed from the atmosphere, then even larger armies of treeplanters will have to take to the field, be trained and resupplied, and be constantly re-encouraged to keep up the effort, despite setbacks.

As I write this, the southeastern quadrant of North America is experiencing a drought the extent of which has not been seen since the 19th Century, even in the dustbowl of the 1930s. In Western Australia in 2005, one farmer was committing suicide every fourth day, on average. Now, in 2007, rates of suicide in rural Australia have risen to 20 per week. (2)

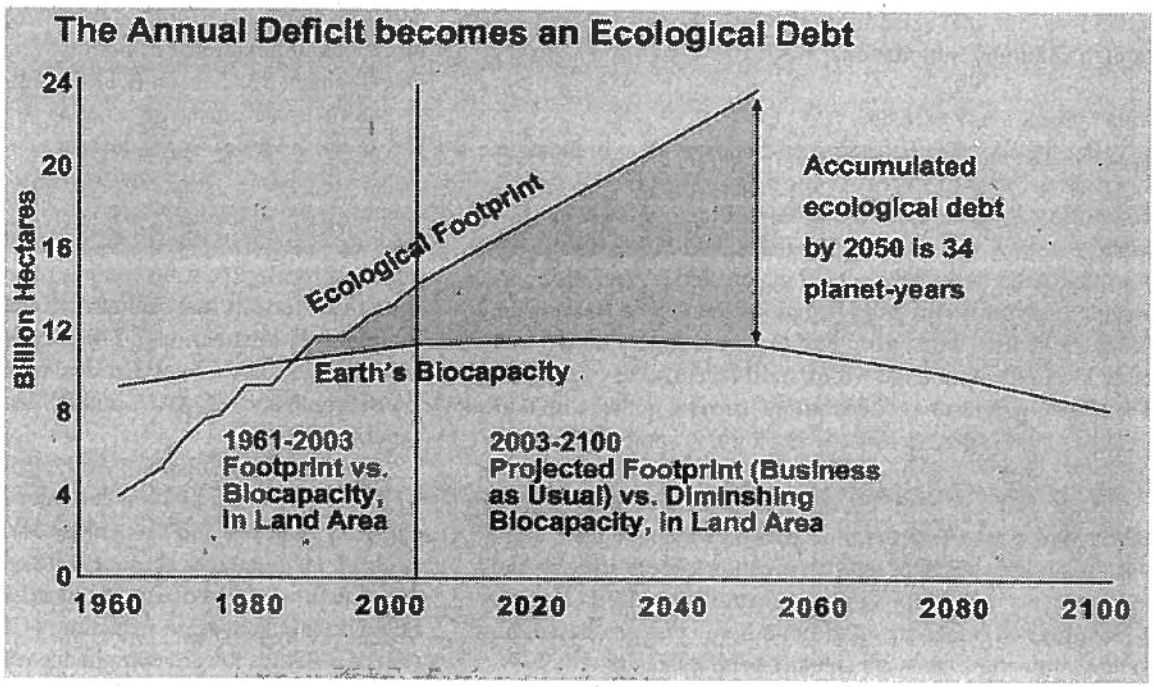
Global warming was measured in 1979 to be increasing a fraction of a degree per century. On closer examination over 25 years, we now see we are in a curve of acceleration never witnessed in natural history. If you think that the scientists you see in the news describing the latest findings and consensus recommendations have a haggard, frightened look, you are not wrong. Many describe themselves as "scared." (3)

For many thousand millennia the fastest change in atmospheric chemistry has been on the order of 30 parts per million (ppm) carbon by volume over a period of roughly 1,000 years. We have come that same distance now just since 1985, and as we have, our rate of emissions has steadily increased. We are still pressing down on the accelerator and haven't yet reached the floor.

For those of us caretaking and gradually expanding the 20 square kilometer Swan River watershed trust that includes The Farm, it means that our local climate has begun to change before our eyes.

The climate that existed when we settled here in south Tennessee in 1971 can now be found near Berea, Kentucky. The climate regime we know today was located in central Mississippi in 1971. A quick trip 300 miles south shows an entirely different ecosystem prevailing there: scrub pine. Here it is mixed hardwood, primarily red oak. Our strategy for the past 30 years has been to re-establish native species like the juneberry, persimmon, and redbud lost during the logging of the great railroad age. That strategy is now obsolete. We were fighting the last war, not the next one.

Today we need to think about aiding the migration of forests from equator to poles. The fastest runner in the tree kingdom is spruce, which uprooted and dashed 700 miles per century as the glaciers retreated 12,000 years ago. It was a dazzling and record-setting display, but not even spruce is fast enough to hold to the pace of the track we are witnessing in 2007.



How fast? Many northern insects hibernate in winter, placing themselves in a low-energy state that allows them to survive the extremes of northern winters. The sachem skipper butterfly *(Atalopedes campestris)*, on the other hand, is a southern species, and it stays active through winter months. That makes it more vulnerable to being killed by sudden frost, and that determines how far north it can successfully breed. The range of the little skipper butterfly has expanded 420 miles from California to Washington State in just 35 years. In 1998 alone, the butterfly expanded its range north by 75 miles.

Our role has changed from preservers of place to agents of change. Diverse forests have the resilience and mobility to host the necessary migrations of companion pollinators and mycorrhizae. Plantation forests do not. Permaculturists are the midwives of the next ecosystem stasis. We are the bulwark that holds robust forest systems against spreading deserts.

So how can we do that and still make a living? I'll list four ways:

1. Private Donations / Websites
2. Government / UN / Kyoto Carbon Trading
3. Partnering with Major Organizations
4. Agroforestry / Mycoforestry

Here at The Farm we recognized fairly quickly that if preserving biodiversity is our holistic goal, then we need to continue expanding our wild areas by acquiring additional forest. This has come at a point in the history of our region when the demographic tide is against us. Sprawl is spreading in our direction from population centers to our North, West and South. MacMansions gnaw at our field and forest edges. Against this tide, we have managed to add contiguous land in conservation trust and easements, often by trading with paper and pulp companies in the aftermath of clear-cuts. While 20 square kilometers (5000 acres) of acquisitions in 35 years may appear miraculous, our goal is ten times that. Mostly, this happens through charitable solicitation.

Private Donations / Websites

A decade ago, The Farm created a conservation foundation called Swan Trust (the Swan is our river). We raise donations through forest walks, special events, mailings, and the website. Some years ago, another of our organizations, Global Village Institute for Appropriate Technology, created a "Trees for Airmiles" exchange program and promoted that on its website. The Institute uses the funds raised to support tree-planting in many locations around the world, most recently the occupied West Bank in Palestine. The Institute has now joined with a local organization, Center for Holistic Ecology, to sponsor "Trees for Tennessee."

It is not difficult to set up a website and start taking donations for this type of work, but as time goes on we notice there are more and more such sites, and verification of performance has become an issue. When you give an extra $10 to Dell Computer to plant trees to offset that new monitor you just purchased, how do you know those trees are actually being planted?

Government / UN / Kyoto Carbon Trading

The need for verification is an important part of the Kyoto Carbon trading scheme. Many of us might have qualms over the idea of buying and selling carbon credits, thinking them more as Paypal Indulgences (sorry), enabling the rich to assuage guilt at the expense of the poor. The concept is actually more sound than that, if you look at the underlying dynamic that is created.

Trade in "pollution rights" was first proposed by Canadian economist John Dales in 1968. The U.S. EPA began experimenting following the Clean Air Act amendments of 1977. Twenty years of trial and error proved the concept and provisions for international emissions trading for greenhouse gases (GHG) were included in the Kyoto Protocol in 1998.

Lets take an example. Suppose both Bob and Sue emit significant quantities of a given pollutant. Authorities decide that emissions should be reduced by a given amount, say, ten percent. At first, both Bob and Sue cut their emissions by ten percent.

Bob and Sue are not equal however, and they soon discover their differences. Sue may, by the nature of her activities, be able to cut ten percent or even more at relatively low cost. Bob, on the other hand, finds it very difficult and expensive. It is this potential difference in reduction cost between Bob and Sue that creates a market.

Sue says to Bob, "I will make additional reductions on your behalf if you will compensate me for the cost and make it worth my while." Bob says, "Such a deal!" Bob is prepared to pay for reductions at a price that is above the cost to Sue but below what it would otherwise cost him to make the reductions himself. In this situation, Bob saves money, Sue makes money, and the planet benefits. Where air pollution is concerned, it makes no difference whether the cuts are made by Bob or Sue, it is the overall reduction that counts.

The Kyoto Protocol establishes three mechanisms that give countries trading flexibility in reducing greenhouse gas emissions: International Emissions Trading (IET); the Clean Development Mechanism (CDM); and Joint Implementation (JI).

International Emissions Trading is a 'cap-and-trade' system for Annex B Parties (the industrial world, minus some key players like China, India, and Indonesia). The allocation to each country is determined by its Kyoto commitment—its national emissions limitation for 2008-2012—plus adjustments for net removals by eligible sinks such as planting trees and no-till agriculture (efforts that can remove carbon from the atmosphere for relatively long periods). The allowances traded are assigned amount units (AAUs) and removal units (RMUs). There is a brisk international trade in AAUs and RMUs, some official, some experimental.

The Clean Development Mechanism (CDM) allows countries without emissions limitation commitments to earn credits for emission reduction and sink enhancement projects. The rules establish an international process for reviewing the baseline and the reduction achieved. Credits awarded for CDM projects—called certified emission reductions (CERs)—can be used by Annex B Parties toward compliance with their national

commitments.

Joint Implementation allows Annex B Parties to award credits for emission reduction and sink enhancement projects. JI credits—known as emission reduction units (ERUs)—are subtracted from available AAUs or RMUs to avoid double counting. The rules allow countries not eligible to participate in IET to host JI projects.

That about uses up my complexity limitation commitments to the publisher of this magazine, so although we could continue to go deeper into IET, CDM, JI, CERs, ERUs, sanctions for non-compliance, weaknesses in the enforcement regime, and so on, I think we can leave it here and let you look up the details from available references. (4)

Because the United States has refused to join the Kyoto process, most recently in June, 2007, individual states and municipalities are now taking the initiative away from the U.S. government. Massachusetts and New Hampshire have passed legislation that regulates electricity generators in those states and allows GHG emissions trading as a means of compliance. California and Oregon have enacted similar measures, not limited to electric utilities, and have plans to trade for credits internationally.

The European Union has applied GHG trading to 7,300 companies and 12,000 installations among energy utilities, oil refineries, iron and steel producers, the pulp and paper industry, and producers of cement, glass, lime, brick, and ceramics.

Does it work? In volume terms, 466 million tonnes changed hands in the CDM market in 2006. One billion tonnes of emission reductions will flow from projects approved and underway while another one billion tonnes is expected to flow by 2012 from projects in the pipeline, the end of the Kyoto commitment period. Carbon markets traded $30 billion worth of greenhouse gas emission reductions around the world in 2006, an almost three-fold increase on the previous year's $11 billion. Another $5 billion was traded in CDM carbon offset credits in return for clean technology transfer to the developing world and former Soviet bloc.

At IPC-8 in Sao Paulo, Giovanni Barontini (5) went into some detail looking at the question of how permaculture projects might be certified to earn tradeable credits by tree planting or appropriate technology transfer. The Project Design Document (PDD) is the official application drawn up by a group applying for project approval under the Clean Development Mechanism (CDM). PDDs must be validated by an independent third party, then approved and registered by the CDM Executive Board before a project qualifies as a CER carbon credit earner. The process begins by getting the project concept document approved by the regional committee of the entity designated by the United Nations to audit the program. Then the methodology is validated, an interministerial commission gives approval, and the program can apply for registration. Once registered, the program must pay for independent monitoring, auditors' reports and various one-time or annual fees. All told, according to Barontini, the process can cost $75,000 to $125,000, well beyond the budget of most small tree-planting projects.

Partnering with Major Organizations

The alternative to the red tape and expense of qualifying under the CDM and JI is for small projects to associate themselves with larger ones. Fortunately, there are a great many excellent programs around the world, and many have already gone through the process of accreditation for carbon trading. I recommend that tree planting groups or similar organizations search out their own favorite organizations to affiliate with. A quick Google search will locate many excellent candidates. (6)

Agroforestry / Mycoforestry

We can also find strategies to make trees pay by developing forest products and services. In my community we have a company, Mushroompeople, begun in 1974, that has been

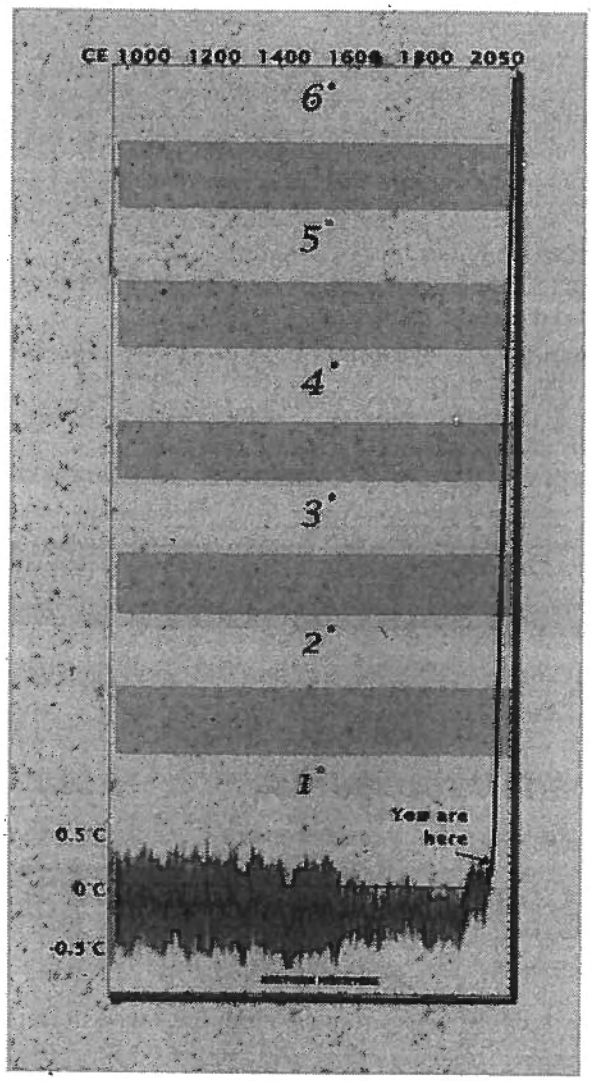
providing farmers and woodlot owners the means to make a supplementary, or even primary, income from growing forest mushrooms. Gourmet and medicinal mushrooms are a steadily enlarging market, and seeding a shady stand of trees, stumps, and fresh cuttings with the right combination of mushrooms can provide a substantial revenue stream. Of course, mushrooms are not the only extractive resource a healthy forest can supply. There are many nut crops, vine crops, shade crops, and coppice or pollarding for fuel, furniture, and other uses.

At the G8 Summit of industrial nations in June, 2007, the German Chancellor, the Prime Minister of the UK, and many other world leaders in attendance urged upon the United States, China, and any remaining Kyoto holdouts, a quick reversal of policy in order to avert "climate chaos." What Chancellor Merkel and G8 senior officals foresaw was precisely what Lovelock, Lynas, Gelbspan, Monbiot, Tidwell, Pearce (8) and others have written increasingly desperate warnings about. Somewhere above 2° warming, the IPCC Fourth Assessment says, tipping points cascade and the result is "unacceptable."

At 3 degrees, reaching 4 degrees becomes a *fait d'accompli*. At 4 degrees, processes are set in motion that automatically take us to 5 degrees, and then 6 degrees. Can we stop at 6 degrees, or will we continue to be swept up to 10 degrees, or more? We have a chance, now, at 1 degree, perhaps, to halt emissions and hold the increase in check at below 2°. At present rates of GHG generation, that window closes by perhaps 2015, so the missed opportunity in the path not taken by the United States, China and others could be a very sad tableau, an epitaph for humanity.

Actually flipping the trend, by halting the spread of deserts, reversing deforestation, and increasing the capture of carbon dioxide and other greenhouse gases in soils and oceans, is potentially within our reach. At least that is what we can hope. What will be required will be to hold water in the landscape, grow forests large enough to make their own rain, and re-green the Earth now, everywhere, at once.

Δ



Albert Bates is an environmental educator at the Ecovillage Training Center at The Farm community in Summertown, Tennessee and author of Shutdown: Nuclear Power on Trial (1979); and Climate in Crisis: The Greenhouse Effect and What We Can Do (1990). His latest book, The Post-Petroleum Survival Guide and Cookbook: Recipes for Changing Times, *is available from New Society Publishers.*

NOTES

1. Order the book or DVD from www.herondance.org.
2. *Drought Casts Suicide Shadow over Rural Australia*, Planetark.org, June 7, 2005.
3. Richard A. Kerr, "Pushing the Scary Side of Global Warming." *Science*, 316:5830, pp. 1412-1415 (8 June 2007).
4. A good starting point is http://unfccc.int/kyoto_protocol/background/items/3145.php. Emissions trading schemes for greenhouse gases and other pollutants are already operating or being developed in various parts of the world: European Union Emissions Trading Scheme (www.ec.europa.eu/environment/climat/emission.htm); Chicago Climate Exchange (www.chicagoclimatex.com); Acid Rain Program (www.epa.gov); Regional Greenhouse Gas Initiative (US) (www.rggi.org).
5. Giovanni Barontini, *Mudanas Climaticas e Mercado de Carbono: Panorama general*. Fabrica …thica Brasil, Consultoria em Sustentabilidade Ltda. www.fabricaethica.com.br
6. See, e.g.: carbonfund.org; carbonpositive.net; carbonneutral.com; americanforests.org/global_releaf; tist.org; and onf-international.fr.
7. Lovelock & Tickell, *The Revenge of Gaia: Earth's Climate Crisis and the Fate of Humanity* (London: Allen Lane, 2006); Lynas, Six Degrees: Our Future on a Hotter Planet (London: Fourth Estate 2007); Gelbspan, The Heat Is on: The Climate Crisis, the Cover-Up, the Prescription (Boston: Basic, 2003) and *Boiling Point: How Politicians, Big Oil and Coal, Journalists, and Activists Have Fueled a Climate Crisis—and What We Can Do to Avert Disaster* (Boston: Basic, 2006); Monbiot, Heat: *How We Can Stop The Planet Burning* (London: Penguin 2007); Tidwell, *The Ravaging Tide: Strange Weather, Future Katrinas, and the Coming Death of America's Coastal Cities* (Free Press, 2007); Pearce, *With Speed and Violence: Why Scientists Fear Tipping Points in Climate Change* (Boston: Beacon Press, 2007). See too: *Imagining the Unthinkable: An Abrupt Climate Change Scenario and Its Implications for United States National Security*, a report by Peter Schwartz and Doug Randall, www.ems.org/climate/pentagon_climatechange.pdf.

The Skies are Abundant—

Eight Principles for Successful Rainwater Harvesting

Brad Lancaster

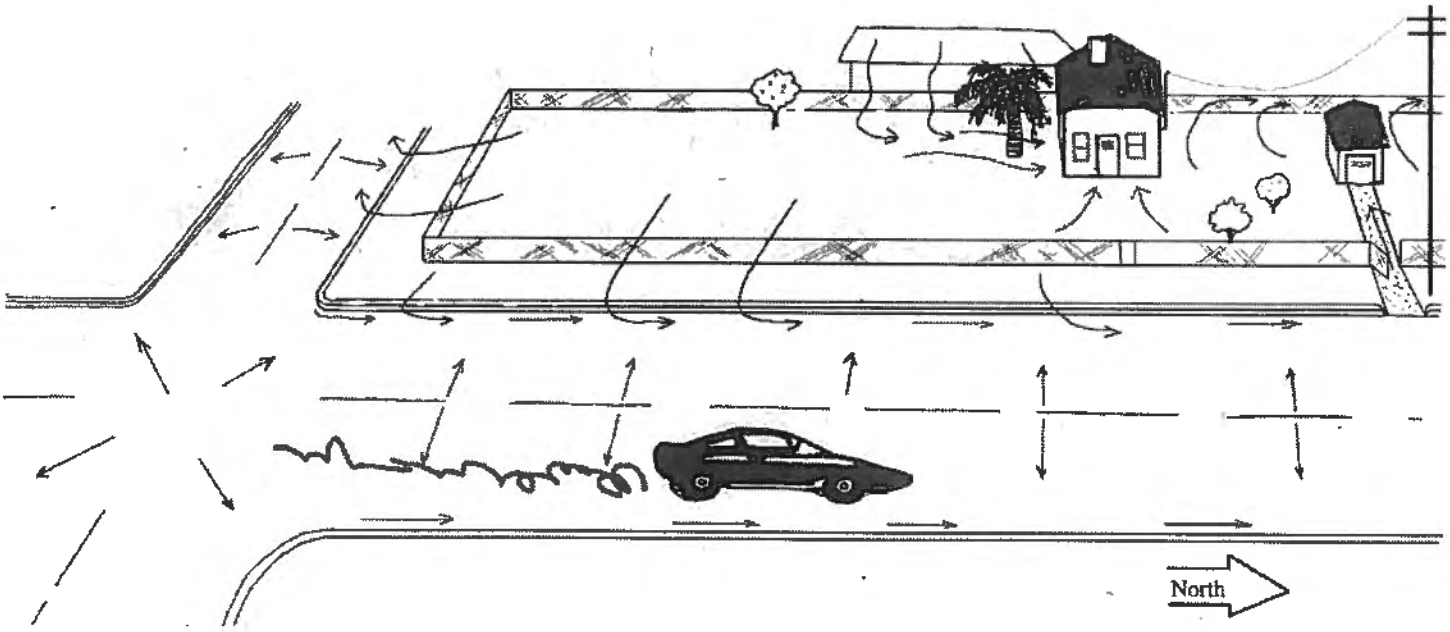
MY INTEREST IN WATER HARVESTING AROSE from a desire both to reduce my cost of living and to be part of the solution rather than the problem in my desert city of Tucson, Arizona. One of Tucson's biggest problems is mismanagement of water resources, pulling more each year from the water table than nature can replace. This is a practice that has dried out the Santa Cruz river, killed countless springs and wells, and severely depleted available groundwater resources.

Living in the desert—and as the planet heats up, deserts are expanding—has put a special emphasis on water harvesting for me, but it's a valuable strategy for non-desert environments, too. Rainwater harvesting is effective for reducing or preventing erosion and downstream flooding while improving stormwater quality. Thus, Portland and Seattle have embraced water-harvesting to protect salmon populations, and Maryland is doing the same to protect the Chesapeake Bay. And anywhere in the world, water harvesting is a smart strategy for helping to recharge groundwater tables, springs, wells, and rivers.

Back in 1994, my brother Rodd was also interested in water harvesting, but as long as we were both renting, all we could do was read up on the subject. At the time, we were both self-employed, making what the government considers poverty wages. No bank would touch us. On our own, neither of us could afford to purchase a home, but together, it was feasible. (It helped that the house we wound up purchasing was about to be condemned.) We did 95% of the renovation work ourselves and used mainly salvaged materials.

Twelve years later, our property value has shot through the roof. The integrated water-harvesting techniques Rodd and I learned and implemented on this once-barren urban lot have transformed it into an oasis in the desert, with temperatures ranging an average ten degrees lower than our neighbors'. Our land produces 15-25% of our food, which includes organic, homegrown fruits, nuts, vegetables, eggs, honey, and mesquite flour grown solely with rainwater and greywater (reclaimed household wash-water.) Our utility bills have been dropping steadily since we moved in and now average $20 per month.

A sketch of the author's home and street before implementation of rainwater harvesting techniques. All surfaces were designed to take water away from the home and landscape where it is most needed.



In the course of creating a sustainable oasis here in Tucson, Rodd and I arrived at eight basic principles that anyone can use to implement successful rainwater harvesting of their own.

Principle #1: Begin with long and thoughtful observation

Right after we bought the house, monsoon rains poured from the sky. Rodd and I got to learn where runoff pooled against the house and how the bulk of the rain ran off our site into the street. We mapped these observations and others, including noise, headlights, and pollution from the street; where we wanted privacy; where we needed shade; and where we needed to enhance winter solar exposure. Wherever you direct rainwater, you will be nurturing plant life, so take the time to ensure that this vegetation is part of your overall plan.

Next, calculate the rainwater resources available within your site's "watershed." For us, that area included not only the 12 inches of annual rainfall on our roof and 1/8th acre property, but the 20-foot wide public right-of-way adjoining our property, the section of street draining past the right-of-way, and the runoff from our neighbor's roof. (See Table) This totaled about 104,600 gallons (397,000 liters) of rainwater in an average year!

Principle #2: Start harvesting rain at the top of your watershed, then work your way down.

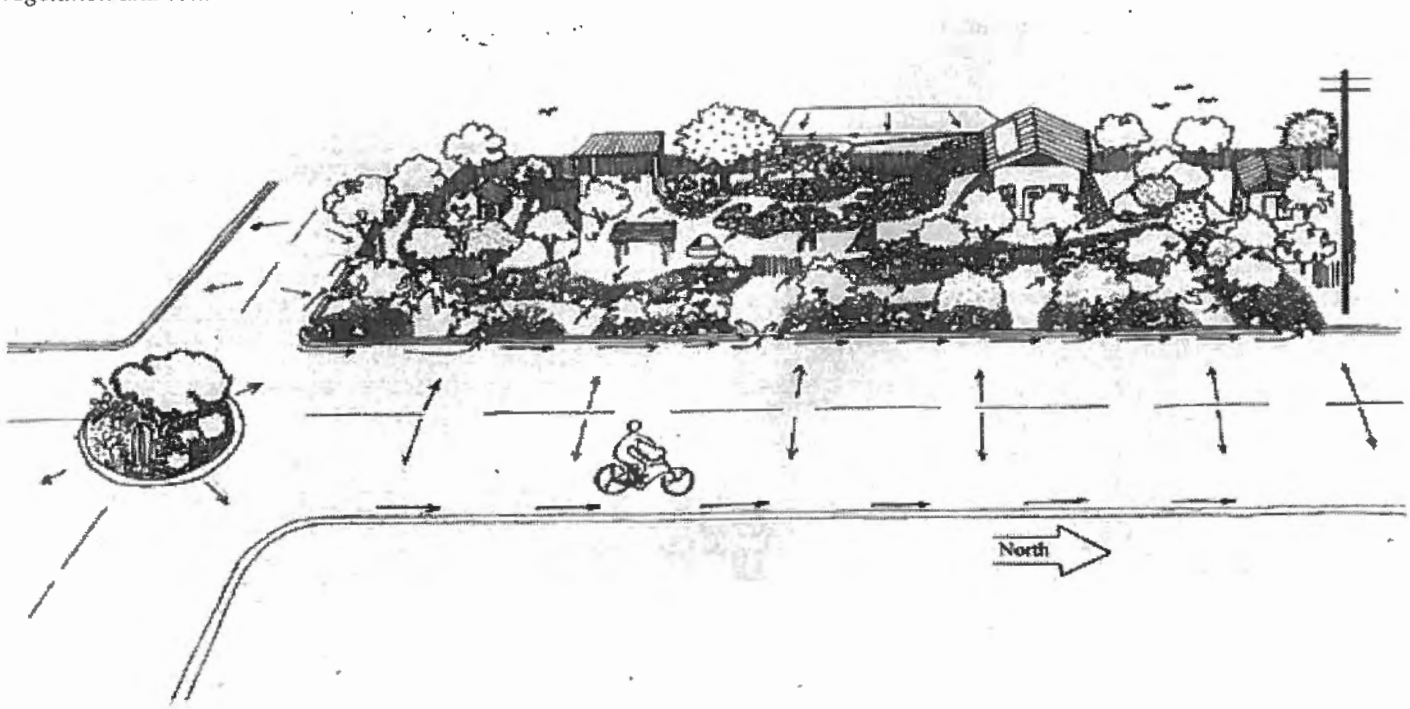
In most cases, the top of your watershed means the roof of your house. Our leaky asphalt roof was a mess, so we removed it and installed 26-gauge galvanized steel metal roofing instead, which harvests rainwater in a potable form. However, as long as you're only harvesting rainwater for use in landscape irrigation, this isn't a necessary step. (Rainwater harvested off a conventional asphalt roof can also be made safe for consumption with appropriate filtration.)

Take a look at your roof. Where do the gutters drain? Where is rainfall currently being directed? This is where you should begin with mulched water-harvesting basins and plantings (at least ten feet from the building's foundation.) On our property, just under half of the roof runoff is directed to earthworks and fruit trees north of the house. The rest is directed to an above-ground cistern west of the garden along our property boundary on top of a two-foot (60 cm) high earthen platform.

Living in the desert— and as the planet heats up, deserts are expanding— has put a special emphasis on water harvesting for me. . .

Our cistern is a custom-modified new ferrocement septic tank, but a number of good alternatives exist. (See, Choosing a Tank.) We selected the location of our cistern to provide multiple

Brad's design captures rainwater from all surfaces to feed a lush landscape abundant with food and micro-climate enhancing vegetation and soil.



functions. By placing it on the western boundary of our yard to shade out the hot afternoon sun, it creates a beneficial microclimate for our garden. By acting as part of the property line, it provides a privacy screen from a peering neighbor. And by placing the cistern on an elevated platform, water can flow by gravity from the tank to the garden.

Whatever type of cistern you choose, locating your garden nearby will keep hose length to a minimum (25 ft. ideal) This will reduce water-pressure loss to surface-friction inside the hose and make watering with rainwater a convenience. (Your plants will love it too!)

Principle #3: Always plan an overflow route, and manage overflow as a resource.

Eventually, all water-harvesting systems will meet a storm that exceeds their capacity, so don't get taken by surprise. All rainwater harvesting structures should be managed so they can overflow in a beneficial, rather than destructive way.

In that spirit, overflow from our backyard cistern is directed via a four-inch diameter pipe to a series of adjoining mulch basins that passively irrigate a citrus tree and our garden. In addition, all of our sunken earthworks have overflow spillways. Typically, one earthwork overflows to another and another, until all are full and then, if needed, the lowest basin can spil to a natural drainage—or, in a typical city context, the street.

Your goal should be to harvest the rain, but never get flooded by it. This is key.

4. Start with small & simple strategies: harvest the rain as close as possible to where it falls.

When people think of rainwater harvesting, cisterns and tanks usually spring to mind. But the water collected from the roof is typically much less than what's falling on your whole property. Simple earthworks, such as basins, terraces, contour berms, and check dams will harvest the rain where it falls on the land.

The earthworks Rodd and I created collect most of our rain. We dug flat-bottomed basins throughout our watershed, and mulched them deeply (about four inches)—starting at the highest points of the yard and working down. Overflow was directed from the upper to the lower basins.

5. Spread, slow, and infiltrate flowing water into the soil.

Cisterns, along with mulched vegetation and overflow routes, will effectively transform erosive runoff from heavy rainfall into a calm, productive resource, while reducing losses to evaporation and downstream flooding.

Raised pathways and gathering areas are also a great strategy for spreading water through the landscape. This pattern of "high and dry" regions that drain to adjoining basins kept "sunken and moist" will help to define those areas through vegetation while spreading and sinking the flow of water. (This also helps keep ice off walkways and driveways in colder regions.) At our place, we use earthworks to redirect the runoff that used to pool against our house to planting areas ten feet or more away from the building's foundation.

A ferrocement cistern, partially concealed by stone and vegetation, stores rain-water from the roof, cools the landscape, and provides privacy from neighbors.

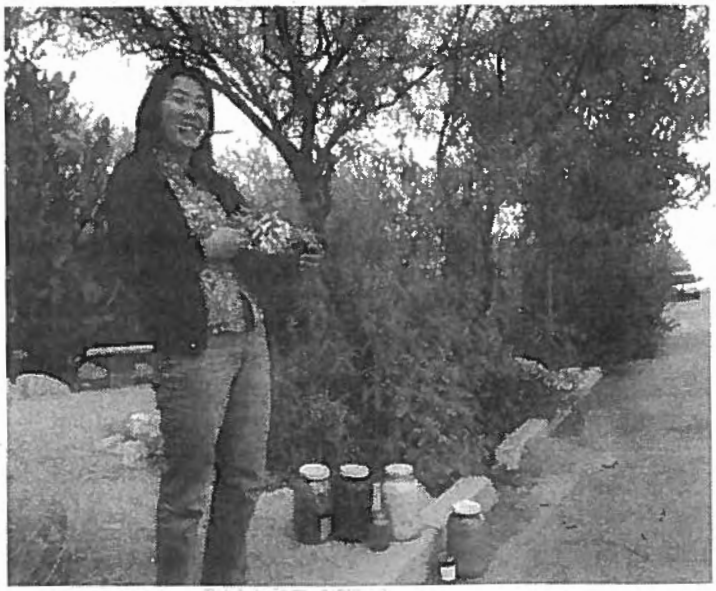
6. Maximize living and organic groundcover.

All your basins and other earthworks should be well mulched and planted. This creates a "living sponge" effect that will use the harvested water to create food and beauty in your surrounding landscape while steadily improving the soil's ability to infiltrate and hold water due to the vast network of growing roots and beneficial microorganisms.

Groundcover is equally important in helping to ensure that, in your enthusiasm for harvesting rainwater, you don't wind up creating a haven for mosquitoes. Mosquitoes need three days of standing water to transform from eggs to adults. Basins typically allow water to infiltrate below the soil surface within one hour.

Take a hike in the unmanaged natural areas near your home to determine what native vegetation would be best to plant within or beside your earthworks. In the wild, you'll notice which plants grow naturally in low spots—they can be planted in your basins. Wild plants preferring better drainage can be planted beside, but not within earthworks.

Blue paloverdes, velvet mesquite, chuparosa, oreganillo, and desert lavender are natives found along the ephemeral washes in our area of Tucson that we plant within our earthworks.



Produce from the rain-fed landscape provides additional income to the household and makes good neighbors.

7. Maximize beneficial relationships and efficiency by "stacking functions."

As mentioned previously, water-harvesting strategies offer maximum benefits when they're integrated into a comprehensive overall site plan. We focused on locating the earthworks where we wanted to stack functions with multi-use vegetation.

Through rainwater harvesting earthworks, we've nurtured a solar arc of deciduous trees on the east, north, and west sides of our home that cool us in the summer, but let in the free light and warmth of the sun in winter. A living fence of native plants along the property line (along with an existing citrus tree) form part of a sun trap. This suntrap shades our garden from the afternoon sun, controls stormwater on-site, and enhances habitat for native songbirds and butterflies.

The Big Picture

Within our generative landscape, rainwater has become our primary water source, greywater our secondary water source, and municipal groundwater a strictly and infrequently used supplemental source (meeting no more than 5% of our outdoor water needs). Most of our established landscape has even become regenerative as it thrives on rainwater alone.

Our household consumes less than 20,000 gallons of municipal water annually, with over 90% of that being recycled in the landscape as greywater. Additionally, we harvest and infiltrate over 100,000 gallons of rain and runoff into the soil of our site (and, by extension, the community's watershed) over the course of a year.

As a household, we're shifting more and more to living within our rainwater budget: one of the natural limits of our local environment. As a result, we're enriching the land, growing up to 25% of our food on site, creating a beautiful home and neighborhood environment—and giving back more than we take!

The further we go, the easier and more fun it gets, which brings us to the eighth and last principle:

8. Continually assess and improve your system.

Three years ago, Rodd and I set up an outdoor shower so the bather could either use pressurized municipal water at the shower head or cistern water distributed from a shower bucket on a hook. We have also created a solar-powered greywater "laundromat" in our backyard (used by seven neighboring households), and reduced the impermeable surface of our yard by replacing the asphalt driveway with lush plantings and earthworks.

Choosing a Rainwater Cistern

Our cistern has a 1,200-gallon (4,560-liter) capacity. We selected this size after calculating the average annual roof runoff, assessing our water needs, and determining the resources we wanted to commit to the system. We opted for a precast concrete septic tank for a number of reasons, but primarily because it was affordable as well as a workable size and shape for our space (five feet wide, six feet tall, ten feet long).

Our septic tank was custom-made for use as a cistern, and further reinforced for above-ground installation. The cost back in 1996 was $600, which included delivery and placement. Itís been working great ever since.

Other options for pre-manufactured cisterns include light-proof, dark green or black polyurethane plastic, corrugated metal, and fiberglass. See www.watertanks.com for options and look in the yellow pages under tanks for local suppliers.

Calculating Your Rainwater

To calculate the volume of rain falling in an average year on a specific surface such as your roof, yard, or neighborhood, use the following calculation:

CATCHMENT AREA (in square feet) multiplied by the AVERAGE ANNUAL RAINFALL (in feet) multiplied by 7.48 (to convert cubic feet to gallons) equals the TOTAL RAINWATER FALLING ON THAT CATCHMENT IN AN AVERAGE YEAR

or, alternately:

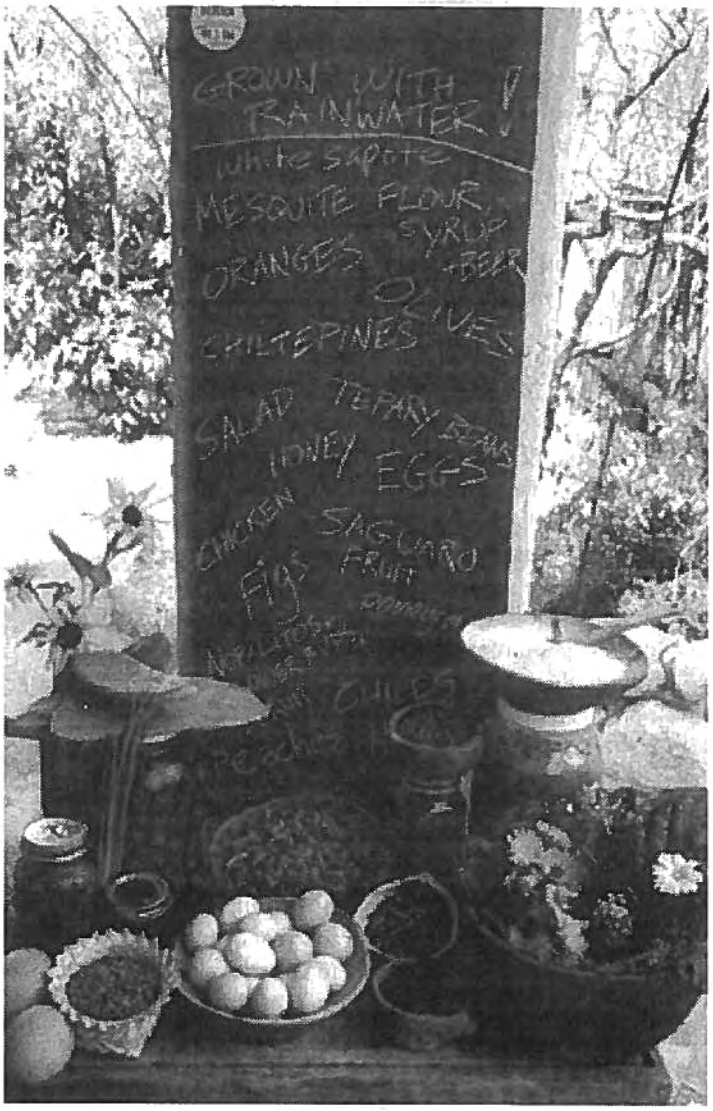
CATCHMENT AREA (ft^2) x RAINFALL (in/yr) x 5/8 = TOTAL AVAILABLE RAINWATER (gal/year)

One of our most rewarding recent projects has been working with our neighbors and the city to replace 26% of the pavement from the street intersection with a water-harvesting traffic circle planted with native vegetation. We also implemented a system that captures street runoff in mulched curbside basins to grow a greenbelt of trees along the street and sidewalk, so the street now passively irrigates the trees.

As a result, our neighborhood—once the victim of urban blight—is now one of the greenest and most livable areas of the city.

My advice to anyone who wants to get started living more sustainably is to start with rainwater harvesting. Start at the top. Start small. But above all—start! Δ

Brad Lancaster (www.HarvestingRainwater.com) is a permaculture consultant based in Tucson. His new book Rainwater Harvesting for Drylands, Volume I: Guiding Principles to Welcome Rain into your Life and Landscape *was published in 2006 by Rainsource Press. Volume II will be released in the fall of 2007.*



Create Your Own Climate with an Indoor Garden

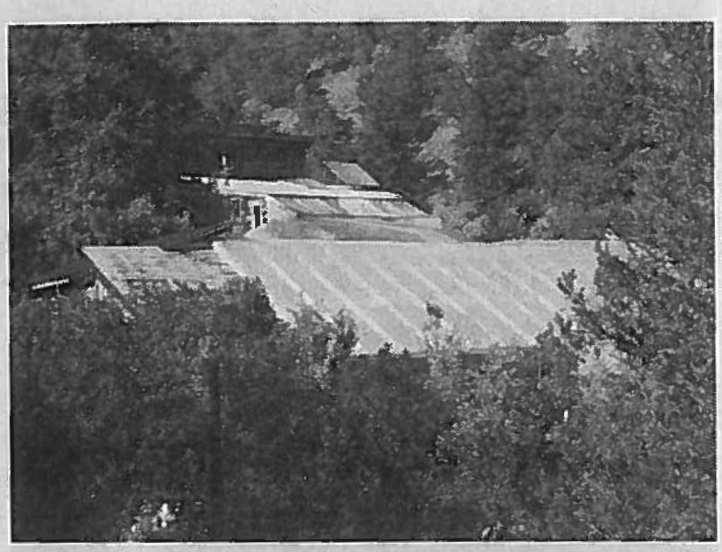
The Greenhouse Effect

Peter Bane

CLIMATE CHANGE IS MAKING HUMANS acutely aware of the basic physics of Gaia. Our life depends on a thin veil of gases that surround the planet: we draw on these not only for our breath, and as a reservoir of nutrients for plant growth, but just as importantly, as an insulating blanket that holds in the warmth of the Sun's rays and makes our little chunk of rock habitable as it hurtles through the cold void of space.

Carbon dioxide, water vapor, methane, and as we have learned to our chagrin, refrigerants like chlorofluorocarbons (CFCs) trap much of the long-wave radiation of heat from the Earth's surface to warm the lower atmosphere and the ground. The greenhouse effect, as we call this, reminds us that the Earth and atmosphere are the original model for all sustainable shelter.

Jerome Osentowski, director of Central Rocky Mountain Permaculture Institute at Basalt, Colorado, has made a quarter-century study of the greenhouse effect and its practical applications to make life in a cold, rocky place a great deal more comfortable.



Double inflated poly coverings provide thousands of square feet of controlled climate growing space, courtesy of the sun.

Jerome explains polyculture stacking to students and visitors.

The Institute, built around Jerome's small homestead 7200' up Basalt Mountain overlooking the Frying Pan River between Aspen and Glenwood Springs on Colorado's western slope, enjoys clean air, spectacular views, and abundant sunshine, but also clings tenaciously to steeply sloping land, and endures bitterly cold winter temperatures. The dry mountain air is susceptible to wide temperature swings from day to night; rainfall is light and erratic at an annual average of 17"; frost can occur every month of the year; and the historical climate measurements put this rugged patch of red rock piñon-juniper forest in Zone 4. Winter minimums regularly hit -25°F (-32°C).

This wouldn't seem a very promising place to do market gardening, let alone grow tender subtropical plants like bananas and jujubes, yet Jerome has successfully cultivated these and many other plants and pursuits over the nearly 30 years he's dwelt on this narrow south-facing ridge.

I visited Basalt this spring and interviewed Jerome about the basis of his success.

PB: It looks like almost everything you've been able to do here has hinged on the use of greenhouses. In fact, the place increasingly looks like one sprawling greenhouse. How has your thinking about them changed over the years?

JO: I've built four greenhouses here and many more elsewhere in Colorado and I've come to realize that they're essential for self-reliance in our high-altitude climates, but I had no such idea at the beginning. I was simply trying to extend the growing season

Books from The Permaculture Activist

PERENNIAL VEGETABLES
A Gardener's Guide to Over 100 Delicious Easy-to-Grow Edibles

by Eric Toensmeier
This brightly written and pioneering work profiles plants for North American gardens with notes about their climate range, ecology, history, cultivation, harvest, storage, and uses. Includes choosing species to match design aims and techniques for propagation. Color throughout. (2007) $35, 242 pp. paper. color illus.

THE EDIBLE CONTAINER GARDEN
Growing Fresh Food in Small Spaces

by Michael Guerra
This compact, inspiring book covers a vital component of urban permaculture. Beautifully designed and illustrated with brilliant color photos, it shows how to make the most of every growing space, from windowsills and pots to trellises and rooftops. (2000) $16. 159 pp. pap. color illus.

GUERRILLA GARDENING: A Manualfesto

NEW!

by David Tracey
Placemaking with a green thumb and a little whistling in the dark. Hardy plants for tough places, making seed bombs, making friends; when to run and when to call in the cameras—a lively guide to new urban spaces. (2007) $20. 228 pp. pap. illus.

THE BACKYARD ORCHARDIST & BACKYARD BERRY BOOK

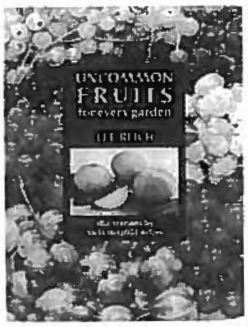
by Stella Otto. "The finest single source on fruit growing published to date,"—*Pomona*. Planting, pruning, pollination& pest control for apples, pears, cherries, plums, apricots, peaches, and crosses. *The Berry Book* covers strawberries, rhubarb, brambles, currants & gooseberries, grapes, and kiwis: varieties, site selection, troubleshooting, and more. **Orchardist** (1993) $16. 250 pp. **Berry Book** (1995) $17. 284 pp. pap. illus. ***(Both for $30)***

for Growers & Gardeners

PLANTS FOR A FUTURE
Edible & Useful Plants for a Healthier World

by Ken Fern

This top-notch database of trees, shrubs, plants for shade, water plants, perennial vegetables, hedges & ground covers gives plant characteristics & growing requirements in depth. Cross references uses and habitats. (1997) $19. 300 pp paper. illus.



UNCOMMON FRUITS for EVERY GARDEN

by Lee Reich. Highlights 23 top quality fruits little known in commerce. This beautiful volume reflects the author's literary talent and his horti-cultural experience. Featuring pawpaw, persimmon, jujube, currants, gooseberries, hardy kiwi, medlar, asian pear, lingonberry, and a dozen more exotic but hardy botanical treasures. (2004) $22. cloth. illus. 288 pp.

THE GREENHOUSE GARDENER'S COMPANION

by Shane Smith
A complete guide to designing, building or selecting, and managing a small greenhouse. Emphasizes multifunctional uses for heating space and for growing tender plants. An award-winning best-seller. (2000) $23. 544 pp. pap. illus.

GROWING FOOD in the SW MOUNTAINS

by Lisa Rayner, illustrations by Zackery Zdinak
A permaculture garden primer for the Four Corners region. Covers ordinary and unusual crops, planting and harvest calendars, frost- and drought-tolerance, water management, sun, wind, birds & insects.

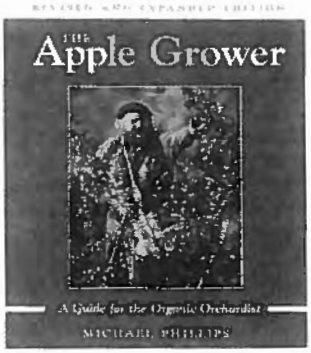
www.permacultureactivist.net

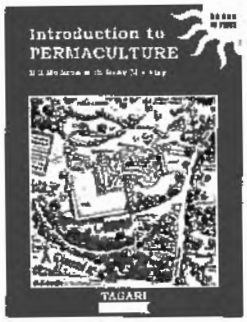
FOUR-SEASON HARVEST

by Eliot Coleman
Using simple techniques and good design the author grows and eats abundant fresh food 12 months of the year in Maine. An excellent resource for cold climate gardeners, with crop profiles and a step-by-step illustration of methods. 2nd ed. (1996) $25, 272 pp. pap. illus.

THE APPLE GROWER
A Guide for the Organic Orchardist

by Michael Phillips
A pioneer of organic production, Phillips lays out everything you can learn about orcharding from a book. His methods are well tested for commercial success, and each chapter contains a section addressing needs of the home grower. 3rd ed. (2005) $40.00, 343 pp. pap. illus.





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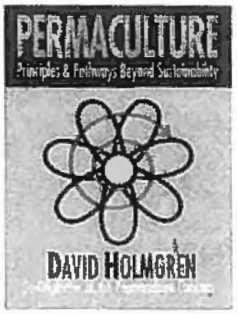

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Trees and shrubs are planted at the back while basil, spilanthes, nasturtiums, or other low-growing herbs occupy the front beds.

for salad greens and herbs. That was how I made my living in the early years after I bought this place. I built the first greenhouse, Mana, on the front of this house and it was dual-purpose: it captured heat for the building, and it gave me a place to grow salads during the fall and spring. Pretty soon I figured out how to make it work as a growing space throughout the year. Not long after that I planted this fig, which as you can see now, pretty well fills the greenhouse 20 years later. I think that was the first turn in my thinking. I saw that it was possible to grow perennials indoors, and the lightbulb went on, so to speak!

PB: So how do the greenhouses work for you now?

JO: Well, if I first thought of them as additions to the house, or a utility for the market garden, they've gradually become my main indoor living spaces, especially in winter. They really function to bring nature into my life through all the seasons, and I think that's the main value they hold. There's been some change in technology, and I've gotten more experienced with the nuances of good greenhouse design, but the real development has been a new paradigm in thinking about the greenhouse as an indoor-outdoor space. Permaculture tuned me in to multifunctions for everything, and the greenhouses exemplify that especially well. I obviously intended to capture heat for the house and to grow crops, but Pele (the lower, free-standing greenhouse) now has become my main design studio. I have my hammock down there and my archery range, and I do my best thinking under the bananas! (Laughs)

I saw that it was possible to grow perennials indoors, and the lightbulb went on...

PB: What other uses do you make of the space?

JO: Oh, we still grow herbs for market, though more and more I'm interested in adding value to what we grow, since the commercial marketplace has become so competitive on price. We always have to find a niche that hasn't been filled. I grow a lot of spilanthes understory in the greenhouses as well as culinary herbs like basil. I tincture the spilanthes, which is a modest little East Indian herb called toothache plant. I find it has a tremendous range of medicinal uses: it's antimicrobial, analgesic, and immune-stimulant all in one. I use it as a groundcover, then sell the tincture. There's plenty of light and it does well. Of course

Rosemary, bananas, and other tender perennials shelter smaller plants. Jerome harvest grapes in June from his greenhouses.

I've got my sauna attached to Pele: it's both back-up heat on cold nights, and a comfort and health support for me throughout the winter. There's plenty of food for home consumption in the greenhouses: we eat for months on these figs, and have enough to sell some. But it's really the environments that are created that I'm after. It makes life here just so much more pleasant.

PB: Can you really grow subtropical plants here?

JO: Well, seeing is believing. The bananas in Pele, which is our big subtropical greenhouse, have occasionally been knocked back a bit by frost,,but they've never been killed. The jujubes are quite happy. I grow chayote squash, which is a Mexican vining species. But we aren't aiming simply for the most tender crops, just trying to push the edge of what's possible. That edge has been advancing over the years as my understanding of greenhouse technology and design has evolved. I started out just trying to get a warm-temperate climate: you know, where spinach and other hardy greens would go through the winter: like in the Southeast or California. Then we ventured into Mediterranean crops like the fig and the rosemary, both of which do supremely well indoors here. Gradually, I saw that it was possible to reach beyond those limits and get some true subtropicals to persist.

The greenhouses have gradually become my main indoor living spaces, especially in winter.

PB: How do you do it? Describe your systems for us.

JO: The principles are simple and the structures are not complicated, but the design thinking has become more sophisticated over the years. I always built my own, and I think people should realize they can too. It's not that hard. I use wooden structures: they're cheap, lightweight, and flexible, and with rubberized paints they can last 50 years. And most of the wood has been recycled or salvaged. All the surfaces are primed and painted white for additional reflection. I also use the double-inflated poly glazing. Glass is too heavy, and you lose quite a lot of the valuable UV spectrum. The framing to hold up glass becomes overbearing and costly. I don't care much for polycarbonate. It's expensive and it's failed on me, but the double-inflated poly, which is a plastic sheeting that's treated for UV resistance will give me 4-5 years. It's modest in price, lightweight, and insulating, and it gives a good spectrum of light. I insulate foundations and sidewalls for extra thermal protection too.

PB: What's your heat-storage mechanism?

JO: Your greenhouse won't do you a lot of good unless it's got a good amount of thermal mass in which to store the incoming solar heat. We use the soil of the growing beds themselves. And yes, there's stored water in containers, and stone terraces retaining the beds, plus the masonry stem walls, but we use the soil as a thermal battery. The key innovation—and this comes from my work with John Cruickshank—is a series of large pipes that are built into the beds. They're connected to a plenum with a fan and a thermostat that turns on during the day when temperatures rise in the greenhouse. This forces air through the pipes under the soil to warm it. Then at night, when the temperature drops, the fan kicks on in reverse to pull heat out of the soil. With warm soils, the plants can actually withstand a few degrees of frost in the indoor air. Mana here is backed up against the house, so it has that source of heat, and Pele, down below is backed up on cold nights by the sauna. We used to make compost against the north wall of it too. That helped, but we don't need as much anymore—either heat or compost. We're generating more of our own on site.

Potted plants provide maximum flexibility in this attached greenhouse. Note vents in insulated stem wall to south and west.

PB: What about other seasons than winter? Do you get overheating?

JO: We have cool evenings here, even in summer, which helps reduce overheating, but ventilation is essential. I have big vents that I can open above and below. I have several other things going for me that most greenhouse growers don't. By using

perennials adapted to high temperatures and drought, such as the fig and the rosemary, which in their native habitats have adapted to go through long summers without rain, I get a lot more tolerance from the plant communities in the greenhouse. Then too, the overstory plants help shelter the smaller ones underneath, so that light levels are less of a problem. This is the genius of the forest garden model.

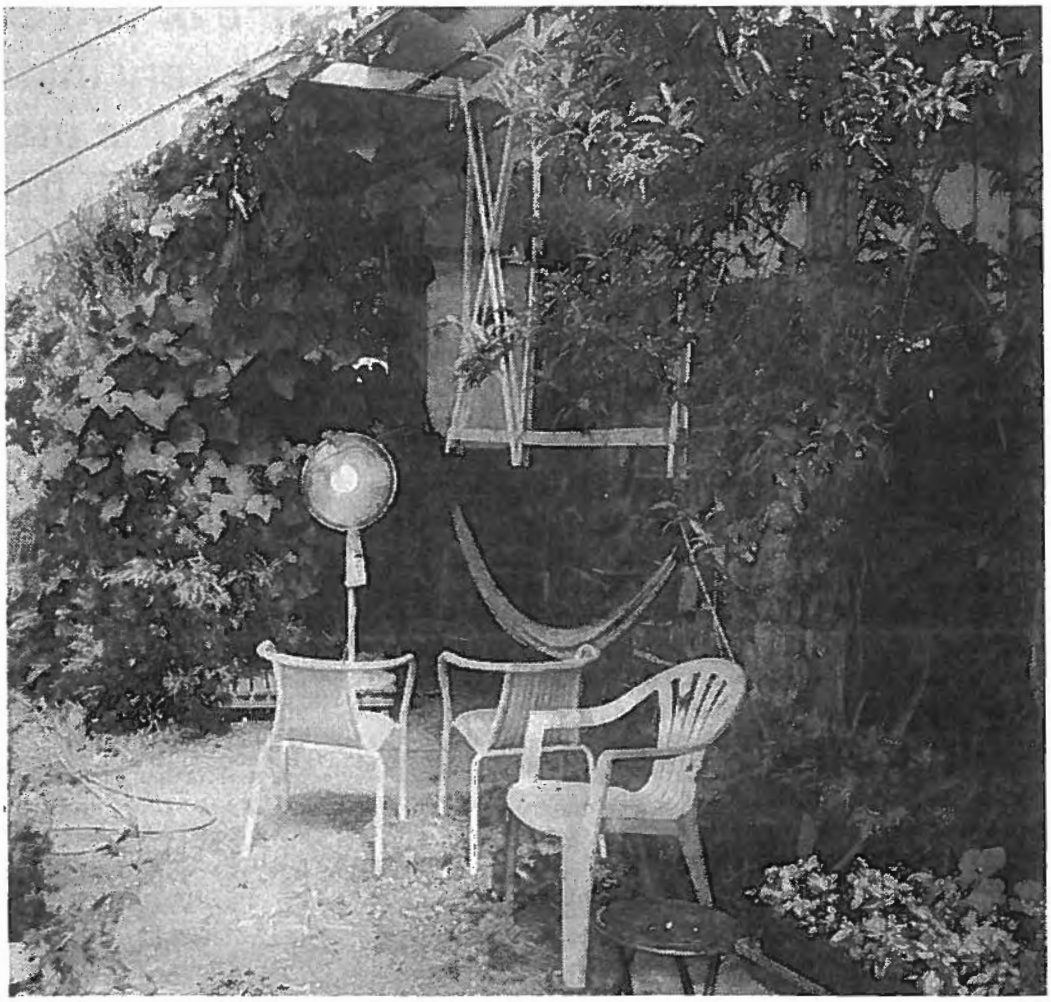
I always built my own, and I think people should realize they can too.

PB: Say more about that.

JO: I studied permaculture with Mollison in '86, and at that time the concept of forest gardening was unknown for temperate climates. Mollison and Holmgren had talked about permanent agricultures, following J. Russell Smith in the 20s, and certainly all the elements were there in the permaculture synthesis: perennial plants, polycultures, multi-story growing systems, but Robert Hart was really the first person to show that these systems, which had been traditional in many tropical countries for centuries, could work in cooler, northern latitudes. He wrote a pamphlet in 1987 and a book in 1991 that introduced these ideas. They percolated through the permaculture worldwide community, and I began experimenting with more perennials outdoors in the early 90s. In part it was a response to changing conditions: my salad green operation had faltered a bit in the face of competition from California growers in the local markets, and I didn't need all the bed space for annuals, so I planted more fruiting trees and shrubs among them, then began developing a nursery business. Growth is slow in this climate, so it took some years for the system to begin filling in and closing canopy, but now the whole property is a forest garden. It was easy for these ideas to spill into the greenhouse environments where they work just as well. It helped that I had traveled in the subtropics in Nepal and Baja, and had worked in Nicaragua. I became familiar with a wider range of plants and it gave me ideas about having them at home.

PB: This takes the greenhouse into another world, maybe more akin to the conservatories of the 19th and early 20th centuries.

JO: Yes, only now you don't have to be Rockefeller or Dupont or Louis XIV to have orange trees indoors. You see the garden has been a place for outdoor living since humans have been living in towns. The Spanish brought it to the Americas but the idea is Moorish: a walled garden with fountains, a place of visual and aesthetic delight, and completely in contrast to the harsh environment outside the walls. You walk down the streets of Managua or other large Latin American cities, and you see walls. You have no ideas what's behind those walls. In many cases there are gardens. The family lives in rooms that surround the garden. We can do something similar by creating greenhouse gardens around our buildings in cold climates. If you think of a greenhouse as just a production space with one or two crops,



"Pebble Beach," Jerome's indoor living space, reveals the heart of the greenhouse effect.

that's not very interesting, but when the greenhouse is filled with fruiting trees, shrubs, and many kinds of plants, it's suddenly a space you want to be in all the time.

PB: One of your little greenhouses is built on the west side of the house. How does that work?

JO: As you can see from the site, land is at a premium, and we'd about built out the main area here, but I realized that we could fit another small greenhouse in here against the west wall of Mana and gain some valuable growing space. Although it's on the west side of the other greenhouse, the glazing actually faces the south, but you can work with other aspects besides south…east and west are possible, you just get different microclimates. East will be a little cooler, west a little drier.

PB: Commercial greenhouses are typically quite toxic environments. How do you avoid insect and disease problems?

JO: We've sidestepped most of those problems by abandoning the monoculture model of agribusiness. The forest garden perennial polyculture provides lots of habitat for beneficial insects and other pest predators. There's always some sort of plant flowering either in or around the greenhouse. We have mints planted outside the vents. Their aroma repels whiteflies. You see those stones over there. I have snakes living in there that eat a lot of bugs and slugs. The cat ranges through here and catches mice. It's not that we never see pest organisms, but the outbreaks are usually small and easily contained because there's such a variety of plants and environments in the greenhouse. The basic strategy is to confuse the pests and harbor their predators. The indoor forest garden does that very well.

PB: How do you deal with snow?

JO: The roofs are pitched to shed snow. We use an 9:12 pitch. Eight/twelve just barely works, 9:12 is better.

PB: Do you have problems with wind?

JO: The inflated poly sheeting is held in place by fasteners and a fan separates the two layers. You adjust the tension by the air pressure. If you need more resistance to wind you increase the tension. Here we are sheltered by the flanks of the mountain, so wind is not such a problem.

PB: I think of greenhouses as wide along the east-west axis, but this one is longer than it is wide. How has that worked?

JO: Well, most commercial greenhouses are free standing, and are laid out on a north-south axis to optimize light on all the growing beds. But they also cost $25,000 a year to heat! If you are using the sun, then the best orientation is east-west, and ideally with the north wall attached to another structure or partly bermed into the earth. That is the most expensive and complicated part of the structure, as it needs insulation or other shelter. Mana here was built as part of the house heating system. The long north-south dimension was a compromise. We could only extend it east-west as wide as the house, but I wanted more growing space, so we made it longer to the south. It's not optimal, but it has worked, in part because I've used the perennials to fill the space. By planting trees in the back, like the fig, I can fill the space with plant material. If I was growing annuals, the beds in the back wouldn't get as much light as the ones in the front, but by growing taller perennials in the back, they can send their branches right up to the glazing to get the light. Then it doesn't matter that the back of the greenhouse is shadier. That's just where the trees have their roots.

PB: The new greenhouse up on the cabin seems to expand on the outdoor room concept. It has a deck and a toilet built in. What's next?

JO: That greenhouse was added onto the existing cabin and the deck was already there, so it made sense to retain it. We added the toilet to improve the whole facility, and putting it in the greenhouse also made a lot of sense: we could do a composting design more easily there than indoors, yet it's still accessible and comfortable in all seasons. I think I've finished building greenhouses at this place, though I continue to design and build them for other people. What's next is a book about greenhouses. I'm at work on that now.

If you think of a greenhouse as just a production space with one or two crops, that's not very interesting, but when the greenhouse is filled with fruiting trees, shrubs, and many kinds of plants, it's suddenly a space you want to be in all the time.

PB: Do you have any thoughts about how greenhouses maybe useful to people in other climates?

JO: Well, what climate do you have now and what will you have in 10 years? These structures can last for decades, so we need to think about the changes now underway. The planet may be warming now, but the only thing we can be sure of at the moment is more erratic weather, including late freezes and other freak events. Creating sheltered growing environments is one important response, and if those indoor gardens take on the form of the forest garden, well, they could help us adapt more easily to an uncertain future. Δ

Central Rocky Mountain Permaculture Institute will host its 21st annual Permaculture Design Course from September 17-30. Jerome@crmpi.org.

Make Your Own Charcoal for Self-Reliance in Drinking Water

Charcoal Water Filtration

Josh Kearns

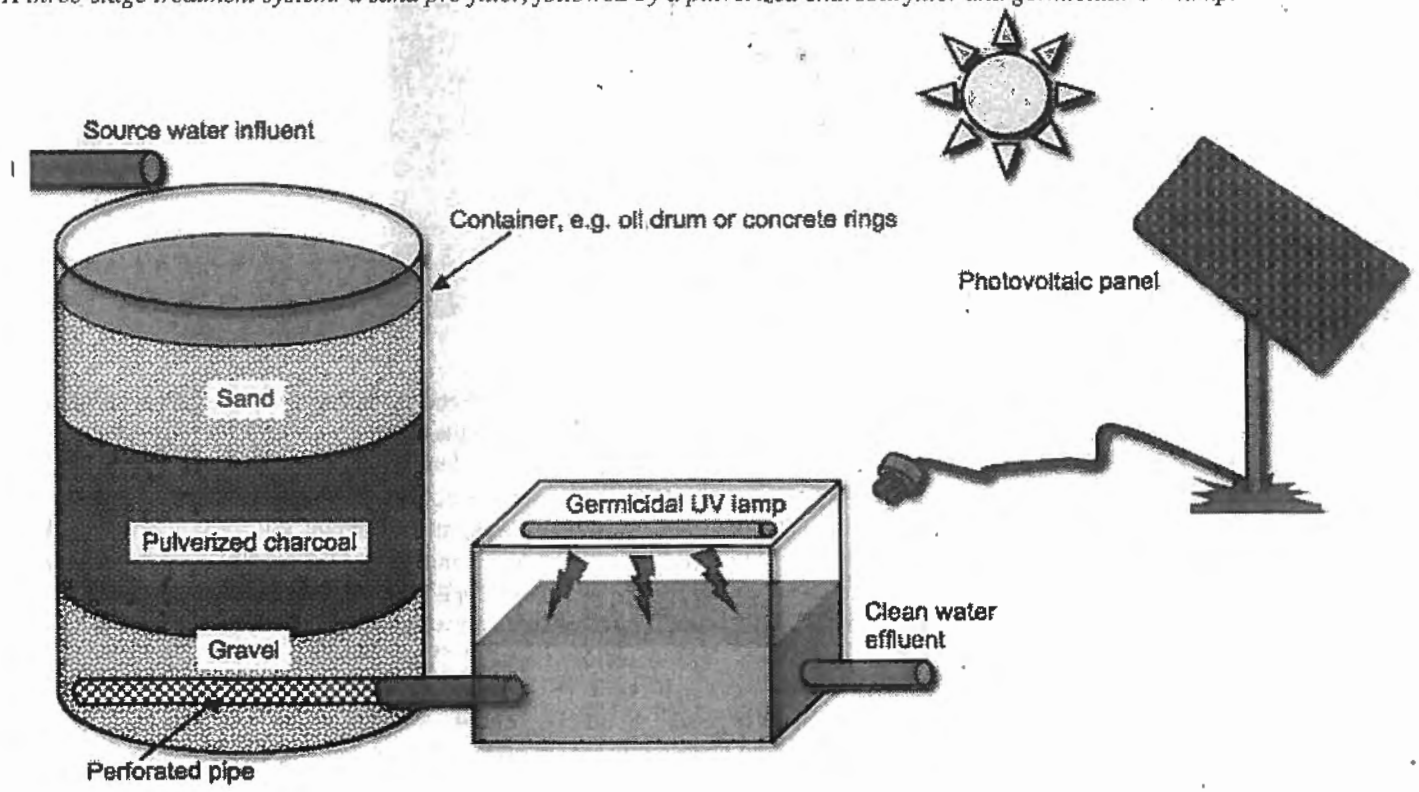
THE ENVIRONMENTAL AND HUMAN health consequences of the widespread application of large quantities of hazardous agrochemicals are a mounting concern around the globe. In the United States, for example, a recent study by the Center for Disease Control detected pesticides and their breakdown products in 100% of test subjects. The highest concentrations of many agrichemicals were detected in women of childbearing age, children, and Mexican-Americans.

The situation in the developing world is even worse, where agrochemical corporations find markets for many of their products deemed too hazardous to human health and the environment for sale in Western countries. For example, each year the US produces hundreds of millions of pounds of pesticides considered too dangerous for domestic use. Meanwhile, over 70 percent of the pesticides used in Thailand and India are banned or severely restricted in the West. A survey by the Thai National Environment Board found residues in 86 percent of water samples. Furthermore, in the Indian state of Punjab DDT and BHC—agrochemicals banned in the west—have been widely detected human breast milk.

A survey of the agrochemical products in common usage around our community in northern Thailand revealed that, out of 29 substances, 16 exhibit moderate to highly acute toxicity to humans, eight are possible human carcinogens and three are known human carcinogens, nine are cholinesterase inhibitors (indicating neurotoxicity), eight are suspected endocrine disruptors, five are reproductive or developmental toxins, nine are classified as "Bad Actors" by the Pesticide Action Network, and 13 represent significant threats to groundwater contamination. "Bad Actors" are chemicals that exhibit one or more of the following properties: high acute toxicity, cholinesterase inhibition (neurotoxicity), known or probable carcinogenicity, known reproductive or developmental toxicity, or are known to constitute a groundwater pollution threat.

Contamination of drinking water supplies by agricultural runoff is one of the principal routes by which we are exposed to chemical pesticides. This article presents a DIY (Do-It-Yourself) drinking water purification system using simple, inexpensive and readily available materials designed to effectively remove pesticides and other chemical contaminants. This system thereby

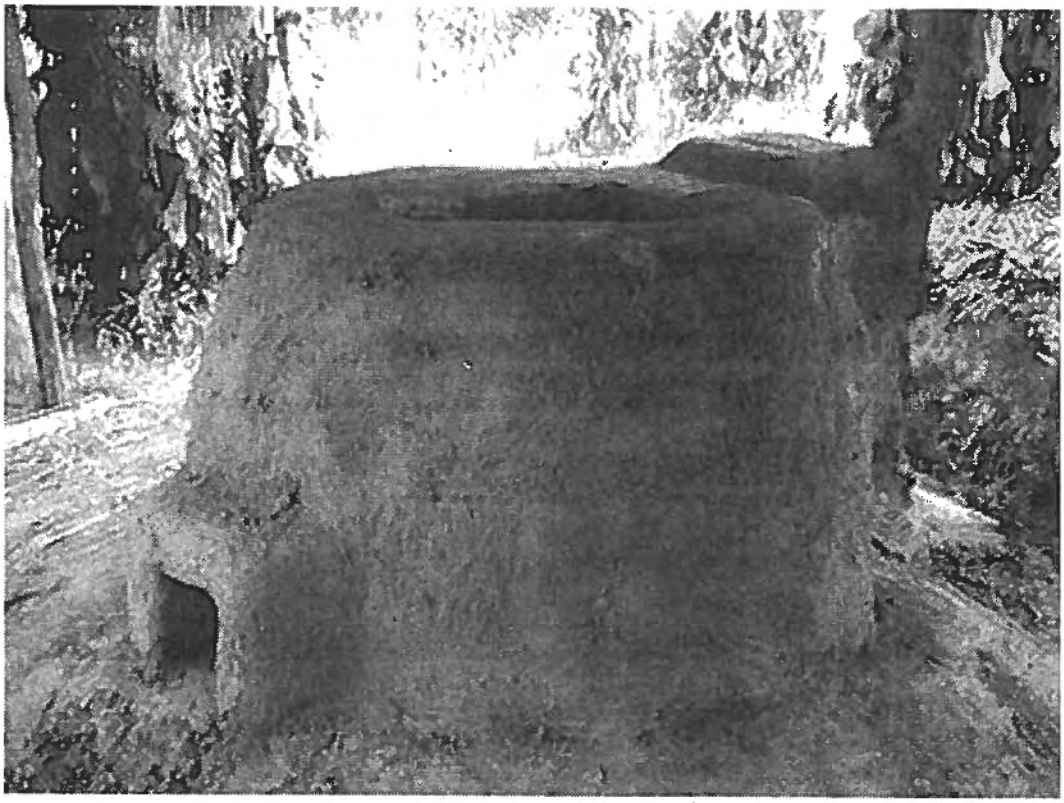
A three-stage treatment system: a sand pre-filter, followed by a pulverized charcoal filter and germicidal UV lamp.



enhances the potential for local self-reliance in the vital sector of drinking water.

Carbon filtration

The U.S. EPA, the World Health Organization and several academic studies identify granular activated carbon (GAC) as the best available technology for the control of many agrochemicals and synthetic organic chemicals in drinking water. GAC is made from charcoal, by "activating" it using a variety of physical or chemical processes designed to greatly increase the microscopic surface area of the material. A few grams of industrial grade GAC, for instance, can have a surface area equal to a football field. Itís this highly reactive surface area that attracts dissolved contaminants and binds them electrochemically.



A simple adobe kiln can be made to burn the charcoal for filtration.

Charcoal itself is made by pyrolizing—heating in the absence of oxygen—wood or other organic matter such as coconut or rice husks, nut hulls, peat, etc. While it isn't possible to produce high-grade activated charcoal without an industrial process, charcoal with a lower, but still significant, reactive surface area can be readily produced in earthen kilns. Researchers have observed, for instance, a low-grade char produced by burning wheat straw to be about one-third as efficient as industrial activated carbon for adsorbing particular dissolved pesticides.

Carbon filters are effective for removing chlorine, mercury, iodine, and some inorganic compounds as well as many problematic organic contaminants such as hydrogen sulphide, formaldehyde, and volatile organic compounds (VOCs). Activated carbon does not bind well to certain chemicals including lithium, alcohols, glycols, ammonia, strong acids and bases, metals, and most inorganic substances such as sodium, lead, iron, arsenic, nitrates, and fluoride.

As a general rule, carbon will bind non-polar materials while polar materials will tend to remain in aqueous solution. Most pesticides are organic and strongly non-polar and thus should display an affinity for adsorption onto the carbon surface.

Water contaminants that can be reduced to acceptable standards—according to EPA National Drinking Water Standards—by activated carbon filtration include: organic arsenic, chromium, and mercury complexes as well as inorganic mercury, benzene, endrin, lindane, methoxychlor, 1,2-dichloroethane, 1,1-dichloroethylene, 1,1,1-trichloroethane, trihalomethanes, toxaphene, 2,4-D, 2,4,5-TP (Silvex), and p-dichlorobenzene.

Carbon filters have limited capacity for removing microbial contaminants and should not be considered a sufficient method for eliminating this risk. The World Health Organization recommends coupling charcoal treatment with chemical (e.g. iodine, chlorine) or ultraviolet (UV) disinfection to ensure neutralization of microbial pathogens.

This finding suggests that effective home water purification systems can be constructed inexpensively using homemade charcoal. Of course, carbon-based water filters are commercially available in most countries although they are expensive, and prohibitively so for most people in the developing world. Besides, charcoal has many uses in addition to water filtration. For example, it is the preferred cooking fuel for the majority of rural people in the developing world who cook indoors over an open fire as it burns longer and hotter than the common alternatives (cornhusks, bamboo) and produces less smoke.

Charcoal also can be pulverized and used as an additive to bar soap as a scrubbing aid and skin exfoliant. Very finely ground charcoal has medicinal qualities and is used to treat stomach and enteric infections, as well as poisonings and overdoses following oral ingestion (it prevents absorption of the poison by the gastrointestinal tract).

Wood vinegar (pyroligneous acid) is a by-product of the charcoal making process. It is distilled by passing the smoke through a long chimney or heat exchanger to encourage condensation of water vapor containing a mixture of volatile

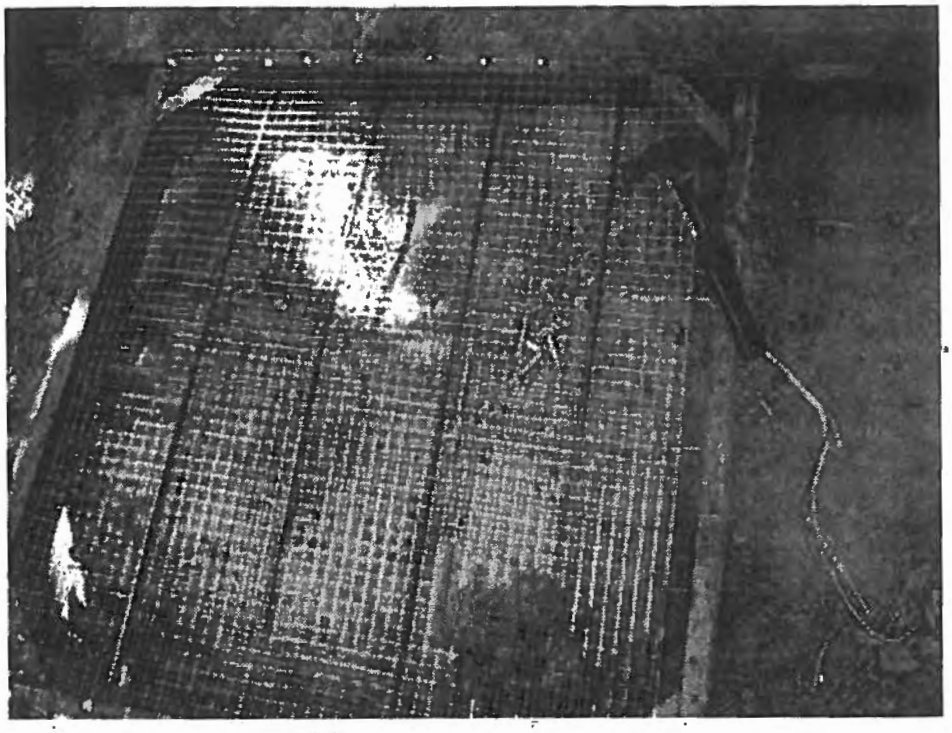
organic compounds driven off from the pyrolizing wood. It is reputed to be a natural aid with various uses including relief of mild pain such as toothaches, and to sterilize and promote the healing of minor wounds. Wood vinegar is also a mild natural pest deterrent, and can be applied to crops, or to wood surfaces to protect from termites.

Making charcoal using an adobe kiln

The prototype of the system described here has been developed for a self-reliant community in northern Thailand. The Pun Pun Organic Farm and Seed Center, the Panya Sustainable Living Project, and the You Sabai Thai Cooking School form a community of about 30 people located 50 km north of Chiang Mai city. This community's mission is to provide a working example of locally self-reliant, sustainable living through permaculture, organic farming, seed saving and natural building.

A year-round source of freshwater is available to the community from a network of irrigation canals fed by a nearby reservoir. However, prior to consumption this water must be treated for possible contamination by fertilizer and pesticide runoff from neighboring agricultural zones afflicted by conventional (i.e. agrochemical intensive) farming practices.

For this, we have constructed an adobe kiln in which to make charcoal. Adobe bricks are made by mixing mud, roughly 80 percent sand and 20 percent clay, with fibrous organic material such as chopped straw or rice husks. (In Thailand we use rice husks as they are superabundant.) This adobe mixture is poured into wooden molds and the bricks allowed to harden in the sun over about a week's time. This kiln design requires about 80 bricks.



The lid is about eight inches thick and made of cob reinforced with wood, steel rebar, and medium-gauge wire mesh.

The bricks were stacked in an approximate beehive shape about 1 meter in inner diameter and mortared together with a similar mixture of mud and straw or rice husks. The heat intake is approximately cylindrical, about 24" long and eight inches in diameter. Cob—a mixture of mud and straw—was applied to build up and shape the outer surface of the kiln and to provide additional insulation. The entire kiln was plastered with a sand-rich mix of mud, omitting organic material that would burn during use in the interior plaster.

The lid is about eight inches thick and made of cob reinforced with wood, steel rebar, and medium-gauge wire mesh. Cob was first applied beneath the frame. With the frame in place, cob was applied to the frame interior. Then the upper layer of wire mesh was nailed into place and cob applied over the top. We made efforts to commingle the layers of cob with each other as much as possible. Nails sticking out of the wood frame provided additional surfaces for cob attachment. A layer of sand-rich earth plaster completes the lid. Holes were drilled in the four handles protruding from the cob for connection to a rope and pulley system. Owing to its weight, we installed a block-and-tackle mechanism attached to the center support beam of the kiln building for raising and lowering the lid.

The chimney, made of tin metal and jacketed by a flowing water heat exchanger, connects to its earthen base that opens at the bottom-rear of the kiln interior. Smoke from the charcoal making process condenses in the chimney and is collected as wood vinegar, a useful natural pest deterrent. Effluent water heated by the smoke will be used to supply a hot shower or stored for watering the nearby gardens. (A simpler chimney can be constructed using a long piece of thick bamboo; however in this instance we wanted to experiment with the condenser to gauge the degree of enhancement of wood vinegar collection, as well as make use of the source of hot water.)

We estimate that the kiln will provide perhaps as much as 50 kilograms (110 lbs.) of charcoal per batch. Once a sufficient quantity (mass) of charcoal is obtained, it is pulverized into grains fine enough to pass through a three-millimeter sieve. The grinding process is necessary to increase the material's surface area and enhance contaminant adsorption. The plastic mesh bags that produce is sold in (e.g. potatoes or oranges) are widely available, are free or inexpensive, and make a good sieve for the pulverized carbon.

Treatment system design

How much charcoal is necessary to treat a given volume of drinking water depends on the concentration of contaminants in the water as well as the adsorption capacity of the pulverized charcoal. Here we have made conservative estimates based on the scientific literature regarding these terms in order to design a system that we can be reasonably confident will produce clean water. Accordingly, we find the ratio 5 grams of charcoal to 1 liter of water to be sufficient for our design.

With this ratio, and assuming the EPA recommended daily water intake of 2.5 liters per person per day, roughly 4.5 kilograms (about 10 lbs.) of charcoal are required to supply drinking water to one person for one year. For our system in Thailand, given the hot tropical climate and the demanding nature of the farm work performed by community members, we doubled the drinking water intake to five liters per person per day. This results in our system design requiring 9 kilograms (20 lbs.) of charcoal per person to meet one year's drinking water needs.

Furthermore, laboratory analysis of our charcoal filter medium as well as of local water supplies may permit the amount of charcoal required per liter to be reduced significantly. We have established contact with university laboratories in the US to perform these analyses—the results, insofar as they affect the treatment system design or lifetime, will be reported in subsequent publications.

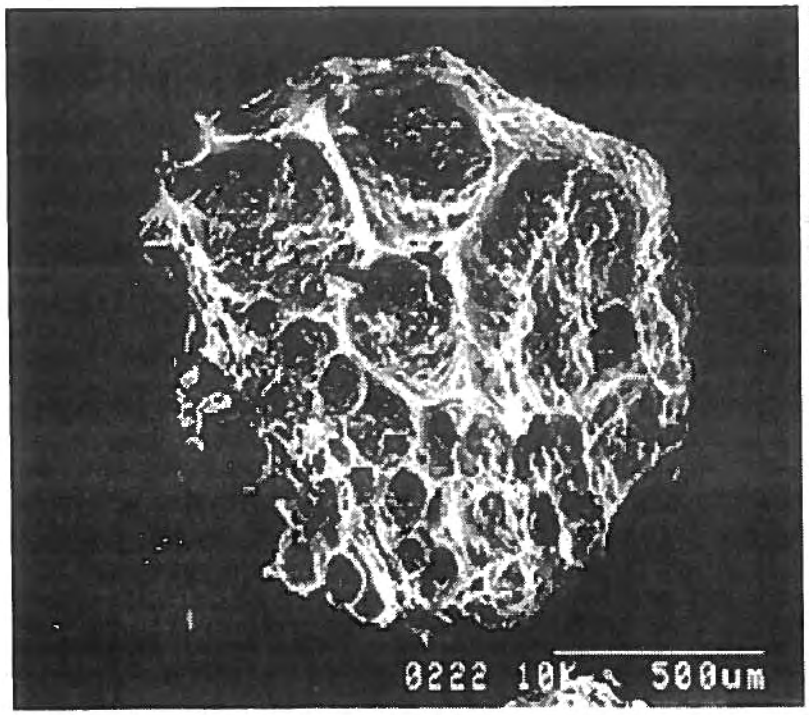
Conservative estimates suggest that the sand layer should be about 50 cm thick. A diffuser plate is placed over the sand to reduce the turbulence of the influent and prevent channels forming through the sand. The thickness of the charcoal layer will depend upon how many people are using the system as well as its desired lifetime (i.e. the time until the charcoal has to be replaced). The purpose of the gravel layer is to prevent clogging of the perforated pipe by carbon granules—this layer need only be about 20 centimeters in thickness.

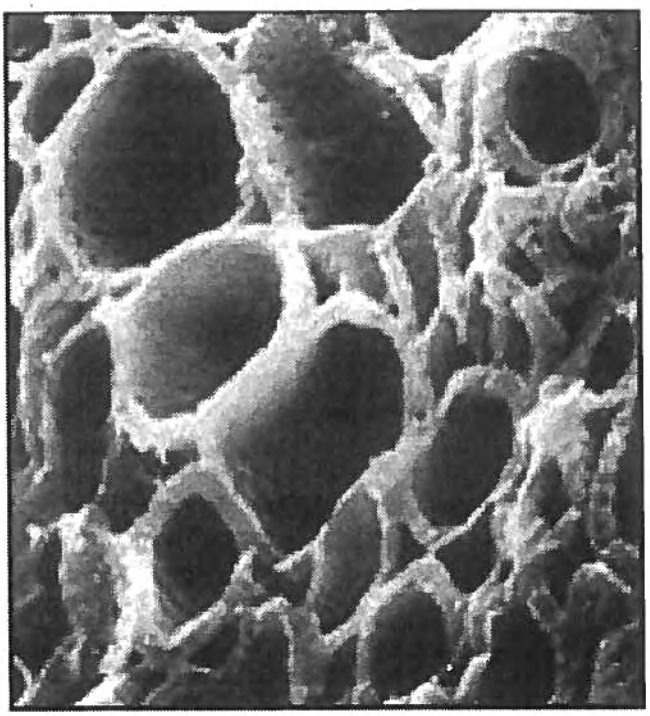
Finally, we recommend running the filtered water under a germicidal UV light to eliminate bacterial and viral contaminants. Application of germicidal UV systems is widely described in other publications. A combined system of charcoal filtration and UV decontamination represents, in our estimation, the best available technology to ensure a plentiful supply of clean drinking water.

Employing this system provides a demonstration of a working prototype for a simple, effective, and inexpensive drinking water system extensible to communities worldwide seeking to advance their practice of self-reliant living. Δ

...charcoal has many uses in addition to water filtration.

Electron microscope image of granular activated carbon. The grain on the left is about one millimeter across. The right image is a close up of the pore spaces.





Blessed Unrest

The Changing Human Climate

Paul Hawken

OVER THE PAST FIFTEEN YEARS I have given nearly one thousand talks about the environment, and every time I have done so I have felt like a tightrope performer struggling to maintain perfect balance. To be sure, people are curious to know what is happening to their world, but no speaker wants to leave an auditorium depressed, however dark and frightening a tomorrow is predicted by the science that studies the rate of environmental loss. To be sanguine about the future, however, requires a plausible basis for constructive action: you cannot describe possibilities for that future unless the present problem is accurately defined. Bridging the chasm between the two was always a challenge, but audiences kindly ignored my intellectual vertigo and over time provided a rare perspective instead. After every speech a smaller crowd would gather to talk, ask questions, and exchange business cards. These people were typically working on the most salient issues of our day: climate change, poverty, deforestation, peace, water, hunger, conservation, human rights. They came from the non-profit and non-governmental world, also known as civil society; they looked after rivers and bays, educated consumers about sustainable agriculture, retrofitted houses with solar panels, lobbied state legislatures about pollution, fought against corporate-weighted trade policies, worked to green inner cities, and taught children about the environment. Quite simply, they had dedicated themselves to trying to safeguard nature and ensure justice. Although this was the 1990s, and the media largely ignored them, in those small meetings I had a chance to listen to their concerns. They were students, grandmothers, teenagers, tribe members, businesspeople, architects, teachers, retired professors, and worried mothers and fathers. Because I was itinerant, and the organizations they represented were rooted in their communities, over the years I began to grasp the diversity of these groups and their cumulative number. My interlocutors had a lot to say. They were informed, imaginative, and vital, and offered ideas, information, and insight. To a great extent *Blessed Unrest* is their gift to me.

My new friends would thrust articles and books into my hands, tuck small gifts into my knapsack, or pass along proposals for green companies. A Native American taught me that the division between ecology and human rights was an artificial one, that the environmental and social justice movements addressed two sides of a single larger dilemma. The way we harm the earth affects all people, and how we treat one another is reflected in how we treat the earth. As my talks began to mirror my deeper understanding, the hands offering business cards grew more diverse. I would get from five to thirty such cards per speech, and after being on the road for a week or two would return home with a few hundred of them stuffed into various pockets. I would lay them out on the table in my kitchen, read the names, look at the logos, envisage the missions, and marvel at the scope and diversity of what groups were doing on behalf of others. Later, I would store them in drawers or paper bags as keepsakes of the journey. Over the course of years the number of cards mounted into the thousands, and whenever I glanced at them, I came back to one question: Did anyone truly appreciate how many groups and organizations were engaged in progressive causes? At first, this was a matter of curiosity on my part, but it slowly grew into a hunch that something larger was afoot, a significant social movement that was eluding the radar of mainstream culture.

The way we harm the earth affects all people, and how we treat one another is reflected in how we treat the earth.

So, curious, I began to count. I looked at government records for different countries and, using various methods to approximate the number of environmental and social justice groups from tax census data, I initially estimated a total of 30,000 environmental organizations around the globe; when I added social justice and indigenous peoples' rights organizations, the number exceeded 100,000. I then researched to see if there had ever been any equals to this movement in scale or scope, but I couldn't find anything, past or present. The more I probed, the more I unearthed, and the numbers continued to climb, as I discovered lists, indexes, and small databases specific to certain sectors or geographic areas. In trying to pick up a stone, I found the exposed tip of a much larger geological formation. I soon realized that my initial estimate of 100,000 organizations was off by at least a factor of ten, and I now believe there are over one—and maybe even two—million organizations working toward ecological sustainability and social justice.

By any conventional definition, this vast collection of committed individuals does not constitute a movement. Movements have leaders and ideologies. People join movements, study their tracts, and identify themselves with a group. They read the biography of the founder(s) or listen to them perorate on tape or in person. Movements, in short, have followers. This movement, however, doesn't fit the standard model. It is dispersed, inchoate, and fiercely independent. It has no manifesto or doctrine, no overriding authority to check with. It is taking shape in schoolrooms, farms, jungles, villages, companies, deserts, fisheries, slums—and yes, even fancy New York hotels. One of its distinctive features is that it is tentatively emerging as a global humanitarian movement arising from the bottom up. Historically social movements have arisen primarily in response to injustice, inequities, and corruption. Those woes still remain legion, joined by a new condition that has no precedent: the planet has a life-threatening disease, marked by massive ecological degradation and rapid climate change. As I counted the vast number of organizations it crossed my mind that perhaps I was witnessing the growth of something organic, if not biologic. Rather than a movement in the conventional sense, could it be an instinctive, collective response to threat? Is it atomized for reasons that are innate to its purpose? How does it function? How fast is it growing? How is it connected? Why is it largely ignored? Does it have a history? Can it successfully address the issues that governments are failing to do: energy, jobs, conservation, poverty, and global warming? Will it become centralized, or will it continue to be dispersed and cede its power to ideologies and fundamentalism?

I sought a name for the movement, but none exists. I met people who wanted to structure or organize it—a difficult task, since it would easily be the most complex association of human beings ever assembled. Many outside the movement critique it as powerless, but that assessment does not stop its growth. When describing it to politicians, academics, and businesspeople, I found that many believe they are already familiar with this movement, how it works, what it consists of, and its approximate size. They base their conclusion on media reports about Amnesty International, the Sierra Club, Oxfam, or other venerable institutions. They may be directly acquainted with a few smaller organizations and may even sit on the board of a local group. For them and others the movement is small, known, and circumscribed, a new type of charity, with a sprinkling of ragtag activists who occasionally give it a bad name. People inside the movement can also underestimate it, basing their judgment on only the organizations they are linked to, even though their networks can only encompass a fraction of the whole. But after spending years researching this phenomenon, including creating with my colleagues a global database of its constituent organizations, I have come to these conclusions: this is the largest social movement in all of human history. No one knows its scope, and how it functions is more mysterious than what meets the eye.

What does meet the eye is compelling: coherent, organic, self-organized congregations involving tens of millions of people dedicated to change. When asked at colleges if I am pessimistic or optimistic about the future, my answer is always the same: If you look at the science that describes what is happening on earth today and aren't pessimistic, you don't have the correct data. If you meet the people in this unnamed movement and aren't optimistic, you haven't got a heart. What I see are ordinary and some not-so-ordinary individuals willing to confront despair, power, and incalculable odds in an attempt to restore some semblance of grace, justice, and beauty to this world. In the not-so-ordinary category, contrast ex-president Bill Clinton and sitting president George W. Bush. As I write this, Bush is on TV snarled in a skein of untruths as he tries to keep the lid on a nightmarish war fed by inept and misguided ambition; simultaneously the Clinton Global Initiative (which is a non-governmental organization) met in New York and raised $7.3 billion in three days to combat global warming, injustice, intolerance, and poverty. Of the two initiatives, war and peace, which addresses root causes? Which has momentum? Which does not offend the world? Which is open to new ideas? The poet Adrienne Rich wrote, "My heart is moved by all I cannot save. So much has been destroyed I have cast my lot with those who, age after age, perversely, with no extraordinary power, reconstitute the world." There could be no better description of the audiences I met in my lectures.

America has been the home of some of the most important progressive efforts in history. . . but you would not know that, given the narrowness of scope of today's education.

This is the story without apologies of what is going right on this planet, narratives of imagination and conviction, not defeatist accounts about the limits. Wrong is an addictive, repetitive story; Right is where the movement is. There is a rabbinical teaching that holds that if the world is ending and the Messiah arrives, you first plant a tree and then see if the story is true. Islam has a similar teaching that tells adherents that if they have a palm cutting in their hand on Judgment Day, plant the cutting. Inspiration is not garnered from the recitation of what is flawed;

it resides, rather, in humanity's willingness to restore, redress, reform, rebuild, recover, reimagine, and reconsider. "Consider" (*con sidere*) means "with the stars"; reconsider means to rejoin the movement and cycle of heaven and life. The emphasis here is on humanity's intention, because humans are frail and imperfect. People are not always literate or educated. Most families in the world are impoverished and many suffer from chronic illnesses. The poor cannot always get the right foods for proper nutrition, and must struggle to feed and educate their young. If citizens with such burdens can rise above their quotidian difficulties and act with the clear intent to confront exploitation and bring about restoration, then something powerful is afoot. And it is not just the poor, but people of all races and classes everywhere in the world. "One day you finally knew what you had to do, and began, though the voices around you kept shouting their bad advice," is Mary Oliver's description of moving away from the profane toward a deep sense of connectedness to the living world.

Although the six o'clock news is usually concerned with the death of strangers, millions of people work on behalf of strangers. This altruism has religious, even mythic origins and very practical eighteenth-century roots. Abolitionists were the first group to create a national and global movement to defend the rights of those they did not know. Until that time, no citizen group had ever filed a grievance except as it related to itself. Conservative spokesmen ridiculed the abolitionists then, just as conservatives taunt liberals, progressives, do-gooders, and activists today by making those four terms pejoratives. Healing the wounds of the earth and its people does not require saintliness or a political party, only gumption and persistence. It is not a liberal or conservative activity; it is a sacred act. It is a massive enterprise undertaken by ordinary citizens everywhere, not by self-appointed governments or oligarchies.

Blessed Unrest is an exploration of this movement—its participants, its aims, and its ideals. I have been a part of it for decades, so I cannot claim to be the detached journalist skeptically prodding my subjects. I hope what follows is the expression of a deep listening. The subtitle of the book—how the largest movement in the world came into being—cannot be answered by one person. Like anyone, I have a perspective based on biases accumulated over time and a network of friends and peers who color my judgment. However, I wrote this book primarily to discover what I don't know. Part of what I learned concerns an older, quiescent history that is reemerging, what poet Gary Snyder calls the great underground, a current of humanity that dates back to the Paleolithic. Its lineage can be traced back to healers, priestesses, philosophers, monks, rabbis, poets, and artists "who speak for the planet, for other species, for interdependence, a life that courses under and through and around empires." (4) At the same time, much of what I learned is new. Groups are "intertwingling"—there are no words to exactly describe the complexity of this web of relationships. (5) The Internet and other communication technologies have revolutionized what is possible for small groups to accomplish and are accordingly changing the loci of power. There have always been networks of powerful people, but until recently it has never been possible for the entire world to be connected.

Blessed Unrest is an overview that describes how this movement differs from previous social movements, particularly with respect to ideology. The organizations in the movement arise one by one, generally with no predetermined vision for the world, and craft their goals without reference to orthodoxy. For some historians and analysts, movements only exist when they have an ideological or religious core of beliefs. And movements certainly don't exist in a vacuum: a strong leader(s) is an earmark of a movement and often its intellectual pivot point, even if deceased. The movement I describe here has neither, and so represents a completely different form of social phenomenon.

Abolitionists were the first group to create a national and global movement to defend the rights of those they did not know.

The first three chapters are glimpses of some of the movement's roots. One cannot do justice to its history in a clutch of books, much less a few chapters. America has been the home of some of the most important progressive efforts in history—women's suffrage, abolition, civil rights, food safety—but you would not know that, given the narrowness of scope of today's education. My survey reflects the views of a North American because it is the only history I can adequately present. This bias is important to acknowledge, because global history is invariably skewed when seen through the eyes of Western culture, no matter how hard one tries to be objective. There are other histories, African and Native American, English and Japanese, Brazilian and Mediterranean, all equally valid, and all with their own particular inflections. In India, for example, environmentalism is a social justice movement, concerned with the rights of people to the land and its bounty. In 1991 Sunita Narain, the director of the Center for Science and the Environment in New Delhi, called global warming environmental colonialism, and was one of the first to question whether environmental management should be based on human rights rather than legal convention. In the United States the environmental movement found itself faced with a backlash when it was accused of placing the rights of the animals and plants on the land before those of people. Ron Dellums, an African-American congressman from Oakland, California, asked the Sierra Club, "I know you care about black bears but do you care about black people?" (6) In Germany the green movement became an organized political party, and its members now hold

positions at the highest echelons of government. In the global South, environmentalism is a movement of the poor, with peasants leading campaigns that address land reform, trade rights, and corporate hegemony. The environmental movement began in England as a series of public health campaigns during the Industrial Revolution. In Italy, it concerns the dynamics between *la citte* and *la campagna;* in South Africa it is inextricably bound to social justice issues embedded in the country's history. (7) My purpose in recounting some of the threads of the past is not merely to extol great personages such as Darwin, Gandhi, Rachel Carson, or Thoreau, but to recognize the importance of connection and coincidence. Long ago small, seemingly inconsequential actions took place that eventually changed the world—outcomes the original actors might never have imagined. One such occurrence was Emerson's encounter with the Jussieu family of scientists in Paris, a little remarked-upon event whose influence, as we will see, eventually wends itself into the civil rights movement 123 years later. In a time when people feel powerless, a history of altruism can be a balm because it reveals the power of helpful and humble acts, a reminder that constructive changes in human affairs arise from intention, not coercion.

"Indigene" and "We Interrupt This Empire" concern globalization. "Indigene" is concerned with indigenous cultures. Their traditional lands represent the greatest remaining sanctuaries of life on earth, and resource-hungry corporations are commercializing and destroying these biological arks. The cultures that have coevolved with these environments are resisting the encroachment, uniting with alliances of nonprofits to bring accountability and limits to unchecked development. "We Interrupt This Empire" focuses on organizations that are engaged in protecting citizens, workers, and environments from the juggernaut of free market fundamentalism.

The final two chapters look at the entire movement from two perspectives. "Immunity" uses the cellular metaphor of how an organism defends itself as a plausible way to describe the collective activity of the movement. The immune system is the most complex system in the body and provides a useful model for examining the properties of these groups. The terms environment and social justice encompass innovative organizations that are redolent with ideas and inventive techniques, and a few are explored here. I also consider the weakness of the movement, how its multiplicity and diversity may hobble it as the world descends into violence and disorder. "Restoration" describes the biological principles that inform all forms of life, including human beings, and uses the principles as a framework to bring a different vocabulary to the movement. In biologist Janine Benyus's quintessential summation, "life creates the conditions that are conducive to life." It is fair to ask whether that might not be a suitable organizing principle for all human activity, from economics to trade to how we build our cities. While it is risky to rely on life sciences to explain social phenomena, it is equally risky to assume that the standard language that has served to chronicle past social movements is sufficient to describe this one. The individuals featured in this book all try to do good, but this book is not only about doing good. It is about people who want to save the entire sacred, cellular basis of existence—the entire planet and all its inconceivable diversity. In total, the book is inadvertently optimistic, an odd thing in these bleak times. I didn't intend it; optimism discovered me. Δ

Paul Hawken is an environmentalist, entrepreneur, journalist, and author. Starting at age 20 he dedicated his life to sustainability and changing the relationship between business and the environment. His practice has included starting and running ecological buisinesses, writing and teaching about the impact of commerce on living systems, and consulting with governments and corporations on economic development, industrial ecology, and environmental policy. This article is reprinted by arrangement with Viking, a member of Penguin Group (USA) Inc., from Blessed Unrest *by Paul Hawken. Copyright Paul Hawken, 2007.*

Reviews

Now or Never
Review by Peter Bane

GEORGE MONBIOT
Heat: How to Stop the Planet from Burning
South End Press. Cambridge, MA. 2007. 278 pp + xix. hardcover. $22.

Well received and urgently written, *Heat* is, in the words of its author, "both a manifesto for action and a thought experiment." Monbiot's review of the science of climate change has led him to the conclusion that cuts of 90% in energy use by the developed nations are required by 2030. He has asked the question, "Can this be done, and if so how?" This book is the answer. It is also a passionate attempt to engage as many people as possible in the effort to make and call for early and dramatic reductions in CO_2 output.

Heat starts from the proposition that climate change is underway and accelerating, that we are very close to irreversible and runaway warming, with catalysmic consequences for human life—thus climate change is the top priority for action facing all political bodies, and that none of the current political positions of government or public agencies is yet radical enough to address the threat posed by "business as usual." As I write this, the U.S. and the E.U. are arguing about the feasibility of making 50% cuts in carbon emissions by 2050. One hears similar positions from some of the U.S. presidential contenders. Not nearly enough, says Monbiot.

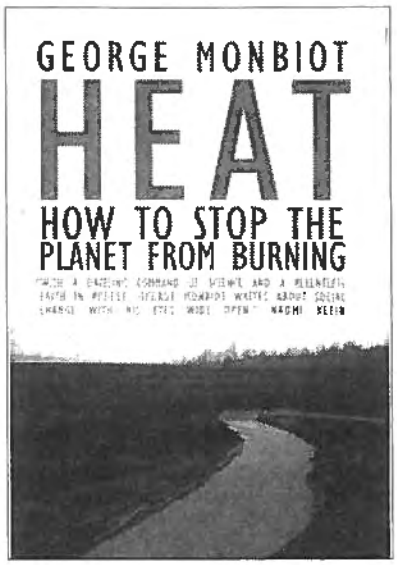
If we are to prevent more than two degrees Fahrenheit of warming above pre-industrial levels, 1.4° above the present level—a point at which the odds of avoiding catalysmic change begin to tip strongly against us—carbon dioxide levels in the atmosphere must be held to the equivalent of 450 ppm. This is about the present level, considering combined impacts from methane and other greenhouse gases. Annual releases must be brought down from the present 7 billion tonnes to 2.7 billion, a 60% reduction, made greater by the expected loss (by 2030) of one-third of the the absorptive capacity in present carbon sinks such as the ocean and forests. Furthermore, the carbon cuts must all be in place by 2030, and, to limit total carbon emissions (the effect of which lasts up to 200 years) we must weight the cuts to the front end of that time period, meaning the next decade.

So how does this number square with Monbiot's insistence that industrial countries cut carbon emissions by 90%? Because he factors in an expected increase in world population to 8.2 billion, and assumes that the only way we can achieve effective reduction is by distributing the "right" to burn carbon equally across all populations.

This strategy, called elsewhere "contraction and convergence," because it assumes both an absolute reduction in output and a levelling of the rates of carbon consumption in all countries over time, is central to Monbiot's argument. It cuts through the Gordian knot of Kyoto's compromise. It insists on justice as a fundamental prerequisite of sustainability. The rich must lead by example, making greater cuts because there can be no moral justification for perpetuating their privilege to pollute. If the planet burns, we all die. To prevent that, everyone must be constrained by similar personal and national limits. That limit is about 0.33 tonnes of carbon burned per year per person. (A tonne is 2200 lbs. or 1.1 so-called "short" tons.) For North Americans and Australians, that translates into about a 94% cut from current levels. For Britons and other Europeans, from 83-88%.

If you attempt to follow the arguments about atmospheric gases, one potential source of confusion—and Monbiot does little to avoid this—is the distinction, or lack thereof, between carbon-based fuels, and carbon dioxide. In effect they are the same, as burning the fuel produces the CO2, but when we talk weights of carbon and weights of carbon dioxide, the numbers are different. To illustrate, a gallon of gasoline, weighing about six lbs. produces, when burned, 15 lbs. of CO2. Some of the weight of the gasoline is hydrogen, some oxygen, plus traces of other compounds. About 3/4 of the weight is carbon, and when it burns, it combines with more than twice its own weight in oxygen to produce CO2. The US population presently releases an average of 20 tonnes of CO2 per person, equivalent to 6 tonnes of carbon in fuels.

Heat is a book about economic changes, many of them technical, some of them behavioral or socio-political, and it glosses the climate science to focus on a program for carbon reduction. That program will require urgent action by all sectors of society, most especially



government. Nevertheless, the author's frank attitude about political change inspires confidence. He laments much in the modern world, but not the benefits of hot water, refrigeration, electric lighting, and thermal comfort. I am with him there, as I suspect most of us would be. The economic conditions of very poor third-world countries have little appeal to most people in the developed world. Policies that threaten to diminish living standards to those levels would be rejected politically. Thus the thought experiment of Heat is to reduce carbon consumption, or rather carbon dioxide output, while maintaining substantially similar living standards as are enjoyed by Europeans and North Americans today.

In some areas he admits this will be impossible altogether. We must abandon most of our use of airplanes, a conclusion he personally regrets. In most other ways, however, he has succeededóbarely he admits—in meeting his targets without

significant degradation of living standards. Indeed, there will likely be substantial gains in quality of life as time spent in commuting and other non-productive activities is redirected. Automobile mileage, for example, must contract, but present levels of mobility may be maintained.

The rich must lead by example, making greater cuts because there can be no moral justification for perpetuating their privilege to pollute.

How does he suggest we do it? First, he says, by rationing fuel and electricity to ensure fair access by all to the essential services these commodities now provide. And secondly, by breaking the link between carbon and the economy. This latter approach involves many different steps, beginning with buildings. Some are very mundane measures for conservation such as improving house insulation and lighting and appliance efficiencies. Others involve shifting sources for electricity production to renewables such as wind, water, tidal, and photovoltaic power. Another important approach would be to combine heat and power generation in buildings using microgenerators, boilers, or fuel cells running on hydrogen that would be either split from water on-site using grid electricity or photovoltaics, or supplied directly by pipelines.

Power generation needs to switch from coal to gas because gas yields more energy with less carbon than coal. I must confess I look on his assumptions about the supply of natural gas with some skepticism. He projects a good supply of gas through 2090, but as supplies in N. America have already peaked, this aspect of his argument doesn't appear to transfer to the US as easily as we might wish. Power companies in North America began switching from coal and oil to gas over the past 15 years, but are now looking at building more new coal burners.

The gas-fired generating plants Monbiot calls for must be equipped with carbon sequestration technology, whereby the CO2 in the smokestack is scrubbed out chemically, and later extracted by heat so that the chemicals can be reused. The extracted CO2 is pumped into empty gas fields, oil fields, or other subterranean aquifiers. When placed below 800m depth, the CO2 tends to act as a liquid and stay in place. Initially negative toward sequestration technology, Monbiot became convinced that it can work and would be useful. There are costs: it takes about one-third more energy to produce the same amount of electricity this way as when the CO2 is released up the chimney. But by reducing the carbon content of the electricity, he suggests, we can maintain essential services and blunt the impacts of reduced fuel use in other areas of the economy. Carbon from transport fuels cannot practically be recaptured.

Transport is the other main area of energy use Monbiot addresses. Most of his suggestions aren't new, but the filtering and costing he has done are helpful. He proposes a systematic improvement in long-distance coach service along with schemes to price cars off the motorways and out of city centers, steps he asserts could likely be self-financing from the start and would require little new infrastructure. New integrated urban designs that bring together residence, commerce, and public services would reduce some need for travel altogether. Telecommuting, modified work weeks, schemes for car sharing, hypercar technologies to improve fuel efficiency, and improvements to cycling and walking facilities combined with a large shift to coach travel could cut transport fuel use by 90% while preserving present standards of mobility.

Monbiot looks at two other areas where carbon dioxide emissions are significant, and might be cut sharply: shopping and cement production. For the former, he proposes expansion of home delivery services to reduce the need for driving. Also, by shifting from storefronts to warehouse operations, retailers could eliminate many energy costs that are at present unavoidable: high levels of lighting, open refrigeration, signage, etc. Home delivery apparently already works well for some grocery chains in Britain, which are able to achieve reliable delivery within two hours of order. And each delivery van pulls three cars off the roads.

Globally, production of portland cement produces five to ten percent of carbon dioxide emissions—about a ton of CO2 for each ton of cement. A switch to pozzolan or geopolymeric cements, which is technically feasible, could cut this by 90%.

Monbiot uses Britain for his case study, but has tried to choose strategies that could be universally adopted. Whether this is true remains to be tested. He acknowledges that the US is a different country with a more widely distributed population and greater climatic challenges than Britain, but makes the obvious point that a ton of carbon in the atmosphere is no respecter of political or cultural differences.

Monbiot acknowledges the impending peak in oil production, but for reasons not clear in the book or obvious to me, thinks that gas supplies will not become a limiting factor for most of this century. This could be a significant flaw in his case for carbon savings in power generation, or, his focus on 2030 may spare him most of the negative effects of the peak in gas production.

Monbiot looks at two other areas where carbon dioxide emissions are significant, and might be cut sharply: shopping and cement production.

On the other hand, he fails to account for potential carbon savings in agriculture by shifts to organic and local production. And he adopts a dismissive attitude toward carbon sequestration in forests and soils, which I think may be unwarranted.

In part his view seems to stem from research indications that forests may increase atmospheric warming in boreal regions and that their spread into areas formerly glaciated or covered in snow may have a net negative impact on global warming. Whether or not this is true, vast opportunities exist to reduce surface heating, increase carbon uptake, and in many ways exert beneficial influences on the climate from planting trees in warmer regions of the planet.

Monbiot does not understand the potentials of permaculture design to incorporate trees in agriculture, nor does he appear to understand the interaction of forests with water cycles. In this I believe he is not so much lacking in intelligence as at the mercy of questionable authorities in the fields of agriculture and forestry. In that regard, he is like many western intellectuals, relatively divorced from the land and thus from innovations which have arisen in landcare over the past generation.

Though I can find fault with Monbiot's conclusions in some areas, *Heat* is an important book, and one worthy of our respect. The author is under no illusions about the seductive appeal of our present comforts, the inability of our politicians to lead the populace, or our profound capacity for unwarranted belief in salvation by technology or other miracles. He has staked out new territory politically by insisting that we can and must soon make 90% cuts in carbon emissions in the developed countries. It remains for his readers to force governments to take the actions that will enable us to do so. Δ

By Both Ice and Fire
Review by Peter Bane

FRED PEARCE
With Speed and Violence: Why scientists fear tipping points in climate change
Beacon Press. Boston. 2007. 278 pp + xxvi. hardcover. $24.95.

As I read chapter after chapter of this survey of climate and global systems science, I began to feel that I was under a pile of stones and more were being heaped on top. Fred Pearce is an accomplished writer and his science reporting is top notch, but the emotional weight of his conclusions is nearly crushing.

The subtitle of the book tells its story. Global warming is no longer news. It's been underway for more than three decades with increasing momentum. It is surely though not exclusively driven by human activities. Indeed, much of this book lays out the processes by which humans may have leaned our not-inconsiderable weight into the delicately balanced mobile of forces that sustain the current climate: increasing smokestack and tailpipe emissions, development in tropical forests leading to huge fires, the ongoing disaster of agriculture, and more. The consequences, scientists are beginning to fear, may be upon us far faster and with greater violence that has heretofore been imagined. The power of the climate system, once destabilized, to shift the ecosystems of the planet, is profound and frightening. This is chiefly because the Gaian system is subject to very strong positive feedback loops, a number of which are beginning to stir.

We have, through ignorance, hubris, and the random but widely spread release of fossil carbon into the atmosphere, set

loose forces which threaten to destroy us. We are playing the sorcerer's apprentice, only there is no one to save us from our folly, but our own capacity to mount a rapid and coordinated global response.

Pearce examines the state of the science, much of it under-reported in the popular press, much of it quite new. To do this, he reviews the geologic record of climate change since the end of what he calls "Snowball Earth" 600 million years ago, then introduces a "cast of characters" who are scientists of the past three centuries, most of them living today, who have contributed significantly to advancing our understanding of the interactions of atmosphere and oceans. In this context, he then examines the major feedback loops which seem to "tip" the climate system from one extreme—glaciation, to the other—warm interglacials, and back again. That tipping appers to occur from relatively "small" inputs of energy, and to proceed with fearsome rapidity, if the fossil record is to be believed.

We are now in an interglacial period, an exceptionally mild and stable, if brief interlude between long periods when the planet's climate was dominated by massive ice sheets that spread primarily in the Northern Hemisphere, but also in Antarctica and outward from all the planet's high mountains. This roughly 13,000 year interglacial embraces our near universal settlement in villages, later towns, and cities, the worldwide spread of agriculture, and the entire history of human civilization. Despite prehistoric periods of near-Ice Age conditions and significant cold swings and droughts during the Middle Ages, this mild, stable epoch has left us poorly prepared for what may lie ahead in the next decades.

The difference between the two states of the climate can be measured by the movement of about 220 billion tons of carbon between the land and sea and the atmosphere. Glacial epochs are marked by low levels of carbon in the atmosphere, interglacials by high levels. From a low of 440 million tons, we reach about 660 million as the climate swings to its warm

phase. Though the root cause of the change is a wobble in Earth's orbit on its axis combined with slight variations in our distance from the sun and fluctuations in solar surface temperatures, the minute differences in solar energy reaching the surface of the planet seem to be magnified by feedback relationships about which we are just learning over the past decade. Ice cores containing fossil atmosphere show that half the warming from the last glaciation to present conditions, for instance, (about nine degrees F increase) occurred in less than a decade.

As if this were not disturbing enough, since about 1800 AD, humans have pushed yet another 220 billion tons of carbon into the atmosphere. This is new territory, not seen in tens of millions of years, and may take us beyond the two-state system of climate that has prevailed for the past three million years.

Pearce emphasizes the weight of carbon rather than its concentration. (expressed as parts per million, about 380ppm presently), as being a more tangible and comprehensible measure of the potential greenhouse forces at work.

He argues, in his conclusions, that we must attempt by almost any means possible, to prevent atmopheric carbon from topping one trillion tons, a level which will correspond to about 2 degrees F of warming over pre-industrial levels. Had we acted promptly after the Rio Summit of 1992, we might have succeeded in capping carbon levels at 935 million tons, or some 400 ppm, but this now seems almost impossible. A net of 4.4 billion tons enters the atmosphere each year, the sinks which absorb carbon from the atmosphere are diminishing in their effectiveness, and we are already within about a decade of what he calls the "safety-first" level (935 million tons).

So we are barreling toward the threshold of dramatic climate change. What could happen and how might it come about?

• Rapid industralization in China and India is increasing the rate of carbon entering the atmosphere as measured at Arctic stations.

• Arctic temperatures are rising faster than those at lower latitudes, with consequent decreases in the ice pack. Water now covers large areas previously under ice, but the dark water absorbs much more heat from the sun, and once across the threshold from ice to water, a change which requires huge inputs of energy, the water can warm very rapidly. The Arctic may be completely ice-free in summer within a few years. There is nothing within the Arctic region itself that can reverse this process.

We are playing the sorcerer's apprentice, only there is no one to save us from our folly, but our own capacity to mount a rapid and coordinated global response.

• Arctic ocean warming would increase global atmospheric temperatures by several degrees, could shut down a major driver of the oceanic and atmospheric circulation, release seabed and permafrost methane (a potent greenhouse gas), and hasten the melting of the Greenland ice cap.

• The Greenland ice cap is two miles thick and a quarter the size of the continental US. Though stable in size for tens of thousands of years, it began melting in 1979, and is now losing 180 million acre-feet of water a year, a rate that has doubled in a decade. Tongues of ice miles long have broken off. Lakes that used to form on its surface in summer are now draining in huge volumes right to the bottom of the ice cap and running out to the sea beneath the ice. Seismic activity has increased, probably due to lightening of the ice burden. These accelerating processes could lead to a complete breakup of the ice sheet within decades, pushing sea levels up by as much as 18 feet.

• Ice shelves near the Antarctic Peninsula are breaking up with dramatic rapidity, and though they do not themselves change sea levels (as they were previously floating), they remove barriers to direct glacial discharge, which does raise sea levels. When Larsen B, a chunk of ice bigger than Luxembourg and 650 feet thick shattered like a pane of glass in 2002, the glaciers that used to empty onto it began cascading into the sea eight times faster. If more of the giant ice shelves break loose, the West Antarctic ice sheet may itself begin to collapse. It contains a similar amount of water to the Greenland ice cap.

• Pine Island Bay, west of the Antarctic Peninsula, one of the harshest and most remote areas of the planet, receives the flow of two of Antarctica's five largest glaciers, Pine Island and Thwaites, both draining the West Antarctic ice sheet. Together they are dumping a net of 70 million acre-feet of water a year into the ocean, a figure which has trebled in a decade. The glaciers have accelerated flow as far inland as 125 miles. Ocean heat is moving their "grounding point" (the furthest downstream point where the glacier rests on rock) inland by a mile a year. There is nothing to stop them from continuing to retreat. They contain enough ice to raise sea levels 3-6 feet, and their collapse would destabilize the West Antarctic Ice Sheet, which rests precariously on only a few seamounts, possibly also the much more massive East Antarctic Ice Sheet. These two glaciers appear to be in runaway collapse and are likely already the greatest source of sea-level rise worldwide.

• The East Antarctic Ice Sheet, the planet's final bulwark against warming may already be discharging more ice than it gains annually.

• Sea levels during the last interglacial period 120,000 years ago were some 20 feet higher than today at temperatures comparable to what we may see within a decade or two. About 14,500 years ago sea levels rose by about 65 feet in 400 years, almost certainly because of the collapse of ice sheets. It seems likely that sea level rise is the greatest immediate threat to the human population, half of whom live within 50 miles of the ocean coast. Measured rates of sea level rise have increased from 0.08" per year to 0.14" per year.

• The Amazon forest is already adding

some 200 million tons of carbon per year to the atmosphere from fires. If rising ocean temperatures bring drought such as struck in 2005, and it persists for more than a year, the entire basin might go up in flames. The forest contains 77 billion tons of carbon and its soils that much more. Desertification or conversion of the Amazon to scrub or savanna would increase the current rate of global warming by 50%. If the Amazon goes, rains may fail across Brazil and Argentina, and even the weather in the North Atlantic will be affected.

• The Asian Monsoon, which waters crops that feed half of humanity, could shut down from changes in the ocean conveyor brought on by polar warming and other forces.

• In 1997 the most intense El Nino event on record snuffed out rainfall over Borneo and landowners took advantage of the dry weather to increase oil palm plantations by burning forest. Burning out of control, perhaps the worst forest fires in human history released 2.2 billion tons of carbon into the atmosphere. The following year was the hottest on record in the 20th century and may have been the hottest of the last thousand years. The peat bogs of central Borneo, ordered drained for rice cultivation in the early 90s by Indonesia's president Suharto, have been dessicating steadily for over a decade. They have not yet produced any rice, but are now releasing vast amounts of carbonóperhaps a billion tons a year—from burning. Some 50 billion tons remain, and if the fires continue, one of the world's biggest carbon sinks could become a major source.

• Methane is already bubbling out of Siberian permafrost as it melts. Though it ultimately degrades to carbon dioxide (in about a decade), methane is ten times more potent at trapping solar radiation in the atmosphere than CO2. If sea temperatures rise enough, methane clathrates on the seabed could melt and release large amounts of the gas. Something similar happened about 55 million years ago and led to a sharp spike (18 degrees F) in global temperatures accompanied by a large-scale collapse of living systems across the planet within a few centuries.

While this litany of cataclysm is not a complete listing of the feedback loops Pearce covers, it is enough to convey the deadly seriousness of the climate debate. His main point is to caution us that the climate models and predictions of the International Panel on Climate Change (IPCC) sobering or controversial as they may appear, are very likely inadequate.

Much of the remainder of the book presents a fascinating history of climate as it has fluctuated both during the recent interglacial period (Holocene era), and at times in the more distant past. It also examines the history of and current debates within climate science, reaching no clear conclusion about which parts of the global system—the tropical oceans or the polar seas and icecaps is the primary accelerator of the planet's dramatic temperature swings.

Pearce concludes with a plea for rapid changes in policy to respond to the risks of runaway climate shift. Among his more creative ideas is a call to reduce industrial methane releases immediately to buy a little time. These have a dramatically greater short-term impact on the climate, but their reduction should have markedly lower impacts on the human economy than cutting carbon emissions, which are directly linked to energy use and indirectly to economic output.

This book provides little help in the political arena—for that, read Monbiot's *Heat*—but the science on which Pearce reports should light a fire under every reader. There is no time to dally. Δ

City Beautiful
review by Peter Bane

A Convenient Truth: Urban Solutions from Curitiba, Brazil
2007. DVD. Color. 52 min. $25.

Bill McKibben wrote extensively about the city of Curitiba; some of that writing was published in *Natural Capitalism*, by Paul Hawken and Amory and Hunter Lovins in 1999. Stories and apocrypha have circulated in green publications and circles about this city of the future from the south of Brazil, yet until now, one had to travel to see the phenomenon for oneself. *A Convenient Truth*, despite its cliche title, provides a valuable lens on one of the planet's great ecological success stories.

Rio de Janeiro was the site of the 1992 global summit on Climate Change; Porto Alegre the host city to numerous gatherings of the World Social Forum. With the publication of this visual report from Curitiba, a city of twp million in the southern state of Paraná, we cannot fail to recognize Brazil as a world leader in ecological reform.

Curitiba (pronounced "koo-ree-CHEE-ba") grew from a small regional capital of 150,000 in the late 1940s to its present megalopolitan size by the same processes that swelled Rio and Sao Paulo: high birth rates and a flood of immigrants from the rural areas in search of money. By the late 1960s this tumultuous process was well underway and colliding with the growth of automobility as Brazil's industrial capacity expanded. The city was on the verge of building its first freeway in 1971 when mayor Jaime Lerner, an architect appointed by the state governor under Brazil's top-down military government of the time, intervened to close 20 blocks of the downtown to car traffic. The move was controversial, executed by city workers almost overnight, and completely turned around the popular vision of what the center might look and feel like.

Shopkeepers who on Friday had railed against the street closings, on Monday were petitioning for them to be extended to their sections of the downtown.

Lerner, who served three non-consecutive terms as mayor, was part of a growing consensus of the city's professionals, nurtured by the university's School of Design, who saw the need and seized the opportunity to steer city planning away from car-dependent systems toward pedestrian and transit orientation. These men, now in their 60s and 70s, are the heroes of the film. They appear in both historic clips and live interviews in their casual jackets and shirtsleeves seen against the backdrop of an amazingly green city which they helped create. The solidarity of vision contrasts exquisitely with the diversity of color and ethnicity on display throughout the film. Cassio Taniguchi, whose two terms as mayor alternated with Lerner's, talks about his efforts to build housing and create jobs for new rural refugees. In a subtle note of irony, he is interviewed in his office with a shadowy but unmistakeable picture of New York's Statue of Liberty on the wall to his right as he talks about the functional process of taking in the country's poor and giving them a hand up. Architect Rafael Dely helped the city create diverse neighborhoods where many people were able to start their own businesses and take pride and ownership in their public housing homes by remodeling them. Nicolau Kloeppel, the genius behind the city's massive expansion of parks and its model recycling program, beams with pride as he explains how the parks increased property values and tax revenues and enabled the city to relocate poor residents from the disease-ridden and flood-prone favelas to neighborhoods with clean housing, schools, and health clinics. Former Brazilian Secretary of the Environment Hitoshi Nakamura explains how the city created wetlands along its river parks to controls floods, and how it uses sheep to mow the grass in the city's many miles of parkland. Architect Angela Bertolini explains how the beauty of the parks helped increase and lengthen visits by travelers connecting in Curitiba to points north and south.

In hindsight these successful efforts seem easy and sensible, but their authors were forced by the urgent demands of growth and dire budget constraints to innovate or see the city collapse. These daring designers turned common sense and cleverness into miracles and they stuck to their drawing boards for three decades and more.

Without building a single mile of overhead freeway, Curitiba created a transit system used by 60% of its citizens daily, a system that carries more riders than the New York City subways. (This in a city with the second highest rate of car ownership in Brazil—one per three persons.) The "Trinary" system uses three parallel avenues to move buses, cars, and emergency vehicles. The center avenue has three parallel sets of lanes: the outer lanes are for local automobile access in alternate directions. The central lane moves bi-articulated buses that carry up to 270 persons and can be boarded at special platform stops every half-kilometer, much like an aboveground subway but at one-hundredth of the cost. On average a bus pulls into each transit station—where passengers enter and exit via turnstiles, and fares are collected before boarding—every 50 seconds. These same lanes also move emergency public vehicles and express buses which travel two to three miles between stops and can deliver people rapidly to distant destinations. The outer avenues of the Trinary system are multi-lane express routes that move cars quickly in and out of the city center.

The transit revolution was the root of much that followed. The city organized new growth away from the downtown and along the new transit routes, thus creating a linear center that prevented congestion and increased access to main city services throughout a wide area of the metropolis. In permaculture terms, the city planners increased the edge between the city's key functions and its inhabitants. The buses are color coded and transfers are free all the way from rural areas right to the downtown core. The city collects and distributes all fares through a public agency, but the bus lines are owned privately and run at a profit. The bus companies are paid on the basis of bus-miles driven per day and route miles covered. This not only ensures broad area coverage, but allows the city to issue bus tokens as a form of currency, because these only help fill unused transit capacity and do not disadvantage the bus operators.

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The bus tokens, which are also valid at city markets for some food purchases, are used to buy garbage from individuals, both in neighborhoods and at city-run recycling stations. A big cottage industry has emerged as otherwise economically disadvantaged people take up trash collection at large, making on-average, twice the minimum wage. This in turn feeds a robust secondary market in

recycled materials as feedstocks for industry.

The city-run recycling centers hire the unemployed and double as job-training centers. In three months from its initiation, the city's recycling program achieved 70% separation of wastes.

Parks were created out of the floodplains along the city's two major and five minor rivers. Sports fields and recreation areas replaced cardboard huts and packing-crate slums. Public green space increased 50-fold in a few years.

In five parts, the 52-minute film examines transit, recycling, housing and job creation, parks, and the political process by which these changes came about. It does not emphasize the educational reforms that were implemented in the city's public school system, but it does hint at the pedagogy that helped bring change about. Stories about the city-run plant nurseries, urban gardening programs, marketing links with regional farmers, and the inventory of urban wildlife are not mentioned. Indeed, there is far more to Curitiba's story than meets the eye in this film, but it is a great introduction.

In three months from its initiation, the city's recycling program achieved 70% separation of wastes.

The cityscapes on view are impressive: modern yet almost otherworldly in their beauty: spacious, well-ordered, and clean.

Production values in this film by Giuseppe Vaz del Bello and Maria Terezinha Vaz, Los Angeles-based artists, are good. English narration by Giuseppe is clear and articulate, though reflecting a strong accent. All the interviewees speak in Portuguese, so following the extensive audio requires careful attention to subtitles. In a number of places the editing is less than crisp as we see visual cuts just before the subtitles change. These complaints are very minor, however. The important story is of a city that has deliberately made itself more livable for its citizens.

Curitiba is a living testament to the power of ethical and ecological design. It is one of the few large-scale examples in the modern world of effective and inexpensive mass transit, and it is proof of the oft-quoted maxim that a small group of people can change the world for the better. Americans in particular would do well to measure our political leaders against the "stars" of this film. As Jaime Lerner says, "If all the world's cities were made like this, we would have no problems with climate change." Highly recommended. Δ

Future Food

Review by Peter Bane

ERIC TOENSMEIER
Perennial Vegetables:
From artichoke to 'Zuiki' taro, a gardener's guide to over 100 delicious easy-to-grow edibles.
Chelsea Green. White River Jct. VT. 2007. 242 pp. paper. illus. $35.

Every now and then we get to take a step forward without hesitation or retreat. The publication of *Perennial Vegetables* is one such moment. Both a complement to *Edible Forest Gardens*, on which the author cooperated with Dave Jacke, and a major contribution to ecological gardening in its own right, this book is a welcome and long-awaited addition to the permaculture literature, whose success is assured and whose worth will continue to be recognized for many years to come.

Most readers are familiar with only a handful of perennial vegetables, asparagus, globe artichoke, and perhaps multiplier onions. Many other plants also provide edible leaves, roots, tubers, fruits, or flowers while regrowing on their own

year after year. Groundnut, yacon, ferns, skirret, water chestnut, and scores of others are profiled in these pages with full color illustrations, maps of climatic range, and notes on ecology, history, cultivation, propagation, harvest, use, and storage. It is easy to peruse the profiles, which are both practically written from the author's own research and testing, and are grouped by plant families for ease of further work.

An introductory section discusses design of gardens and ecological considerations for use of perennials, including pest and disease issues, soil preparation, and the usual helpful garden advice, here informed by a permaculture perspective. We are treated to some suggestions for ornamental use of perennial vegetables, and offered lists of perennial vegetables for particular microenvironments: boggy, arid, shady, or sandy, etc. These are helpful but barely slow the reader down on the way to the plant profiles. These latter are not only the meat of the book, but much of its sauce as well, for Toensmeier is an engaging author who shares his personal gardening practice and evident delight in the subject in every paragraph.

A few choice recipes for unfamiliar foods spice up an already tasty text, while the extensive reading list and bibliography are delicious in themselves and speak well of Toensmeier's wide familiarity with the field.

Eric Toensmeier is a self-described plant geek and you don't have to turn many pages before that becomes evident. The core of the text is the Plant Species section, listing over 100 species suitable for temperate regions of North America.

Most are perennial in much of the US and Canada, but the range offered includes some tender perennials which can be grown either as "dieback" perennials or perhaps as annuals, along with a few strictly tropical species of major importance, albeit subject at present to a small distribution in the southern US. Readers working in the Mexican highlands or parts of the Caribbean would find this book of some use, though the author has had to limit his selection based on current North American climates.

As climate shift progresses in the next decades, we will find more and more of these species adapted to the mid-latitudes.

The importance of perennials to the future of food cannot be overemphasized. Though they are not the answer to all gardening needs, perennials are more ecologically sturdy in the face of erratic weather patterns, help build soil, and reduce the burden of cultivation. While many of these plants have been been in cultivation for hundreds or thousands of years, few of them have been subjected to the intense breeding work that has in recent decades made our annual vegetables so highly productive. Thus, there is room for improvement on plants of considerable promise, and the author suggests that home gardeners are just the ones to do this work.

Many of the crops presented here are already sweet or savory and highly nutritious, if nearly unknown. Some offer challenges in cultivation, special attention in cooking, or challenge us to acquire new tastes. But that is evidence that we are on a horticultural frontier.

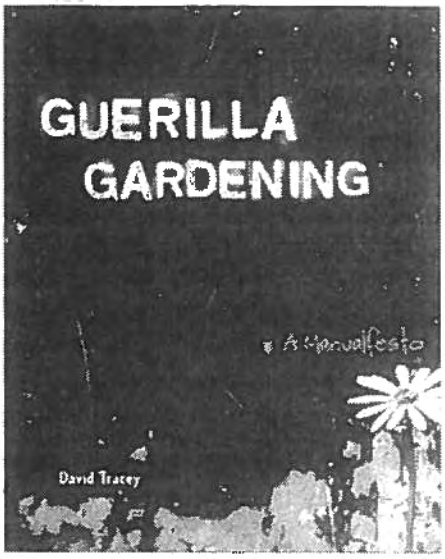
Further evidence of that frontier, not entirely welcome, are the discussions of "invasive," prohibited, or regulated plants to which the author introduces his readers. I share Toensmeier's perspective that our present agriculture is much of the problem in destruction of ecosystems and that climate shift and disturbances long underway and now unstoppable require us to be flexible and experimental in making crop choices. What I find unwelcome is the evidence of encroaching regulation on the use of plants. While I am confident that in a few decades, the magnitude of climate shift will sweep away not only plant prohibitions, but many existing ecosystems, and very likely even the governments now attempting to regulate plant use, in the intervening period, which is critical to the research and establishment of new agroecosystems, such regulations pose an unwelcome burden.

Still, ours is a unique era in which it is still possible to assemble new systems of species from around the planet with relative ease at just the moment in history when this is of utmost importance. The author has clearly enjoyed his many years' foray into plant exploring, and he invites us to share that pleasure. Clear, well-illustrated in color throughout, and sensibly organized, *Perennial Vegetables* should attract a wide audience. By crossing temperate and tropical boundaries, Toensmeier has done a great deal to set the stage for seasons yet to come. Δ

The Wisdom of Weeds

Review by Peter Bane

DAVID TRACEY
Guerrilla Gardening: A Manualfesto
New Society Publishers, Gabriola Isl. BC.
2007 228 pp. paper. $20.



The modern metropolis is inherently chaotic: it has too much energy flowing through it to be properly contained by its structure. We're well aware of the negative consequences of this condition. David Tracey reminds us of the positive opportunities presented by that chaos. Individual actions can make a big difference in shaping public space and thus the character and vital life of the post-modern city.

The best thing about *Guerrilla Gardening* is the author's atittude: just do it. Being Canadian, however, and both practical and well-read, he's full of good advice about how to be most effective and, how not to get caught, or if you are, what to say, to the police, to the judge, to the media. The unauthorized, spontaneous, planned or unplanned, grassroots, or bandit-like planting of gardens across the untended (or worse, buttoned-down) cityscape is a profoundly hopeful, anarchic (or should I say, truly democratic), and deeply instructive action. It gives form to a vision of the living city, one dwelt in by its residents, a place worth knowing, with color, character, and mostly importantly, the demonstrated capacity for renewal, a fundamental quality of all living systems.

For make no mistake, cities are the frontier of human culture. Both Tracey in passing here, and Mike Davis at greater length in *Planet of Slums*, point out that half of humanity now lives in cities and they are the sole locus of a growing world population. Cancerous or creative, we have made them, and they are in turn making us. Guerrilla Gardening brings together the primary tropes influencing city formation: firstly, they are living systems, however ugly, and thus susceptible to thoughtful, and even incremental human tampering, and secondly, they are a battleground of memes, of visions, of economic and cultural survival. To give up either on their living quality or on the importance of continuing struggle is to lose everything.

Tracey keeps a light tone throughout this book, but grounds his advice in solid theory. Christopher Alexander's placemaking for ordinary people, and Jane Jacobs' wisdom of the streets figure prominently in the author's intellectual

lineage. Much like city structure, you can dip into the book just about anywhere and begin. Tracey begins with a friendly look at why cities need gardeners, what processes shape public space, and why it matters, and then goes right on into hows and wherefores: plants, soil, tools, and seed bombs; getting help, getting started, being surreptitious but successful. The text is peppered with plant profiles of likely survivors: sunflower, nasturtium, apple, lavender, sweet pea, scarlet runner bean, and more. Design tips run in the margins, drawing on Zen aesthetics and landscape architects' tricks of the trade. Profiles of guerrilla gardeners people the pages with humor, courage, and heartwarming stories.

There's enough basic gardening information in this book to get the rankest novice started safely, and enough design sophistication and political savvy to interest any professional or activist. Want to know how to prevent potted plants from being stolen? How to make a small space seem bigger? How to get nursery stock free (or cheap)? How to ward off hungry developers? Get the attention of city hall? Avoid the attention of the police? It's all in here, along with reams of well-winnowed, practical information.

Individual actions can make a big difference in shaping public space and thus the character and vital life of the post-modern city.

The overarching lesson the book conveys, and which would be useful to almost any gardener (or guerrilla), anywhere, is how to reclaim the commons from the encroachment of private greed, deadened imaginations, and the plagues of the mass mind: hysteria, fear, boredom, prejudice, ignorance. Surprise, delight, and photosynthesis are the real weapons in the struggle for our cultural heritage and future commonwealth. Read it and weed! Δ

Fuels Gold

Review by Albert Bates

DAVID BLUME
Alcohol Can Be a Gas! Fueling an Ethanol Revolution for the 21st Century

Soquel, California: The Intl. Inst. for Ecological Agriculture. 2007. 550pp. illustrated.

Arriving in Sao Paulo for the 2007 International Permaculture Convergence (IPC-8), I checked the online schedule for the convergence and saw that the organizers had set me down for a morning session on "making money from tree planting" (I have since turned that into an article for this issue). Caught by surprise, I had to scramble to prepare a powerpoint and one of the ideas I thought to explore was biofuels. Conventional wisdom has it that "agrifuels" are in competition with food production and climate remediation. I dashed off an email to David Blume asking for an example of "permafuel."

He replied, "Well to take a page from the book. In semi-arid areas where the temperature goes no lower than 0°F you can plant an overstory of mesquite to provide both 340 gallons of alcohol per acre from the pods and fuel the plant with coppiced branches from the tree. In the understory you plant perennial *Opuntia* (nopales) thornless cactus, and between there and the dripline and beyond you plant the starchy root crop, Buffalo Gourd, for a total yield of far over 1000 gallons per acre without irrigation."

There you have it, a polyculture for food and fuel. But what about climate change? I wrote him back, "Would you say the guild above is a net carbon sink?"

He responded, "It is absolutely a massive carbon sink. Pretty much all arid country crops put the majority of their growth underground and have a robust mycorhyzzal feeding regime. Perhaps 80+% of carbon produced in the top growth is exuded for rhizosphere associates. Mesquite is unique in that a large portion of its root burrows deep to support it with water extracted from far below. There have been recorded instances of mesquite going down 160 feet for water."

And that, in a nutshell, is David Blume's permafuel thesis. That he takes several hundred pages to flesh it out, in *Alcohol Can Be a Gas! Fueling an Ethanol Revolution for the 21st Century*, is an enduring blessing for permaculturists everywhere. This six-volume set, bound into one thick paperback, is both required reading and a standard reference on a par with *A Pattern Language* and David Jacke's *Edible Forest Gardens*.

The six books contained in one are, in order, *Understanding Alcohol: Visions and Solutions* (including "busting the myths," polyculture and photosaturation, and Brazil's national program dissected), *Making Alcohol: How to Do It* (including 30-odd feedstocks from algae to whey, the sugar method, the starch method, fungal and bacterial enzymes, fuels, and distiller construction), *Co-Products from Making Alcohol* (animals, aquaculture, mari-culture, mushrooms, methane, etc.), *Using Alcohol as Fuel* (carburetion, injection, small engines, flex-fuel conversions, and cogeneration of heating, lighting, and cooling, and typical conversions), *The Business of Alcohol: Hands-On Advice* (legal and economic considerations and case studies); and *A Vision for the Nation* (state and federal incentives, Community Supported Energy, and permaculture).

Ethichol

Just exactly what may be the appropriate role for alcohol fuels is an old, but ongoing discussion, and it has been known to get heated at times. The Tortilla Rebellion in Mexico, catastrophic overplanting of maize and soya, gene splicing by multinationals for cellulosic substrate alchemy, forest clearing worldwide—these are serious concerns.

As I write this, the U.S. Senate is considering legislation to increase ethanol production by giving generous subsidies to

the US farm belt. The pending bill mandates the use of 15 billion gallons of biofuels annually by 2015 and 36 billion gallons by 2022 (up from 8.5 billion subsidized gallons now). Nearly all of this would be corn ethanol, taken from grain stocks, with the stover burned or plowed in. Beginning in 2016, the government would ask farmers to add the corn stover, along with switch grass or wood chips, to make annual increases of 3 billion gallons in "cellulosic" ethanol. This legislation faces opposition from Big Oil and food manufacturers, but is just the kind of massively soil-destroying, economically bankrupting, petro-addicted type of legislation that is likely to be viewed by politicians as harvesting votes in the Iowa caucuses.

By showing how ethanol can be ethically produced in combination with food, soil, carbon sequestration, and other objectives for healthy system design, Blume provides a rescue remedy for our planet at a time when it could scarcely be needed more.

Loek Boonkamp, who studies agricultural trade and markets for the Organization for Economic Cooperation and Development, estimates replacing just ten percent of the world's current petroleum use with biofuels would consume about 30 percent of all the grain, oilseed, and sugar produced in the U.S., Canada, the European Union, and Brazil, not to mention a huge volume of water. Blume takes Boonkamp's argument head-on.

The US has 1500 million acres of agricultural land and uses 70 million—about five percent—for corn. Mesquite covers 70 million acres of desert land. Harvesting mesquite pods would yield more alcohol than corn without any inputs of soil, fertilizer, or water. The US could achieve similar yields from the lawn clippings coming off suburbia on any given Saturday (30 million acres at last count). There are dozens of these examples in the book. Moreover, one has to consider how much of that corn produced in the US is actually used as a food, and how much is used in floor wax, plywood, crayons, and other products.

But then, why use farmland at all? Why not harvest ethanol from cattails or dried seaweed? Willows and bamboo planted on berms separating long canals of cattails, with greywater, spent mash and fermentation carbon dioxide returned to the roots could yield 10,000 gallons of ethanol per acre.

The Chinese are getting 4.8 dry tons per acre off seaweed from coastal waters, and the Vietnamese, who farm shrimp from April to September, harvest algae from the same shallow lagoons and estuaries the rest of the year. Kelp grown on nets can cover hundreds of acres of ocean and provide bread flours, carrageenan, agar, and other ethanol co-products while also restoring health to over-nitrified "dead zones." Blume estimates the energy return on marine ethanol is on the order of 15 to 1, significantly better than current returns on petroleum exploration and production.

This six-volume set, bound into one thick paperback, is both required reading and a standard reference on a par with *A Pattern Language* and David Jacke's *Edible Forest Gardens*.

The downside of success

In Albert Bartlett's classic lecture on exponential growth, he uses the example of a bottle filled with bacteria. Bacteria grow by doubling, so one bacterium divides to become two, the two divide to become four, and so on. Suppose we had bacteria that doubled this way every minute. Suppose we put one of these bacteria into an empty bottle at eleven in the morning and then observed that the bottle was full at 12 noon.

First Question: When was the bottle half full? Answer: 11:59, one minute before 12, because they double in number every minute.

Second Question: If you were an average bacterium in that bottle, when did you first realize that you were running of space? Answer: At 12 noon the bottle is full. One minute before that it's half full. Two minutes before noon itís a quarter full, then an eighth, then a sixteenth. At five minutes before noon, when the bottle is only three percent full and 97 percent open space just yearning for development, it is unlikely you, being a bacterium, would realize there's a problem. If bacteria had human intelligence, you might see your predicament in the last ten seconds.

The US has 1500 million acres of agricultural land and uses 70 million—about five percent—for corn.

Last Question: How long can the growth continue as a result of this magnificent discovery? Answer: Suppose the bacteria are very smart—even smarter than humans—and they go out in that last ten seconds and find three more bottles and get back with them before noon. At 12 noon, one bottle is full and there are three to go. At 12:01, two bottles are filled and there are two to go, and at 12:02 all four are filled and that's it. Game over. They'd need to find four more bottles to go another minute.

The WorldWatch State of the World 2007 report includes a graph showing that Earth's carrying capacity was crossed in 1989-1990. Mathis Wagernagel calculates that we have been in deficit spending ever since, adding stress and diminishing resilience with every passing year, so that by 2050, at present rates, we will be 34 planet years in debt.

Says Bartlett, "It is an inconvenient truth that all proposals or efforts to slow global warming or to move toward sustainability are serious intellectual

frauds if they do not advocate reducing populations to sustainable levels at the local, national and global scales."

That is where David Blume's permafuel formulation comes in. I recently got into an argument with the author about population sustainability. We went around about "what good is it to put people in ethanol-powered cars if by doing so they can postpone addressing the fundamental problem of consumer society." After assuring me that he understood the point made by Bartlett, and the relationship between development, womens' rights, infant mortality, senior care and fertility, he reminded me that his prescription of small-scale, polyculture ethanol production bore little resemblance to the industrial, mechanical, globalizing production meme. Localized societies, whether island cultures, forest cultures, mountain cultures, or whatever, do not tend to overpopulate. They stabilize at equilibrium with their resource base. Local fuel production is inherently population-stabilizing, if for no other reason, because water supply is a limiting factor.

The 2050 Stanley Cup

Two decades ago, when I was writing *Climate in Crisis,* I first heard the reference to the growth of greenhouse gases as a "hockey stick" but it wasn't until more recently that I realized I was looking at the hockey stick from the wrong end. I saw the millennial timescale on the X axis as the handle, the sudden jump of Greenhouse Gases (GHG) and concommitant temperature change as the blade, which had thrust us suddenly half a degree warmer in the 20th Century. Now I see that I was holding the stick by the blade. The Y axis is the handle. According to the IPCC report just released, world temperatures may rise 6° by 2100, or perhaps 2050. It really doesn't matter even if the process takes several centuries, because a change of that magnitude would spell the end of terrestrial life as we know it. The Anthropocene will draw to a close and every form of life on Earth will adapt or perish.

If human population is the mother of all hockey sticks, then a prescription for re-localization by becoming regional food-and-fuel specific should bring population back into equilibrium. Brock Dolman has a slide show in which he puts up an image of a lifeboat and then he matches the shape to an image of a watershed valley. Watersheds are our lifeboats. In the Copper Age, every valley in Europe had a distinct culture. Local economies, dependent on local resources, squeeze more solar income from every photon and use it wisely, returning parts of every harvest to rebuild the resource.

Alcohol Can Be A Gas! goes beyond helping the mechanically adept convert their internal combustion engines to ethical fuels. It provides clear operating manuals for the farmers who will grow those fuels, the fermenters who will build and operate the stills, and the artisans who will create and trade myriad co-products. Δ

Albert Bates is an environmental educator at the Ecovillage Training Center at The Farm community in Summertown, Tennessee and author of Shutdown: Nuclear Power on Trial *(1979); and* Climate in Crisis: The Greenhouse Effect and What We Can Do *(1990). His latest book,* The Post-Petroleum Survival Guide and Cookbook: Recipes for Changing Times, *is available from New Society Publishers.*

Vlys and Tarns and Quagmires, O my!

Review by Scott Horton

BARRY LOPEZ, Ed. & DEBRA GWARTNEY, Managing Ed.
Home Ground: Language for an American Landscape
Trinity Univ. Press. San Antonio, TX. 2006.
447 pp. cloth. illustrated. $29.95

Standing at the counter of my local bookstore waiting to be rung up, a chance sideways glance made Barry Lopez's name jump to my attention. I am mad for his essays and short stories and so, without hesitation, picked up the hefty book, entitled *Home Ground: Language for an American Landscape,* and added it to my pile on the counter. Lopez is among the most insightful, quotable, compelling, readable, and re-readable nature writers that come to mind. His essays are based on an amazing body of personal experience in parts of the world ranging from the Arctic to the Caribbean, and he has an uncanny knack for vividly describing the edges and interactions between natural and cultural landscapes. He never fails to convey profoundly what he calls "belonging and a sense of intimacy with place" and the indispensable value of preserving long-standing cultural connections to the land as a way of understanding where we come from and where we are headed.

When I arrived home I cracked open the book only to find it was not at all what I had expected. Hoping for Lopez's latest essays or fiction, I was, at first look, disappointed, and wished I had read the dust jacket before spending $30 on impulse. But beginning to read, I realized this would be an extremely enjoyable and informative read and, ultimately, an important reference. Lopez as editor, with Debra Gwartney as managing editor, have assembled in *Home Ground* a compendium of North American landscape terms, their definitions, and derivations that is hard to put down. It can be read cover to cover or grazed upon luxuriantly as I did, flipping pages and randomly scarfing up each entry my eyes fell upon, then going back to the beginning to make sure I hadn't missed a single one.

Forty-five writers from virtually all regions of the US contributed to *Home Ground,* from blue-chip, best-selling all-stars like Barbara Kingsolver, Bill McKibben, and Terry Tempest Williams, to authors I had never heard of, and many of whom I'd like now to read more. All write of their homelands, and the results are loving, informed, sometimes incisive, sometimes intriguingly meandering, often humorous, and unfailingly enlightening accounts of how landscape and language, the human and the natural, affect each other in profound and lasting ways. Bound up in the volume and its more than 400 entries are an American history lesson like

no other, a geography text without maps, a fascinating expose of how we shape the land and how it shapes us and our language, and a page-turner for anyone interested in nature, culture, and words.

Where Barry Lopez's other books make readers think, *Home Ground* answers an awful lot of questions for those of us who wonder where words and terms come from. If you have ever puzzled over the derivation and meaning of words and expressions like acequia, steephead, vly, malpais, manche, tarn, flaw lead, quagmire, chaparral, nickpoint, runnel, and literally hundreds more, put down that etymological dictionary and search no more. I found that as I read, I visualized elements of the landscape I have seen in various parts of the country never knowing their names. Names are an essential part of any introduction; just ask Emily Post or Ann Landers. How can we hope to engage in a relationship with the land and its features without having a vocabulary to describe and understand? Naming is one demonstration of the intimacy with place Lopez writes about, and having this beautifully written reference of words of place is a terrific icebreaker for relating to the land.

In his introduction to the book, Lopez describes the modern alienation from the land for most of us who live in cities, as more than 50% of us do now. "Some of us in the United States can trace our family lines back many generations to, say, the Green Mountains of western Vermont, the urban hills of the San Francisco peninsula, or the sandhills of western Nebraska; to small towns along the Mississippi River or a red-earth farm in Alabama. Many of us come from ranching, farming, or logging families, and might have listened with a measure of envy while a grandparent spoke of these places of origin, using a language so suited to the place being described it fit against it like another kind of air. A language capable of conveying the most evanescent of the place's characteristics," he writes.

Most of us move away from "home" to go to college, work, or other pursuits and lose our direct and original connections to the land of our birth, choosing to negotiate an often steep learning curve, if we choose to negotiate at all, of new landscapes and peoples' connections with them elsewhere. "...almost without our knowing it, the particulars of these [home] landscapes have slipped away from us. Asked, we might still conjure them, but we probably could no longer still name the elements that make them vivid in our memories."

Home Ground conjures and vividly refreshes our cultural and natural memories. Without doubt, readers from anywhere in the US will recognize their own homeland and appreciate others while rebuilding a vocabulary of precise and evocative language that connects us with the earth.

Movement Musings

Storing Carbon in Soil: The Possibilities of a New American Agriculture

Peter Bane

I had the pleasure of hearing Joel Salatin describe his remarkable Shenandoah Valley farm recently when he appeared as a guest speaker at a permaculture design course I helped teached in Nelson Co. Virginia. Polyface Farm is just over the mountain from the Rockfish Valley Community Center near Afton, and in keeping with his commitment to family-friendly farming, Joel came with his wife Teresa and a young intern.

Salatin is the author of numerous books on farming with animals: *Pastured Poultry Profits, Salad Bar Beef, You Can Farm,* and most recently, *Everything I Want to Do is Illegal.* He farms with his son Daniel on 500 acres of what was once a beat-up hill farm and is now perhaps the most famous piece of ground in modern agriculture. As Joel will tell you, Daniel, 25, now does most of the work while Dad is increasingly out making speeches on the sustainable agriculture circuit.

The Salatins own 500 acres, but use only about 100 of those acres for intensive rotational grazing of cattle, hogs, chickens, and turkeys. They are developing some aquaculture in ponds and carving some agricultural savannas out of their woods as they harvest and sell firewood locally, but the heart of the operation, making them a sound living, is the sale, direct to customers, of chicken, beef, rabbit, and pork from the main pastures. They butcher the poultry and rabbits on site and return all the offal to the soil as compost. The beef and pork go to local abbatoirs for slaughter.

The soil test measured 8% organic matter. That's by no means an upper limit of what's possible...

They have developed the art of rotational grazing with animal polycultures to a high level. Basically they mimic the movement of buffalo herds over the prairies, but in a farm context. And innovation continues: each year they seem to find new niches to exploit in the farm ecosystem. The willingness to experiment and to apply rigorous economic and ecological analysis to the farm operation has made Joel famous as an exponent of

profitable and clean small-scale farming. He describes himself with a smile as a Christian libertarian environmentalist, and his stump speech is truly stirring. But what got to me most in his recent talk was a remark he seemed to offer almost in passing, about soil tests.

Joel is a hard-nosed businessman right along with all his other fine and quirky qualities. He measures his economic success by labor hours, dollar costs, and cash returns on sales. As a practical biologist, he measures his ecological success by the health of herds and flocks, the number of species in his sward, and the depth of green in his grass at the end of the summer. Soil tests are not a big item of concern, but at the urging of a colleague he had a test done recently on the farm's main pastures. It measured 8% organic matter. That's by no means an upper limit of what's possible, but it's impressive at a time when most farms in America are showing 2-3% O.M. in their soils. Even more impressive is the comparison to a soil test of the same land done in 1961 when the Salatin family first bought their Shenandoah farm: 1.5%

I did the math.

In 46 years of rotational grazing without the addition of any fertilizers except composted manures from the animals' winter bedding (supplemented with woodchips and other carbon from local sources, but minus the animals that leave the land), Polyface has built up 6.5% additional carbon in their pasture soils while taking a profitable return from the sale of meat. They use essentially no toxic inputs, and need very little machinery. Joel uses a tractor and manure spreader to return the composted manure and bedding from the barn to the fields in the spring. He doesn't till the soil. I can tell you from personal observation that those pastures are green, green, green. I saw them in July 12 years ago when it hadn't rained for weeks. That's a sure sign that the carbon is really there, for it's holding extra moisture.

An acre of soil covers 43,560 square feet. The top six inches, which is where most the plant roots grow and where most of the carbon is stored, weigh about 1900 tons per acre. The annual increment of increase in soil carbon at Polyface is 0.14%, about 2.7 tons per acre. Now bear with me.

Dave Blume says there are 1500 million acres of agricultural land in the United States. Some of that is marginal western land with low or erratic rainfall. I think a more reasonable estimate of land with 30 or more inches of rainfall per year (the average in the Shenandoah Valley is 32" per year) is a 800 million acres. That's about 2/3 of the area east of the Dakotas, roughly from Omaha and Topeka east to the Atlantic and south to the Gulf of Mexico. It's mostly growing corn and soybeans now, and they are mostly going to animal feed or industrial uses: paint and ink, ethanol, fizzy drinks, and junk food, none of which is good either for people or livestock. If that land were farmed as the Salatins farm Polyface in Virginia, it could sequester 2.2 billion tons (2 billion metric tonnes) of carbon per year. That's equal to present gross US atmospheric releases, not counting the net reduction from the carbon sinks of existing forests and soils. With carbon sequestration trading at $10-$50 a ton on the commodities exchanges, that represents a potential yield of $20-$100 billion a year for American agriculture. Who needs subsidies from Washington?

If that land (present US farmland east of the Dakotas) were farmed as the Salatins farm Polyface in Virginia, it could sequester 2.2 billion tons (2 billion metric tonnes) of carbon per year.

Organic matter is built up by the action of soil organisms, all of which are harmed by chemical inputs and tillage. Soil losses were horrific in the first half of the last century, with the Dust Bowl emblematic of the failure of agriculture.. Soil degradation has accelerated since WWII because of increased traction and chemical inputs. Soil conserving practices may have slowed carbon losses on some lands. Perhaps organic farmers are building up soil carbon, but I would argue that most of the acreage farmed in the US is losing soil carbon, that it is not a net sink today. That doesn't even count the combustion of fossil fuels and release of chemicals. Forests are almost certainly still a net sink, sequestering atmospheric CO2, but we need not convert any forest land to farming to address the problems of climate change.

My back-of-the-envelope calculations suggest that without expanding farm acreage or removing any existing forests, and even before undertaking changes in consumer lifestyle, reduction in traffic, and increases in industrial and transport fuel efficiencies, which are absolutely imperative, the US could become a net carbon sink by changing cultivation practices and marketing on a million farms. In fact, we could create 5 million new jobs in farming if the land were used as efficiently as the Salatins use theirs. We have no business lecturing to India and Brazil about trade liberalization.

Let me summarize. The most prominent example of sustainable agriculture in the United States today, though by no means the only one, is Polyface Farm. It has been under continuous family management in rotational grazing for 46 years. The operation started with degraded, rolling land. It's located in a mid-latitude region of average temperature and rainfall. It's a proven example of economic and ecological success. It's creating no toxic legacy, it's not in debt, it earns two families a good living on the use of about 100 acres and pays some hired help, and it's pointing the way to solving the biggest crisis humanity has ever faced, just by doing its ordinary business. The proprietors espouse and exemplify values that are arguably embraced or genially accepted by the vast majority of the American people.

Why are we not doing this NOW? Is it time for land reform? Cleaning house at USDA? A march on Congress? PERMAnent agriCULTURE. Get it! Δ

EVENTS

Permaculture Teacher Training
San Juan Islands, WA

Dates: August 12-18
Location: Orcas Island, WA
Description: We will explore 1. How people learn and how can we create experiences that people get the most from; 2. How effective planning and logistics lead to improved course outcomes; 3. Improving our own understanding of permaculture concepts and hands-on skills. There will be ample time for networking and sharing specifics about your intended course particulars.
Prerequisite: Permaculture Design Course Certificate or equivalent experience.
Instructors: Michael Becker, Dave Boehnlein, Douglas & Samuel Bullock.
Cost: $700., $250 deposit req.
Contact: Dave Boehnlein
360-840-8483
permaculture.dave@gmail.com
www.permacultureportal.com

Conference: International Design for a Loving Future
Northwest US

Dates: September 20-23
Location: Olympia, WA
Description: The Conference will be organized around three themes: Permaculture and Peak Oil, Healthcare Design, and Social Justice/Multicultural Activism.
Cost: $575 includes meals, housing, and materials.
Contact: www.designforthefuture.org
360-250-2258

Permaculture Design Course
Northern California

Dates: September 15-28
Location: OAEC, Occidental, CA
Description: Students will enjoy our 80 acre site with its 30-year history as a cutting edge learning institution. Topics to be covered include permaculture theory, food diversity, soil enrichment, water use, erosion control, natural building, organic gardening, forest farming, and more.
Instructors: Brock Dolman.
Cost: $1,350 includes lodging & meals. $1250 if registered ahead two weeks.
Contact: Occidental Arts and Ecology Center
15290 Coleman Valley Rd.
Occidental, CA 95465
707-874-1557 x.201
oaec@oaec.org

2007 Earth Activist Trainings

Advanced EAT Intensive
October 6-13
Sonoma County, CA

Urban EAT Weekend Series
November 16-18 and 7 other weekends
San Francisco, CA

Description: EAT combines a full permaculture certificate course with earth-based spirituality and practical political know-how. Learn Magic 101, Nature Awareness, Solutions (urban gardens, organic farming, natural building, bioremediation, greywater systems, ecoforestry, soil-building, watershed restoration), Consensus Process, Planning for Big Changes, Creating Ritual, Movement Building, Renewal of Hope, Breaking the Spell (of fear, rage, grief, frustration).
Instructors: Starhawk, Erik Ohlsen, Penny-Livingston-Stark, Ethan Castro, Charles Williams, Patricia Allison, and more.
Cost: $1100-$1600 sliding scale, work-trade and loans available.
Contact: www.earthactivisttraining.org

Permaculture Teacher Training
Central California

Dates: November 11-16
Location: Esalen Institute, Big Sur, CA
Description: This permaculture teacher's course builds upon a revolutionary new way of teaching the concepts of ecological design; by applying the principles of Permaculture to the teaching of Permaculture. We will cover every aspect of being an exciting and effective educator and promoter of a more sustainable, just future. These techniques can be applied to any teacher in any field. In this TTC one will learn: diverse teaching methods that work; techniques to help you prepare quickly and organize thoroughly; confidence building through practice and supportive critique. Elements for whole person learning and learning styles. Topics inlude: teaching permaculture techniques, strategies, materials, course planning, marketing, and evaluation. A working knowledge of permaculture design is a prerequisite for attending this course.
Instructors: Kat Steele and Benjamin Fahrer.
Cost: $585-$1120 (sleeping bag space to standard accommodation).
Contact: Kat Steele
510-547-7889
info@urbanpermacultureguild.org
www.urbanpermacultureguild.org
www.esalen.org

Permaculture Design Course
Northern California

Dates: August 2007-July 2008
One Saturday per month
Location: Bolinas, CA
Description: Re-design your life, Re-envision the world! This course is a great opportunity to take a Permaculture Design Course over a full year of nature's rhythms. You will learn how to observe and use the same principles that make ecological systems self-sustaining, and apply them to integrated homes and gardens. In addition, you will learn how to apply these principles to energy systems and water supplies, healthy communities, meaningful and fulfilling work, ecological economies, and global political movements for change. The course also weaves together the principles and practices of permaculture with wilderness awareness. Learn bird language, tracking, and participate in activities that deepen your awareness and intimacy with the rest of the natural world. The program will be founded upon the reality that we are nature and have an amazing role in our watershed ecosystems.
Instructors: Penny Livingston-Stark
Contact: Regenerative Design Institute
PO Box 923
Bolinas, CA 94924
415-868 9681
info@regenerativedesign.org
www.regenerativedesign.org

Regenerative Design and Nature Awareness Program
Northern California

Dates: Autumn, 2007
Location: Bolinas, CA
Description: This unique intensive 9-month program offers a curriculum like no other, weaving together Permaculture and Regenerative Design, Nature Awareness, Leadership, Peacemaking, and Mentoring Skills. The foundation of this program is rooted in a new and unique form of education where participants experience the fullness of creativity, curiosity, and genius. Participants will develop an intrinsic power and passion for designing through the integration of personal experience, practical skills and theory, supporting them in the development of a lifestyle that regenerates the earth while providing for their needs.
Contact: Regenerative Design Institute
415-868 9681
info@regenerativedesign.org
www.regenerativedesign.org

Permaculture Design Course
Northern California

Dates: August 4-17
Location: Heartwood Institute, Garberville, CA
Description: Permaculture refers to land use systems which promote stability in society, use resources in a sustainable way, preserve wildlife habitat, and promote the genetic diversity of plants and animals. The primary ethics are care for the earth and care for people through energy efficient and health inducing methods of cultivation and building. Course topics include organic agriculture, ecosystem restoration/reforestation, erosion control and water storage, edible landscaping/medicinal herbs, and appropriate technology. Through lecture, slides, discussion, observation, field study, and hands-on activities, students will learn to design and implement systems that are harmonious with the natural world.
Instructors: Tom Ward, Nadine Chapdelaine, and staff.
Cost: $500 plus accommodations.
Contact: 877-936-9663
www.heartwoodinstitute.com/content/advanced/perm2.html

Permaculture Design Course
Central Colorado

Dates: August 6-18
Location: Denver, CO
Description: Learn high-altitude and urban Permaculture. This design certificate course will be held on the grounds of an urban farm and CSA site within metro Denver. Topics: principles and ethics of Permaculture, design techniques, natural building, urban farming, Community Supported Agriculture, organic gardening, healing ourselves and healing the land. Students will participate in planning and designing onsite. Personal design projects are welcome, with advance notification.
Instructors: Andrew Goodheart Brown, Becky Elder, Travis Beck, and guests
Cost: $1177 includes camping, organic meals, and course materials. $200 discount for registration by May 15.
Contact: Pikes Peak Permaculture
PO Box 60098
Co. Springs, CO 80906
gary@pikespeakpermaculture.org
www.pikespeakpermaculture.org

Next Issue: #66
Animals in Pc Design
Deadline: September 1st.
editor@permacultureactivist.net

21st Annual
Permaculture Design Course
Colorado Rocky Mountains

Dates: September 17-29
Location: Basalt, CO
Description: At 7200' elevation in the Roaring Fork Valley, CRMPI's 26-year old site features maturing forest gardens, commercial greenhouses, small livestock, and a useful plants nursery. Excellent organic food, a superb site, and a nationally prominent teaching team make this a unique experience. Learn practical permaculture from Colorado's most experienced designers.
Instructors: Peter Bane, Jerome Osentowski, Becky Elder, and others.
Cost: $1100 includes meals and camping.
Contact: Central Rocky Mountain Permaculture Institute
POB 631, Basalt, CO 81621
970-927-4158
www.crmpi.org
jerome@crmpi.org

Certificate Program in Earth-based Vocations
Southwest US

Dates: August 2-October 12
Location: Santa Fe, NM
Description: The 10-week certificate program builds on a permaculture base and includes Natural Building, Sustainable Land & Garden, Alternative Energies and Land Arts, and Community Activism. Classroom and field work with real-life projects and installations. Graduates learn skills for living on the land, and working with earth-based enterprises. Recommended for people seeking alternative vocational skills and practical experience to pioneer a meaningful livelihood.
Contact: EcoVersity (see above)
505-424-9797 x-10

Permaculture Design Course
Middle Tennessee

Dates: September 2-19
Location: Summertown, TN
Description: Sponsored by Gaia University as part of their BSc and MSc programs, this course provides the Permaculture Design Certificate.
Instructors: Andy Langford, Liora Adler, Albert Bates, and special guests.
Cost: $1500 incl. meals & lodging.
Contact: Ecovillage Training Center
PO Box 90
Summertown TN 38483
931-964-4474, fx/-2200
ecovillage@thefarm.org
www.thefarm.org

Permaculture Teacher Training
Middle Tennessee

Dates: August 12-17
Location: Summertown, TN
Description: Develop your skills and gifts as a teacher of permaculture in a variety of settings. Permaculturists with a design certificate and two years of practice will gain invaluable experience learning to develop programs, workshops, and courses. Course topics include presentation skills, developing lesson plans and curricula, techniques for adapting permaculture education to different communities, audiences, ages, and needs; teaching in other cultures, marketing and promotion, and more.
Instructors: Albert Bates & Scott Horton.
Cost: $600
Contact: Ecovillage Training Center
The Farm www.thefarm.org
ecovillage@thefarm.org

Fundamentals of Permaculture
Middle Tennessee

Dates: August 31-September 9
Location: Summertown, TN
Description: The aim of this workshop is to liberate people to provide for their own and their communities' needs from the smallest practical area of land. Learn straw, cob, bamboo, and other natural materials. Perennial gardening, shelter, water and waste management, aquaculture, forestry, and how to organize supportive local economies.
Instructors: Albert Bates, Scott Horton, A. Goodheart Brown, Valerie Seitz, Matthew & Jennifer English, and Cliff Davis.
Cost: $1200 includes meals, lodging and course materials.
Contact: Ecovillage Training Center
The Farm, www.thefarm.org
ecovillage@thefarm.org

Permaculture Design Practicum
Middle Tennessee

Dates: September 9-18
Location: Summertown, TN
Description: The second half of the Permaculture Design Course. Site selection, master planning and pattern design for ecovillages, including consensus and conflict resolution, financial aspects, work issues, and best practices. This and the Fundmentals completes the Permaculture Design Certificate.
Instructors: Albert Bates, Scott Horton, A. Goodheart Brown, Valerie Seitz, Matthew English, Jennifer English, and Cliff Davis.
Cost: $750 includes meals, lodging, and course materials.
Contact: Ecovillage Training Center
The Farm, www.thefarm.org
ecovillage@thefarm.org

Ecovillage Apprenticeships
Middle Tennessee

Dates: October 1-November 5
Location: Summertown, TN
Description: Learn organic food production, natural building, and permaculture. Field trips to nearby Amish community, local bamboo nursery, and more.
Contact: Ecovillage Training Center
The Farm, POB 90,
Summertown TN 38483-0090
931-964-4474, fx/-2200
ecovillage@thefarm.org
www.thefarm.org

Permaculture Design Course
Southeast US

Dates: July 28-29, August 4-5, 11-12, 18-19, 25-26
Location: The Southern Cultural Heritage Centre, Vicksburg, MS
Description: Our permaculture program is both theoretical and practical and is taught using a wide variety of learning tools. Through site visits, hands-on activities, and a high level of group interchange, a wide and deep understanding of the principles and techniques of sustainable living can be gleaned. Midweek activities are less formal. Students may camp on our demonstration site during weekends.
Instructors: Akia and Dr. Rebecca Chabot and guests.
Cost: $600 ($450 if you register with a friend).
Contact: Akia or Rebecca
601-636 4302
akia@gfootprints.com
www.gfootprints.com

14th Annual
Permaculture Gathering
Western North Carolina

Dates: August 3-5
Location: Celo, NC
Description: The Permaculture Gathering is an annual reunion of friends and family, and the welcoming of new friends. A time of retreat and rejuvenation, fun, joy, magic, and learning. Includes a ceremonial village, self-organizing "open space" agenda, permaculture and sustainable culture, fantastic organic food, plant walks, drum circles, cool temperatures, mountain swims, seed and plant exchange, healing tent, Saturday night fun, and more!
Contact: Sam Ruark, 828-675-0863
www.sepermaculture.org
ruark4peace@hotmail.com

Permaculture Design Practicum
Ohio Valley

Dates: August 24-September 1
Location: Loveland, OH
Description: Second half of the certificate course also open to PDC graduates and design professionals. Community-supported organic agriculture, wetland wastewater treatment, youth education, empowered women, progressive and earth spirituality, and an emerging ecovillage distinguish this site on 300 acres near metropolitan Cincinnati. Our design work will help prepare the community to realize the vision of Heartland Ecovillage. Accommodations at the Grailville conference center make this an exceptional opportunity.
Instructors: Peter Bane, Keith Johnson Andrew Goodheart Brown, Rhonda Baird.
Cost: $695 includes tuition, meals, lodging, and materials.
Contact: Peter Bane
Association for Regenerative Culture
812-335-0383
pcactivist@mindspring.com
www.permacultureactivist.net

Permaculture Design Course
New York City

Dates: July 21; Aug. 18; Sept. 8, 15, 29; Oct. 13, 20, 27; Nov. 3.
Location: Manhattan, NY
Description: A compact, intense introduction to basic permaculture principles plus application of the traditional curriculum to urban living. The format of nine, 10-hour days promises to test our limits—this is NYC! Practical field work at near-by sites will be included and additional field opportunities are ongoing. Pattern understanding, observation, claiming public space, community development, economic equations, health and more. We will draw on NYC's unique resources. Many visitors and teachers from our diverse community will participate.
Instructors: Claudia Joseph
Cost: $1,125
Contact: Maria Rodriguez
Open Center
212-219-2527 x.-135
www.opencenter.org

Permaculture Design Course
Western Pennsylvania

Dates: August 6-19
Location: Sandy Lake, PA
Description: Three Sisters Farm is a 20-yr. old bioshelter/market garden farm. Students will plan and design teaching gardens and natural building projects. The course uses hands-on methods and team learning. Our site includes a 10-acre woodland homestead. We will visit local sustainability sites including the Jenkins homestead and Slippery Rock Univ.
Instructors: Darrell Frey
Cost: $1000 includes tuition, meals, camping, & materials.
Contact: Darrell Frey
Three Sisters Farm
134 Obitz Rd
Sandy Lake, PA 16145
724-376-2797
defrey@windstream.net

Permaculture Design Course
Upstate New York

Dates: August 4-19
Location: Ithaca, NY
Description: A comprehensive two-week intensive course covering all elements of the curriculum as well as urban design, David Holmgren's synergy of principles, and education. Upon successful completion of modules and a design practicum students will receive a certificate. We will use the backdrop of the Finger Lakes bioregion to consider specific local issues of energy use, water catchment, season extension, and food preservation.
Instructors: Stephen Gabriel, Karryn Olson-Ramanujan, and guests.
Contact: Finger Lakes Permaculture Institute
607-273-6260
www.fingerlakespermaculture.org

Biodynamic Training
Upstate New York

Dates: 9 weekends
September 2007-June 2008
Location: Chestnut Ridge, NY
Description: An introduction to biodynamics, a scientific and spiritual approach to farming and gardening.
Instructors: Mac Mead, Hugh Williams, Steffen Schneider, Gunther Hauk and others.
Contact: The Pfeiffer Center
Chestnut Ridge, NY 10977
845-352-5020 x20,
info@pfeiffercenter.org,
www.pfeiffercenter.org.

Ecovillage Design Course and Practicum
Australia

Dates: September 3-14
Location: Crystal Waters Ecovillage, Queensland, Australia
Description: This course offers training and key insights into the design of successful village-scale communities. International Designers' Conference follows. The Design Course is eligible for credit towards a Masters in Sustainable Development at Stellenbosch University, South Africa.
Instructors: Max Lindegger
Contact: EcoLogical Solutions
59 Crystal Waters,
65 Kilcoy Lane,
Conondale Qld 4552,
Australia
+61 (0)7 5494 4741
fax: +61 (0)7 5494 4578
info@ecologicalsolutions.com.au
www.ecologicalsolutions.com.au

International Ecovillage Designers' Conference
Australia

Dates: September 15-17
Location: Crystal Waters Ecovillage, Queensland, Australia
Contact: EcoLogical Solutions
info@ecologicalsolutions.com.au
www.ecologicalsolutions.com.au

Ecovillage Design Course and Practicum
Australia

Dates: March 15-July 15, 2008
Location: Crystal Waters Ecovillage, Queensland, Australia
Instructors: Max Lindegger and guests.
Cost: AUD $7000 includes food, accommodation, tuition, tours, extensive course notes.
Contact: EcoLogical Solutions
info@ecologicalsolutions.com.au
www.ecologicalsolutions.com.au

12th Annual
Permaculture Design Course
On-line

Dates: begins October 14
Location: On-line
Description: Our 12th annual, six-month course includes reports, weekly reading assignments, and participation in questions and discussion via email. The heart of the course is The Permaculture Design Course CD-ROM, which includes more than 300 files including several "posts" of course notes and readings for each of the 21 course modules, numerous papers and pamphlets, at least one sample of a full permaculture design, sample standard designs, databases, and other resource materials including a full-length book. The course CD, now in enlarged and improved Version 3, is also available in a self-study edition and an economy edition that includes only the weekly posts and course tools, but not any of the additional reading materials. Purchasers of the full self-study edition may monitor the course at no tuition charge.
Instructors: Dan Hemenway, Cynthia Hemenway, and Willem Smuts.
Cost: $1200
Contact: Barking Frogs Permaculture Center
barkingfrogspc.tripod.com/frames.html
BarkingFrogsPC@aol.com

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1.MSc and Graduate Diplomas in *Integrative Ecosocial Design*: Orientation and Core Curriculum: **Sept 18-Oct 2.**

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3. MSc and Graduate Diplomas in *"Open Topic"* (You design and name your project and program in any area of sustainability/ regeneration). Orientation: **Sept 18-25.**

Integrative Ecosocial Design includes specializations in Permaculture, Ecovillage Design, Life Transitions, Social Communication, Appropriate Technology, and other self-selected areas of sustainable/regenerative design. Credit for PDC and EDE certificates and diplomas as well as for prior experience.

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www.gaiauniversity.org
info@gaiauniversity.org

LETTERBOX

Fast Delivery

Permaculture Activist,

I would like to thank you very much for putting out such a knowledge-rich publication along with some of the fastest service out there. I ordered a 3-year subscription just this week and only a few days later received my first copy of *The Activist* (I figured it would be a few months till summer's issue came out!) Having read several articles already I am quite thrilled with the magazine.

Looking forward to future isses,

Jamieson Moran
New Park, PA

Enjoyed the Issue and the Calendar

Hello Activist team,
I just wanted to drop you a line that I really enjoyed the last issue (#64) and my PA subscription in general. True some images are blurry, fonts bit mapped, and some pictures need captions. But, overall the content is useful and informative. I also enjoy the calendar in back that lets you see what's happening around the country as well as the book reviews and more.
Anyway, thanks for all your work,

Chuck Burr
Telluride, CO

Ultimate Soil?

Dear Pc Activist,

I just read your review of *Teaming with Microbes,* in which you said that it is "not the ultimate soil book," leading me to ask "What is?" I found *Teaming...* very useful and would like to continue learning. Thanks for your suggestions.

E. E. "Mitch" Mitchamore
from The Web

Send Event and Calendar Listings to:
pcaeditor@earthlink.net

Back Issues of *The Permaculture Activist*

I, 1 July '85 Permaculture In Oz
I, 2 Nov. '85 Fruit & Nut Trees
II, 1 Feb. '86 Garden Design
II, 2 May '86 IPC-2 & Pc Courses
II, 3 Aug. '86 2nd Int'l PC Conf.
II, 4 Nov. '86 Fukuoka, Keyline, Genetic Cons'vn, City Farms, Oceanic PC
III, 1 Feb. '87 Networking, Natural Farming, D-Q Univ., Children's PC
III, 2 May '87 PC Restoration of Wild Lands, Design for Sacramento Farm
III, 3 Aug. '87 **Annual Planting Cycle**
III, 4 Nov. '87 **Trees for Life**
IV, 1 Feb. '88 **Marketing PC Products,** Bamboo, Home Wastewater Treatment
IV, 2 May '88 **Urban-Rural Links:** Economics & Community Development
IV, 3 Aug. '88 **Social Forestry,** Gabions, Jap. Org. Ag., Prodc/Cons. Coops
IV, 4 Nov. '88 Multi-Story Tree Crops, Greening Domin. Repb, Runoff Gardens
V, 1 Feb. '89 Permaculture:A Designer's Manual, Tree Bank, Water in PC
V, 2 May '89 **Plant Guilds,** Roof Gardens, Small Livestock
V, 3 Aug. '89 Rainforest Conservation in Ecuador, Gaia, Weed Gardens
V, 4 Nov. '89 PC Def's, Water Conservation, Small Dams, Ponds, Keyline
VI, 1 Feb. '90 **Household Greywater** Systems, Soil Imprinting
VI, 2 May. '90 Insectary Plants, more Greywater, Land Use for People
VI,3 Aug. '90 **Water:** Forests &Atmosphere, Catchment, Nepal, Pond Design
VI,4 Nov. '90 **Urban Permaculture:** Ecocity Conf., Soil Detox, Suburbs & Pc.
#23 May '91 **Politics of Diversity:** Greenhouse Market Gdn; PC in Nepal.
#24 Oct. '91 **Creativity in Design:** Examples; **Index Issues #1-23**;
#25 Dec. '91 **Design for Community:** CSAs, Restoring Forest; Garden Ecol.
#26* May '92 **Soil:** Our Past, Our Future: Fertility, Worms, Cover Crops
#27* Aug '92 **Integrating Pc:** Deconstructing Utopia, Grassroots Organizing, Garden Polyculture, Pattern Learning, Living Fences
#28* Feb. '93 **Structures:** Comn'ty Dsgn, LETS, Industry, Strawbale/Timber-frame Bldgs.
#29/30* July '93 **Networks:** Special Media Rvw, Rural Reconstr'n, Leaf Conc., Comn'ty Food Initiatives, Pc in Palestine, Do-Nothing Educ., *Feng Shui*, Pc Acad.
#31* May '94 **Forest Gdng:** Energy & Pc, Mushrm Cultvn, Robt.Hart's F.G., Spp for N. Cal., Alders, Agroforestry in Belize & China, Honeylocust, N-fixers.
#32 April '95 **Animals & Aquaculture:** Animal Polyculture, Small-scale Cattle, Goat Dairy, Keyline, Feral Chickens, Bee Plants, Constructed Wetlands
#33 Dec. '95 **Cities & Their Regions:** Green Cities, LA Eco-Village, MAGIC Gardens, CoHousing, Micro-Enterprise Lending, Suburban Conversion.
#34 June '96 **Useful Plants:** Bamboo Polyculture, Medicinals, Pest Control, Root Crops, Oaks, R. Hart's For. Gdn, Russian Plants, Regl. Plants, Sources
#35 Nov. '96 **Village Design:** Pattern Language, Consensus Democracy, Conflict, Historic & New Villages, Planning for Tribe, Vill. Economics
#36 Mar. '97 **Climate & Microclimate:** Climate Change,Windbreaks, Low-Tech Sun Locator, Drylands, Cool Slopes, Straw-Clay Bldg, Round Beehive, Water Catch.
#37 Sept. '97 **Tools & Appropriate Technology:** Dowsing, Workbikes, New Energy, Scythes, Japanese Saws, Nursery, Ferrocement, Greywater, A-frame & Bunyip Levels, Ram Pump, Solar Toilet, Log Yoke, Cookstoves…
#38* Feb. '98 **Economic Transformation:** Speculative Economy, No Middle Class Worker-Owned Coops, WWOOF, No Money!, Global Warming, What Profits?, Holistic Financial Planning, Land Use, Adopt-A-Hive
#39 July '98 **Knowledge, Pattern & Design:** Pc: A Way of Seeing, Sand Dunes, Native Conservation., Language Worldview & Gender, Patterning as Process, Land-Use Planning, Teaching Pc, Vietnam, Holmgren on Pc
#40 Dec. '98 **New Forestry:** Regl. Devlpmt., Horselogging, Menominee Reserv'n, Forest Investing, Restoration, Old Growth, Homestead Tenure, Forest Soils, Forest Farming, Woody Agric., Rainforests, Windbreaks, Coppice
#41* May. '99 **Natural Building:** Oregon Cob, Cordwood, Bamboo, Thatch, Ethics, High Winds, Origins of Conflict, Greenhouses, Ponds, Adobe, Road-Building, MicroHydro, Bldgs. That Live, Under $20K Houses, Dreams
#42 Dec. '99 **Self-Reliance & Community Cooperation:** Co-Intelligence & Self-Orgn., Archetype Design, Sovereignty, Samoa, Mondragon, Natural Housing, Comm. Gdns., Zone Zero, Solar Electric Tractor, Beekeeping
#43 June '00 **Food & Fiber:** Hunger, Ferments, Seasons Salads, Heirlooms, Fencing, Self-Fertile Gdns, Rice Revolution, Cold-climate Food, Edible Insects, Chilies, Food Origins, Garlic, Ethnobotany, Wild Food, Bamboo, Hemp
#44 Nov. '00 **Earthworks & Energy:** Spreader Drain, Horse Swales, Earth Dams, Machinery, Carpet-lined Ponds, Constr. Wetlands, Biogas, Windmills…
#45 Mar. '01 **Medicine & Health:** World & Self, Healthy Home, Designing Care, Ayurveda, Agents of Decay, Comm. Health Centres, Women Trad. Med 4th World Apothecary, Healing Weeds, Medicinal Crops, Hawaiian Bot'ls.
#46 July '01 **Good Work & Right Livelihood:** Pc Golf Course, Downsize Cost of Living, New Forest Economy, Energy Currency, Buddhist Mkting., End Wage Slavery, What's Surplus?, Urban Community, Enterprise Facil'n.
#47 June '02 **Watersheds:** Water as Commodity, Basins of Relations, Beavers Watershed Development, Skywater Center, Urban Stormwater Gabions, Conservation Investments, Peat Bogs, Rabbits.
#48 Sept. '02 **Making Changes:** Co-Intelligent Activism, Webs of Power, Urban Food, How to Change, Teaching for Change, Global Transformation, City Repair, Escaping the Job Trap, Argentine Recovery, Costa Rica Pc
#49 Dec. '02 **Where is Permaculture?** Land-Rent Reform; 10 N. American sites plus Cuban Agric.; Beauty+Sustainability in NZ; Cacti/Succulent Plants; Animal Self-Medication; Challenge to Pc Movement
#50 May '03 **Ecosystems:** Holmgren on Pc Mvmt; E. Hazelip & Synrg. Agric. Chestnuts/Pigeons; Oak Savannas; Root Crop Polycultrs.; Alders Fungal Ecosys.; Humans & Wildn; Indoor Ecos.; Humid Tropics.
#51 Jan '04 **Traditional Knowledge & Regeneration:** Bates on Cataclysm& Collective Memory; Shepard's Wisdom of the Genome; Waru Waru; Biosculpture; Inuit Medicine; Fermented Stimulants.
#52 May '04 **Aquaculture:** Ecological Aquaculture; Fish for Health; Dowsing; Designing Ponds; Greywater Biotreatment; N. Amer. Polyculture; Managing for Native Species; Integrated Village Fisheries; Vietnam.
#53 Aug. '04 **Education:** Life-long Learning; Edge-ucation; The Albany Free School; Indigenous Education & Ecology; Ecocentric Pedagogy; School Gdn and Dances; Ecology of Learning; Brain Gym.
#54 Nov. '04 **Fire & Catastrophe:** Designing Beyond Disaster; Opportunity; Rise of Globalization; Invasion Biology; Street Orchards as Security; Community Food Security; Water Rising; Disrupted Climates.
#55 Feb. '05 **Learning from Our Mistakes:** Petroleum Dependence;Village Design; Aust. Hard-Won Lessons; Read the @!#*!@ Manual; Trial&Error; Experiments in Forestry; Owner-Builder; Ten Mistaken Ideas in Pc.
#56 May '05 **Tree Crops, Tree Guilds:** History of Pine Nuts; Tree Vegetables; Acorns; Restoring American Chestnut; Honeylocust as Silvopasture; Broadscale Agroforestry; Bamboo; Wondrous Willow; Social Forestry.
#57 Aug. '05 **20th Anniversary Issue:** Challenges; Remembrance; Pc in USA; Hawaii Retrospective; Pc Changes; Permatecture; Pc's Soft Edge; PINC; Gaia University; Oil Depletion; IPC-7; Retrofitting Suburbs.
#58 Nov. '05 **Urban Permaculture:** Urban/Rural Futures; City Zones & Sectors; Growing Food; Detroit Visionaries; Rebuilding New Orleans & Everytown; Transformation of a Military Base; Workers Co-op; Energy Descent.
#59 Feb. '06 **Peak Oil:** Peak Oil & Pc; Ecological Collapse & Trauma Theory; Thom Hartmann; Pathways for Energy Descent; How Cuba Survived; Oil & Food; Biofuels; Cultivating Algae for Fuel; Relocalize.
#60 May '06 **Land Use Past & Present:** Sust. Ag an Oxymoron?; Negev's Bedouin; Eastern Woodlands Agroforestry; Pc Heals in India; Arcosanti Land Planning; Pop. Growth/Land Hunger; Mexican Reforest; Rocky Mtns.
#61 Aug.'06 **Unseen Kin-doms:** Observation as Design Tool; Soil Food Web; Bees; Mycelial Internet; D-I-Y Mycorrhizal Inoculum; Cover Crops as Bee Forage; Earth Energies; Local Currencies; Dead Zones; Birds at Risk.
#62 Nov.'06 **The Art of Permaculture:** Painting,Writing & Pc; Ecoartists; Art, Activism & Cmty; Street Theatre; Art & Bioremediation; LivingWillow; Body as Zone 0; Art of the Found;Water Magic; Pc in Pop Culture.
#63 Feb.'07 **Building & Technology:** How to Dwell?; Natural Bldg & Legal; Meeting Code; Strawbale in China; Mr. Cob in Armenia; Integrated Solar Heating, Cooking, Pumping; Self-Build; Nation-Scale Pc in Brazil.
#64 May '07 **Waste = Food:** Throwaway Economy; Strategy of Salvage; Peak Soil; Pigs & Intgrtd. Waste Mgmt.; Bicycles, Soil, & Garbage; Farm as Organism; Opportunistic Plant ?; Simple Biodigester; Waters of Spain; Vermiculture.

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CALENDAR

July 21, August 18, September 8, 15, 29, October 13, 20, 27, November 3. New York, NY. Permaculture Design Course. Maria Rodriguez. Open Center. 212-219-2527 x-135. www.opencenter.org.

July 28 & 29, August 4-5, 11-12, 18-19, 25-26. Vicksburg, MS. Permaculture Design Course. Akia or Rebecca, 601-636 4302, akia@gfootprints.com, www.gfootprints.com.

August 2-October 12. Santa Fe, NM. Certificate Program in Earth-based Vocations. EcoVersity. 505-424-9797. www.ecoversity.org, info@ecoversity.org.

August 3-5. Celo, NC. *14th Annual* Permaculture Gathering. 828-675-0863. www.sepermaculture.org, ruark4peace@hotmail.com.

August 3-August 17. Santa Fe, NM. Permaculture Design Course. EcoVersity. 505-424-9797. www.ecoversity.org, info@ecoversity.org.

August 4-12. Coquille OR. Complete Cob Construction. Cob Cottage. 541-396-1825. www.cobcottage.com.

August 4-17. Garberville, CA. Permaculture Design Course. 877-936-9663. www.heartwoodinstitute.com/content/advanced/perm2.html.

August 4-19 Ithaca, NY. Permaculture Design Course. 607-273-6260. www.fingerlakespermaculture.org.

August 6-18. Denver, CO. Permaculture Design Course. Pikes Peak Permaculture. gary@pikespeakpermaculture.org, www.pikespeakpermaculture.org.

August 6-19 Sandy Lake, PA. Permaculture Design Course. Three Sisters Farm. 724-376-2797. defrey@bioshelter.com, www.bioshelter.com.

August 10-12. Summertown, TN. Biofuel Conversion and Production. Ecovillage Training Center. www.thefarm.org.

August 12-18. Orcas Island, WA. Permaculture Teacher Training. Dave Boehnlein, 360-840-8483. permaculture.dave@gmail.com, www.permaculturepotal.com.

August 18-20. Pacific Northwest, US. Northwest Herbal Faire. www.nwherbalfaire.com.

August 24-September 1. Loveland, OH. Permaculture Design Practicum. Peter Bane, Assn. for Regenerative Culture, 812-335-0383, pcactivist@mindspring.com, www.ARCulture.org.

August 31-September 9. Summertown, TN. Permaculture Fundamentals. Ecovillage Training Center. www.thefarm.org, ecovillage@thefarm.org.

August 2007-July 2008 (One Saturday per month). Bolinas, CA. Permaculture Design Course. RDI and PINC. 415-868 9681. www.regenerativedesign.org.

August/September. Bolinas, CA. Regenerative Design and Nature Awareness Program. RDI. 415-868 9681. info@regenerativedesign.org, www.regenerativedesign.org.

September 1-16. IRELAND. Cob Construction, Plasters, Lime, Treadmill. Cob Cottage. 541-396-1825. www.cobcottage.com.

September 2-19. Summertown, TN. Permaculture Design Course. Ecovillage Training Center. The Farm, 931-964-4474, fx/-2200. ecovillage@thefarm.org, www.thefarm.org.

September 3-14. AUSTRALIA. Ecovillage Design Course and Practicum. EcoLogical Solutions, 59 Crystal Waters, 65 Kilcoy Lane, Conondale Qld 4552, Australia. +61 07 5494 4741, fx/-4578. info@ecologicalsolutions.com.au, www.ecologicalsolutions.com.au.

September 4-14. Summertown, TN. Alternative Energy. Ecovillage Training Center. www.thefarm.org, ecovillage@thefarm.org.

September 4-7. Summertown, TN. Solar Installation. Ecovillage Training Center. www.thefarm.org, ecovillage@thefarm.org.

September 9-18. Summertown, TN. Design Practicum. Ecovillage Training Center. www.thefarm.org, ecovillage@thefarm.org.

September 15-16. Albany, NY. R.U.S.T. Radical Urban Sustainability Training. The Rhizome Collective. 300 Allen Street, Austin TX 78702. 512-385-3695. rhizomecollective.org, skotty@rhizomecollective.org.

September 15-17. AUSTRALIA. International Ecovillage Designers' Conference. EcoLogical Solutions, info@ecologicalsolutions.com.au, www.ecologicalsolutions.com.au.

September 15-29. Hot Springs, MT. Permaculture Design Course with Michael Pilarski. Alameda's Hot Springs Retreat, 406-741-2283. alamedas@hotspringsmt.net, www.alamedashotsprings.com.

September 15-28. Occidental, CA. Permaculture Design Course. Occidental Arts and Ecology Center, 15290 Coleman Valley Rd. Occidental, CA 95465. 707-874-1557 x.201. oaec@oaec.org.

September 17-29. Basalt, CO. Permaculture Design Course. Central Rocky Mountain Permaculture Institute. POB 631, Basalt, CO 81621. 970-927-4158. www.crmpi.org, jerome@crmpi.org.

September 18-October 2. US. MSc and Graduate Diplomas Orientation and Core Curriculum. Gaia University. www.gaiauniversity.org, info@gaiauniversity.org.

September 20-23 Olympia, Washington. International Design for a Loving Future Conference. www.designforthefuture.org.

September 22-23. Summertown, TN. Fall Equinox Green Gathering. Earth Advocates Research Farm. BambooInstTenn@aol.com.

September 27-30. Flagstaff, AZ. The Resourceful Nomad. Ancient Pathways. Tony Nester. 928-526-2552. www.apathways.com.

September 28-30. Flat Rock, NC. Southeast Women's Herbal Conference. Red Moon Herbs. 828-669-1310. www.redmoonherbs.com.

September 2007-June 2008 (9 weekends). Chestnut Ridge, NY. Biodynamic Training. The Pfeiffer Center, Chestnut Ridge, NY 10977. 845-352-5020 x20, info@pfeiffercenter.org, www.pfeiffercenter.org.

October1-November 5. Summertown, TN. Ecovillage Apprenticeship. Ecovillage Training Center. The Farm, 931-964-4474, fx/-2200. ecovillage@thefarm.org, www.thefarm.org.

October 6-13. Sonoma County, CA. Advanced EAT Intensive. www.earthactivisttraining.org.

October 14. On-line. Permaculture Design Course. Barking Frogs Permaculture Center. BarkingFrogsPC@aol.com, www.barkingfrogspermaculture.org/Protocol4-23-06.pdf.

November 1-4. Albuquerque, NM. International Conference on Environmental Issues. Peter Holter, HMI. 505-842-5252. www.holisticmanagement.org.

November 2-4. Occidental, CA. Starting and Sustaining Intentional Communities. Occidental Arts and Ecology Center. oaec@oaec.org.

November 3. Summertown, TN. Shiitake Mushrooming Basics. Ecovillage Training Center. www.thefarm.org.

November 10-11. Dorchester, NH. Soil Nutrition From a Plant's Eye Point of View. D Acres of New Hampshire Organic Farm & Educational Homestead, 218 Streeter Woods Rd., Dorchester, NH 03266. 603-786-2366. info@dacres.org, www.dacres.org.

November 11-16. Big Sur, CA. Permaculture Teacher Training. Kat Steele. 510-547-7889, info@urbanpermacultureguild.org, www.urbanpermacultureguild.org.

November 16-18. Occidental, CA. Introduction to Permaculture. Occidental Arts and Ecology Center. oaec@oaec.org.

November 16-18 and 7 other weekends. San Francisco, CA. Urban EAT Weekend Series. www.earthactivisttraining.org.

December 13-16. Rural, WV. International Design for a Loving Future Conference. www.designforthefuture.org.

January 23-26, 2008. Asilomar, CA. Ecological Farming Conference. EFC Assn. 406 Main St. Ste. 313, Watsonville CA 959076. 831-763-2111, fx/-2112, www.eco-farm.org.

March 15-July 15, 2008. AUSTRALIA. Ecovillage Design Course and Practicum. EcoLogical Solutions, info@ecologicalsolutions.com.au, www.ecologicalsolutions.com.

Networks

Creating Abundance Around the World

The newly-launced Permaculture Across Borders (PAB) is a globally-focused, U.S. registered, permaculture non-profit with an aim to provide technical expertise to further the practice of sustainable and integrated practices that create permanent abundance around the world.

PAB was born through discussions among teachers and students at various PDC courses held in Australia and the USA in recent years.

The groups involved felt there was a need to create a world-wide dialogue among permaculture practitioners, to facilitate connections between regions and countries, and to grow the number of PDC courses available to students in poorer countries.

Permaculture Across Borders commits to listening to and working with indigenous communities worldwide to expand the knowledge and practice of integrated sustainable design. Further, PAB is committed to using local knowledge, to connecting people to resources, and to training those who wish to to become teachers and leaders of regenerative development in their communities and countries.

Working with the Permaculture Research Institute of Australia, PAB's first project will more fully develop the Dead Sea Valley Project profiled in 'Greening the Desert' (view the video at www.permaculture.org.au) by expanding the design and implementation of a locally-adapted education and demonstration center. PAB's aim, as with all future projects, is to have the project self-funded within three years.

PAB is also partnering with the newly-formed 'Permaculture Global Report' (www.permacultureglobalreport.com), a multilingual full-color quarterly magazine reporting on the successes and challenges of permaculture projects around the world. PAB and PGR invite members of the worldwide permaculture network to contribute articles, photos, stories, and designs from their work so that we all may learn from each other. PAB sees its role within the permaculture community as one of linkage: linking permaculture practictioners; linking sister city/regions; linking permaculture demonstration sites; and linking projects to available funding.

PAB is inviting dialog among those working to create permanent abundance. Please contact them with ideas for projects; articles for PGR; links across regions and countries, and potential financial resources.

Write PAB at:
www.permacultureacrossborders.com.
Additional contacts: Geoff Lawton, Co-Chair Australia, at info@permaculture.org.au. Δ

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One dollar of each ***Activist*** subscription-year goes to a Tree Tax fund for new forestry projects. Please print in ink the information requested below.

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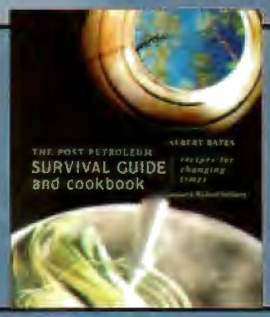

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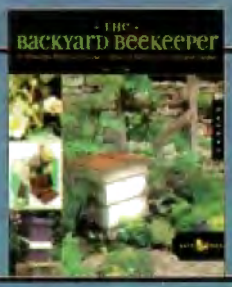

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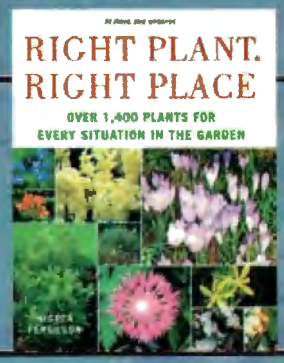

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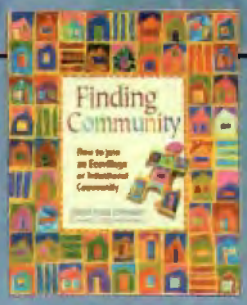

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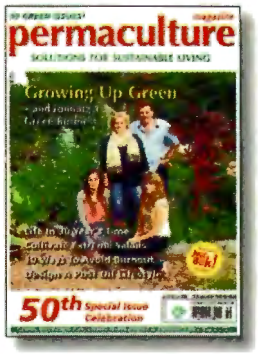

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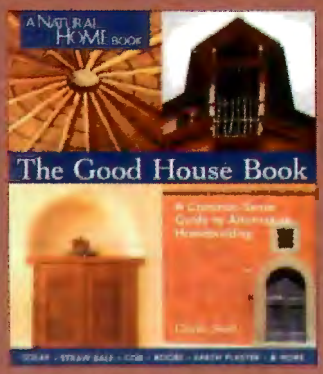

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