THE PERMACULTURE ACTIVIST

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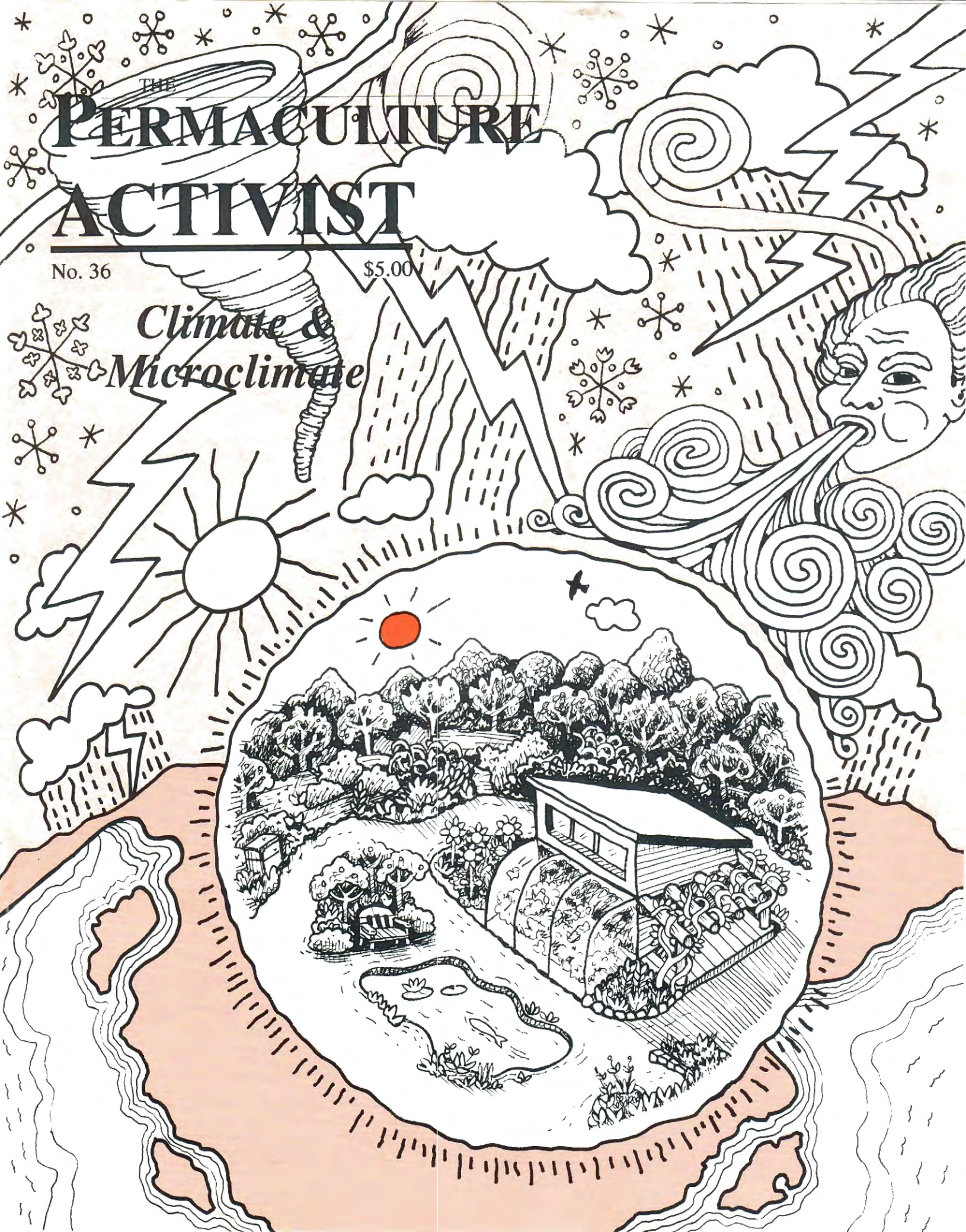
Climate & Microclimate



A Window of Opportunity

Peter Bane

Microclimate lies at the heart of permaculture design. In micro-engineering topography, vegetation, and human-built structures, we shape the movement of wind and water to our advantage, enhancing our comfort and security and the productivity of our cultivated landscapes.

As global climate becomes more unstable from the cumulative effects of the industrial system, it becomes increasingly important to build this kind of insurance into our regional and local environments. Forests and bodies of water are the most powerful modifiers of climate and we will do well to study their effects and apply what we have learned to restore the functioning of natural systems around us.

At present this kind of work is being done primarily by individuals and small community groups. As Erik Ronneberg points out, large scale landscape restoration and conservation was last systematically carried out by the federal government during the New Deal era of Franklin Roosevelt. We look in vain to the present generation of policy makers for such wisdom and vision.

However, just as utility companies are slowly coming to realize that investing in conservation of energy is a better use of shareholder funds than building new power plants, so we may see, in the not too distant future, insurance companies paying landowners to fire-, drought-, and storm-proof their properties by planting windbreaks, building ponds, restoring wetlands, etc. The linkage between finance capital and earth repair is needed, and could be made once the message that climate change is bringing us has been heard. Staggering losses from a string of class 5 hurricanes, earthquakes, and massive floods in the past decade have not gone unnoticed. And there is some evidence that the insurance industry is now waking up, as its spokespersons increasingly argue in global climate forums for faster implementation of international accords to limit carbon and CFC build-up in the atmosphere. Pitting the global insurance industry against the petrochemical giants seems like good politics for the rest of us.

Identifying such key leverage points in the global economic system is the next big piece of the work the Permaculture community needs to take on. The early period of testing technologies and establishing a permaculture presence in most regions of the planet is beginning to give way to a time of broadscale implementation. In the ecovillage movement and on the earth repair front, there are major opportunities emerging for engaging finance capital in healthy and transformative projects. It is time to carry our ethical imperatives of earthcare, peoplecare, and resourceshare assertively into political and economic decision-making forums. There will continue to be resistance, but we will increasingly find allies in unexpected quarters. We must build on ground already won. As an example, the Organic Standards Act of 1990, which recognized organic food production at the federal level in the U.S., and more importantly the burgeoning demand for organic food, has created institutional and market support for restoring soil health. We must look for ways to expand from this position and to establish similar supports for more comprehensive earth repair as well.

The Permaculture Activist will take up the issue of economic transformation in the November 1997 issue, #38. Please send us your best thoughts on this complex subject. We want stories of local economic renewal, alternative currencies, micro-enterprise development, channeling investment into green projects, social lending, community banking and credit unions, bioregional government, practical politics, and much more!

The kinds of solutions suggested by the articles in this issue are commonsensical and in many ways quite ordinary. Yet across vast landscapes, windbreaks, water storages, and the intelligent placement of buildings are nowhere to be seen. Why, we must ask? The persistent distortion of present investment choices stems from the continued ignoring of environmental costs, or "externalities," as they are called by economists. Anywhere we can chip away at this collective, institutionalized delusion that "nature" is free for the taking, we are making headway. And while we must press for full-cost accounting in all investment and pricing, we must also remain alert, as green economics emerges as a discipline, not to fall prey to the materialistic assumptions that living systems can be reduced to the money equivalent of their utility to humans. All living things are intrinsically worthwhile.

As we approach the millennium, there appears to be a break in the oppressive political and economic weather: we are entering a clear stretch in which the future that so many have invoked for decades is indeed becoming visible. At the same time, the dangers have never been greater. It is by no means certain that humanity will choose evolution over extinction, but the pathways by which evolution would take place are now evident. For those, like many in the permaculture movement, who have been slipping, slinking, or crawling through the tall grass of mass consciousness, hoping to avoid the predators, it is time to rise up and sprint across this open field toward the now barely visible tree line and its promise of safety.

Get ready for that sprint, for we are going to dive willingly into the living earth, get back to the garden we left 10,000 years ago, and soon, or be laid down as so many layers of charcoal for the contemplation of whatever intelligence emerges from the present catastrophe, eons hence. If we make it through this transition, we may even get a crack at some really exciting projects, like restoring the Sahara desert to the lush condition we first found it in. Δ

Readers expecting an index of recent back issues, which was promised for this issue, should look for it in #37 in July of this year. Space and time limitations did not permit us to publish it here.

Summer issue, #37—
Tools and Appropriate Technology
submission deadline May 21st

Fall issue, #38—
Economy, Ecology, and the Politics of Transformation
submission deadline September 22nd

Winter/Spring issue, #39—
Pattern & Design
submission deadline January 20th

Permaculture Activist welcomes reader contributions. For details see masthead on the next page.

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Thinking Globally

Albert K. Bates

Multiple choice: read this statement and then attribute the source:

"Experts are beginning to agree that climatic warming is likely to have some major economic impacts. Rising sea levels, for example, could flood agricultural land and changing weather patterns could result in more violent storms and thus, more expensive storm damage claims for insurance companies."

(a) *Science News*, December 14, 1988
(b) *Wall Street Journal*, January 20, 1997
(c) *OPEC Ministers Bulletin*, June 30, 2015
(d) All of the above.*

Walking into the Eleventh Annual Conference on Sustainable Development and Global Climate Change in Washington D.C. a year ago, I had a strong sense that it was, as Yogi Berra said, "*deja vu* all over again."

Many of the people milling about over coffee and danish were familiar faces from the past decade: Bert Bolin, the white-haired elder scientist who chairs the U.N.'s Intergovernmental Panel on Climate Change (IPCC); Robert Watson, the combative British climatologist who now watches thermometers from inside Al Gore's wing of the White House; Mohan Munasinghe, meteorological bean-counter for the World Bank; Nick Sundt, Global Change's cyber-ubiquitous town cryer; a busload from the National Oceanic and Atmospheric Administration; and a couple dumpster loads of industry representatives, government staffers, scientists, lobbying lawyers, and diplomats.

The tale was a familiar one. The globally-averaged surface temperature was 0.40°C above the 1961-1990 average, according to observations made at land stations, sea surface temperatures measured from ships and buoys, and satellite infrared imaging. The previous warmest year in the record, 1990, had an anomaly of 0.36°C for the year as a whole.

Although differences of a few hundredths of a degree between global average temperatures in individual years are not significant, we have been on a warming trend since the mid-70s. Most scientists, with a few oddball exceptions, would concur with the IPCC statement that "the balance of evidence suggests a discernible human influence on global climate." The credibility problem is that any rise in global temperature as emissions increase will not be steady and uniform; there will still be colder years and colder decades and even whole cooling regions due to natural climate variability and geographic anomalies. If you want exceptions to prove the rule, they're out there.

For people and other living things, the warmest year on record did not bode well. In Chicago, they buried hundreds of unidentified heat victims in mass graves, and brought in refrigerated semi-trailers to serve as temporary morgues for the legions of the known. Iowa got its second 100-year flood in three years. In New Orleans, homes were overrun with cockroaches and termites after a fifth winter with no killing frost. London had its driest summer since 1727, its hottest since 1659.

Then in the fall, a chorus line of hurricanes danced across the Atlantic from the West African coast to the shores of Florida. The speed at which scientific predictions are being fulfilled is unsettling. In November, 1994, the Argentine Antarctic Institute predicted that the Larsen Ice Shelf would crack within ten years if warming continued. In March, 1995, a 48- by 22-mile chunk broke off, exposing rocks that hadn't seen daylight in 20,000 years.

Seven years ago, the EPA warned that global warming and destruction of rainforest habitat would lead to the spread of new infectious diseases in the 21st Century. By 1991, just two years later, algae blooms in Asia and South America infected more than 400,000 people with cholera. In 1994, the mosquito responsible for dengue and yellow fever doubled its range in Central and South America.

These are signposts at the edge of an abyss. There are 10,000 new people arriving on Earth each hour. We are putting too much carbon into the air. We need more trees. We need less coal and oil being burned. Deep down in this well of common sense many of those attending the Eleventh Annual Conference commiserated.

"Suppose we were to burn all our recoverable fossil fuel stockpiles (except oil shales) right now, in just a year or two?" rhetorically asked Pieter Tans, and then proceeded to answer himself. The rate of increase in warming would be three to four times faster than at present and the temperature would hit a peak in perhaps 100 years and only come down slightly over the next 2000 years, holding at a plateau substantially above where it is today for at least 7000 years. And just how hot is that, Pieter?

Well, we are now warmer than we have been in 100,000 years. Burning everything at once would bump us to 2000 ppm of carbon by volume, and after 2000 to 7000 years we might get back down close to present levels of 350 ppm if all went well. The problem is that natural carbon absorption depends on plants, particularly in the mid-latitudes, and at least a third of all vegetation changes with a doubling of atmospheric carbon. The dynamic equilibrium which is Earth's healing process may not be as dynamic when airborne carbon jumps to unprecedented levels. There are no observable analogs for change on this scale.

Okay, so we don't burn it all at once. Well, suppose we achieve the ambitious targets of the Framework Convention on Climate Change and reduce our outputs to 1990 levels by the year 2005? That would probably put us at 450 ppm by 2100 and 600 ppm by 2200. Oops.

If 450 ppm can only be achieved with a significant cutback, we asked, what would the cutback have to be which would keep us at, say, 350 ppm? The answer was bothersome. Cutting back to 350 is probably not do-able, because it means burning zero fossil fuels forever. And at 350 ppm, where will temperature be? Probably about 5°C warmer on average. That die is cast, although global inertial factors like the surface temperature of the oceans mean it could take a century or more to unfold.

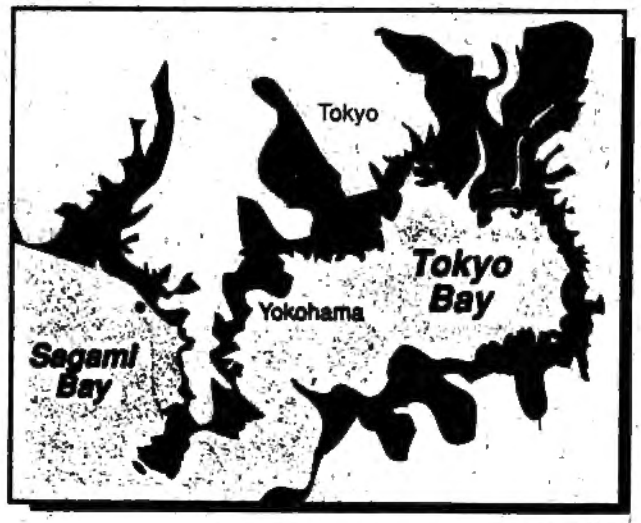
If a half-degree increase in average warming creates mass graves in Chicago, what will a five-degree increase do? Well, that is roughly the distance the Earth has traveled over the past 18,000 years, since our last small ice age. This time we expect to travel the route in perhaps 100 years, and in so doing, make the planet warmer than it has been in at least 1 million years.

And this room full of scientists told us, in essence, that at this point, the writing is set in stone.

Once you get to that giddy state, the dancers get better. A public relations flack for the coal industry said there are no good guys and bad guys in this, because it is all tradeoffs. An economic consultant said that value judgments have no role because they can't be quantified. Another official bean-counter said it makes no difference whether you do the reductions now or in the future, in terms of total impact and atmospheric lag mechanisms, so why not wait, because with technology improvements, washout of near-term emissions, and discounting, later is always better. He concluded that while the costs of stabilizing at 350 were very high, costs of stabilizing at 550 were almost zero. You do the math.

Near as I can tell, by that equation, it will always be better to wait rather than do anything.

Tokyo Bay, Japan during the Jomon transgression



Source: Machida, 1975

Estimated shoreline change attributed to a 5°C. rise in average temperature, based on fossil evidence of 15,000-6,000 years ago.

Okay, so here we sit, drifting, as Einstein said, toward unparalleled catastrophe. We are rummaging through the glove box and we can't seem to find the manual for this spaceship that tells us what to do when that red light starts flashing. Did the dinosaurs have that problem once before? Will we find it flashing again next time, say a 100 million years from now, when another species gets another chance?

I'm not ready to toss in the towel, as that room full of the best and brightest minds seemed to be. I believe, as Buckminster Fuller said, that the closing years of this century will be a race between education and annihilation. Tell folks the truth, they'll do the right thing. They have to.

Missing Links

Recent laws protecting brazil nut trees spared many of them from being bulldozed as the rainforests were cleared. For a time, the majestic trees stood out in clearings, silent witnesses to the loss of forest diversity. And then they began to die.

Brazil nut trees flower only in November. They are pollinated by a forest bee. For the bees to survive, they need to gather nectar from a whole series of different trees, each flowering in turn, and each providing food for the bees in its season. The bees need a wholesome variety to get through an entire year. If any significant gaps develop in this variety, the bees leave and the brazil nut trees, as well as many other species, no longer produce.

The male bees are also dependent on orchids in the deep forest, which they visit at mating time. Rubbing against the orchids, they pack the scents on their hind legs and then fly off to form a lek, a group that attracts females for the mating ritual. If the orchids do not find suitable conditions for growth, they vanish from the forest, and with them go the bees, and with the bees, go the trees.

When brazil nuts fall to the forest floor their outer shells are eaten by large rodents, called agoutis *(Dasyprocta cristata)*. The agoutis bury the seeds but often forget some of the caches. The agoutis' poor memory has the effect of dispersing seeds to favorable locations for new growth. The survival of the brazil nut trees is as dependent on the agoutis at the forest floor as on the bees in the tree canopy. If conditions are not favorable for any member of the forest community, all parts are endangered.

There are many examples of interwoven ecosystems. There are plants that are protected by birds, birds that are protected by hornets, hornets that are protected by trees, trees that are protected by fungi, fungi that are protected by ants, ants that are protected by plants. The demise of one plant species may eventually lead to the loss of up to 30 animal species because of the complex interplay of consequences.

The global ecosystem is an intricate lace of symbiotic species, and all that inhabit this macro-network have evolved into a condition of interdependence, whether they recognize it or not.

Having wandered, like Alice, through the looking glass into that climate meeting in Washington D.C., I'm left wondering: what part of the stable macro-political-ecosystem are we missing here? We have the scientists, and they are in pretty good agreement. We have the government officials and they are somewhat behind the curve—purposefully obtuse—but, at the highest policy levels, they are paying good people to see the magnitude of the problem. The captains of industry are largely in denial and obfuscation, and their money is doing a lot of damage to the clarity of mind in capital cities, but this diversion is nothing new, and should not pose an insurmountable barrier to good policy winning out. So what is it, exactly, that is missing? Why are good climate policies, like the BTU tax, or investment in carbon reduction technology, dying like brazil nut trees?

What needs to be in this picture for us to avert catastrophe? Could it be catastrophe itself? Given the length of time it takes to change climatological patterning and the far greater period required to restore the world we knew, that conclusion seems too dire to adopt. A mere universal eco-spiritual awakening will have to do. Δ

**The correct answer to the quiz is (b).*

Albert Bates is an attorney, educator, and author who lives at The Farm community in Summertown, Tennessee, where he serves as regional secretary for the Global Ecovillage Network and publishes a quarterly journal of sustainability, The Design Exchange. *Albert is the author of a seminal book on global warming,* Climate in Crisis: The Greenhouse Effect and What We Can Do, *from which the illustration is reproduced.*

A Microclimate Primer

Toby Hemenway

Our house backs into the yellow clay of a south-facing hillside in southern Oregon. On bright but chilly days, below the house, almost against it, is a place where warmth seems to pool and linger. This little pocket of comfort is markedly more enticing than sites just a few feet away, especially on those exceptional winter days when the Oregon rain yields to the sun. Let's examine this southerly sun-bowl, for it holds some basic lessons about microclimate. Then we can walk to a meadow, a forest, and a garden, and learn from them in turn.

If we sit with our backs to the south wall of the house, we can feel the sun on our faces. And therein lies the heart of microclimate: the transfer of energy from one medium to another.

Understanding microclimate requires a quick look at the four basic types of heat transfer. First there's *conduction,* as when the electric coil of a stove heats the pan that it is touching, and the pan heats the water inside of it. When soil warms in the spring, the lower layers not directly absorbing heat via solar radiation are warmed via conduction. Heated by the sun, the lively molecules on the surface jostle the cooler, deeper ones and conduct heat several feet into the ground. The air above the heated soil is also warmed by conduction.

Then there's *convection,* the rising of heated liquids and gases. Convection plays a much larger role in climate than conduction. Conduction alone will only heat the few feet of air closest to the ground, but mixing caused by convection boosts this warmth thousands of feet skyward. Wind and weather patterns are created partially by convection currents.

Next is *evaporation.* When water changes from liquid to vapor, energy is transferred. We're all familiar with the evaporative cooling that makes refrigerators work, as well as the cooling of our bodies due to the evaporation of sweat.

And last is *radiation:* electromagnetic radiation in the form of X-rays, radio waves, etc., radiation from the sun, and radiation from a warmer body to a cooler one. Solar radiation is the engine that drives climate, both macro- and micro-.

Radiation is the primary factor in making our sun-bowl so comfortable, in part because the energy absorbed and reradiated by the south wall of the house warms us. But more importantly, the wall enormously reduces our heat loss from radiation. If you're standing in an open field, your body radiates energy to the sky in every direction, losing heat. With a wall against your back, that loss is reduced by two-thirds. (Let's not go into the math. Microclimatology has been called "the mathematician's paradise," and it's a rare book or article on the subject that isn't liberally laced with formulae.) On an open plain, it's got to be a warm, still day before the energy you gain from the sun exceeds what you radiate out. Any sort of shelter—a wall, a slope, a basin, or a house-lined street—cuts that loss.

The steeper the slope of that shelter, and the closer you are to it, the less your radiation loss will be. And the slope needs to be fairly steep to be effective. Most radiation loss is to the zenith—straight overhead. The atmosphere is thinnest there, so less radiation is bounced off the air and water vapor back to you. Snuggling your home right into a steep hillside, minimizing the overhead exposure, will protect you far more than siting your house in a shallow basin.

The radiation cycle also operates at night. Daytime sun warms the atmosphere and the ground, and air and earth reradiate this absorbed energy. At night, energy radiated from the warmed ground bounces off the lower atmosphere, and this reflected counterradiation creates and holds a band of relative warmth near the surface. We've all felt how much cooler a clear night is than a cloudy one. The water vapor in clouds reflects radiation rising from the ground. Heavy, low clouds do a better job of this than thin, high ones: night-time cirrus clouds boost counterradiation by only 4%, but low nimbostratus and fog each enhance it by 25%.

Mixing it Up

After radiation, air mixing from wind or convection is the second largest factor in creating microclimates. At our house, the winter wind blows from the southwest, whistling right at our little sun-bowl, but the wind is both lifted over the house by the forest downslope and slowed by friction against the tree trunks and canopies. Not only does this knock down radiative heat loss from wind-chill, it also prevents cool air from mixing with the warm air nestled against the wall. This uneven air mixing is essential for the formation of microclimates.

When wind sweeps across a bare plain, the air at head height or above mixes well. At the ground, however, friction slows the air and prevents good mixing. On a sunny day, the air an inch above the soil can be ten or twenty degrees hotter than at eye-level. Add a few trees, walls, or buildings to this bare plain, and friction of the wind against these causes turbulence. Pockets of warm air gather. Uneven air mixing now occurs horizontally as well as vertically. Voila! Microclimates are born.

Air mixing also stems from convection, when sun-heated cells of air are lifted, pushing cooler air out of the way and sucking nearby air underneath. Convection causes gusts, which are eddies in the wake of rising or settling air. Both convection and friction help mix daytime air, but at night, without solar heating, only friction is at work.

Soil, Sun and Slope

The soil also absorbs and radiates heat, affecting microclimate. The dense clay behind my house, however, doesn't warm much on any given day. Only after a good sunny spell is soil heating a major factor in that microclimate. A fluffier, sandy soil would warm faster. Soil color is important too: a black loam will absorb energy more rapidly than our tan clay.

There are tricks for warming your soil: Maori farmers darken their soil with charcoal in the spring to speed warming. Tibetans toss rocks on snow-covered fields to melt holes. This pockmarked surface in turn reflects less light and absorbs more solar energy, accelerating the thaw.

Slope also affects our sun-pocket. Ground angled toward the sun absorbs more solar radiation than flat land. Also, an elevated slope is above nighttime frost drainage. At night, altitude-chilled air piles up on plateaus and broad ridges, and loses heat further by open-sky radiation. Soon these stacks of cold air topple and spill downhill. If unhindered, the frozen air will drain into valleys and basins. Many is the morning I've looked down on a valley full of frost, yet the max-min thermometer on the north side of our house never reached freezing.

Just a few feet of elevation can make a big difference. In a peach orchard on a gentle slope, blossoms can survive on trees only a few feet above their frost-damaged neighbors. Even slope-dwellers should be careful, though. Rick Valley tells of planting, downslope of a vegetable patch, a bamboo grove that grew up nice and thick, to everyone's approval. But cold air could no longer drain out of the garden: they'd built a fine frost pocket. Out came the bamboos.

Here's the worst possible microclimate to farm: In a valley that lies above an obstruction, like a dense forest or narrow canyon, and is located below a slope forested with tall old-growth, with a large plateau above the forest. Cold air will build at night on the plateau, and drain easily through the undergrowth-free forest. Protected by the dense canopy, the cold air won't mix with warmer air above the trees. The frigid air will then pool in the valley and build to a tremendous depth, trapped by the blockage below. The sun will need hours to warm the deep lake of frosty air. A disastrous site for a farm, and an unpleasant place to live.

Microclimates range in size. Entire cities have their own microclimate, but so does a young seedling in a bootheel-sized depression. Researching this article opened my eyes to the infinitude of tiny climates around us. Anywhere that incoming or outgoing radiation is altered by slope or shade or density or color, anywhere friction or convection changes the mixing of air, this is where microclimates form.

A Meadow Microclimate

Now that our sun-bowl has given us a basic lesson in radiation and air mixing, let's look at microclimates in a nearby meadow of grasses and herbs. Most plants here are two to three feet tall. Their tops are warm in the sun, but near the soil surface, protected by the leaves, it's cool, still, and humid. The shaded earth stays moist, and water vapor from it and from transpiring leaves keeps humidity near the ground high. This water-laden air requires more energy to heat and cool it, so its temperature fluctuates only slowly. Wind here is stopped by friction against leaves and ground, reducing air mixing and preserving the moist, cool environment. Higher up in the leaves it's hotter, drier and breezier. In this dense meadow, insects sensitive to light shelter at the shady leaf bases. In more open vegetation, however, the midday sun can bake the exposed ground, driving snails and slugs into the leaves to escape blistering ground heat.

Identifying Microclimates

Jeff Ashton

There was a time when our family hound's main criterion for finding a spot for his afternoon nap was the aesthetic value of our flower beds. It could be guaranteed that at 1:30 p.m. on any given day, he could be found sleeping in the middle of whatever perennials or annuals were at their peak of perfection in bloom. It's a wonder the dog survived my spouse's wrath into his current old age.

Now in his eleventh year, the beast has developed more discriminating criteria for his napping niches, and they are especially revealing as the weather turns towards the colder months. As he has gotten older, I've noticed that Dakota, in choosing venues for his daily siesta, has developed an uncanny ability to finding the warmest spots on the property. Unknowingly, he has been identifying microclimates which I can use for some special gardening purposes.

However, it doesn't take supernatural skills (or a dog named Dakota) to figure out which areas on your property are the warmest. Simple observation of spots that melt first after a snowstorm will give you a pretty good idea. Observing pets and other animals will allow you to fine tune your knowledge of the real "hot spots."

Every gardener's property has its own microclimates, different from any other. Yet those where cold frames have been set up at due south alignment can be studied comparatively. In his 1929 text, *Starting Early Vegetables and Flowering Plants Under Glass*, Charles Nissley mentions a series of experiments where temperature and light readings were taken inside cold frames. Nissley found "morning light to be more intense than afternoon light, ... our experiments showing a difference of 10% and ranging as high as 30% for some months." Nissley observed the hottest spot—to be used for the least hardy plants—is the northwest corner of any south-facing frame. The Ashton family hound confirmed the existence of this cold frame hot spot during the brutal winter of 1994 when he broke into one of my frames and chose that corner for his afternoon naps from January until I kicked him out in early March.

While on the subject of cold frames, it's interesting to note a study conducted by folks at the Rodale Research Farm in the early 1980s, comparing plant growth and interior colors of identical insulated cold frames. Growing the same cool-hardy plants, frames with interiors painted white proved to be superior growing areas (because of reflected light and more even temperatures) than those interiors painted black (even though higher temperatures were reached).

To be honest, I've always started my gardens on a new property before identifying the really "hot spots," usually with only some fairly hurried evaluations of where the beneficial microclimates might be located. My initial garden assessments center around questions such as, "How close to the garden site can I drive a dump truck load of manure?" rather than "Is this a 'hot spot' where I can extend the season?".

Be that as it may, I have used hot spots identified by the family beast to harden early spring potted vegetable plants and to air winter-tired house plants safely outdoors. At my last home in New England, my favorite spot for this was beneath the low spreading branches of a white pine which apparently reflected heat back to the nondescript-looking patch of ground below it. That useful spot was made evident to me by the family hound. I haven't found a spot to match it yet at my new North Carolina home, but with the onset of cold weather, I'll be paying close attention to my canine friend for some clues.Δ

— Reprinted with permission from the newsletter of the Western North Carolina chapter of the Carolina Farm Stewardship Association, Jan/Feb 1997. Jeff Ashton gardens near Weaverville, NC.

At night, air within the vegetation acts as insulation, and the leaves prevent the soil heat from rapidly radiating away, so the ground stays warmer than the leaf tips. Leaves are very effective radiating surfaces because they are thin and broad (high surface to volume ratio). They lose so much heat at night that they cool to below the air temperature, and frost even when the air is above freezing, just as car surfaces sometimes do.

The upper leaves of a plant reflect radiation back to lower ones, protecting lower leaves from frost. Short or mowed grasses, with less insulating air and radiation-blocking plant mass, can frost later into the spring than tall grasses. Delaying mowing can protect tender plants nearby.

Even flowers have microclimates. The interior of a daffodil blossom in morning sun can be 15°F warmer than ambient air. Bees know this, and often sleep inside. At daylight, they warm to flying temperature before their outside companions and begin pollinating much earlier in the day.

Into the Woods

Let's walk from the meadow to the adjoining forest. This is a fairly old stand with a closed crown. These are conifers, although much here applies to broadleaves as well. The microclimate here is like the meadow's writ large, but the massive trunks and much larger enclosed air mass greatly enhance heat storage capacity. Temperatures amidst the tree-trunks shift very slowly.

At dawn, the sun strikes the canopy top. Much of the morning sun's energy is consumed drying dew on the leaves. Only afterward can energy go to heating the canopy. As the air above the canopy warms, a swirling mass of insects often gathers above the trees in a band that sharply illustrates this microclimate's edge. No insects yet venture into the cool air below, where it's still night.

Once the dew evaporates, the crown air heats quickly and becomes unstable, then rises and mixes with the drier, cooler air above. By noon, temperatures peak in the crown. Down among the trunks of this dense forest, daytime temperatures stay several degrees lower. This coolness can protect against bark beetles, who swarm at about 70°F. In dense forest, beetles will linger in the warm leaves and twigs, and only slowly tunnel down to the chilly trunks. In more open forest (a freshly thinned plantation, for instance) the trunks warm in sunlight, and radiation from them and from the sun-heated ground keeps the crowns warm at night. Bark beetles will hungrily and quickly ravage these open trees.

Forests absorb most of their radiation at the top. Only a small fraction penetrates to the floor, often as little as 1% in dense old growth. "Sunflecks," those momentary spatters of light that dance on the forest floor, can make up 40-70% of the total light in the understory.

The trunk-columned cathedral below a closed canopy has few leaves to transpire water, so humidity there depends on soil moisture. After a rain the air feels damp, but in dry spells the humidity perches up in the canopy, amidst the vaporous sighs of the leaves.

At night, the canopy cools quickly, and cold air drains down, cooling the trunks and soil. Heat from the ground also radiates to the canopy, minimizing nighttime temperature differences between crown and soil. Often at night, though, it feels warmer in a forest than on bare ground because the canopy blocks radiation loss to the sky, and the wind dies to a whisper from friction against the trees.

Removing trees can alter microclimates, sometimes for the worse. A clearing whose edges are about the same dimension as the tree heights creates downdrafts that can back smoke down chimneys, whereas selective cutting can create a mostly open space with reduced wind (See Figure 1).

Figure 1

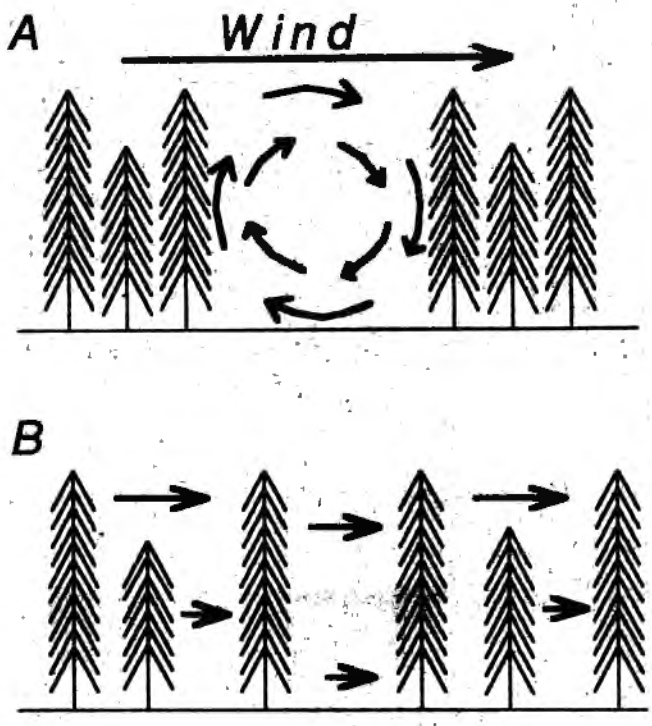


Figure 1. Wind blowing through a clearing whose length and width roughly equal tree height (A) will create downdrafts and blow smoke down chimneys of houses on right side of clearing. By thinning instead of clearing (B), wind is reduced (length of arrows corresponds to wind velocity).

Gardens and Greenhouses

Let's take these observations into the garden to understand and adjust the microclimates there. First, the soil: Most permaculture gardeners avoid tilling, and this can prevent late frost damage. Entrapped air reduces soil's ability to conduct heat to and from deeper earth, so tilled soil warms more in sun but cools further at night by up to 5°F. Frost can kill plants quickly in newly-weeded soil.

Light-colored soils stay cooler and more moist than dark ones. In an experiment, soil topped with coal dust got hotter than that sprinkled with light clay. However, rapid moisture evaporation cooled the dark soil to only a few degrees above temperature of the light field, at first. Once the dark field dried out, though, it roasted to 25°F hotter than the light one during the day. The light field stayed moist for several weeks longer.

Mulches keep the underlying soil cool and moist, but can really scorch at their surface. They're full of air and so won't conduct heat into the soil. A thin mulch of leaf litter, peat moss or sawdust can heat to 110°F on a sunny spring day, thus a sparse mulch dusting around seedlings can give them a boost if you're careful not to cook them.

Rock mulches are a nice trick in dry climates. Two inches of gravel can add an extra foot of moisture in the soil beneath through dew collection and reduced evaporation.

Northern gardeners build rock walls around plants to keep them warm on chilly nights, but the color of the wall has an effect too. Researchers found that painting a rock wall black boosted the growth of tomatoes trellised in front of it but didn't affect the yield. Painting the wall white, however, upped the yield substantially. Peaches and grapes backed by a white wall yielded more buds and fruit, though wood growth was better in front of a black wall. In general, longwave radiation (heat) is absorbed by black, boosting growth, but shortwave radiation (light) bounces off white onto the plants, improving flowering and yield. Perhaps you could start with a black wall and then paint it white once your seedlings had matured.

In dry-climate nurseries, savvy workers protect against drought by digging up a divot of soil, planting a seedling in the hole, and laying the divot grass-side down just east of the seedling (B in Figure 2). Shaded from the morning sun, these seedlings can use the night dew and humidity for a few extra hours before the day's heat burns it off. Contrary to what you might think, plants in with the divot to the west (A) often die, because the slight afternoon shade doesn't make up for the moisture cooked off by the morning sun.

Figure 2

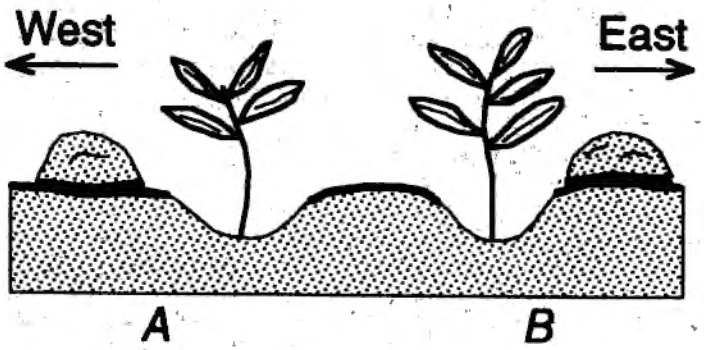


Figure 2. Slight afternoon shade from divot to west (A) doesn't aid seedlings as much as preservation of dew in morning by divot to east (B).

Come into the greenhouse for a moment. I've always thought it was so warm in here because glass lets in shortwave radiation (light), but blocks the escape of reflected long waves (heat). I'm way behind: in 1909 a fellow built two small greenhouses, one of glass, and one of rock salt, which is transparent to both long and short waves. On a sunny day, both reached the same temperature, which means it's irrelevant whether long waves stay in (glass) or bounce out (salt). The "greenhouse effect" doesn't matter in greenhouses! Greenhouses, it turns out, are heated more by reduced air mixing. The sun heats the ground, plants, and building, then these heat the air, and the rising air is trapped by the glass instead of lofting into the sky or drifting away on the wind. At night, greenhouses radiate so well that they can cool below ambient air temperatures, and their inability to mix with warmer outside air becomes a liability.

Creating microclimate in the landscape

When macroclimate isn't favorable for your crop, you must rely on microclimate. An exemplary integration of many microclimate principles comes from Germany, which is at the northern extreme of wine-growing country. Here are weinbergs, or wine-mountains, selected for their south-facing slopes, and ideally flanked to the south by a river or lake to enhance radiation by reflection. The hills are terraced, and each terrace is backed with a stone wall that stores heat. Stone walls also descend the slopes, gaining heat and blocking wind but not impeding frost drainage. If a plateau lies above, it is thickly edged with trees and shrubs to block cold air flow. The grapes themselves are trained high to let frost flow away below them.

Though the vines are planted in east-west rows, they are bounded by open north-south running lanes. These lanes heat up during the day, and radiate into the vine rows at night, keeping the grapes warm and compensating for the cooler shaded ground below the vines.

We are awash in a world of microclimates. We don't need to blanket the environment with temperature and light and wind sensors to inform us. Just put your hand on the ground, in the bottom of a swale, or in a clump of grass; just watch a bee inside a flower.

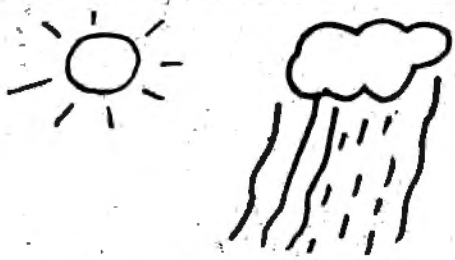
A few days ago we had a light dusting of snow. On our deck the nailheads melted clear several hours before the cedar planks. There's a microclimate lesson there. The keys are radiation and air mixing. Watch how these two factors interact, and use these observations to understand and shape the microclimate in the place you live.

Further Reading

The Climate Near the Ground, by Rudolf Geiger, is the classic text on microclimate. This all-inclusive work by the brother of the inventor of the Geiger counter is now in its 5th edition. Geiger's writing, though scholarly, shows a love and a keen grasp of his subject, and personal experience balances his summaries of other's research. Δ

Toby Hemenway lives in Oakland, Oregon and writes frequently for The Permaculture Activist. *Illustrations by the author.*

Notes from a Weatherman's Handbook



Lee Barnes

With practice, anyone can develop the ability to forecast weather. You need a general knowledge of weather systems and local climate, supported by lots of observations. Most of my weather observations have been made in the eastern half of North America, in the southern Appalachian Mountains particularly, so I carry the bias of this locality, weather-wise. That said, modern weather channels and computer web sites provide an endless array of weather information for anywhere in the world. I love getting current weather maps on my computer, but nothing beats sticking your head out the window and noting subtle changes in the clouds, wind, and humidity.

As a gardener and avid backpacker, I have learned to notice the subtle changes which precede a storm. If you are going to be out-of-doors for weeks at a time, it helps to know if the approaching clouds mean rain for a few hours or for three days. Determining wind speeds helps me select the right clothing to avoid hypothermia. Here's a few weather observations which might help you stay warm, dry, and maybe soft.

The Weather-Makers

Weather is the result of the interaction of numerous major and minor factors including the earth's rotation, uneven heating and cooling of the planet, behavior of moisture at different temperatures, and interactions with local features (such as mountains, forest cover, desert, nearby water bodies, average soil temperature and moisture content, etc.).

Most weather phenomena that we are aware of—clouds and wind—occur in the lower 40,000 feet of the atmosphere. In a column of air from the earth's surface to the edges of space, about half the total molecules are found below 5000 feet. Thus, the interactions of air with surface conditions such as ground and water temperatures and surface humidity are very important in determining weather conditions.

All major weather patterns on Earth move from west to east due to the rotation of the earth. This constant, combined with the uneven heating and cooling of air masses over land and water and at different latitudes creates characteristic weather patterns for every region of the earth. These patterns, reflected in prevailing seasonal wind directions, shape yearly cycles that are fairly consistent.

The Patterns of Fronts

Weather fronts advance across North America at the rate of about 600 miles in 24 hours. Warm fronts move more slowly, averaging 400-600 miles a day, while cold fronts move faster, 500-700 miles a day. Typically fronts move across the continent at five-to-seven day intervals, which explains why it sometimes seems to rain every weekend. These patterns are less regular several weeks before and after the spring and fall equinoxes, as the planet undergoes its two major thermal shifts of the year, but can stabilize for weeks at a time during the middle of summer and winter.

There is about a month's lag between the solstices (which are the times of greatest or least daylight) and the thermal extremes of the seasons: temperatures are coldest about a month after the winter solstice (late January), and hottest a month after summer solstice, in late July.

For detailed information about broad regional climate patterns, I recommend reviewing the *Climatic Atlas of the United States* and *Weathering the Wilderness* (see resources). The National Climatic Data Center (704-271-4800) is the largest source of worldwide climate data, including an on-line search service with detailed weather information available at commercial rates. For local climate information, check with your library. Climatic data will usually include long-term mean temperature and precipitation, as well as extremes of wind, flood, snow, etc. Local weather folklore and expressions are more often fact than fiction, so pay attention to stories as well.

Predicting Local Weather

The key to understanding and forecasting local weather is to weave personal awareness (including body sensations) with observation of sequential weather changes. This requires a basic knowledge of how individual people, birds, insects, and even fish detect and respond to weather changes. Observable changes include air pressure, temperature, humidity, cloud formations, and wind directions. Understanding different cloud types and major differences in the behavior of warm and cold fronts is essential. (I recommend *Eric Sloane's Weather Book* as one of the best illustrated and simplified explanations of weather for the beginner.)

Clouds form as invisible moisture in the air condenses due to dropping temperatures (this is also expressed as the dew point, a temperature at which the relative amount of moisture in the atmosphere will begin to precipitate in droplets). The amount of moisture (also known as the relative humidity) held in a given volume of air varies greatly with temperature, so that a cubic foot of air at 60°F. can hold twice the amount of moisture than it will at 40°F. When air becomes saturated with moisture, clouds become visible.

Clouds are named after their relative height in the sky, physical structure, and weather characteristics. Very high clouds are named cirrus (or with prefixes of "cirro"), from the Latin root meaning "curl, tuft, or filament." These icy clouds form at 20,000 to 40,000 feet and are generally seen as thin layers or streaks. Stars will disappear behind thickening cirrus clouds and large halos will be seen around the sun or moon. Cirrus clouds form far in advance of warm fronts as moist air is wedged upward over a cooler air mass, causing the moist air to form ice crystals at the perpetually freezing temperatures of the upper atmosphere. As a rule, average air temperature decreases 3.5°F. for each 1000-foot rise in elevation (about 5°F. for very dry air), which greatly affects cloud formation and the potential for rain.

Clouds appear in specific sequences with approaching fronts. Middle altitude clouds form at 8,500 to 20,000 feet and bear names prefixed with "alto," such as in "altocumulus" and "altostratus." Altostratus clouds form at the middle heights of the upward air wedge preceding a front. Alto- clouds form at a later time and at lower elevations than cirrus clouds, and become thicker with increasing moisture content. The sun and moon can still be seen through alto- clouds, but with "corona" or circling

rings. Larger rings indicate higher clouds while smaller rings indicate lower ones, and generally, approaching storm clouds. I can often determine cloud thickness by subtle shadows of my hiking stick—thinning clouds usually mean fair weather.

Low-level clouds (below 8500') are named after their form or apparent structure, whether it be stratus, meaning "layered," or cumulus meaning "heap." Nimbus, or the prefix "nimbo-" before other names, indicates rain clouds. Thunderclouds may develop along the lower layers of the actual front and can rise to several thousand feet—even to 20,000 or 30,000 feet or higher in a short time (often less than half an hour). They can create heavy and violent rains. See *The Audubon Society Field Guide to North American Weather* for excellent typical cloud photos.

One rare and unusual cloud type is mammatocumulus, which has numerous drooping breast-like undersurface lobes. It is often associated with tornadoes, which themselves are often associated with cold fronts. Tornadoes generally travel from southwest to northeast at 20-40 mph, especially during the period of April through July, and usually between 3 and 7 pm.

The key to predicting the upcoming weather is observation of:

1) the sequence of cloud types,
2) the direction of cloud movement in the sky, and
3) the changing of wind directions.

Lowering, thickening, and darkening clouds usually mean rain soon.

Cold Fronts

Clouds and weather events, especially violent storms, occur along advancing fronts due to the overlapping of vast cold or cool polar air masses which "fall" (they are relatively heavy) and collide with warmer air masses. Fronts are most commonly marked by a pressure difference between two air masses, which also differ in temperature, humidity, and wind speed and direction. In North America, cold fronts generally approach rapidly, moving faster than 20-25 miles per hour (some 10-35 mph) with winds from the southwest, the barometer falling, winds shifting, and a quick progression of different cloud types. Cold fronts are often violent, but generally pass by within three or four hours.

Cloud types change with advancing cold fronts from high, flat cirrus to thicker mid-level clouds, then into dark, fluffy rain-threatening nimbus. One can generally expect rain 12-20 hours after seeing the first high cirrus clouds. The sequence of clouds changes rapidly with altostratus clouds seen 10-15 hours prior to expected rain (the sun appears to be behind frosted glass), cumulus-congestus appear 5 to 10 hours prior to rain, and cumulonimbus clouds indicate rain real soon!

Thunderstorms often form along cold fronts, like beads-on-a-string. Short duration (about 30 minutes) thunderstorms are common in summer and are more locally isolated. Typically, front-associated thunderstorms in the U.S. move from the southwest to the northeast at 25 mph. After a cold front passes, the winds usually shift to coming from the northwest or north, the barometer rises steadily, clouds break up, and temperatures fall.

One way to predict whether a storm will hit you or not is to turn your back to the current wind and extend your left arm laterally. This will point toward the center of the front (actually just behind the actual center). If you then turn your back to where the wind was coming from previously and then extend your arm, you can determine whether the center of the storm will pass over your position or miss you. If in turning your back and extended arm between the two wind bearings, your arm sweeps in a counterclockwise direction, the wind is said to be "backing": expect weather to worsen. If your arm sweeps clockwise, the wind is "veering," and "veering means clearing."

Warm Fronts

Warm fronts behave differently than cold fronts. In general, warm fronts are slower in approaching, create less violent weather, and bring longer lasting rain (often several days) than that associated with cold fronts. Warm fronts are generally preceded by winds from the southeast, with a slowly falling barometer. Cirrus clouds are first seen 24-36 hours prior to the front, with clouds thickening as cirrostratus, then altocumulus, and finally to nimbostratus and cumulonimbus (rain clouds!). After the front passes, the wind begins to flow from the southwest, the barometer rises, skies clear, and temperatures rise.

Weather Awareness

We all have the ability to sense changes in the weather. By our own observations, we can see different cloud formations and know the types associated with approaching storms. Folklore records astute observations by our ancestors such as "red sky at night, sailor's delight; red sky at morning, sailor take warning." Since weather generally moves from west to east, red sunsets indicate few clouds to the west and continued fair weather. Red skies at morning occur through overrunning and thickening, clouds with rain likely to be approaching from the west.

People, animals, and plants all sense changes in air pressure, humidity, average sky brightness, and wind directions. People may sense lowering air pressure in bone joint stiffness, or as pains in old wounds and scars. People (especially young children) often become more irritable with approaching lower air pressure and increasing humidity. Hair readily absorbs moisture from the air, elongating and becoming less manageable with increasing humidity. Indeed, humidity indicators are often made with strands of human hair, especially blond hairs, which are thinner in cross-section.

Smells, both distant and close—as from the body, are more noticeable as barometric pressure drops because they more readily diffuse from their sources, conversely, high air pressure keeps smells pressed close to their origins. Scent is also more noticeable in humid air than in dry. Distant sounds (such as planes, trains, or barking dogs) become more audible when air moisture increases before a storm. Smoke from campfires and from chimneys rises vertically in dry air with high pressure, but drifts, then settles at lower levels when humidity increases and air pressure drops.

Twinkling stars indicate strong upper atmosphere winds, so expect rain in two-to-three days. Stars appear bluer than normal when rain is approaching, since humid air absorbs more of the red wavelengths. Heavy dews indicate fair weather (since available moisture is on the ground and not in the air), but lack of dew indicates the atmosphere is retaining moisture, which may increase until clouds and rain occur.

Observing Other Observers

Animals commonly signal weather changes by their behavior. Birds are especially noisy and active 24 hours before rain. As storms approach, birds become quieter and less active, tending to "nest." Birds feeding in the rain usually indicates that it will continue to rain for a long time; if they stop feeding, expect only a brief rain. Birds have more difficulty flying in low pressure conditions, so their flights tend to become shorter in length and lower in elevation as the barometer falls. Normally solitary birds such as hawks may flock together when faced with extended poor weather.

Spider webs break up readily with increasing humidity, so

unrepaired webs may indicate approaching rain. When spiders are actively spinning webs, expect fair weather. Bees are less active and remain closer to the hive when rain approaches. Most insects become less active with the approach of rain. Flies are an exception, often becoming more numerous, irritating, and biting before rain. Animal behavior is a useful guide, but when making predictions of rain, don't depend upon any single indicator, instead look for at least three signs.

A few other fairly reliable weather indicators:

- Flies scatter in fair weather.
- Swallows and bats fly close to the ground before rain.
- If cows in a field face east, the weather will remain fair (they like to have winds arrive from their back side—possibly to smell predators which they won't see behind them), but if they face to the west, expect rain from the east.
- Lowering clouds bring rain.
- If clouds move in opposite directions, expect rain in less than 12 hours.
- If cumulus clouds are smaller at sunset than at noon, expect continued fair weather.
- Fish bite aggressively before a rain, less aggressively after.
- If hair is limp, rain is near.
- If lightning and thunder is to the north, expect no rain, but if it's to the southwest, expect a storm.
- Mosses, if dry, indicate low humidity; if soft to the touch, expect increasing humidity.
- "Rainbow in the morning, shepherd take warning, rainbow at night, shepherd's delight."
- Winds from southwest or northwest, expect fair weather.
- If during a storm, the wind shifts from out of the east to out of the west, expect clearing.
- For most of the U.S., strong and steady winds from the south-to-east indicate rain within 36 hours.
- If air temperatures do not fall after a thunderstorm, expect a second 'boomer.

Plants foretell approaching storms by showing their leaf undersides. This is especially noticeable with maples and plants with light-colored leaf undersides. As leaves emerge from buds, they expand and align with average wind circulation patterns; irregular winds associated with approaching storms can upturn leaves. The curling of rhododendron leaves helps me to estimate temperature, with leaves rolling tighter as it gets colder. When the rhodies' leaves are rolled as tight as a pencil, I know the temperatures are in the lower teens.

I have trained myself to be a fairly accurate local weather predictor by being sensitive to and aware of changing conditions within the context of my region's seasonal and daily cycles. Knowing the normal relative humidity cycle of high humidity in morning, drier air in the afternoon, and increasing moisture through the night, I notice subtle changes in humidity, especially as they deviate from the norm. I have learned to guess temperature within a few degrees (I practice a lot...), so I notice changes out of the ordinary. The average human can detect temperature changes of 2-3° F., most easily upon the cheek.

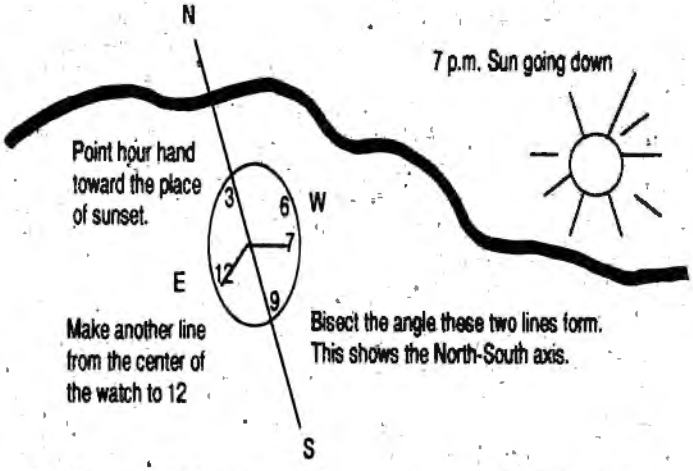
Wind Speed Estimation Through Tree Observation

Wind speed and direction can be closely estimated by observing movement in twigs, leaves, and tree branches. Wind at 3-5 mph can be felt on the face.

The Beaufort Wind Scale was developed for sailors, but can be used on land. For example,

- A gentle breeze (8-12 miles per hour) will keep leaves and small twigs in constant motion.
- A moderate breeze (13-18 mph) moves small branches and blows loose paper.
- A fresh breeze (19-24 mph) causes small trees in leaf to sway.
- A strong breeze (25-31 mph) keeps large branches in constant motion and may cause whistling sounds from wires.
- With a moderate gale (31-38 mph), whole trees are kept in motion.
- Twigs and branches break off in fresh gales (39-46 mph) and walking becomes very difficult.
- Trees are uprooted in whole gales (rarely experienced inland) of 55-63 mph.

Figure 1. Determining direction without a compass



Wind speeds help us to predict approaching weather, but are also important in determining the kind of clothing we need to wear for comfort. Since wind exaggerates the felt effects of cold temperatures (wind chill), wind speed can make an important difference to anyone working outdoors or hiking. Hypothermia, a drop in the body's core temperature, can occur anytime air temperatures drop to 50°F. or lower, if windchill, exposure, or loss of metabolic energy is also a factor. While most references indicate shivering as a first sign of hypothermia, I notice that my vision becomes blurred, I have difficulty focusing my eyes, and I am slower thinking prior to the onset of shivering. That's when I put on more clothing!

Determining Direction Without a Compass

If you do not have a compass, you can still determine the wind direction (or just plain direction for other purposes) if the sun is visible and you know what time it is. The sun is always due south at noon local time. If Daylight Savings Time is in effect, subtract an hour to get Standard time.

If I point my watch's hour hand at the sun, and then draw an imaginary line that bisects the angle formed between the line from the center of the clock and 12 and the center of the clock and whatever hour it is, the resulting line will point north-south, with the sun always toward the south in the northern hemisphere. *(See Figure 1)* This trick works with digital watches if you just convert the time to an imagined radial watch dial and determine the line between current time and noon on the imaginary dial.

Consult with Local Farmers

Climatic summaries are widely available but need to be used with local knowledge of micro-conditions. For example, I consult with farmers in the southern Appalachian Mountains—their local knowledge of the weather can mean the difference

between harvesting well-dried hay and losing the crop due to spoilage from high moisture content. Since their yearly economy hinges on these critical decisions, they have become quite skilled.

Though one can often guess which valleys and slopes are drier or wetter by the types of vegetation growing there—pine and oak forests are generally drier than maple or beech forests—the subtle temperature and humidity differences between local valleys and surrounding ridges, combined with the interplay of winds off ridges and slopes make guessing the weather in the mountains quite a challenge. Valley weather can vary dramatically in a few miles or a few minutes. It is often said here that "if you don't like the weather, wait five minutes," which hints at the variability of local conditions. Farmers have shown me their time-tested weather knowledge by advising me to ignore a rain shower coming from one direction, but warning that if the wind shifts and start coming from a particular direction (unique to each valley depending on its orientation and proximity to high mountain ridges), stop what you're doing immediately and run for the truck! Experienced farmers will be able to tell a short shower which will pass from an all-day rain settling in.

I have often seen the entire hydrologic cycle revealed in a single day in the mountains—morning fogs melt and rise when sunshine peeks over surrounding ridges. Fogs thin and swirl upward as temperatures rise and moisture climbs invisibly to the sky. Clouds form at distinct heights along the mountainsides (marking dew points associated with cooler sky temperatures), often producing local thunderstorms in summer. Sometimes these are so regular that it may rain at 4 o'clock each day for a week. These short thunderstorms drop the moisture back to the ground, whence morning fogs develop...and the daily cycle continues. Commonly after a summer rain front, we get afternoon showers for several days, since local moisture is available for cloud-making, but these local storms lessen in intensity as the average moisture content of the atmosphere drops.

Weather affects us all, so we might as well get good at observing and predicting it. The best weather prognosticator I know of is a dowser who listens to his inner voice about the severity of winters: if he gets a feeling to cut more wood, he listens to that feeling and cuts accordingly. He always has just the right amount of wood for the season. I would hope to be so good!

Facts on Types of Clouds

by Morgan Marshall-Clark (a kid...)

Fact 1: Big fluffy Cumulus clouds are nice-weather clouds, going upward from a flat base.

Fact 2: Cirrus clouds are made up of thousands of ice crystals. These clouds are 10,000 feet or even higher! These clouds are usually so thin that the sun shines through them. They are nicknamed "horsetails" because that is what they look like.

Fact 3: Nimbostratus clouds are gray sheets that cover most of the sky. Here and there, sunlight can be seen.

Fact 4: Stratus (or layer) clouds cover much of the sky. They are usually continuous or connect and are often gray and laden with rain or snow. They are usually spread over large places.

Fact 5: Altocumulus clouds are white or gray sheets with rounded pells (bumps on the bottom), which may be separate or merge together.

Fact 6: Stratocumulus clouds are usually lower than nimbostratus clouds. They are usually gray or white rounded masses that may merge or be separate.

Fact 7: Cumulonimbus clouds are heavy towers. Their tops are often flattened into trapezoidal shapes, which are storm clouds.

Fact 8: Cirrocumulus clouds are thin white clouds with grains and ripples which are quite regular in appearance.

References

It's Raining Cats and Dogs
Weather: A Kid Book

Morgan Marshall-Clark is nine years old and lives, reads, writes, and builds fantastic Lego structures at Earthaven in the mountains of North Carolina.

Recommended Reading

David Ludlum. 1991. *The Audubon Society Field Guide to North American Weather.* Alfred Knopf. 636 pgs. - wonderful guide to weather including 378 photos of clouds, and unusual weather phenomenon. Widely available.

William Reifsnyder. 1980. *Weathering the Wilderness: The Sierra Club Guide to Practical Meteorology.* Sierra Club Books. 276 pgs. - excellent introduction to weather, esp. for hikers and campers, but with detailed U.S. regional climatologies.

Robert Fisher. 1951. *How to Know and Predict the Weather.* Mentor Books.167 pgs. - classic overview of weather reading tips.

Eric Sloane. *Eric Sloane's Weather Book,* and 1963. *Folklore of American Weather.* Hawthorn Press. Both books are delightfully illustrated, with much practical knowledge.

U.S. Dept, of Commerce - N.O.A.A. 1968. *Climatic Atlas of the United States.* Reprinted 1993. National Climatic Data Center, Federal Bldg., Asheville, NC 28801-2733, Attn: Publications. 80 pgs. - wonderful collection of weather maps printed as oversized folio (16" x 22" spiral bound). Data summaries include 271 climatic maps covering the years 1931-1960 with precipitation and temperature means, frost-free periods, monthly wind speeds and directions, snowfall, monthly mean percentage of possible sunshine, etc. An incredible bargain for map lovers at $15.00 plus shipping.

WWW sites not to miss:

intellicast.com	ncdc.noaa.gov.
atmos.uiuc.edu	met.fsu.edu.

Lee Barnes is a naturalist and avid bioregional proponent of his adopted homeland Katúah, the Southern Appalachian Mtns. He has been a weather reporter, agricultural extension agent, and professional nurseryman, and was awarded a Ph.D. in horticulture from the University of Florida for research into specialized aspects of tissue culture. Lee teaches permaculture, makes jewelry, and is the author of a guide to the hiking trails of the Great Smoky Mountains. He is training himself to be a dowser. Contact him at Box 1303, Waynesville, NC 28789, or by email: lbarnes@primeline.com.

*"The answer, my Friend, is blowing in the wind..."**

Prolegomena to a Pattern Language for the New Village *(part 2)*

"Empowering a generation of nomads for the work only they have the freedom to do."

Paul Caron

It has been said that at this point in human evolution all problems have been reduced to the problem of human consciousness. Whereas fifty or sixty years ago, the solutions to various situations, such as disease, poverty, and war, were handicapped by obstacles of a logistical nature, it does now seem that with the growth in the power of technology, these limitations have tended to recede in importance. Limitations in perception and attitude, not understanding the true nature of our situation, and large populations lacking the *collective will* to make obviously sensible choices have come forward as the main obstacles to escaping the crisis of unsustainable modern culture. What we have gained in material mastery we have lost in spiritual dimension.

The process of gaining power and control in these spiritual dimensions has always been called "education." However, this does not necessarily mean more emphasis should be placed on "institutions of higher learning."

Education and the Demise of the University

Since the mid-50s, when the corporate insight took hold that the level of money growth experienced in the economy during wartime could be sustained during peacetime by driving consumption, the trend in the university system has been increasingly toward adapting its goals to those of the market. Seeking the universal has taken a backseat to producing skills to fuel machine production, to make people "fit" for the job market.

What's wrong with the market? Consumption is no longer driven by needs but by desires. Needs are not created by language. They exist completely beyond human control although they may change. The need for clothing and food defines our embodiment, something which it is difficult to conceive of doing/being without. Desires, on the other hand, are easily created and manipulated. Through the powerful engine of advertising language, the manipulation of desires has predominately replaced the satisfaction of needs as the basis of the modern economy.

The need for community exists in the same way as the need for food and warmth. As the market tears apart the human family, liquidating older forms of social and even biological capital in order to tap, however briefly, their generative power, that is becoming apparent. Returning to the university, we find it a sort of high-tech trade school. It also moves toward a centralized means of social control by monopolizing the industry of knowledge, gathering and harnessing it into industrial production, and by serving as a training facility to the interests of the market. People's real needs are sacrificed to the economic imperative to convert as much of the earth's resource into money as possible. In this type of centralized system, research into alternative cultural options is not encouraged, to say the least.

What is needed is an alternative to the university or a return to the study of "universals."

A New Place of Learning

In the new human-scale village we are in the process of envisioning, the old model of a hierarchy of education, where "teaching" proceeds down from academic institutions to secondary then primary schools is giving way to learning by individuals motivated by personal choice, as the sharing of skills by people who possess them replaces training. In such a permaculture-based system of education, every element serves multiple functions and all functions are fulfilled by multiple elements. This implies the whole communal life of a living community becoming an informal educational matrix, and each activity within it an opportunity for more formal learning. In *A Pattern Language,* (1) this conception of community-based learning is described in the patterns "Network of Learning," "University as a Marketplace," and "Master & Apprentices."

Besides providing general education, we want this community-based education marketplace to form a specific response to the crisis we face as a species. There are two distinct questions here: What type of learning is essential to evolve our culture (our collective mind) in a sustainable direction, and how or by whom ought new models be implemented through the mass of society.

The Modern Crisis and the Archaic Revival

In answering these questions, I want to focus on a phenomenon which has been referred to by Terence McKenna as "The Archaic Revival."(2) In a nutshell, this is the concept that when a culture or society gets into an historical evolutionary *cul de sac,* when it loses its forward thrust, when its motivation falters and ceases to make sense, people will reach back to an earlier stage of their development in a search for models that make sense and that will give them inspiration to proceed beyond the obstacles they face. A recent example would be the classicism of the late Middle Ages, a revisiting of the ideals of the Hellenic world which led to the extraordinary flowering of culture that was the Italian Renaissance.

McKenna's main thesis is that our crisis is so profound that we must reach back to the very dawn of culture to find a moment which makes sense in light of our present predicament. Thus we have about us today everything from neo-paganism to shamanic healing and body piercing and scarification. At this point, there is a very great temptation towards what Hegel called "romantic primitivism." In his day (1820s-30s), it was rampant in the fraternities of the German university in the form of a cult of Germanic nationalism, and probably very directly led to the rise of Nazism 100 years later. We cannot expect naively to adopt the form of what we imagine to be "tribal" or "earth-centered" spirituality while we still live modern consumerist lives in which the main imperative is comfort: comfort and the satisfaction of as

many of our desires as possible. Rather we need to look to the Archaic as a structural model and adapt what we can of its virtues to our situation.

Nomadism and Atonement

Two characteristics of life in the Archaic period (late Neolithic era) are prominently linked to our situation today. Tribal peoples were—and still are in parts of the world where they survive—*nomadic*, and they practiced a spirituality based on the premise and probably the direct experience that the individual exists essentially as a part of the group as well as of the world at large (animals, trees, nature...).

The meaning of the crisis we are in hinges on the understanding of these two facets of neolithic life. For us the context of life is not isolated tribes nor even villages, but a global society possessing weapons of mass destruction. That is why the New Village movement must have education as its central purpose.

In short we need to focus on the kind of education needed to develop and implement new models of sustainable lifeways. This may involve a lot of information, but the essence of the pedagogical task is really one of demonstrating that an alternative is possible. Education that takes place in a community setting reaches to the heart of the matter. Besides specific teaching and learning about "subject matter," the community experience informs all the time experientially. What people need is to feel what a sane life would be like. We can each then take the concrete steps needed to create that in our own spheres.

New Messengers of Culture

I have become aware of a particular group of people who are especially open to the transformative power of what I am describing, those I refer to as "nomad youth." Feeling alienated from society's mainstream—in fact seeing no real future in it—hordes (scores) of young people have forgone college and even high school for a life on the road. Many are just burnt-out or lost, but quite a few are sincerely and consciously searching for alternatives to the dead end that is plainly in store for them in the late 20th century global economy. They are aware that sometime in their lifetimes everything may come to a crashing halt, and that they will need skills to survive on the land. What is probably not directly apparent, but is essential to know, is that not only now, but always, living on the land is a communal enterprise.

If it is to be effective, that is, really make a difference in the transition from the self-destructive path we are on to the road less traveled, the Communities movement, or the New Village network, requires a mechanism of knowledge transfer, so that experiments do not need to be repeated over and over, and successes in one location can inspire good progress throughout the whole. Besides using conscious and direct means such as classes, conferences, newsletters, and other printed and electronic media for its outreach, the New Village must spawn a cultural, that is to say, organic and body-centered transmission of the new paradigm. Nomad youth inspired in these cultural hothouses could function somewhat like spores, spreading memes, or thought forms, through the linkups of the communities they visit, staying a month here, a year there...

Not just the passing round of particular techniques developed at one place, but a general raising of the level of awareness of co-operation must be stimulated. A substance of *we-feeling*— would be spread throughout the whole network of ecovillages. The infusion of young energy and enthusiasm is also needed by developing villages. Making a very appreciated contribution to what promises to be part of the solution to the global culture crisis will empower hope in the lives of those who will need it most. While the generation in their prime now is taking the lead in developing models, when it comes to implementing the solutions to problems, establishing sustainable culture, it will be today's youth to whom the task will fall.

I am not talking about a salvage operation for the dregs of society. What we want is to empower those individuals who have potential to take great benefit from the experience of community, those who will go out into the world and make a difference. Many of the people who are on the road now will not choose to live in rural settings; this is good. Village life must take root right downtown, and in every city block and every suburban neighborhood if it is to be more than a quaint side note to the general decline. Yet it is in these mostly rural laboratories, remote from administrative control, that the new paradigm is being hammered out. For mutual benefit and for the success of our mission, a well-functioning ecovillage network will have many provisions to bring in and many leavening agents to interact with this mass of youth.

The developing Youth Center at The Farm (described by Patricia Allison in her article "Creating a Teenage Society," in *Permaculture Activist* #35) could serve as a model for what this might look like in individual communities. There are no doubt others. When this type of program developing independently in many places is linked up by a process of references and referrals, learning and sharing skills would become a trans-network system, e.g. masters of many trade skills and even academic subjects in villages all over the country could offer their classes and apprenticeships to youth directed to them from throughout the network. What we would have at that point might look quite like a "Permaculture University."

References

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* *Lyrics by Bob Dylan, 1962.*

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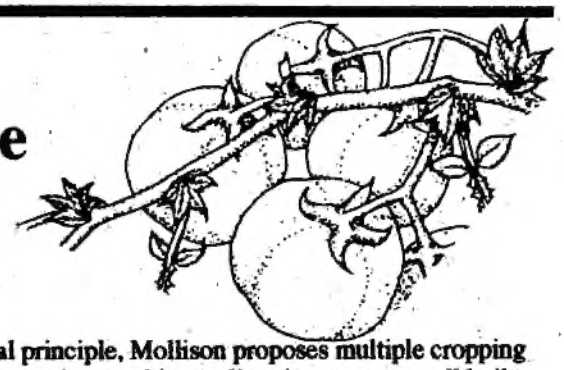
Dance the Seasons:
Catastrophe and Climate Change



Jamey Thompson

Successful permaculture design depends on integrating many factors: soil, water, vegetation, human energy, and the placement of structures. But whether we are concerned with the production of crops or the choice of construction materials, climate is our first consideration. As we enter the brave new world of climate shift, we can be sure only that climate will change in ways we cannot predict. Familiar weather patterns are giving way to the unknown, challenging us to hone our patterning skills. We must learn to ask: What limits can I expect to meet on this site? How much will the climate change for this area? And when will the shifts occur? The extremes of the last decade may represent a "burp" in a cycle or the shift to a new one. Their causes are unknown and may even be unknowable to us. Either way, they emphasize the impact of climate on design and encourage us to plan for a wider climate range at whatever site we have care of.

What exactly are we in for? Getting any climatologist to give solid predictions for next week is dicey, let alone for the next decade, but there are a few things most climate scientists will agree on:

1. Solar input will stay the same.
2. Prevailing winds won't change.
3. Rainfall patterns may shift.
4. Cloudiness may change.
5. Average temperatures are increasing.
6. Sea levels may increase dramatically.
7. Extremes will occur more often.

So while different areas of the continent can expect different effects, the overall picture is disturbed everywhere: record droughts, floods, and unseasonable weather. In the face of more chaotic weather patterns, is there any reason to change the guidelines for permaculture design?

Past Climate Considerations

The introduction to Mollison's chapter on climate in *Permaculture: A Designers Manual* offers an excellent summary of climate effects on design. Noting the uncertainty of prediction in respect to complex and chaotic systems such as weather, he boldly asserts, *"We should always allow for variability"* (original italics), and goes on to provide a broad classification of climatic zones along with the main qualifying factors which influence climate regionally. He describes patterning in global weather systems and the engine of the atmosphere as it establishes the prevailing winds, and notes a number of little-recognized forms of precipitation and their importance in local climate regimes, e.g. coastal fogs, dew, etc., along with the principal processes by which rainfall develops. Citing examples of traditional and non-traditional water-collection techniques, he emphasizes the importance of working with these nearly invisible climatic effects. In his treatment of radiation and wind effects, however, he exceeds even these useful remarks, providing both a clear scheme of microclimatic patterns and a wealth of example for the attentive reader.

As a general principle, Mollison proposes multiple cropping and building strategies to mitigate climatic extremes—all built upon a thorough understanding of the local soil, geography, wind, vegetation and, of course, their interactions.

I believe this chapter to be a great touchstone for design: "It is the local climate that inevitably decides our sector strategies," Mollison advises. Sectors describe those influences—and their geographical relationship to a particular piece of land—which come from off-site, for example storm, fire, pollution, wildlife migrations, prevailing winds, etc. The aim, of course, is to create beneficial microclimates. This is the key to increasing yields in complex designs. But even more importantly, a heightened awareness of microclimate prompts us to look more carefully at our everyday surroundings, opening us to the world of functional relationships which support the web of life.

Climate Effects on Systems

Any shift in climate patterns will affect biological systems and force them to adapt or collapse. Agricultural systems will probably adapt easily (i.e. with a lot of effort and capital), but the wilder communities will probably adapt much more slowly on the local level, due to lower resilience. A resilient population has the genetic resources to adapt quickly to new conditions, usually meaning either a short generation time (insects) or a large gene pool (oaks). A resilient community is much more difficult to describe, but in general it relies on the health of the exchange functions in the community. At what point a community is no longer functioning in a healthy manner is hard to tell until after the fact, but I think that human-induced stresses through deforestation, development, and the extinction of species are combining with the natural stresses of climate to pitch many biological communities into the danger zone. Already, we face a crisis situation in some communities such as Appalachian Cove Forests and regenerating stands of oak-maple forest.

I also think climate change is central to the debate on sustainable uses of Zone III through V (commercial agriculture, pasture and woodland, and wilderness, respectively) since the inner zones (I and II, garden and orchard—food for home consumption) depend heavily on nutrient and elemental cycles from the outer, wilder zones. As marginal and sensitive species go locally extinct and natural systems shift, the balance of energy flows between the inner and outer zones will change radically. The surrounding biotic communities are our "support system," and if we don't start working to heal them now, we may be powerless to prevent their collapse later. We can hope there won't be such a collapse or catastrophic shift, but to plan for the future without considering the health of natural systems beyond our backyard is folly.

Permaculture Strategies for Climate Change

I don't think that either recent weather or research on climate's effect on biotic communities call for revamping permaculture guidelines. I do think the importance of climate

cannot be overestimated in sustainable design. Where predictions fail, caution is king.

Observation is our first and best course. Patterning skills arise from a deep understanding of the interactions around us. They are the base of any future land wisdom we might hope to pass on to our children. The point is to go beyond observation and learn to "dance the seasons," celebrating what we are a part of. Here are some suggestions I have found helpful:

1. **Keep a journal of the weather and its effects on vegetation and wildlife.** Saying, "Last winter was a doozy," doesn't say as much as, "It dropped to 25 below and the peach tree trained on the barn wall died back, but the one on the house didn't." Knowing both the weather and its effects provides a record of interactions—the key to becoming a good pattern interpreter.

2. **Find or collect a regional plant sourcebook.** The best records of which plants can survive and which already live in your area are the state guide to flora and your Coop Extension Agent's brain. The flora guide will give the current native and naturalized residents of the state which you can whittle down to region: The Extension agent is your source for agricultural plants that grow well around you. Great sources of information and free (after taxes)!

3. **Keep a running local plant inventory for your property.** This is not as hard as it seems. It is not necessary to know every single plant on the site at the start; sometimes just knowing the keystone or indicator species is enough to get an idea of what is going on in the community. Look for easy-to-spot indicators in various guilds and track them year after year. The more you know about long-term trends, the better choices you can make.

4. **Always seek out local history and anecdotes.** Even if you don't believe a word about the size of the tomatoes growing behind the outhouse, there are gems of truth in any story. Recently, I heard a tale about peaches growing here in northern Vermont—almost inconceivable. The elderly growers dodged around my questions about exposure, fertilizing, and spraying schedule and kept telling me about the peach cobbler they got from the harvest. Turns out they were growing the peach tree on the south side of the house, sheltered by walls and buildings, and facing Lake Champlain. That is the secret to peaches in northern Vermont—which even Extension Agents don't know!

Strategies for Zones I & II

The first and most important strategy for inner zones is **healthy systems at the start.** In temperate climates healthy plants depend on healthy soil. Fertilizing will never be enough if the soil lacks a single major nutrient, so use soil tests to determine limiting nutrients, then build up fertility using composts, cover crops, and mulch before expecting to sustain intensive production. Animals are another important link in the fertility cycle—intensive pasture graziers have a lot of information to offer here.

The next strategy is one of the oldest: **seed-saving.** Saving your own seeds is a form of plant breeding because you choose seed from the best-adapted plants for your own garden to grow for next year's seedlings. Over the long term, this actually develops a complex of genotypes uniquely suited to your site. Some farmers in Oaxaca, Mexico have strains particular to certain fields that are centuries old. May we hope to match that! Heirloom varieties may or may not be more adapted to variable climate, but the odds are in their favor since they have been around longer and survived wider swings in climate than this year's hybrids. The best bet is to grow seed that has a record locally or regionally (look for local seed savers and become one yourself).

Don't put all your eggs in one basket. Plant multiple staple crops. It also helps to grow a number of varieties of important crops. The Oaxacan farmers grow several strains to insure that at least one of their crops will do well. We can grow early, mid- and late season tomatoes or apples and spread the risk in the same way.

The last major strategy is, **"Plan for extremes."** There is not much you can do to stop a tornado, hurricane, or blizzard, but you can buffer the effects of some extremes with a little planning. Raised beds promote better drainage, hedgerows give wind shadows, walls radiate heat to tender crops. A little bit of extra thought in the beginning could make a world of difference—especially for peaches in Vermont.

Strategies for Zones III, IV & V

Wild areas form the foundation of the inner zones' energy and material cycles. Therefore our larger-scale approaches to mitigating climate change involve mitigating human disturbances as well. We must buffer and manage for very small "footprints" as we move outward from our homes and settlements. Restoring streams and rehabilitating forests will be necessary in some areas. Here are four broad guidelines:

1. **Human activities should mimic natural disturbances,** especially on small plots. See work in natural selection forestry, prairie restoration, and intensive grazing management for further guidance.

2. **When in doubt, do nothing.** If you don't need to manage an area to minimize human disturbance, then don't. There are other areas that need active help. *(The best source of information on restoration work is The Society for Ecological Restoration, 1207 Seminole Parkway, Madison WI 53711.)* Talk to local restoration ecologists to see what works.

3. **Think big.** Work to integrate Zone V areas with surrounding wild areas in a regional network. The Wildlands Project coordinates regional conservation projects in your area: 1955 W. Grant Rd., Suite 148A, Tucson AZ 85745.

4. **"Share and share alike in the Great Potlatch."** It always comes back to you. You can't save the world, but you help heal your corner of it every morning. Δ

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Windbreaks—Tried and True

Erik Ronneberg

There is nothing new under the sun. As interest in sustainable agriculture and permaculture grows, many old ideas are coming back into favor. One of these ideas is windbreaks.

Windbreaks are rows of trees or shrubs planted around fields to block the wind. They came into favor in the US during the 1930s, when President Roosevelt proposed planting them from Canada to Texas, to stop the Dust Bowl from advancing eastward. With clouds of dust blowing off the Great Plains reaching Washington, DC, something needed to be done. The Soil Conservation Service was started by Hugh Bennett appealing for funds as the skies darkened over the nation's capital. S.C.S. ran the Shelterbelt Project during the 30s and 40s, which led to thousands of miles of treelines being planted.

With the end of World War II came the rise of chemical agriculture, and a retooling of the nation's infrastructure. The government and the land grant colleges shifted focus from conservation to production, and many farmers lost interest in windbreaks, favoring larger fields that could accommodate larger tractors. Windbreaks were seen as trees taking crop land out of production. High grain prices encouraged farmers to plow from fencerow to fencerow. Except in the north central states (Montana, North and South Dakota, Nebraska, and Minnesota) where cold winds remain a severe environmental challenge, windbreak planting and maintenance languished or become sporadic throughout much of the United States.

Why Windbreaks are Important

A look at plant physiology reveals the value of windbreaks. Plants transpire as water evaporates through the stomata, tiny pores on the underside of the leaves. In windy conditions plants must close their stomata as the roots can't take up enough water to compensate for the loss. Closed stomata stop evaporation losses, but they also mean that the plant isn't taking up carbon dioxide, and isn't growing. A plant can also be directly injured by wind, and small seedlings are vulnerable to being cut off by blowing particles of sand.

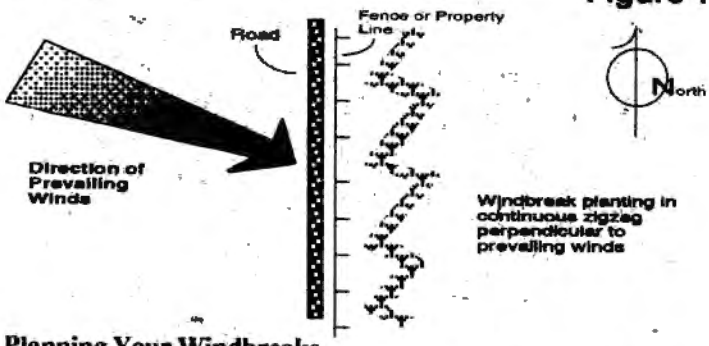
Numerous studies have shown that crops grown in the shelter of a windbreak have higher yields. Sixteen studies on winter wheat showed an average yield increase of 23%. Six studies on corn showed an average yield increase of 12%. Fruit crops show yield increases, in part because bees and other pollinating insects, which can't operate in high winds, can do a more thorough job.

Livestock also benefit from shelter, especially sheep giving birth to lambs. In Australia, windbreaks and other agroforestry practices are common; they go straight to the farmer's bottom line by directly cutting otherwise tremendous rates of lamb mortality. And working outside is made a lot easier on humans if there is shelter from chilling winds.

In addition to improving the microclimate of fields and pastures both windward (up to 5 times height of the trees) and leeward (up to 10 times tree height), windbreaks can provide a direct harvest, depending on the selection of species planted. If several rows of trees are planted, the middle row can be pruned up for sawlog production, as protection will still be provided by lower branches on outside rows. Thinnings from other rows of the windbreak can be used for firewood or pulpwood. Windbreaks have doubled as a source for Christmas trees, especially since the species used for that purpose are planted thickly and need to be thinned out. It is unrealistic to expect commercial crops from fruit or nut trees planted in a windbreak, but mast and forage for bees and for wild and domestic animals can be part of the yield from a well-planned windbreak or hedgerow. Crabs or seedling apples could be one of the middle height rows of a multi-row planting, for example.

Windbreaks provide habitat and travel corridors for wildlife. Quail, rabbits, and pheasants are popular upland game species, and hunters will always head for the windbreaks and brush to find them. Birds and beneficial insects in windbreaks provide excellent natural pest control. Indeed the windbreaks on a farm should be considered biological refuges for beneficial insects, from which they can repopulate the periodically harvested crop fields.

Figure 1



Planning Your Windbreaks

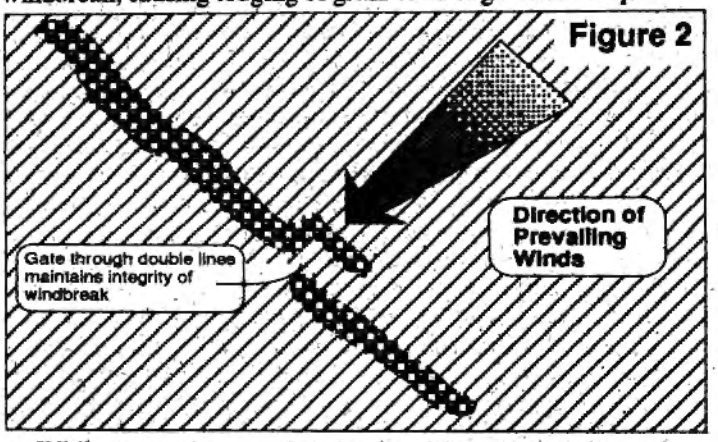
Windbreaks require planning, not only in placement, but in shape and composition. Careful thought must of course be taken so that tree planting doesn't interfere with power lines or tile drainage lines, cause snow drifts over roads, or block important lines of vision. It is preferable to plant evergreen windbreaks to the north side of roads, rather than the south, where their winter shade would cause snow and ice to build up and remain longer on the road surface. Winds will whip around the ends of windbreaks, so place them where this won't cause problems.

Wind accelerates along a surface, so for greatest effect, windbreaks should be placed exactly perpendicular to the direction of the prevailing wind (northwesterly in most parts of the northern U.S. and Canada during winter). Unfortunately, most windbreaks are planted along property or fence lines (often aligned due north/south or east/west) to keep them at the margin of productive land. A design which solves this dilemma is a saw-tooth pattern (see Figure 1) with short, connected sections of the windbreak directly facing the wind in a "stepped" manner. The design of gates and openings in a windbreak is crucial because wind is accelerated through any gap or break in the trees. Where a gate is needed, as between fields, two lines of trees should be offset and overlapped such that the wind is deflected, not funneled (see Fig. 2).

Because of the effect of wind accelerating through any gaps, it is important to plant multiple rows of different heights to ensure good coverage from the ground up. Three to five rows is best, with the tallest species in the middle, and low, dense shrubs, or smaller trees on the outside rows. This allows a selection of different species, ensuring that some will survive even if pests, drought, disease, or changing conditions devastate others. Multi-

row design provides redundancy, ensuring that the windbreak won't fail, and it supports diversity and multiple functions, all vital permaculture principles.

The profile of a multi-row windbreak should be contoured like an airplane wing, rather than abrupt like a wall (see Fig. 3). A contoured surface lifts and lowers the wind gradually, preventing turbulence, where a sharp barrier creates eddies in the airstream downwind, which can drop sharply into crop areas behind the windbreak, causing lodging of grain or damage to tree crops.



While preventing gaps is important, it is preferable that the windbreak be about 40-50% permeable so that it allows a portion of the air to move through it, albeit more slowly. The rest of the wind is lifted up and over. Like abrupt vertical barriers, overly dense windbreaks contribute to turbulence downwind.

The effect of windbreaks extends both down- and upwind. The effect to the lee extends horizontally to about 30 times the height of the break, but most of this downwind effect occurs in the first 10 times height. For continuous coverage across wide fields, plant another windbreak at that point. Because of the lifting effect of increased air pressure on the windward side, a still place is created in front of the windbreak. This still area extends out a distance about equal to five times the height of the tallest trees. Test it by standing in front of a wall facing the wind!

Establishment and Maintenance

In getting a windbreak started, young trees must be protected from weeds and animals, and watered in drought times to ensure survival. Often a windbreak fails for lack of maintenance, especially weed control. Grass can choke out young trees very easily.

As windbreaks mature they still require attention, especially thinning. Each tree should have enough space for green branches all the way to the ground. It is better to remove some trees rather than have many weak trees crammed together. Some windbreaks are planted with a row of a fast-growing species, such as hybrid poplar, followed up with a row of evergreens. In severe conditions of wind, cold, or aridity, it is important to plant species which will survive and grow, even if they are not ideal. Poplar, for instance, does not live long, but its rapid growth rate allows it to quickly modify environmental conditions for trees which are behind it.

Unfortunately, mature windbreaks are often bulldozed out, and new ones planted, when it is preferable to prune the roots with a deep ripper, and plant a new row of replacement trees to the windward side. Continuous shelter is the idea. When the older trees are ready to be cut down, the new ones will be ready to take over.

For any big tree planting project, it is practical to use a tree planter, which is pulled behind a tractor. Tree planters save a huge amount of time, and often do a better job than hand planting. Young trees can be cultivated for weeds mechanically if they're planted in a straight line with a tree planter, although, as mentioned above, this may not be the only design consideration. Trees should be spaced to allow mowers between rows. Two or more staggered rows are always preferable to one, since with only one row, if a tree dies there will be a gap that the wind can whip through with concentrated force.

There is no substitute for experience. Be sure to talk to people with experience before doing anything. Just finding a source for high quality tree seedlings takes time. Large projects may be eligible for various government cost sharing programs, but sometimes the conditions attached aren't worth the hassle.

Windbreaks are an important way of creating favorable micro-climates for plants, animals, and human dwellings. They provide multiple benefits such as crop protection, improved livestock health, increased yields, wildlife habitat, and energy conservation. With careful design and maintenance, a windbreak can greatly add to the quality of life on any farm or suburban homesite . Δ

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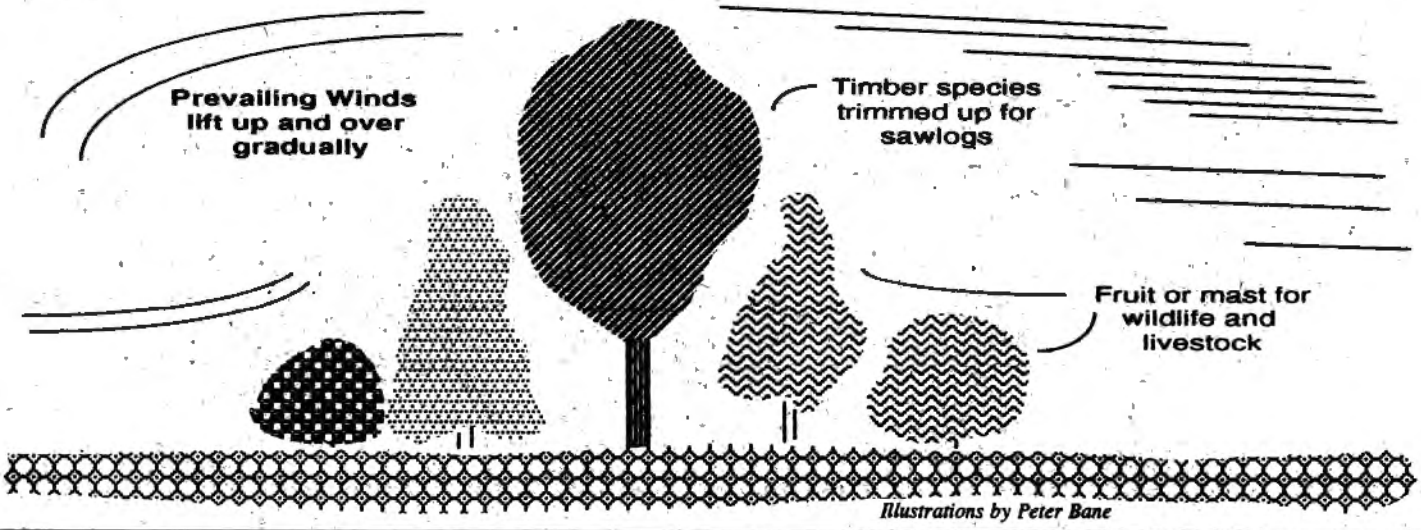
Figure 3



Illustrations by Peter Bane

WINDICATORS

A simple way to observe breezes and wind patterns

Chuck Marsh

The wind is a primary elemental force. Its effect on us is often unseen, but wind's presence is always felt with the body. And it has a great influence on our human comfort when we are exposed to it. Local, microclimatic winds and breezes will effect not only our human comfort, but also the energy costs for heating and cooling our homes and workplaces as well as the health and productivity of the plants and animals in our care.

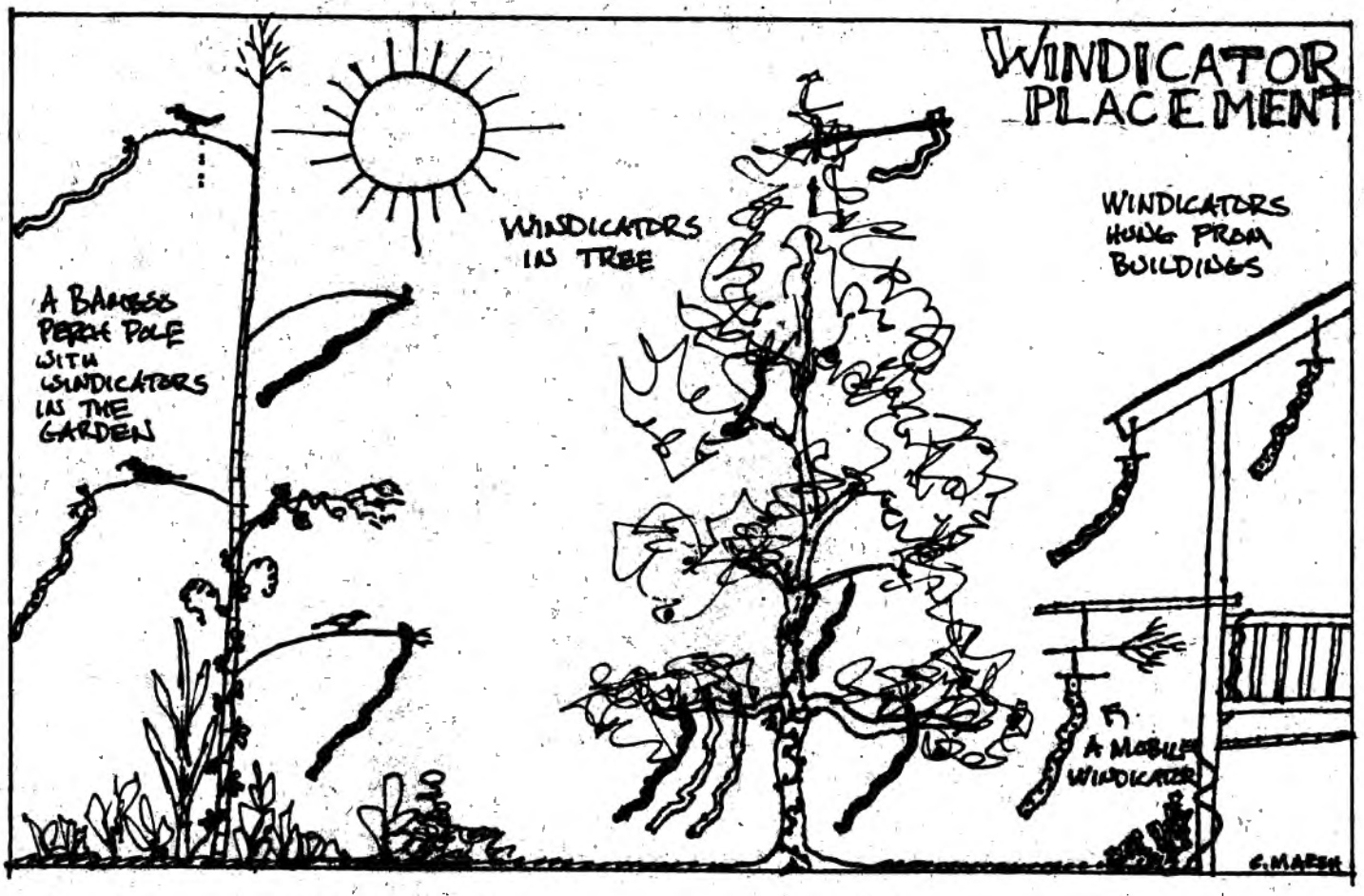
Because of the wind's capricious and invisible nature, it is often difficult to determine its patterns and microclimatic effects on a site from simple observation, unless the winds are strong and steady enough to cause flagging of perennial vegetation. However, a simple tool, which I have called the windicator, coaxes elusive breezes into a visual form that gives us useful information for designing permaculture systems.

So what are windicators? They are ribbons or strips of lightweight cloth hung at various heights and locations around a site so that as they flutter and dance they show the relative speed and direction of even the lightest of breezes. As an added function, cloth windicators will also absorb moisture from the air and so can be used to detect microclimatic variations in air moisture levels from the ground up, particularly at night.

Nothing could be simpler than making and installing windicators. And once installed, windicators require almost no maintenance other than occasional untangling; they will give you continual input (and delight) for many seasons.

To make windicators, tear any lightweight, colorful cloth, such as a cotton broadcloth, into strips about 1"-2" (3-5cm) wide by 2'-3' (0.6-1m) long. (Wider and longer strips don't seem to be as responsive in the wind.) These strips can then be hung from horizontal tree branches—make sure to prune away any twigs that might entangle the windicator—or from poles with horizontal branches left every 3 or 4 feet for tying the windicators to. To make the windicators even more sensitive, the top of the cloth strip can be glued or sewn to a small stick that is then counterweighted and hung from a sturdy thread at the balance point, making a mobile.

I have observed that windicator poles are also used by insect-eating birds such as flycatchers. So by placing them around the garden at strategic locations, I encourage my avian friends to patrol the garden air space for pests. Since birds routinely drop manure before taking flight, the ground beneath these garden flagpoles is fertilized by the phosphate-rich droppings. The



advanced student of *feng shui* or dowsing can locate the poles for maximum beneficial "acupuncture" effect on the local energy meridians.

Hang the windicators at different heights, from near ground level on up, and at different locations around the site. Particularly, choose places where you would expect variations in wind speed and direction. (Any sharp break in the landscape contour, or corner of a building is a likely spot.) It is also helpful to place them so they are visible from inside your dwelling or workspace. Just outside the kitchen or office windows are spots that will be regularly observed. In order to discern the varying wind patterns of the site and to collect really useful information (as if the delight of watching fluttering ribbons all over the place weren't enough), you'll need to spend lots of time observing your windicators, preferably from a hammock (relaxation always aids insight), at different times of day and during different seasons.

Windicators will provide you with *relative* information about a site's microclimatic wind speeds, direction, and moisture content over time at practically no cost. If you're so inclined (or reclined) you could probably calibrate your windicators to give more precise windspeed data based on the angle of inflection at various wind speeds. They're sure to stimulate lots of questions from visitors—what are those things hanging from the trees, anyway? And this provides a teachable moment to seize: rave on about wind and microclimate, or, depending upon your mood, spin off some tall tale about subtle energy streams or whatever you can dream up.

To sum up windicators, these simple cloth strips should be in every permaculture designer's box of tricks. Besides their artful function in adding color, motion, and whimsy to the landscape, windicators make the wind visible, and aid us in deepening our (or our client's) understanding of the winds and breezes on the sites we're working with. We can use what we learn to do a better job of locating homes, outbuildings, orchards, gardens, windbreaks, and other features of our permaculture landscape based partially on the site's seasonal wind patterns and air moisture levels. Besides, these little strips of cloth are a whole lot of fun to play with, and to let the wind play with as well. Δ

Chuck Marsh is a swirling speck of star dust, temporarily in human form. When he can be seduced out of the garden hammock, he teaches permaculture and other forms of creative play. A South Carolina endemic, he has migrated into the Blue Ridge Mountains of N. Carolina, but often winters in the Yucatan. The best sighting times are just before sunset. Watch for flocking behavior at the edge of human habitation, and listen for sounds of ribald laughter.

Understanding Microclimate

Lee Barnes and Peter Bane

Microclimates are local deviations from more regional climates, due primarily to topography, vegetation, heat modifying structures, water bodies, and soil cover. Microclimates can vary in size from a few square feet to several acres or more. As permaculture designers we need to be keen observers of these local variations so that we can incorporate and enhance them in the creation of more comfortable living spaces.

Since biological activity is directly influenced by average temperature, microclimate—the climate near the ground—is important not only to our comfort, but to the health and productivity of plants and animals. By the design and thoughtful placement of buildings, windbreaks, ponds, forest edges, and so forth, we can manipulate microclimate to increase the diversity and resilience of our agroecosystems. We can, for example, extend the growing season by hastening the warming of soils in spring and by delaying the onset of frost in autumn. We can make more favorable conditions for plants by increasing or decreasing soil temperatures, or minimizing day-to-night temperature fluctuations.

In order to do this we need to hone our observation skills, we need to understand the relation of topography, vegetation, water, structures, and soil cover to microclimate in general, and we need to study the range of climate and microclimate in our own regions.

Observation and Interpretation

We (along with other animals, insects, and plants) can directly sense subtle changes in temperature, humidity, wind direction, and wind speed. The average human can detect air temperature differences of about 2.5° F., enough sensitivity to notice significant microclimatic variation within a few feet. We can learn to identify microclimates by paying attention to these subtle temperature and humidity differences. Phenomena such as frost pockets, differences in fogs or dew deposits, thermal belts (where temperatures are affected by heat layering in the atmosphere), and places where snow or ice remain when nearby areas have melted, are all visible or palpable to the willing observer.

Beyond the body's direct senses we can learn to read the landscape indicators of climate and microclimate. Of these, topography provides our first interpretive filter. Natural plant communities, indicator plant species, plant phenology, and plant canopy structure are all vegetative clues to microclimate. Learning to detect existing microclimatic variations is critical to our success as landscape planners and caretakers.

In outlining the elements affecting microclimate Mollison focuses on topography and vegetation.(1) Elements of topography include elevation, aspect, slope, and drainage. Elevation is distance above sea level. Aspect is the relation of the land surface to the path of the sun through the sky, e.g. north-facing, easterly, etc. Slope is the degree of inclination from the horizontal. Drainage of both air and water is affected by the relation of the land to other land surfaces immediately nearby.

Topography influences:

- maximum and minimum temperatures
- aspect to sun
- cold air drainage
- wind speed and direction

Elements of vegetation include canopy structure, growth form, density and color of foliage, and texture of leaf surfaces.

Vegetation influences:

- shade and light reflection (albedo)
- air and soil moisture
- cooling by transpiration
- air movement
- heat gain and loss

The Effects of Topography

Elevation affects climate in several ways. Average air temperatures decrease about 3.5° F. (2°C.) for each 1000-foot increase. In the Southern Appalachians this means that each 1000-foot increase in elevation results in about a 10° F. (5.5°C.) difference in average minimum temperatures, approximately one hardiness zone colder than might be normal for a particular area. So, while our valleys at 3000 feet (900m) might expect a seasonal minimum temperature of 5° to -5° F. (-15° to -20°C, zone 6), a location at 4000 feet elevation will reach -5° to -15° F. (zone 5).

This has obvious implications for the selection of appropriate plants for the garden or orchard. The number of chilling-hours (usually measured as total hours between 28-40° F.) which temperate plants (esp. fruit trees and native perennials) require to overcome internal dormancy is also a factor to be considered. Stimulated by late winter warm spells, cultivars with low chilling hour requirements planted at too high an elevation may start to grow too soon, unless they are kept cooler due to placement (as on a north-aspected slope).

Aspect refers to the angle of the soil surface in relation to the path of the sun - aspect is considered by ecologists to be a major factor affecting plant community composition, in part due to seasonal moisture availability. South-facing steeper aspects are generally drier and better drained than less steep slopes. Angle to the sun greatly influences soil temperature, moisture loss, and root growth.

Two sites near each other with similar elevation, aspect, and slope may nevertheless have different drainage patterns because of the surrounding landscape, and thus they will have very different microclimates. Since cooler air is heavier than surrounding air, the coolest air flows as an invisible current close to the land's surface along the same broad drainage routes as water. Like water it can be slowed, stalled, or deflected from its descent by cross-slope barriers of earth, vegetation, or buildings, creating warmer or cooler microclimates. Knowledge of local air flow is especially important to avoid planting sensitive species in frost pockets, or to suggest better location of structures such as chicken coops and drying barns.

A natural layering of air temperatures occurs in valleys where the land slopes more than 1-to-2%, since cooler air drains to the lower levels. Typically this creates a horizontal band or "thermal zone" of warmer air temperatures from 150-200 feet above the lowest slopes (thermal zone height and width depends on degree of slope and distance to relatively level land shelves). This zone can be felt most readily by walking up and down the slope shortly before and after sunset, or by positioning a series of thermometers at increasing elevations above the valley floor. Thermal zones are excellent places to build homes, due to the moderation of daily and seasonal temperatures. But they are especially valuable places for orchards because they limit the occurrence of late spring frosts which can be so damaging to flower buds and fruit production.

Vegetation Indicators and Impacts

Natural plant communities present us with strong evidence of microclimatic variation. They can indicate differences in elevation, soil moisture, temperature, and chemistry (pH, organic matter, nutrient availability, etc.), cold air drainage, and temperature retention and stratification.(2)

Both average and extreme soil temperatures affect what plant communities develop in a specific area. A sort of feedback system has been observed in our mountain soils where deep soil temperatures (at 2 meters) affect the plant communities found there, and the plant communities in turn affect soil temperature, moisture, and organic matter content so that they co-evolve and become self-stabilizing. We recognize in permaculture analysis that "everything gardens," and plants are no exception; they tend to create their own microclimates and soil environments. Trees are powerful in this way and forests immensely more so.

Individual plant species and plant characteristics can also help us identify microclimates. For example, plants with thick, succulent leaves such as cactus or sedums, or with thick woolly hairs on the leaf surface (observed as fuzzy white or silver-colored leaves) often indicate adaptation to dryer soil conditions because of sun exposure or thin, well-drained soils. Some plants such as reeds and rushes indicate year-round moisture since they cannot tolerate drying for any extensive time. So called "indicator plants" reveal differences in soil pH, soil temperature, nutrient availability, and can provide accurate microclimate information. See Kourik for detailed lists.(3)

Plant phenology is the study of the relationship of average local temperatures to plant development, especially the sequence and timing of growth and bloom in early spring. For example, daffodils blooming may indicate earlier warming of the soil in that area than where they bloom several weeks later. Blooming times of particular species can be reliable indicators of average soil temperature and acquired chilling hours. This is important because soil temperatures directly affect microbial activity which affects nutrient availability, especially of nitrogen and certain low-solubility trace elements. Thus phenology can help us know when to plant our seasonal crops. Careful local observations can also identify growing areas where early blooming crops may be delayed long enough to prevent late frosts from damaging their flowers or young fruits.

The structure of the plant canopy greatly influences solar energy absorption and heat retention, air temperature and humidity, soil temperature and moisture content, as well as wind speed and direction. Manipulation of vegetation height, shape, density, and edge effects such as sun traps (sun-facing parabolic tree arcs on south aspects) and mounded spiral planting beds (affording varied sun exposures and drainages) can create microclimate in many beneficial ways.

Windbreaks and the selection of appropriate plant canopy densities can prevent light frosts or excessive drying. Differences of 5-10° F. are possible, which can significantly alter rates of plant growth and mitigate damage from extremes of heat or cold. A light density canopy of trees such as black locust, or branches overlapping from the forest edge can protect crops planted beneath them against late frost. Even an individual tree can provide a "frost umbrella" for crops growing beneath its south side.

Wind sheering and "flagging" of branches, where buds are killed on the windward side but growth occurs on the leeward part of a canopy, can indicate prevailing wind direction. Plant leaves normally grow in accommodation to the prevailing wind direction—the flipping of leaves so that their undersides are exposed often indicates winds from abnormal directions such as those preceding a rainstorm.

Groundcovers such as grass, as well as shrubs and canopy trees influence reflected light, moderate temperature extremes, and can significantly lower air temperatures due to transpiration.

Other Influences

Microclimate is also influenced by the relative heat storage capacity of the earth, stone outcroppings, and small-to-large water masses. Water has a high specific heat holding capacity

continued on page 24

Lee's Low-Tech Sun Locator

Lee Barnes

Knowing the sun's path through the sky for the entire year is extremely useful for locating homes, greenhouses, gardens and micro-sites, e.g. camp tent spots or shade envelope of a single tree, to take advantage of favorable sun/shade exposures. A simple sun locator can be easily made using the following circular protractor (see illustration) and accompanying latitude tables (Figure 2).

The illustration shows the horizontal angle (once for each month) from due south to where the sun will rise and set at 36° North latitude. The second number (in parentheses) indicates the sun's azimuth, or height in degrees above level at solar noon. Since the sun appears to move through the sky about 15° an hour (due to Earth's rotation), one can also predict the influence of visible trees, buildings, mountain ridges, etc. on hours of solar exposure from a particular point. Hourly sun position can be determined more precisely for any day of the year by checking the sun charts in the references.

The sun locator illustrated below works for 36° North latitude (approx. Raleigh/ Asheville/ Nashville/ Oklahoma City/ Las Vegas/ Fresno) but you can easily photocopy the illustration, "white-out" the lines, and draw new angles for your latitude using the numbers in the table to the upper right. Numbers given are close estimates extracted from several visual charts (1,2) and are accurate to within 1-2°.

To locate the sun's path through the sky, align the locator to due south. Sight from the center point along the date lines to the location of sunrise/sunset on both eastern and western horizons. The sun's path can be estimated by approximating an arc from the sunrise point through the sun's azimuth (only the quarterly azimuths only are shown on the figure—by dashed lines: see table for monthly azimuths), and then declining to the sunset point on the western horizon. One can roughly estimate sunrise and sunset points for monthly date lines by splitting the angles between nearest dates. Hours of potential daily sunshine can be estimating by counting the number of unblocked 15° "segments" (equal to an hour of sun movement) along the sun's path between the visible horizons. For example, the width of my four fingers (held parallel to the sun's movement) at full outstretched arm is about 15° of arc or an hour of sun movement (so for my hand, each finger measures about a quarter hour of sun movement). Estimate the "time width" of your own outstretched hand by noting the change in the sun's position over an hour's time. Especially note any structures (ridges, buildings, trees, etc.) along the sun's path which might block the sun during winter. One can estimate the number of hours of sun or shade by counting the number of hours of direct sun along the arching sun path.

Horizontal Angle from South to Sunrise/Sunset at Northern Latitudes

(Second number is Azimuth in degrees above level at solar noon.)

DATE	28°	32°	36°	40°	44°	48°
Dec. 21	63° (38°)	61° (34°)	60° (30°)	58° (26°)	55° (22°)	53° (18°)
Jan./Nov. 20	68° (41°)	66° (38°)	65° (34°)	63° (30°)	61° (25°)	59° (21°)
Feb. 20/Oct. 21	76° (50°)	75° (46°)	74° (42°)	73° (38°)	73° (34°)	72° (30°)
Mar.22/Sept.21	90° (62°)	90° (58°)	90° (54°)	90° (50°)	90° (46°)	90° (42°)
Apr./Aug. 21	103° (73°)	104° (69°)	104° (65°)	105° (61°)	106° (57°)	107° (54°)
May/July 22	112° (82°)	114° (78°)	116° (74°)	117° (69°)	118° (63°)	121° (62°)
June 21	112° (85°)	118° (81°)	120° (77°)	122° (73°)	124° (69°)	127° (65°)

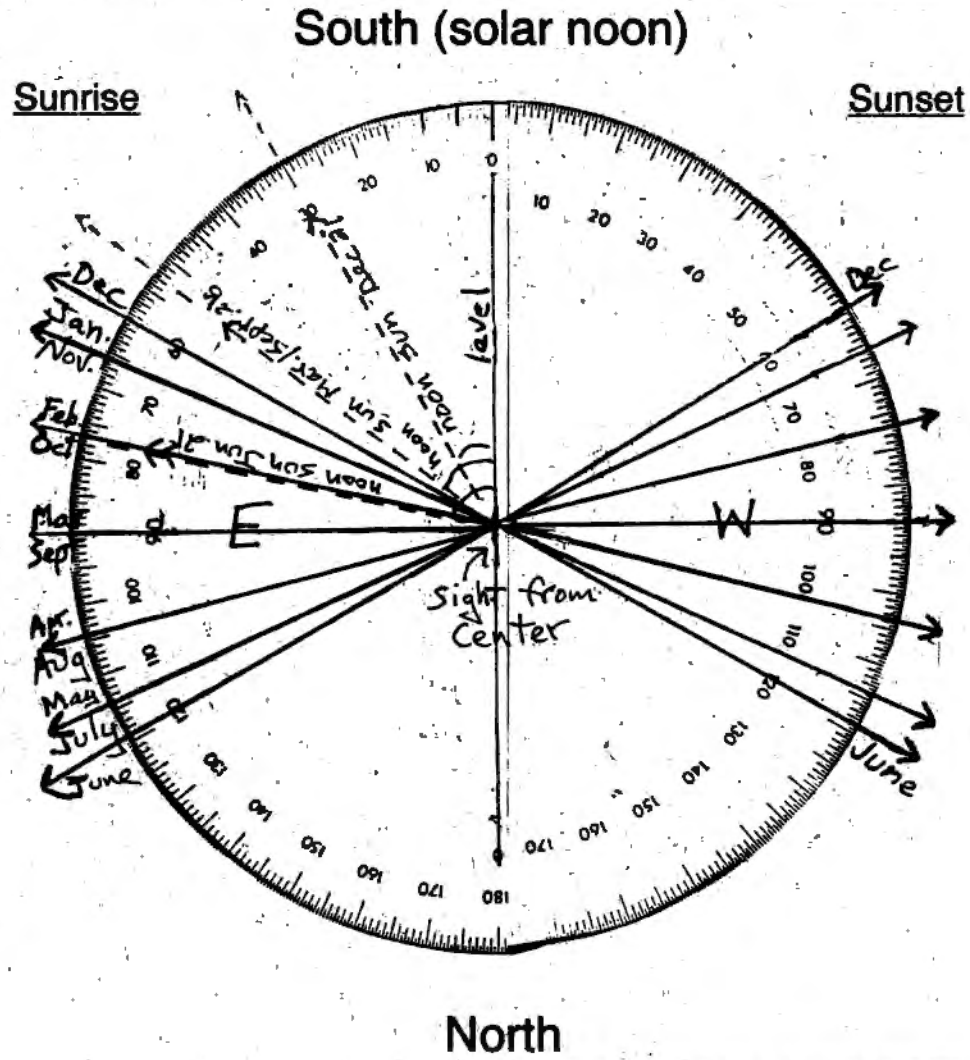
References

1. Edward Mazria. 1979. *The Passive Solar Energy Book: A complete guide to passive solar home, greenhouse and building design.* Rodale Press. 435 pgs. - includes sun charts, shade and solar radiation calculations. Extensive appendices.
2. James McCullagh. 1978. *The Solar Greenhouse Book.* Rodale Press. 328 pgs. - w/ sun charts and excellent overview of solar heat gain and heat retention.

(Both books are out-of-print but are widely available from libraries and used-book dealers.)

3. Smithsonian Institute Staff. 19—. *Smithsonian Meteorological Tables.* Vol. 114, 6th Ed. 0-317-0866-5- contains detailed sun charts and hundreds of tables on about everything meteorological. Check inter-library loans.

Almost any book on solar greenhouses would have similar tables and figures. Δ



which buffers the speed and extremes of air temperature change nearby. In addition, small ponds and larger water bodies will increase local humidity, which can change the comfort level of a given temperature. Humidity levels above 80-95% can increase the apparent temperature by 5-7° F. This may be beneficial in winter, when lower humidities (especially low indoor humidities of 30-40%) are normal, but can cause moderately high summer temperatures to be quite unbearable.

Water bodies also reflect light and can thus improve plant growth rates. This is why you will tan (or burn) faster in the sun at the lake, the seashore, or on a boat than elsewhere. In winter when sun angles are low, the reflection of solar radiation from water surfaces can greatly enhance thermal gain to areas or buildings opposite them.

Careful observation and creation of beneficial microclimates is the key to achieving high levels of productivity in permaculture systems. By moderating local climatic extremes we can promote successful growth and harvest of marginal plant species and enhance diversity in the cultivated landscape. With greater diversity come both greater yields and greater stability.

Notes

1. Bill Mollison. 1990. *Permaculture: A practical guide for a sustainable future.* Island Press. Covelo. 579 pgs.
2. Robert Kourik. 1986. *Designing and Maintaining Your Edible Landscape Naturally.* Metamorphic Press. Santa Rosa. 370 pgs.
3. Michael Schafale and Alan Weakley. 1990. *Classification of the Natural Communities of North Carolina.* Third Approximation. NC Dept. Environment, Health, and Natural Resources. Raleigh. 325 pgs. Δ

Lee Barnes is a naturalist and avid bioregional proponent of his adopted homeland Katúah, the Southern Appalachian Mtns. He has been a weather reporter, agricultural extension agent, and professional nurseryman, and was awarded a Ph.D. in horticulture from the University of Florida for reserch into specialised aspects of tissue culture. Lee teaches permaculture, makes jewelry, and is the author of a guide to the hiking trails of the Great Smokey Mountains. He is training himself to be a dowser. Contact him at Box 1303, Waynesville, NC 28789, or by email: lbarnes@primeline.com. Peter Bane edits The Permaculture Activist *and has taught 13 permaculture courses since 1992.*

Making the Most of Micro-Sites

Andrew Goodheart Brown

Microclimate is the sum of ambient effects on the environment near the ground. Thus, unremarked by the general climate maps of the area, and missed by statements of "average" temperatures, almost any landscape will have a range of microclimatic conditions. Who has not walked out of the wind into a sunny, sheltered side of the house on a cold winter afternoon and felt immediate relief? It is in the observation and manipulation of micro-environments or micro-sites through design that permaculture can help us to increase diversity and yields from our homes and gardens.

If your site appears devoid of natural micro-sites, you may not be seeing all of the possibilities. Perhaps a change of thinking or more quality observation time may be called for. It is easy to allow cultural habits to blind us to the possibilities of the world around us. I like to putter in the garden, and the more I do so, the more I realize that my tinkering with plants and structures helps me to access creativity and unexpected awareness.

Time and energy spent observing the patterns of climatic effect on and around your site is always time well lived. Especially important moments are during and after unusual climatic events: severe storms, high winds, abrupt cold fronts. It is these extreme events which reveal most dramatically the hidden microclimatic patterns of the landscape. If we are willing to pay attention, there is always something to discover and to adjust or design for.

Microclimate can be enhanced through the creative use of on-site and nearby resources. Cutting out some deadwood from a row of elm trees along the edge of our property recently, I wound up with various lengths of wood, which, though well-seasoned, didn't recommend itself to me as fit for the stove. (Elm will certainly burn, but it's a "stinky" wood, and is nearly impossible to split.) What appeared obvious, was to build a tilted raised bed from these remnants. Using the longer sections in the back (east), the shorter sections on the sides, and reclining sections in the front, I built a sloping bed outline, pitched towards the west. By angling it towards the afternoon sun and locating it at the base of a hemlock hedge on the eastern edge of the property, I created a warm and protected micro-site. With plenty of compost on hand, as well as bags of leaves, I laid a mix of these over the top of sheet mulch creating an instant micro-site, ready for planting—higher, drier, and more enriched than the surrounding

Lab lab bean covers bamboo trellis in the author's garden.

areas. To continue the experiment, I moved some previously struggling hops into this bed, and almost had to run backwards to avoid the vegetative explosion. This turned out to be a very good site for hop production!

Semi-urban permaculture isn't so bad, as each fall our neighbors rake up all their valuable resources into large bags, and deposit them along the street where we walk. Identifying the most valuable selections —dogwood... YES, maple ...yes, oak...maybe— we later cruise by in our van, filling it full with these urban nutritive delights.

Another strategy for creating micro-sites and stacking functions is to build brush piles, filling and covering them with leaves and compost. This makes a mound for planting vining crops, such as passionfruit, peas, or beans; the end result is a clever conversion of yard resource (some call it débris) into enriched soil. While that is happening, you get texture in the garden surface, which can be a windbreak, a sun trap, and a home for friendly critters: worms, birds, snakes.

Finally, experimenting with my interest in vertical gardening, I bent and tied together four pieces of bamboo (harvested across the street from a vacant church lot) into an arch, above one of the entrances into my garden, creating another instant micro-site where before, there was none. Lab-lab beans *(Dolichos lablab)* planted at the four corners, along with native passionflower, created a beautiful, productive, and cool shaded oasis for hot summer reclinings.

So, go out into your garden, observe, wonder, and listen. Pay attention to whatever "pops" into your mind, and store it somewhere for potential design considerations. Be creative, the earth is a capable and willing dance partner: you just have to take the first step. Happy spring! Δ

Andrew Goodheart Brown writes frequently for The Permaculture Activist. *When not busy observing his (temperate) garden, he also teaches permaculture and cultivates an interest in tropical agriculture.*

Mini-Cloches

Robert E. McKasson

I have developed a method of growing vegetable seedlings in mini-cloches or mini-greenhouses that is cheap, saves time and water, and affords the seedlings extra protection while leaving them easy to handle. I want to share my experiment. Perhaps others will be able to improve it and refine the method so that it may become even more effective. If they also report back, we can all benefit, again. The basis for this greenhouse idea came from my next door neighbor, Debra Alexander.

The technique is very simple, however, it is quite effective. Take a two-liter soda bottle. I suggest to test both colors equally: clear plastic and green tinted plastic. You can get large quantities of these bottles by paying your local recycler one cent more per bottle than the redemption value. Or, have a fund-raiser, through your local school, requesting a specific number of bottles, at so many cents per bottle.

1. From the school, ask for them without caps. They will be drier and will have fewer germs.
2. Remove the outer plastic bowl from the bottom of the bottle and set it aside. This will take short fingernails. Pulling downward evenly as you go in a circle, slip your fingers between the bowl and bottle. After a little practice you will no longer rip the plastic bowls.
3. Turn the bottle on its side.
4. Using a very sharp knife, cut off the curved base of the bottle between 1 and 1-1/2 inches from the bottom. (Any sharp knife will do. However, you can get an X-ACTO or a Stanley Quick-Point from an office supply or art supply store. These work better than an ordinary knife, but be sure to wear safety goggles, as the small blades may break.

A variation on mini-cloches using glass jars

5. Turn the bottle upside down. Fill the top of it with 1 to 1-1/2 inches of whatever type of moist compost you normally use. Drop in two or three evenly dispersed seeds. Fill up half of the bottle with moist compost.
6. Replace the outer plastic bowl on the bottom of the bottle.
7. Turn the bottle right-side up. Most of the initial compost will fall past the seeds, which will then be covered with a thin layer of compost.
8. Set the mini-greenhouse in the sun or in your greenhouse, depending on what is best for the seedlings.
9. Check every week or two to see if the compost needs watering. As long as moisture droplets gather on the inside of the dome, do not water.
10. Transplant before the seedlings become root-bound or before they start to grow out of the bottle's pouring spout.

Happy Growing! Δ

Robert McKasson does his mini-cloche experiments in Southern California. Write him at 124 - 31st Street, Newport Beach, CA 92663.

A Subtropical Forest Garden

Peter Bane

John Rogers didn't choose his Melbourne, Florida home because it had superb microclimate potential when he moved here 16 years ago. But at that time he wasn't a sub-tropical forest gardener with a keen interest in bananas, mangoes and bamboo. Then a young engineering graduate and Kentucky native, John was enticed south by a job offer on Florida's Space Coast. He bought a starter house two blocks from the ocean in a modest neighborhood populated mainly by retirees, and over the intervening years his inner gardener has emerged to take root in the sandy soils.

Melbourne is of interest to fruit gardeners because it is the boundary on the U.S. Atlantic Coast where sub-temperate climate slides into sub-tropical. Merritt Island, (the home of the Cape Canaveral space complex) lies with its southern tip between Melbourne on the mainland and the barrier islands to the east. Located in the middle of the so-called Indian River (not a real river but an intercoastal estuary of brackish water, fed by many small streams), Merritt is the northernmost extension of Zone 10—the true subtropics—in Florida. Surrounded by water on all sides and favored by warm ocean waters of the Gulf Stream to the east, Merritt supports groves of mangoes and other frost-sensitive fruits which do not reliably bear even at Melbourne. In this part of the country, climate zones are measured in half-miles—and from east to west!

A special spot

At a major climatic edge (the southern limit of red maples—which range to Nova Scotia, and the northern limit of mangoes which range to Brazil) and the immensely fertile zone between land and sea, the Melbourne-Merritt Island area supports a fantastic diversity of plants and animals. Native peoples of the area lived almost exclusively on shellfish, of which great mounds of shells have been left in evidence. Eagles, osprey, and herons compete with more recently arrived humans for the abundant fish. Citrus groves line the coastal counties for miles north and south and the night air along Interstate 95 is drunk with grapefruit perfume. In this heady atmosphere one could be forgiven for thinking that heaven was to be found just around the corner and not at the top of a rocket gantry!

John seems to have warmed to this idea and about six years ago began delving into permaculture and tropical horticulture in a big way. His subtropical forest garden has taken shape on two parcels, his small house lot and a two-acre holding about two blocks away which he has carefully assembled from nine tiny contiguous lots bought piecemeal over the past half dozen years.

Two-year old bamboo grove hides the entrance to John Rogers' Melbourne, Florida home.

"When I started working on the forest garden, this area (the two-acre tract) was covered with scattered palms. Here and there were suggestions of circles, and I got the idea to transplant some of the palms to fill them out," John explains. With the help of a tree spade from a local nursery and his own labor, John got the shallow rooted plants reset into their present clumps, a pattern which creates exquisite microclimate within and affords easy access for harvesting, fertilizing, and irrigation.

Encouraging diversity

The palms give backbone to the forest garden, which along with native oaks and introduced sycamores, also has extensive plantings of banana (20 cultivars), citrus (over 20 rare and non-commercial varieties), figs, avocado (6 varieties incl. seedlings), mulberry (5 cvs.), pecan (6 cvs.), macadamia (seedlings), Kaki persimmon (8 cvs.), mango (10 cvs.), and a scattering of exotics such as white sapote, black sapote, jaboticaba, guava, tamarind, wax jambu, rose apple, malabar chestnut, loquat, acerola, and cassava, as well as the more familiar papaya, aloe, and sugar cane.

Raised and schooled among walnuts and plums in northern Kentucky, John Rogers learned a lot of his tropical botany by combing the literature, reading extensively to determine which fruits had the best chance of succeeding in his area. He has stacked and packed his system with as much diversity as he could obtain, allowing local limits to sort out the winners from the losers. Sharing luscious purple first fruits with me in early March, he explained that he started with nine mulberries, including the favorite Illinois Everbearing variety (which wanted more chill), but has now only the five which have borne consistently in the warm Melbourne climate.

John has also been active in the Rare Fruit Council International, and he credits his contacts there with helping him develop his interest in tropical horticulture, as well as acquire grafting and propagating skills. "We take regular field trips to visit gardens of interest throughout the state. I've obtained many

of my most unusual and delightful fruits from other members. It's a fine group of dedicated enthusiasts," he explained as he treated me to a dish of chocolate pudding fruit. Called mamey sapote, the stuff looks like axle grease, but tastes like chocolate pudding, especially when mixed up with a bit of cream and frozen yogurt.

Fertility cycling

Over the years, Rogers has become adept at garnering local materials— "closing nutrient loops," as he likes to point out. Cultivating relationships with local haulers, he has encouraged them to backhaul organic waste from the county dump, at bargain rates. When local builders clear land for construction, they often have to remove the topsoil with its organic fraction. John gets this bonanza dumped on his urban paradise for free or at a deep discount. The utility crews know where they can leave a load of chips, and even the neighbors have been trained to deposit their yard waste and grass clippings! In addition, John scavenges the urban forest for leavings, using his pickup as a motorized garden cart.

In a move to cultivate fertility even closer to home, Rogers has been trialing some of the cold-hardier species of nitrogen-fixing trees such as *Acacia auriculiformis* (ear-leaf acacia), *A. fargesia* (sweet acacia), *Inga edulis* (icecream bean), and *Dalbergia sissoo* (Indian rosewood).

But his current passion is bamboo—he has nearly 30 clumping subtropical species—which he hopes to propagate for nursery sales and eventually use to build tree houses in the palm circles. Eagerly pointing out the growth of shoots which had barely broken ground on our earlier visit two weeks prior, he knows the cold tolerances, expected cane sizes, likely local performance, and economic uses of all the varieties in his

John Rogers shows blood orange "stacked" under pine for protection

growing collection. He often trades nursery and garden work to friends and mentors for interesting new varieties and also belongs to the Florida Chapter of the Bamboo Society. Already John's present house is invisible a mere 20 feet from the street behind a screen of arching 20-foot canes planted only two years ago.

Also hidden within the bamboo screen is a 1,000+ gallon pond he built up by berming soil above grade and lining the berm with plastic.

Artesian-fed brackish pond supports fresh and saltwater fish.

Capturing the fountain of youth

Water is key to fertility, and Florida has lots of it, from underground aquifers running through its limestone bedrock, to surface wetlands, to tropical storms which regularly dump torrents on the state. Yet sandy soils dry quickly and periodic dry spells mean water can be a limiting factor for some plants. The pond in John's front yard, along with an even larger one behind the house, is fed by rainwater from the 1200-square foot roof. The downspouts are plumbed and sealed, and a column of water stands ready to feed the ponds by gravity. John built them above grade in part because the water table is already high in his area, but primarily because he can irrigate his entire lot by gravity flow in times of low rainfall. The ponds have never gone dry, and are designed to overflow gently across a broad surface, trickling towards the house and the center of the lot through thick vegetation which absorbs every drop—none is wasted on the street!

John's insurance company and the local building safety officials were concerned about the potential for accident, but he met their concerns by suspending a net just beneath the surface of the ponds which would catch any curious children who might

wiggle their way through the dense bamboo screen. The net serves as a trellis for underwater plants which virtually cover the surface of the water: cattails, water hyacinth, lotus, lilies, and more. Gambusia, or mosquito fish keep the population of mosquito larvae under control.

Rogers harvests the abundant water plants for mulching his garden, and of course irrigates when necessary with the nutrient rich water, but from the artesian-fed artificial pond on his larger property, he derives a great deal of pleasure just watching the bird life and the local color. A great blue heron took wing the morning we walked down to view his burgeoning forest garden,

Lined pond bermed above grade allows gravity irrigation

and he says that osprey regularly fish the shallow brackish pond, which supports an amazing variety of fresh and salt water fish. Area children also fish the waters of what looks like a large reflecting pool, and one imagines the raptors have a fine time plucking their readily visible lunch from the lily-covered pool. Some crops, such as taro, however, have not flourished in the pond, which John attributes to the salt content of the artesian water supplying it. Excessive pumping for wasteful and often counter-productive lawn irrigation has drawn down the fresh water lens under the coastal areas and allowed ocean water to intrude, making many shallow wells in the area brackish. "It's not yet a crisis," he laments, "so nothing is being done."

The two-acre tract Rogers has cultivated will soon become his home as he is remodeling a house on one of the lots in preparation for moving. "I'm glad to have had a few years head start on the gardening," he remarks, "and I'm hoping to find a tenant for the other place who will appreciate the forest garden setting and won't mind sharing part of the harvest!" He plans to move one of the two solar collectors from the roof of his present house to the new one. "It's really too much capacity," he explains. "The water comes out scalding hot most of the time, and though I have an electric back-up, it's never needed unless a hurricane keeps us under clouds for a week at a time."

Keeping the lid on

John wishes he had had a few of those clouds back in the middle of January when cold arctic air pushed its way south to Florida, plunging temperatures right to the freezing point. Though the mercury hovered at 32°F. (0°C) all night in the air on his porch, the clear night sky sucked heat away from the ground in what he describes as a "radiative frost." The mangoes, bananas, papayas, and other frost-sensitive plants were burnt by the cold, and were cautiously resprouting six weeks later at the time of our visit. Other sensitive plants survived under the canopy of hardier species. John has taken care to use such nurse plants whenever he can to give his tender tropicals a head start in life.

Reflecting on his career as a gardener, John laughs and admits, "I made most of my big mistakes early on. I'm still largely focused on perennials, tree crops, and plants which can tolerate my casual style of maintenance. I like to travel and I wanted a garden which would withstand considerable neglect. Still, it would be nice to have some annuals."

He would also like to assemble a guild of permaculture friends in the area, and hopes the glories of the subtropics will entice a few more fruit aficionados into range. Δ

Resources

Rare Fruit Council, Intl., PO Box 561914, Miami FL 33256
subscriptions are $35/yr., $45 foreign to:
Carolyn Betts, 12255 SW 73rd Ave., Miami FL 33156

California Rare Fruit Growers, Inc. (publishers of *Fruit Gardener)*
Fullerton Arboretum-CSUF
Box 6850, Fullerton CA 92834-6850
membership $16/yr, $25 Can./Mex., $30 foreign surface, $40 air

John Rogers is seeking additional permaculture breeding stock and can be contacted at 115 Avenue "C", Melbourne FL 32901.

Palm "circle" creates microclimate. Urban "waste" in foreground.

Breakthrough in Beekeeping

Emilia Hazelip

I recently had occasion to visit an elderly bee-keeper living on the outskirts of Tours in France. Gilbert Veuille has kept bees all his life, even when living in Paris!

In 1986 the varroa parasite all but exterminated his colonies. This catastrophe caused him to ponder the question of the health of bees that are housed in the standard fashion; i.e. in square wooden boxes. He realized that drastic action was called for, in order to reinforce the general health of the hives, and to keep this problem in check.

It became obvious to him that wooden boxes are a far-from-ideal habitat for bees. There are too many dank nooks and crannies, and damp cracks, where molds and pathogens can develop. What bees need is living-space where they can develop their own defenses. They need hives where the space unoccupied by the colony is reduced to a minimum, and where the brood-chamber section can be changed easily and often.

Eventually Gilbert Veuille hit upon the solution of a round, divisible hive, consisting of an outer cylinder made of chopped straw bound with plaster. This he calls a *rucheton* - a small hive. The dimensions are as follows:-

inside diameter - 36 cm (14")
height - 18 cm (7")
thickness of walls - 3 cm (1-3/16")
weight - approximately 5 kg (11 lb.)

Within the cylinder are eight removable wooden battens from each of which is suspended a honeycomb. Depending upon the requirements of the colony, more cylinders can be added at the top or at the bottom (under the brood-chamber).

The shallow cylinder above the brood chamber facilitates handling. Notice the battens. photos by the author

Round hives are superior

If one considers the requirements of the bees, it will be seen that a hive of circular section is the most appropriate. For example:

1. The rounded form is a decisive factor in maintaining a constant temperature in the hive; the brood combs have the same shape—they too are round.

Gilbert Veuille making the bee hive.

2. The plaster/chopped straw mixture used in construction possesses excellent insulating properties against hot and cold weather conditions, and, thanks to its porosity, minimizes condensation.

3. The rectangular-section honeycomb battens are only 3 to 4 mm (3/8") thick and are placed on edge in notches cut into the top edge of the cylinder. Inserted in this way they have adequate strength to resist the weight of the combs, and do not impede movement of the bees. Irrespective of the number of cylinders stacked one upon the other (sometimes as many as eight) it never happens that the combs break up. As a matter of fact, comb-building proceeds in a very uniform manner.

4. The biennial renewal of the brood chamber's wax combs is effected easily and without problem. Each year (around early March in temperate climates) a cylinder furnished with empty wax combs is placed under the cylinder containing the brood chamber. The bees rapidly build the combs to completion, and the queen then commences to fill them with her progeny. This regular renewal of the brood-chamber wax is a prophylactic measure against bee diseases.

Proof of the pudding

Mr. Veuille has now been using this type of hive four years, and this is what he has observed:

a. total disappearance of fungal infections.

b. total absence of foul-brood;

c. the varroa attacks seem less virulent;

d.excellent wintering conditions: the colony hibernates within a hot air bubble, free from draughts and without empty spaces needing to be heated; such favorable conditions mean the bees expend less energy and hence do not consume so much honey.

e. spring-time resurgence: as a consequence of early and efficient egg-laying, the hive quickly develops a strong colony.

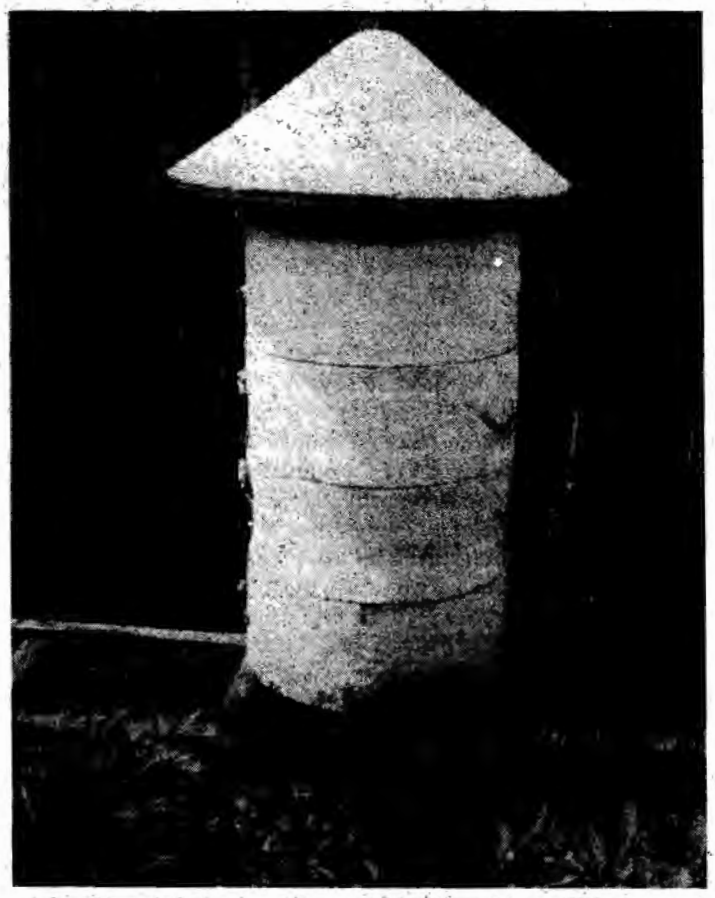
f. If swarming occurs, this also takes place very early (end of April or early May); hence the parent hive can quickly rebuild its numbers, and the swarm has time to develop into a strong colony in the same season.

g. Besides the health-promoting qualities inherent in this type of hive, its construction is an easy do-it-yourself project and the cost ridiculously low (about $2 per cylinder).

The good news regarding this cheap and easy way to produce hives is that it is now practicable to utilize the Juxtaposition System of bee-keeping developed by Marc Bonfils (coming out next: an article explaining this method).

Gilbert Veuille has written a booklet giving construction and management details for this style of beekeeping. You can contact him (in French) at his address: 99, rue S. Pitard, F-37000 Tours, France. I am currently translating this booklet into English. Let me know if you would be interested in obtaining a copy. Δ

Emilia Hazelip has taught permaculture in France, Spain, Portugal, and the United States. She will present a course in Urban Permaculture August 8-16th in Toronto. See page 45 for details. Emilia may be contacted at Permaculture Pyrenees, B.P. 217, F-11300 Limoux, France. Phone & Fax : +33-68.31.51.11.



A bee hive with 4 parts. The stand is about 50cm off the ground.

From Permaculture International Journal *#60—*

In Praise of (South)-Facing Slopes

In Australia, where this article was written, south slopes are away from the sun—toward the pole, and north-facing slopes are sunny.

Caroline Smith

This article is an attempt to cheer up all those would-be permaculturists who feel they can't get off first base without acquiring that magic north-facing slope, and for all those who got stuck with a south-facing block, bought before being enlightened by an interest in permaculture. For those in the Northern Hemisphere, just replace south with north!

Three years ago, we started looking for that dream block—north-facing [sun-facing], naturally. They were like hen's teeth, and the few we did find were priced way beyond our means. Real estate agents know all about them too.

Many frustrating months later we fell in love with a neglected and overgrazed 5-acre block in a small valley—the only trouble was most of the land faces SSE and SSW, and the zone 1 (around the house) area faces due south. What's more, it's in the Dandenong Ranges just outside of Melbourne, Australia (40°S latitude) where there's already plenty of shade from the ridges.

The block suited our pocket, had good soil, and a great view (another no-no to some of our more utilitarian permaculture friends, but I believe a view is balm to the soul). However, the main reason we bought it was because it had an amazing number of mature, if neglected fruit and nut trees. Amongst the creeping buttercup, bracken, and blackberries, there were several varieties of citrus, plums, nectarines, peaches, pears, apples, quinces, walnuts, chestnuts, and most amazing of all, a 15-year-old macadamia bearing prolifically on the SSE slope. We have since learned that macadamias thrive as far south as Tasmania, providing they are protected from frost while young. Someone else near here has a fruiting avocado in a shaded spot facing due south!

The Other Side of the Hill

As we started designing our block using permaculture principles, we soon saw the lengthening shadows as the sun disappeared behind the house, and experienced the short hours of sunlight in winter compared with just over the hill. We got used to seeing the Southern Cross as we walked the block at night.

We have to be vigilant in conserving energy in our conventionally built house. So what do we have going for us? Well, it doesn't get quite as stinking hot on a 35+°C. (95°F.) summer's day. With mulching we rarely have to water anything except young fruit trees and seed beds. We can grow all those marvelous varieties of fruit and nuts with high chill requirements, such as the Cox's Orange Pippin apple (a favorite with the English), currants, pears, cherries, and walnuts.

Robert Kourik, in his excellent book *Designing and Maintaining Your Edible Landscape Naturally*, says that in the Northern Hemisphere (he's American), south-facing slopes are among the trickiest to grow fruit and nut trees on. He goes on to describe how to increase chilling if you are unfortunate enough to have a sun-facing slope: plant your trees on the lowest spot on the property (unless poorly drained), plant evergreens on the sun-side, locating the trees so that they are shaded late into spring, or

plant on the north side of a windbreak. (They will still have some wind protection here, but it will be cooler.) This is not to say that some sun is not needed—of course it is for fruit ripening, but it shows that plenty can be done on less than "ideal" slopes.

We also create microclimates by sheltering some of the sunnier areas so that pumpkins, tomatoes, capsicums (peppers), beans, corn, and basil grow happily in summer. We've planted an avocado tree and some more macadamias. We're trying watermelon this year—but that might be just a bit too optimistic!

Do Not Despair

I believe permaculture is as much about making the best of what you have as finding that ideal piece of land. Friends in northern Victoria have even built a solar-passive house on a south-facing block. It performs exceptionally well. We have done designs for people in this area, most of whom have south-facing slopes and plenty of shade. So don't despair, even if your lot faces away from the sun and towards one of the poles, you can select species which will grow in your conditions and still have a prolific permaculture garden.

References

Kourik, R. (1996) Designing and Maintaining Your Edible Landscape Naturally. Metamorphic Press, Santa Rosa, CA. Δ

Cool-adapted Species

These have worked on our semi-shady (south)-slopes

Vegetables:
Globe artichoke, lettuce (all types), silverbeet (chard), radicchio, chicory, watercress, upland cress, corn salad (maché), asparagus, radish, potato

Fruit:
Red and black currants, raspberry, thornless blackberry, jostaberry, apple (try Jonathan and Granny Smith—they will pollinate each other), tamarillo (in frost-free position), hazel, pomegranate, grapefruit, cranberry (will grow well in hanging baskets), cape gooseberry, mountain pawpaw, avocado (in sheltered, frost-free position)

Herbs:
Lemon balm, bergamot, lovage, mints, ginseng, borage, comfrey, coriander, Vietnamese mint

Climate change is a global issue, so we bring our readers perspectives from Southern Africa—

Climate Change and Agriculture in Zimbabwe

GroundCover *interviews Peter DeVillez, a water engineer who has worked in Zimbabwe for 12 years, as well as in Ethiopia and Sudan in both the commercial and communal farming sectors.*

GroundCover: Do you think that Zimbabwe's climate is changing permanently?

Peter DeVillez: The current dry period is not uncommon even in the last 100 years. In Namibia, for instance, the average rainfall can vary between 200 and 800mm (8"-32" per year). Zimbabwe is more central and has a very stable climate. We are used to 750-1000mm (30"-40") in the higher rainfall regions, and have planned our agriculture around this, especially the Western system of trying to get two crops per year from a natural ecology that only supports one. Africa is "mining" its agricultural resources.

We are going through a period of slightly less than average rainfall. The change is actually very small and is only serious when people are banking on the average rather than adjusting to the change. We are still growing wheat and citrus on flood irrigation. We are still demanding more than the environment is naturally prepared to give. We are artificially forcing the land and complaining that nature is at fault, not us.

GC: What will these changes mean for commercial, small-scale, and communal farmers?

PDV: The whole psychology of farming will have to change. That free and abusable resource—water—will have to be costed as it is in the west. It is just that important as a mineral.

GC: What can farmers do to counteract or alleviate some of the problems that they face with respect to climate change?

PDV: Water resources must be managed. A water budget should be worked out for any given piece of land. In farming, all inputs should be quantified, managed, and exploited sustainably.

Cropping systems need to be designed around the water budget. The crop planted should depend on the amount of water available. The costs must be acknowledged. We should remember that it takes two liters of water going through the turbines at Kariba in order to produce the electricity to pump one liter of water from a borehole. People abuse electricity because it is very cheap in Zimbabwe. Hundreds of boreholes are being sunk every year, requiring more electricity, which means we have to put more water through Kariba, and ultimately into the Indian Ocean. This water could be used in Zimbabwe.

Boreholes must be maintained otherwise they are not a sound investment. They must be cleaned and serviced and looked after in concert with neighbors.

GC: There are a lot of myths about wells and boreholes. For instance, do people using boreholes deplete the water table?

PDC: The water table in the soil is like a spring and can be accessed through wells. This is water sitting on top of rock and is not under pressure. The water table is very unstable and fluctuates with the climate. Boreholes, on the other hand, tap into water stored deep in rock. Borehole water may be recharged by rain falling on hillsides hundreds of miles away. This rain soaks into fissures in the rock and is stored under pressure deep underground.

GC: What is your opinion on the call for more dams?

PDV: More dams are only part of the solution. At present, 80% of Zimbabwe's rainfall water resources are allocated to commercial farmers although they occupy less than 40% of the land. Under the law, a person can not have rights to use water unless they have tenure. So communal farmers have no rights to water. It has to flow through their land and be pumped back to commercial farms where it is abused, over-irrigated, and contaminated with chemicals. This is only a small part of a very complex picture. A committee set up by the Ministry of Water

suggested that 10% of water from commercial farms should go to communal farmers. Yet not all of the water rights due to commercial farmers are taken up.

GC: What is the way forward?

PDV: A new national water policy that is clear and equitable is desperately needed. The Dept. of Water Development bases its criteria on "average rainfall" and predicted use—numbers which don't account for the kind of variation we are experiencing. At the moment, water in Zimbabwe is virtually free at 7¢ per cubic meter; in California, it is sold at US$7 per cubic meter. Δ

GroundCover *is published quarterly by the Natural Farming Network, a group of sustainable development organizations that includes the Fambidzanai Permaculture Centre. Subscriptions outside of Africa are US$15. Contact Box CY 301, Causeway, Harare. Tel. 726538 or 731541.*

from *GroundCover*

Drought Encourages Innovation

"I am surprised your hotels ask guests to donate money toward the environment, yet they change and wash sheets and towels everyday for guests, the majority of whom don't even do that in their own homes," said a foreign tourist on a visit in Harare.

"Couldn't they save water by changing and washing them once in two days?" he continued.

Charles Muketiwa, Sales Manager with Harare Sheraton, does not accept the implied proposal. "Once we do that, we lose our reputation. Even one-star hotels in rural areas provide guests with more than they can get in their own homes. That is the idea anyway."

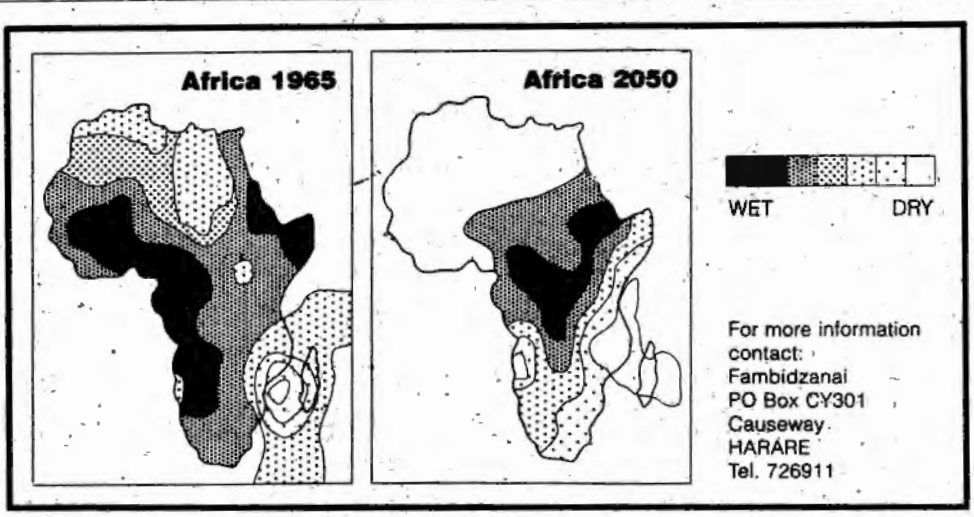
While hotels have not changed much in how they use water, other industries no longer take water for granted. The droughts of the 1980s and 1990s in southern Africa have taught them to conserve water.

"I decided not to rely on rain and to farm as if I lived in a desert. Since then things have been easier," said one South African farmer quoted in *Back to Earth: South Africa's Environmental Challenges*, by Richard Fuggle, a professor of environmental studies.

In South Africa's East Rand area, farmers grow vegetables, some of them for export, using drip irrigation from a tank or a bucket.

On the outskirts of Blantyre, in Malawi, the same method is being used and gardening flourishes on very little water. The technology is convenient because it utilizes local affordable materials.

"(Using the drip method) one 20-liter bucket per day will support a row of 98 plants. Imagine how many buckets one would have to apply the usual way. Drip irrigation cuts on both water and labor," says Beth Adams, an agriculturalist at the Malawi Nazarene Vocational Training School. At the school, six-week courses, for small-scale farmers, are conducted in Chichewa and English.



The spread of drought in Africa expected from a 4°C. rise in global temperature.

In drought-prone northwestern Zimbabwe, small-scale farmers plant clay pots in vegetable beds and fill the pots with water. The water seeps slowly into the soil.

Just outside Zomba in Malawi, during the 1992 drought, the Department of Water constructed a pipe to take water directly from a river instead of letting it flow into a dam where it would be lost through evaporation and seepage.

A new water-harvesting technique that is being tried in Lesotho entails channeling run-off from the roof of a house into a large tank. The tank water is then used to sustain vegetables in the dry season.

Namibia, southern Africa's most arid country, is trying to increase water supply by sinking boreholes—transferring water from the relatively wet north to the dry interior where rivers are seasonal—and by trapping fog in coastal areas.

In South Africa, droughts prompted the Johannesburg municipality to monitor water use closely. It was then that they discovered that many water meters were not working. In the 1980s, Natal firms cut water consumption by 70 percent while maintaining production levels. Power stations in South Africa have since switched over to "dry cooling," saving considerable water.

In Harare, Bulawayo, Pretoria, Johannesburg, and a few other cities in the region, people drink "second-hand water." Recurrent droughts have made this option even more attractive as it conserves scarce resources.

Zimbabwe, which recycles ten percent of its urban water (18 million cubic meters per year), plans to double water recycling over a short period. Botswana plans to recycle water in urban areas by the year 2020.

The droughts of the 1980s also gave momentum to the development of the Lesotho Highlands Water Project, which transfers water from Lesotho to South Africa. But the important development is that the scheme minimizes evaporation by means of deep dams and underground pipes.

Each country now has a drought early-warning system. Information from the countries is synthesized in Harare where the regional early warning system office of the Southern African Development Community (SADC) is located. Documents produced carry information

about the food supply levels in each country in the region. This serves to reflect the current situation and alert governments to seek food on time, in or outside the region.

Traditionally, people in southern Africa grew drought-resistant crops such as sorghum, rapoko, and millet. Today, water-dependent maize is the most popular crop, which, unfortunately, is grown even in not so well-watered areas. Persistent droughts have forced people to resort to growing drought-resistant crops.

Meanwhile, agricultural research institutes are researching on crops and animals that tolerate drought both to minimize the economic impacts and to feed people even during severe droughts.

Another tradition that has been brought back by recent droughts is keeping reserve food to last over a year. Families and governments are now ensuring that the surplus is only sold after another harvest.

The media have appealed to water-users in urban areas to conserve water. In Harare, people are encouraged to report burst pipes immediately so that they can get repaired without serious loss. And this has worked. The major reason is that people—both the suppliers and users—now attach greater value to water than they did before a series of droughts during the past 15 years. Δ

from *GroundCover*

Water Harvesting Methods

Part of a series from the PELUM Association (Participatory Ecological Land Use Management), set up to strengthen training in Tanzania, South Africa, Kenya, Botswana, Zambia, Lesotho, Uganda, and Zimbabwe.

This article examines a number of ways of harvesting water run-off. The method used depends on the cropping intensity of the area. Readers should refer to the first part of the series in the previous issue of *GroundCover* for the principles of water-harvesting.

Pits

Pits are holes of varying sizes into which water run-off is directed. At St. Vincent School, they successfully direct water from the roofs of their classrooms into one meter deep by one meter-diameter circular pits which are filled with organic matter. Trees are planted near the pits, the pits being sources of nutrients and moisture for the trees.

At Nyahode Union Learning Center in Chimanimani, they divert water at regular intervals from their steep circular road into pits. To form a link with their small dam system, often the spillway from the pit runs as a ditch on contour (a swale) around to the streamline, which then feeds the dam.

Mr. Phiri of Zvishavane digs 4m x 2m x 1m deep rectangular pits along his contour ditches. In a heavy storm when the water does run along these ditches, it is trapped by the pits and infiltrates into the soil. He also has pits of a similar size to catch water run-off from the road.

Joe Made in Harare farms on heavy soil. He digs trenches of about one meter wide and one-and-a-half meters deep and then refills them with manure (it could be compost) and topsoil. Water from the gutters is then directed to these trenches where it infiltrates easily and is held by the organic matter for the benefit of fruit trees.

Water force breakers

The force of water is broken by a physical barrier in these methods. The barrier can be a line of rocks on contour or a ditch reinforced with rocks. Another method growing in popularity is using tightly planted bunch grasses on contour. Because of its density, vetiver grass is appropriate for this. It is planted at 15-20cm spacing. Many farmers in Chikukwa in Chimanimani are trying it out.

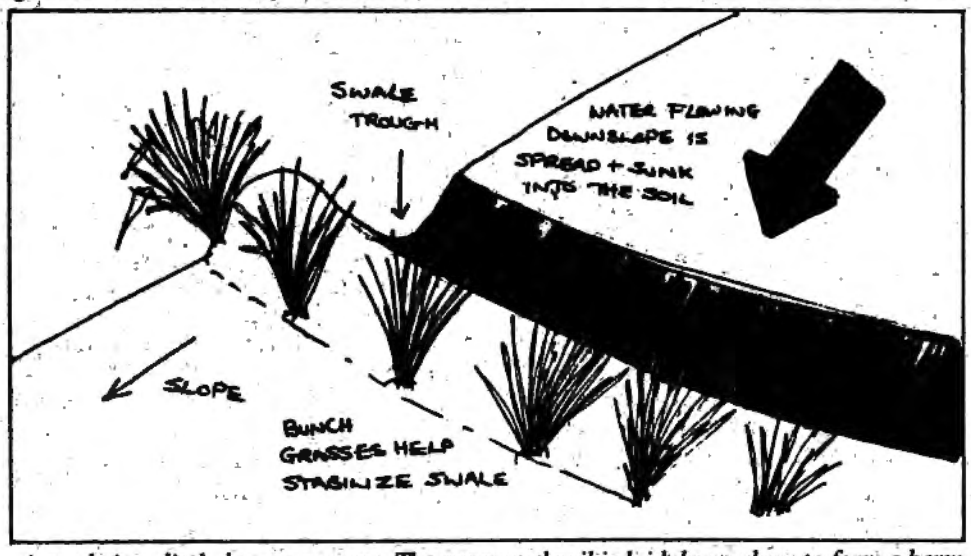
Other grasses such as bana and some of the indigenous bunch grasses are also suitable. Farmers in Kenya have been using napier grass fodder like this for years. Where cattle are controlled, napier may be more appropriate because it is also good feed for them. They can overgraze and kill it, however, if not controlled. Vetiver grass may be better in such instances as it is tougher and not nearly as palatable.

This barrier method works because as the water hits the barrier, it slows down, and some if not all of it sinks into the ground. The silt that may be carried by the water is thus deposited. In time, these barriers help form terraces. In the Biriiri area (Chimanimani District), there are examples of stone terraces formed like this. Mr. Phiri also makes extensive use of rock barriers.

Ditches

A variety of kinds of ditches can be employed. The conventional contour ridge is an example. It is usually sloped 1 in 200. In this way, it slows water which is rushing down a slope and so prevents rills and gullies. In heavy storms, excess water is carried away to streamlines so as to avoid the ridge breaking at any point.

A swale (a ditch truly on contour) can be used to spread water from where it has concentrated. This may be from a road, or the roof of a house, or from the clear-swept area that people often have around their homes in rural areas. In the Keyline system, used by Nyahode Union Learning



A swale is a ditch dug on contour. The excavated soil is laid down-slope to form a berm.

Center for example, the spillway from a dam becomes a swale, running around the landscape on contour to the next streamline.

Some of the water sinks into the ground and the rest spills into the next streamline to help fill a dam below, which in turn can bring water back to the first streamline via a swale spillway.

Diversion drains carry water on a gentle slope to some kind of storage. This may be a dam or a wetland or somewhere the water can be safely spilled to infiltrate immediately into the ground. Nyahode fills some of their dams in this way.

In the higher rainfall areas of Kenya, a lot of use is made of the *funya juu* system on gentle slopes. This is a ditch from which soil is thrown up the slope. This allows terracing to form gradually.

Dams and ponds

Dam-formed ponds are an obvious way to harvest water, but they are too often used as the only method and end up filled with silt. In a dryland environment, the safest place to store water is in the ground. That way, none is lost through evaporation. This water becomes available through seepage and via wells. With a concerted effort to get water into the ground rather than running it off into dams, the perennial springs, streams, and rivers can be returned to many landscapes. Of course, short-term needs must be balanced with longer-term aims such as restoring perennial water systems. But if the longer-term aim is lost sight of, then the problem will only compound itself.

Mr. Phiri's water-harvesting methods all help to feed his well and fish ponds at the lower part of his farm. The water feeds them via seepage underground.

At Nyahode, the water seeps easily out of some of the dams, not through the walls, but into the ground and down the slope underground. This is partly because, due to low rains in the last few years, the dams have not held water long enough to be able to establish a sealed layer at the bottom.

Nevertheless, all the water that the dams do catch replenishes underground water. A well below their largest dam has always had a constant supply of clean water. In terms of water-harvesting, it may be better that water does seep underground rather than be held by the dam, from which a lot would be lost through evaporation. However, if the ponds go dry, it does preclude the keeping of fish. Δ

Microcatchments: A Water Harvesting Resource

Dan Howell

Microcatchments are one strategy to enhance soil microclimate in small areas in drylands, and hence extend the variety of species which may be sustained there. These tiny dams work to concentrate the runoff from a large area onto a smaller area for the benefit of a particular tree or group of plants. Plants that require more water than the average rainfall in the area would provide can grow without irrigation if microcatchments are employed to boost the amount of water they receive.

The principles at work in microcatchments are a refinement of runoff agriculture strategies in general. Instead of acres, the catchment size may be only several hundred square feet. The microcatchment, once defined, may be modified by removing vegetation, by packing the soil, or by chemical surfacing (plastic, asphalt, or other), or it may be left in its existing condition. Presently, the catchments on our high and dry homestead, near Datil, New Mexico, are unaltered.

We have yet to determine the optimum size catchment for a given cultivated area. Runoff is affected by the intensity and timing of rain events, porosity of the soil, vegetative cover, and other variables. The formula we started with assumed that an unaltered catchment would yield 10% of rainfall as runoff, but we are still testing this assumption. To provide enough water, in a region where 15" is the average annual precipitation, for a medium-sized tree requiring 30" per year minimum, the deficit of 15" must be met over the planting area of 100 square feet. At 10% efficiency, or 1.5" of runoff per 100 sq. ft. of catchment size, a catchment of 1000 sq. ft. (10 times the planting area) would be required to yield sufficient water. Our average microcatchment allows 1200 sq. ft. per tree.

photo by Peter Bane

Microcatchment on author's property supports apples on 15" annual rainfall

To build our catchments, I excavated dirt and moved it by wheelbarrow a short distance, then laid it down in lines, these divisions (berms) being built up on top of undisturbed earth. The growing area is located at the bottom of each catchment. Overflow pipes were installed to allow excess water to escape to lower catchments. The drains should be placed two or three inches higher than the level of the growing plot to allow moderate amounts of water to collect before spilling over.

Immediately up slope from the growing area, a holding basin is dug. It should be large enough to contain the runoff expected from an average flood event and should provide enough water to wet the entire root area. Use the dirt to fill the planting area or to build up the berm around it.

As yet, we have only used microcatchments for fruit trees and grape vines. When first planted, we gave these plants two gallons of water per week until the first flood, and have not watered them since.

A few advantages

Microcatchments:

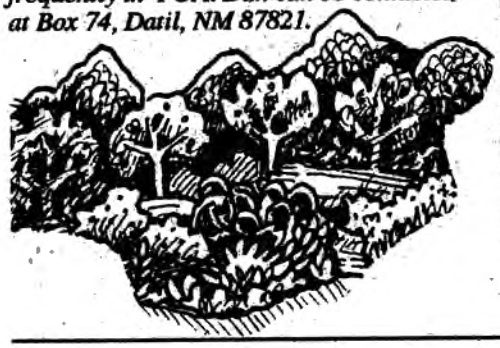
- yield more water per sq. ft. of catchment than larger watersheds
- do not need channels, conduits, or terrace walls
- can be built on almost any slope, including nearly flat
- help to control erosion
- allow runoff to be stored in the ground
- flush salts from the soil

A formula for design:

$$HB = X \text{ ft.} \qquad Ca = \left(\frac{D}{Y}\right) X$$

Ca - Catchment area in sq. ft.
D - Deficiency (R-P)
Y - Yield (P x E)
X - Area of planting basin
Small: vines, sour cherry = 50 sq. ft.
Medium: most stone fruits = 100 s.f.
Large: standard apples, walnuts = 150 s.f.
HB- Holding Basin
Convert values of X to cu. ft.
R - Requirement of the crop for precipitation (in inches). Values of R can be determined by examining the climate at the center of origin of the species and the average annual precipitation in locales where the it can be grown without irrigation.
P - Precipitation. Use on-site records; take a 10-year average.
E - Efficiency. The percentage of rain which runs off. I feel it is best to stay on the conservative side here. Our unaltered catchment area yielded 14%. On-site observation is necessary. Δ

Dan Howell and his partner Karen homestead 40 acres in west central New Mexico. He teaches permaculture at Central Rocky Mountain Permaculture Institute, and their work has been featured frequently in PCA. *Dan can be contacted at Box 74, Datil, NM 87821.*



Dryland Strategies

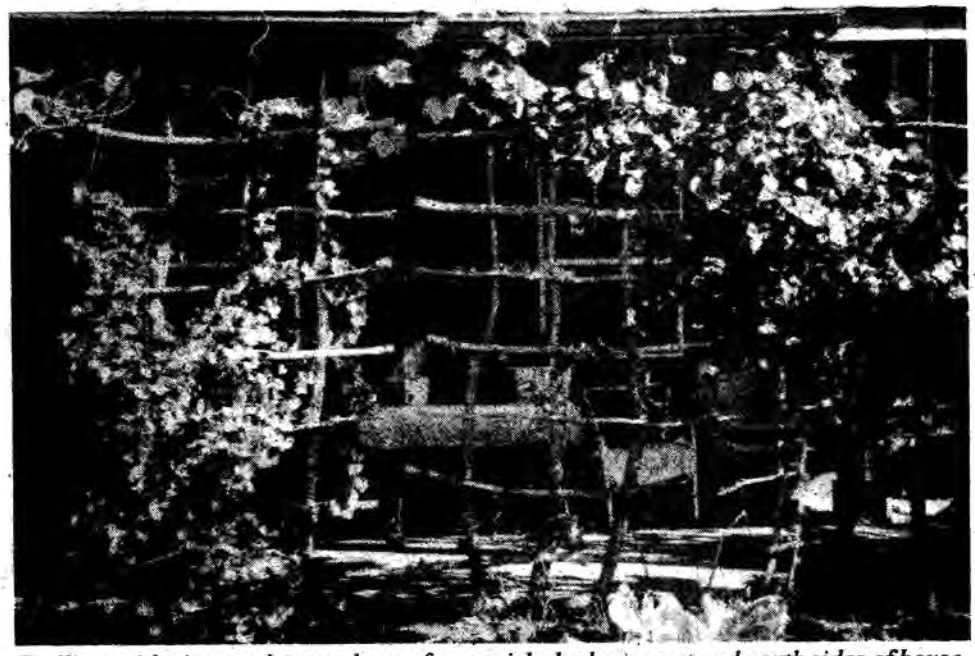
Kirby Fry

As we become more familiar with the characteristics of our bioregion - its climate, soil, flora and fauna, we will have experiences that are both exhilarating and frustrating. Just as there is nothing as gratifying as sowing the seeds for a crop in time for a five- or six-day spring drizzle, there is nothing as disappointing as losing half of your newly planted fruit trees to a summer dry spell. Every storm, drought and freeze serves as a reminder that a designer's work is not finished until she or he has seen the system withstand the elemental forces of Nature. If we are cunning designers then we can anticipate these forces ahead of time, diffuse them, and put them to good use.

Six- to eight-week dry spells in the summer and winter are also possible. The dry spells are long enough and frequent enough that most of our design strategies need to be suited for drylands even though the annual rainfall seems to indicate otherwise. The Cross Timbers bioregion is rated as having a high wind energy potential, and parts of northern Texas are ranked second only to Arizona in number of days of full sunlight per year. So the strongest elemental challenges we face are also potentially the greatest resources.

Housing in the Hot and Dry

Texas is not a continuous desert as a lot of western stories and movies might lead you to believe. Far from it actually.



Trellises with vines and castor beans form quick shade on west and south sides of house.

Bioregional Characteristics

I live and work at Cross Timbers Permaculture Institute, named after the surrounding north central Texas bioregion, a scrub-oak woodland covering steep limestone ridges and hills, narrow ravines, and sandy flats. First frost might hit on November 12th and last frost is usually no later than March 21st. Our growing season is over 210 days long with growing opportunity right through the winter. Annual rainfall is between 25 and 40 inches, with six- to eighteen-inch rain events possible over the course of two days in the fall or spring.

However, our hot and dry summers are indeed infamous and present the greatest design challenge. Human settlements need to be well suited for the extreme heat. Proper orientation, good ventilation, and adequate and timely shade are crucial in order to maintain comfort and conserve energy. The design of the straw bale house we built in the fall of 1995 illustrates a few of the measures necessary to achieve such energy efficiency. The house sits length-wise on an east-to-west axis. There are glass doors and windows on the south wall for letting in the winter sun and no windows on the west wall for keeping out

the scorching summer afternoon sun. The prevailing south-southwesterly winds pass broadside through the entire house, keeping it at about 90 degrees on the hottest summer days and quite cool at night.

Making Shade

Since there were no trees on the site when we began construction, creating a shaded microclimate has been our top design priority. For quick shade we plant castor beans each spring around the entire west end of the house. Castor beans can grow to 12 feet in one growing season, so by mid-summer they are quite effective at shading the west end of the house. Another fast-growing annual is the scarlet runner bean, which will completely cover trellises over the southwest and west walls by mid- to late summer. For longer term coverage, perennial vines such as the Champanel grape and hardy kiwi have also been planted to cover the trellis and part of the roof. Finally, we have planted cottonwoods and water oaks to shade the entire house and roof in 10 to 20 years. We hope that with sufficient tree cover and shade the air will be cool enough around our straw bale house to eliminate the need for fans all together, even on the hottest of summer days.

Of Trees, Pasture, and Blight

Unfortunately, in the Cross Timbers bioregion, many land owners are at odds with the trees on their property. Most of the trees have been methodically cleared in order to create pasture for cattle and goat production, leaving only a scattering of solitary oaks amidst a biological desert of introduced annual short grasses. A few shade trees are usually left standing around the landowner's residence. The result is a picturesque yet bleak artificial savannah that no longer has the stability of a natural ecosystem.

In the mid-1970's, the remaining local red oak and live oak populations became susceptible to a lethal fungal blight, *Ceratocystis fagacearum*, or oak wilt. Consequently, many homes have lost and will continue to lose their only shade trees, as well as the remaining oak trees in their pastures. For over 25 years, oak wilt has wrought ecological and economic havoc on par with that brought about by Dutch elm disease and the pine bark beetle.

The Texas Forest Service combats the blight as if it were an army at war. Newly infected red oaks are cut down and destroyed, expensive fungicides are pumped into the ground and bulldozers have ripped millions of feet of trenches around the surviving live oaks to prevent the fungus from spreading from root to root. The damage is estimated in the millions of dollars, and hundreds of thousands of dollars are being spent on means of control that are unproven. And yet the real problem, human management of woodlands, has not been addressed.

We strongly believe that the oak wilt is the result of over-clearing woodlands and reducing the diversity and richness of the ecosystem. Left alone in a field of short grasses, the oaks are more susceptible to drought and pestilence than they would be if they were surrounded by the flora and fauna they co-evolved with. We recommend that landowners who are compelled to clear land for grazing leave all of the "trash" trees standing within the drip line of the oak rather than clearing right to the trunk, which is the common practice.

These "trash" trees, juniper, hackberry, cottonwood, mesquite, elm, ash, and others will, shade the ground under the oaks, add their leaf and branch litter to the soil, and offer some protection to the next generation of oak trees sprouting beneath the parent tree. Local extension agents refer to such clusters of trees as motts. Strategic lines of sight can be cleared between motts to give a landowner a sense of openness allowing them to see the road, a livestock watering tank, or the favorite afternoon resting place of their herd. Unless we make an effort not only to protect but to restore the biological richness of the Cross Timbers region, oak wilt is likely but the first of many blights to come.

"Bad" Pasture is Good Permaculture

Pasture land that has been allowed to regrow some of its trees and shrubs, usually out of what is seen as "negligence," can be quite attractive. For a permaculture designer, there are some advantages to buying and restoring "degraded" pasture land. One is that many of the invasive "trash" trees on old pastures (which actually lower the real estate value) are quite useful.

Take the juniper for instance: its rot-resistant wood is excellent for posts and beams, its berries can be used as an antibiotic or anti-viral in small doses and the oil from its fruit has been used by women for inducing abortions, though this can be fatal to the mother. Then there is the mesquite, which fixes nitrogen, offers a dappled shade perfect for growing crops under, and produces a hard wood excellent for grilling and smoking meats. Another common pasture invader is the sumac *(Rhus glabra,* but not poison sumac, another *Rhus* species), whose bark is an astringent and is used for treating sore throats, diarrhea, and vaginal bleeding. Sumac berries are rich in Vitamin C, and make a nice tea.

Swales recharge groundwater and create microclimate.

The other advantage to restoring degraded pasture is that it is easier and less disruptive to install swales and ponds on it, since the land has already largely been cleared, (even though trees may be starting to regrow). Earthworking is one of the first steps we should take when building a settlement, since it is the foundation of the productive landscape.

Swales and Shade Trees

Swales and shade trees are essential in this region for establishing low maintenance food forests and perennial food plots. Without these components, water demands would be unaffordable. In the bottom of our swales we can grow dewberry bushes *(Rubus spp.* —its leaves and fruits are used to stop diarrhea), blackberry bushes, and a guild of asparagus and comfrey.

Soon we will be experimenting in one of our swales with a variety of blueberry that is being cultivated for the climate in east Texas. We hope to lower the pH of the soil slightly with juniper mulch and sulfur amendments, and by keeping the swale moist, create a microclimate that would allow us to grow plants, blueberries among them, which we otherwise could not.

The quickest means of providing shade for our perennial food plants has been to allow native trees to sprout up around our swales or to assist them by tossing a handful of seeds into the swales each fall. Some of our healthiest fruit trees are growing

among cottonwoods, hackberries, and "toothache trees" (prickly ash, *Zanthoxylum clava-hereulis* —its bark is used for toothaches and its berry tea is gargled for a sore throat or drunk to stimulate the kidneys). Initially, we considered removing the natives to give our fruit trees more light, but after two years, the young fruits near native trees are doing better than those in full sun.

Never Too Many Ponds

Swales and shade alone, however, are not enough to meet the water needs of many plants while they are getting established. For the driest times of the year, we still need to collect and store water in ponds. Then we siphon it to the swales periodically.

A farm in Texas cannot have too many ponds. We have built seven ponds over the course of two and a half years (five with a bulldozer, one with a back-hoe, and one by hand) and we feel there is still plenty of pond work to be done. Even a small pond in a garden can add the calming presence of water and add tremendous diversity to the yard. A garden pond can easily sustain cattails, lilies, bulrush, wappato, watercress, duck weed, frogs, minnows, crawfish, and much more.

In front of our main building, we have intertwined an herb spiral and a pond (the two forming a 5' diameter circle) in the form of the yin-yang pattern. The herb spiral is the yang (solid) and the pond is the yin (hollow). The whole is under the shade of a mesquite tree and is home to frogs, cattails, lilies, purple cone-flower, yarrow, thyme, marigold, oregano, aloe vera, and more.

Together, the herb spiral and pond are analogous to mountain, hill, valley, lake, and sea with many different aspects of sunlight, water depth and soil moisture. The source of water flow and aeration for the pond is our washing machine, which our staff and interns use a couple of times a week. The pond, which regularly overflows, spills over to irrigate an elderberry *(Sambucus canadensis* —used as a strong laxative), a fig tree, and mesquite.

Cover Crops

Since our property is too large (2.5 acres) to irrigate or mulch economically, we rely on cover crops to shade and enrich the soil, and to conserve soil moisture. The hardiest cool-season cover crops for our region are medicago (a native burr clover), vetch, rye grass, oats, and wheat sown early in September. In mid-March we sow cow peas, millet, and sorghum for the warm season ahead. We mow once in the fall and once in the spring with a sturdy push mower right after sowing our seeds, which is all we need to cut back the Johnson and Bermuda grasses. Any heavier machinery would do more harm than help, by compressing the soil.

After two years of cover cropping, there are areas in our field where the ground now feels like a sponge. I even hesitate to tread there if I am wearing hard-soled boots or shoes. Soon we hope to produce significant yields of annual grains without weeding, tillage, or the use of fertilizers and pesticides.

The Veggie Patch (and Anti-Armadillo Strategies)

In our annual garden a surprisingly effective cover crop is showy evening primrose, which we initially planted for ornament, but which has since spread with a vengeance. Where our green manure plants do not cover the garden soil, we use a light layer of grass clippings or horse manure. This light mulch allows seeds to germinate through it and does not attract armadillos looking for bugs, as a heavier straw mulch would.

When we water our garden, we water all 750 square feet of it, even where there are no vegetables growing. This further throws off the armadillos, who will dig up any moist ground looking for bugs attracted to those areas. Another voracious animal that frequents our garden is the raccoon. Raccoons have eaten almost

Mulch keeps garden soil cool. Notice tall annuals shading house.

all of our corn three years in a row. This has been a fell blow for us, since we would like to cultivate the Three Sisters of North America - corn, beans, and squash. We have yet to find a way to deal with this persistent critter and think perhaps an electric fence or guard dog may be the only solutions.

To protect the vegetables from high winds and the late afternoon sun, we are establishing a border around the south and west sides of the garden. This border is composed of sagebrush *(Artemesia tridentata* —used to induce sweating to break fevers and as a circulatory stimulant), comfrey (used for skin treatments), wormwood *(Artemesia sp.)*, and Jerusalem artichoke *(Helianthus tuberosus)*. Not only will the border buffer the garden against excessive sun, wind, and water run-off, but each of the species in it is quite useful.

On the Art of Making Mistakes

My experience at the Cross Timbers land, as well as my training, has taught me that there are countless ways to diffuse and harvest the natural flows of energy through the landscape. The best way to find out what works for you in your region is keen observation and lots of trial and error. When I make a mistake and am at my wit's end because I will have to rebuild something or wait until next spring to try again, I try to remember what Bill Mollison said to me after my first design course. "Now it's time," he said in his gruff, Aussie accent, "to go out and make as many mistakes as possible."

I think what he meant was, we shouldn't fear to make mistakes, which is inevitable and even to be welcomed, for this is how we learn, and how our designs will evolve. Most important is that we take the first step, then another, and then another. Soon we are over half way to our goal, more experienced than we ever thought we would be, and having more fun than we ever dreamed we could have.

Kirby Fry lives at the Cross Timbers Permaculture Institute, where he practices and teaches permaculture. Cross Timbers is located within the Fossil Rim National Monument. Write him at Rt. 1, Box 210-A, Glen Rose, TX 76043.

Straw-Clay Construction

Second in a continuing series on Natural Building

Ted Butchart

One of the world's older building techniques is the use of straw coated with clay as an in-fill "skin" between timber-frame "bones." Also known as light clay (German *leichtlehm)*, this technique has been used for centuries in northern Europe. Still-standing examples go back over 700 years. Like its cousins, cob and straw bale, light clay yields a graceful and elegant surface. It can be built with minimal training, using all natural materials, and the result is a true breathing wall.

First, a quick description of the process, then we will slow down and look at particulars. The material itself is, not surprisingly, a simple mixture of loose straw and a thin clay soup known as a "slip." Approximating the traditional method, the mix is tamped down between temporary form boards that attach to the structural posts. As the form is filled, willow branches, bamboo, or other "reinforcing bars" are laid horizontally in the middle of the rising wall and slipped into holes drilled in the posts. More mix is tamped on top of the reinforcing.

As each short form is filled, lower forms are removed and reattached higher on the wall, and the filling and tamping continues. These removable forms are known as "slip forms," because you slip them up the wall with the rising straw-clay. (No relation to the clay "slip.") There is no appreciable waiting time before you can move the forms. The tamped wall holds its shape immediately.

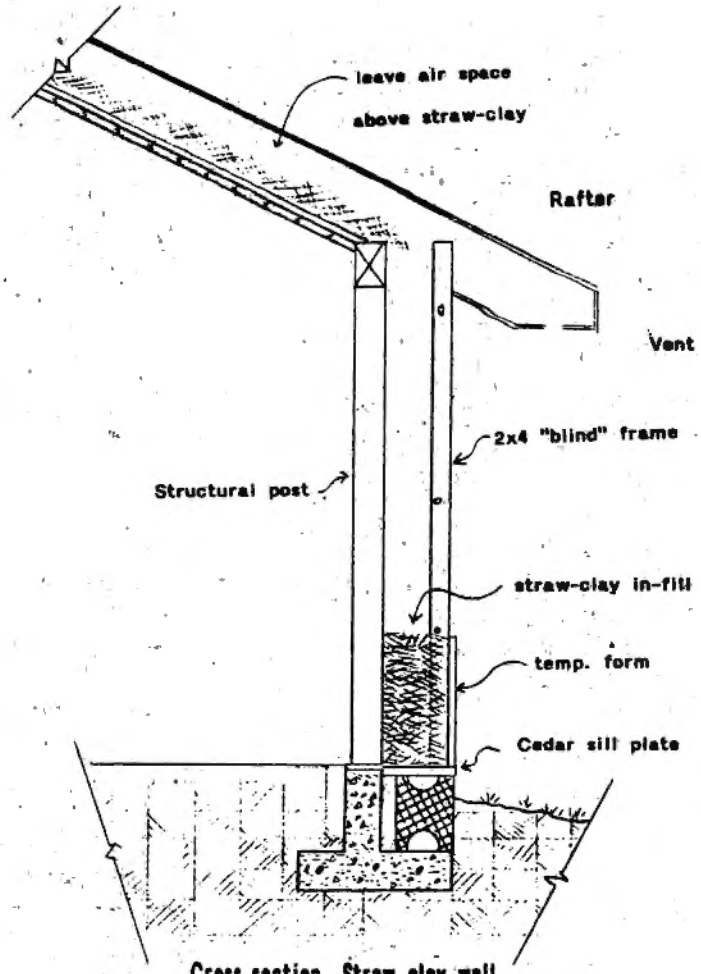
Straw-clay uses the insulating and breathing capabilities of straw and marries them to the fire-retarding properties of clay. (Whereas baled straw is inherently fire-resistant, loose straw is flammable when not coated with clay.) The clay is hygroscopic, so it can absorb excess humidity and then release it when the air is dry: a totally passive moisture fly-wheel. In addition, the mass of the clay can hold more heat than the straw alone, so, by varying the proportions of the clay and straw, we can create more or less massive mixtures for particular uses:

- A south wall could be made more massive to hold and slowly transmit heat;
- A north wall would have proportionally more straw and be more insulating; and
- Ceiling insulation would be very light, with just enough clay to make it fire-retarding.

Preparing the Materials

The straw used is normal grain straw: wheat and barley work especially well. It should be sound, undamaged straw, and it is used loose. Break the bales and use about half a bale at a time.

The clay is preferably pure clay. The best bet is to find a clay deposit and slowly harvest the crumbling powdery clay as it weathers naturally. Powder-dry clay is a lot easier to mix with water than clumpy balls of wet clay. Take some simple care when handling dry clay to avoid breathing the fine dust. Store your harvested clay in garbage cans or another lidded container to keep it dry and easy to use. If you can't find a clay deposit nearby, you can use soil with as little as 50% clay content. Test it by rolling a ribbon and trying to bend it 90 degrees. If it breaks it doesn't have enough clay. Be careful that you don't accidentally use silt.



Cross-section Straw clay wall

Starting with a barrel one-third full of clean water, add the clay powder and mix with a hoe. Pass the clay powder through a sieve to remove large chunks, if necessary. A mason's hoe, with holes in the blade, will help with the mixing. A motorized mortar mixer will help even more. Bring the clay-water mixture ("slip") to a cream-like consistency.

Using a large, clean platform such as a sheet of plywood, combine the straw and slip. Just spread half a bale of straw loosely on the platform and pour slip over it. Toss the mix like a salad, using pitchforks. Getting the proportions right is one of those hands-on things that is most easily learned in a weekend workshop. Not a great deal of clay is needed: you can still see the individual straws. They just look colored by the clay.

Preparing the Building Frame

While the usual method over the years has been to place the straw-clay infill directly between the timbers which frame the building, this has certain limitations. Firstly, the thickness of the wall is limited by the thickness of the posts, since the form-boards are usually attached on either side, then filled. Secondly,

there is the problem of what to do at the top of the wall, where the posts support the beam. Since the beam makes tamping impossible at the top, something else must be done. One solution is to fill the top part of the wall with cob, which, being dense, doesn't need tamping, and plaster over it. However, if you do not plan to plaster, this can look a bit strange.

Robert LaPorte, based in Santa Fe at the Natural House Building Center, has come up with an innovative solution to both of these limitations. In his method, the light clay wall wraps around the outside of the whole frame. Smaller timbers can support a thicker wall, and no beams interfere with tamping.

This is how it works: The inside slip forms are inserted between the main structural posts of the building's frame, thus forming a smooth plane, which continues across the outside surface of the post. *(See drawing)* A "blind" stud wall is built outside the timber-frame, creating a minimum 12" space from the outside of the posts to the outside of the stud-wall where the outer slip forms will be attached. The blind wall studs are nailed to a plate at the bottom and face-nailed to the rafters above. These studs are buried inside the straw-clay. The timber posts are left protruding completely out of the wall on the interior of the building.

So we start with a bare-bones structural frame, with a light-stud wall outside the line of the posts to create the desired depth of wall. Screw some form boards to the outside of the stud wall, and others to the timber posts. The forms should be two feet high, and wide enough to span between the posts. Use 3/4" plywood with whaler strips to keep them stiff.

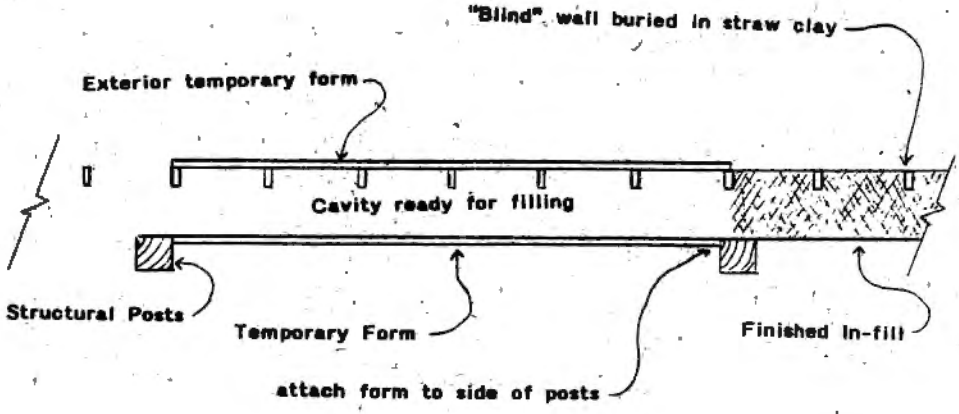
Instead of being laid down the middle of the wall and attached to the timber posts, the horizontal reinforcement bars attach to the studs of the outer blind stud wall. Pre-drill holes in the studs every 24" to accept your reinforcement.

Building the Wall

Now the fun begins. Place large handfuls of the straw-clay mixture into the form. Tamp the mixture down firmly using your feet or 2x4 tampers. Get those corners tamped down, too. As you fill up the first form, socket each end of your horizontal reinforcement "bars" (be they willow, bamboo, or something else) into the holes in the studs. These "bars" give a positive shear connection to hold the panel rigidly against wind forces, earthquake movement, or inadvertent collisions.

Place a second pair of forms atop the first and continue filling and tamping to the next reinforcement point. Move the bottom form up, leapfrogging the upper form board. Continue until you reach the top of the wall. Remove the forms and start over at the floor in the next bay, or continue up into the rafter cavities.

For ceiling insulation use a light mix. First, install a ceiling deck under the rafters or trusses. Fill the rafter cavity completely, side to side, but always leave an air channel at the top of the cavity connected to vents in the eaves to allow an unobstructed flow of fresh air over the top of the insulation.



Horizontal cut through wall, looking down

Finishing

Due to the wetness of the mix and the great width and depth of the wall, it takes some time to dry out completely. And it must be completely dry before you plaster the surfaces. This can take six months or longer outside the arid regions. If the walls are finished as you approach winter, it is important to heat the building to finish the drying. If grain seeds sprout during this period they will merely help the drying process.

Electrical wires can be run through conduit placed before the walls are filled, or channels can be cut into the surface of the straw-clay.

Traditionally, light clay surfaces were covered with earth plasters, which will be featured in an upcoming column. Internal walls can be left unplastered: the surface is reminiscent of a tatami-mat. The external stud-wall allows the option of using a wooden siding.

As you can see, the straw-clay wall building process is straight-forward. Although the use of a timber-frame structure is traditional, I believe you could use this system with other forms of frame if the timber-framing is beyond your skill level. On the other hand, if you are going to acquire new skills in order to do your own building, why not learn a craft that is poetic and loving in its use of wood? Timber-frames are an ideal partner to straw-clay.

A concise little guide to straw-clay and other 'holistic' building techniques is available for $10 from Robert LaPorte at the Natural House Building Center, 2300 W. Alameda, A5, Santa Fe, NM 87501. Workshop schedules are available at that address or at the North American Natural Building College web-page: www.balewolf.com. Δ

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www.balewolf.com.

Registration is possible through your computer!

More information about natural building techniques is also available at this address.

REVIEWS

Not Just the Birds and the Bees

Review by Toby Hemenway

STEPHEN L. BUCHMANN and GARY PAUL NABHAN
The Forgotten Pollinators
Island Press/Shearwater Press, Washington D.C., 1996.
320 pages. $25.00. cloth.

Each spring, beehive-laden trucks migrate northward in sequence with blossoming orchards. This vernal scene only hints at the economic and ecological value of pollinators. Permaculturists have gotten wise—we intersperse our landscapes with insectary plants. But the pollen-dusted link between plants and animals is one of the most neglected aspects of natural history. A new book, *The Forgotten Pollinators*, goes far to remedy this lack. Disguised amidst lively tales of the expected pollinators (bees, butterflies, and hummingbirds) and the unexpected (bats, geckos, lemurs and flying foxes) are many principles of ecology and evolution.

Stephen L. Buchmann, a research entomologist and professor at the University of Arizona, and Gary Paul Nabhan, award-winning author and director of science at the Arizona-Sonora desert museum, have written an engaging and important book. With vignettes from fieldwork they show the relationship between pollinator presence and seed set, and then document the alarming decline of many pollinator species. The culprits include habitat fragmentation, insecticides, and introduction of exotics.

Even the esteemed honeybee has its faults. Honeybees are "generalist pollinators" with huge pollen appetites, the authors explain, and by depleting nectar and pollen, these introduced insects can starve native pollinators. Perhaps the tracheal and Varroa mites that are decimating honeybee colonies are not an unmitigated disaster, but are giving native insects a second chance.

Buchmann and Nabhan's writing is a delight: one species of bat is "not just another nectar-slurping pretty face," and plants don't simply have multiple pollinators, they "rarely dance with just one partner." The authors also know the numbing effect of scientific jargon, and after dosing out a latinate term, usually sweeten the medicine with an apologetic pun or joke.

Natural history writers are fond of bizarre and amusing tales, and the lives of the pollinators fit right in. Male orchid bees mop up fragrant flower secretions with specialized leg hairs, and then work metabolic alchemy upon the perfumes to convert them into sex attractants. The largest pollinator, besides humans, is a Malagasy lemur, which opens the flowers of the 100-foot tall traveller's tree to drink the nectar. Tomatoes, blueberries and kiwifruits are not simply pollinated, they are *sonicated*. Bees climb into the blossoms and vibrate their thoraxes at a note near middle C, 512 cycles per second. This buzzing agitates the pollen until it boils out of the anthers, forming a dense cloud around the bee and pollinating the blossoms far more effectively than does simple contact.

The authors use these stories to illustrate the tight bond between plants, animals, and habitat. A decline in one element often brings the others spiraling down in "linked extinctions." For example, dryland alfalfa farmers ignored the critical role of ground-dwelling alkali bees in pollinating their crop. When they plowed the bee's burrows and sprayed to kill other insects, alfalfa yields plummeted. After suffering the cost of hiring outside pollination, these farmers are now setting aside habitat for alkali bees.

How much of nature's work are we willing to supplant? The authors describe 10-acre hydroponic tomato greenhouses at Bonita Farms in Arizona. A maze of sensors measures water stress and nutrient levels. In the near-sterile environment, there are no diseases, weeds, or insect pests, eliminating the need for sprays (a manager calls these plants "organically grown" but I doubt they'd get certification—or is the hydroponic solution liquid manure?). After renouncing hand pollination, the owners now import Dutch-bred bumblebees via California. Treating bees as technology like this rather than honoring relationships draws criticism from the authors.

For anyone interested in going beyond a simple list of insectary plants, this book will richly reward the modest effort it requires. Covering the history of human use of pollinators, plant/pollinator ecology, and techniques to increase the abundance of these crucial ecological partners, *The Forgotten Pollinators* fills an important gap in our knowledge of the relationship between animals, plants, and landscape.

Don't Go Back to Sleep...

Review by Samantha Lefko

ALBERT BATES
Climate in Crisis:
The Greenhouse Effect and What We Can Do
Book Publishing Co., Summertown, TN, 1990.
232 pages $11.95. paper.

Climate in Crisis was one of the early texts that familiarized the North American public with the terms "global warming" and "greenhouse effect." Published in 1990, this informative book was indeed a wake-up call. It shocked many and moved many more to action within the environmental movement. In 1997, *Climate in Crisis* is the snooze alarm for those who may have found themselves being lulled back into a complacent sleep. This book will not let us forget how dire the situation really is. Despite positive steps, such as increased regulations on industrial emissions and dumping, curbside recycling, and improvements in energy-efficient automobiles, we are reminded that the situation is extremely complex and there is much more work to be done.

Bates illustrates his points and predictions with a series of charts and graphs. He clearly communicates the complexity of the "earth's infinitely interconnected systems." He is able to show how a single element, such as CFCs (chlorofluorocarbons), can set off an endless chain reaction of climatic events that may shape the ecological future of the planet. Once released into the atmosphere, CFCs are able to transport atoms of chlorine into the upper atmosphere where they effectively destroy large quantities of protective ozone. Depletion of ozone creates conditions for higher levels of ultra-violet radiation to reach the earth's surface. Ultra-violet radiation then causes human skin cancer; it also kills invaluable ocean phytoplankton. As phytoplankton communities are diminished, carbon dioxide levels in the atmosphere rise. Increased carbon dioxide results in the warming of the earth, which causes glaciers to begin to melt, seas to rise, and so on.

The text is well-crafted and ultimately drives its point home. Bates also addresses his readers with a much-needed note of practicality. In order for individuals, and Western culture as a whole, to adopt more sustainable worldviews, the transition from old to new must be fairly easy and relatively painless. To quote, "If we move too far too fast, we risk losing touch with human values and abilities, creating resentment and spawning backlash."

Climate in Crisis is an important book to read, or perhaps for some, to re-read. The book gave me a moment for pause. I was able to reflect on the spectacular relationships that make up the planet earth, and I was given the chance to refocus on the crisis.

Correction

Sandra Liebowitz's compendium survey of *Eco-Building Schools*, reviewed in issue #35, costs $7, including first class postage, not $6 as previously stated. Also, she has moved to 3220 "N" St. NW, #218, Washington, DC 20007.

Natural Building Calendar

April 16-20. near Moab, UT. Timber Frame, Strawbale & Straw-Clay Workshop led by Robert LaPorte. Kevin Holladay, 326 Staab St., Santa Fe, NM 87501. (505) 986-5847.
April 18-20. Tucson, AZ. Strawbale Workshop. De Havillan Workshops c/o Out on Bale-By Mail, 1037 E. Linden St., Tucson, AZ 85719. (520) 624-1673.
April 19-20. Tucson, AZ. Swale-Building and Water-Harvesting. Barbara Rose, (520)744-9305, or Permaculture Drylands Institute, PO Box 156, Santa Fe, NM 87504. (505) 983-0663. http://www.amug.org/nshadetre.
May 3. Lummi Island, WA. Straw Bale Home & Permaculture Garden Tour. GreenFire Institute, 1509 Queen Anne Ave., North, #606, Seattle, WA 98109. (206) 284-7470. email: Ted@balewolf.com.
May 5-11. Summertown, TN. Basics of Building With Cob. The Cob Cottage Company, Box 123, Cottage Grove, OR 97424. (541) 942-3021.
May 9-11. Tucson, AZ. Roofwater Harvesting and Storage Tank Construction. Barbara Rose, (520) 744-9305, or PDI, PO Box 156, Santa Fe, NM 87504. (505) 983-0663. http://www.amug.org/nshadetre.
May 17-18. Black Mountain, NC. Building with Earth and Straw. Culture's Edge, 1025 Camp Elliott Rd., Black Mountain, NC 28711. (704) 298-2399.
May 17-30. Taos, NM. Natural Building Extravaganza. Cob Cottage Company. (541) 942-3021.
May 18-June 6. Oakland, OR. Design and Build an Entire Cob Cottage. Cob Cottage Company. (541) 942-3021.
June and July, Dates TBA. Arlington, WA and Whidbey Island, WA. Hands-On Framing Workshop. GreenFire Institute. (206) 284-7470. email: Ted@balewolf.com.
June 7-8. Whidbey Island, WA. Foundation Layout & Footers Workshop. GreenFire Institute. (206) 284-7470. email: Ted@balewolf.com.
June 8-20. Philo, CA. Sustainable Building and Design. Cob Cottage Company. (541) 942-3021.
June 14-21. Black Mountain, NC. Round Pole Post and Beam Building. Culture's Edge. (704) 298-2399.
June 19-26. Murphy, OR. The Second Women's Natural Building Symposium. Groundworks Natural Earth Home Building, PO Box 381, Murphy, OR 97533. (541) 471-3470.
June 23-29. Sedro-Woolley, WA. Strawbale Building. SunRay School of Natural Living. 1356 Janicki Rd, Sedro-Wooley, WA 98284. (206) 781-3525, or 360-854-0413. email: jkelley@ncia.com.
June 28-29. Port Townsend, WA. Weight-Bearing Straw Bale Structures. GreenFire Institute. (206) 284-7470. email: Ted@balewolf.com.
July 26-27. Port Townsend, WA. Surfacing the Straw Bale Home. GreenFire Institute. (206) 284-7470. email: Ted@balewolf.com.
July 27-August 9. Tlaxcala, Mexico. Sustainable Rural Development and Traditional Building. Cob Cottage Company. (541) 942-3021.
August 2-3. Whidbey Island, WA. Straw Bale Construction. GreenFire Institute. (206) 284-7470. email: Ted@balewolf.com.
August 15-17. Black Mountain, NC. Straw Bale Building Workshop. Culture's Edge. (704) 298-2399.
August 29-10. Seattle, WA. Straw Bale Construction. GreenFire Institute. (206) 284-7470. email: Ted@balewolf.com.
September 13-14. Seattle, WA. Straw Bale Construction: Two-Story Urban Infill. GreenFire Institute. (206) 284-7470. email: Ted@balewolf.com.
September 14-28. OR/WA (TBA). Basic Thatching. Cob Cottage Company. (541) 942-3021.
October 18-24. near Knoxville, TN. Cob Building Workshop. Cob Cottage Company. (541) 942-3021.
November 2-6. Central TX. Advanced Cob Building and Design. Cob Cottage Company. (541) 942-3021.

from the Regions...

City Seeds—New Advocate for Urban Permaculture

Samantha Lefko

City Seeds is a grass roots, non-profit organization based in Asheville, North Carolina — and we believe in cities. It is our conviction that cities are appropriate human settlements for the future, because many aspects of "the city" are already designed for sustainability. For instance: the density of urban populations allows for ease in distributing and accessing services, most city dwellers have access to public and alternative modes of transportation like buses, bikes, or walking, and cities provide a racially and culturally rich platform for the exchange of beliefs and ideas. In addition, the urban landscape provides the ideal pallette for permaculture design.

Our four on-going projects reflect our dedication to help redesign and retrofit urban environments. Permaculture philosophy can be recognized in each of our projects, which include:

- The Bountiful Cities Project
- City Seeds Quarterly
- Industrial Ecology
- Passive Solar Design and Retrofitting.

The Bountiful Cities Project is an innovative approach to public, open space. Combining the elements of a park, community garden, and a Permaculture Forest Garden, The Bountiful Cities Project introduces edible, public, open spaces to urban and suburban areas. Perennial fruits and vegetables, along with other useful vegetation, are combined with swings, picnic tables, and park benches to create a low-maintenance garden paradise in the city. We are encouraging other cities to follow our lead and establish useful vegetation in public spaces.

City Seeds Quarterly begins publication this month; it will explore myriad topics including urban permaculture systems and other types of sustainable urban design. The Quarterly will introduce readers to exciting and visionary projects going on in cities in the Southeast and around the country. It will also familiarize its readers with concepts such as Entropy, Urban Metabolism, and Industrial Ecology.

A high priority for City Seeds is introducing the concept of Industrial Ecology to the general public. Industrial Ecology, sometimes called Industrial Symbiosis, is a system designed to take the waste product of one industry and use it as raw materials for another. Thus, by setting up a network of industrial exchanges, there is not only a reduction in operating and production costs, but there are far-reaching, positive ecological benefits achieved by reducing or eliminating waste from many industrial processes.

The advocacy and promotion of solar retrofitting and design is also a key issue to sustainability, especially urban. At present, solar additions to low-income housing would create economic relief for struggling families and individuals. Solar design in housing, schools, businesses, industry, and everywhere else, will prove to be an economic advantage to all income groups; it is, of course, one of the most ecologically sound ways to capture and use energy.

It is City Seeds' intent to create excitement over the potential of urban centers. We want to help others see the vision of what our cities and suburbs could and should be.

For more information contact us at:
331 Hillside St.
Asheville, NC 28801
(704) 253-3689
e-mail: cityseeds@waonline.com

Permaculture As Native Science

Ann Krush

Native Americans in the Southwest US and Northern Plains are using permaculture as a framework within which to encompass their own Native Science, to ensure the permanence of their own culture, and to bring the philosophy and practice of Native Science into the schools.

In order once more to be independent in food production, to increase the quantity and improve the wholesomeness of food for their Pueblo, and to pass living philosophy on to the next generation, the Native Americans of Tesuque, New Mexico are practicing permaculture, imbued with the Spirit of Mother Earth. They have joined together as the Traditional Native American Farmers Association (TNAFA), and are the base for a Native American permaculture network.

Native Americans around Winslow, Arizona, and the school kids of Leupp's Little Singer school are learning Native Science. With the special energy of the Spirit, they are turning the land around their school into a permaculture oasis. With assistance from the Black Mesa Permaculture Project, local instruction is given, as are full design courses to which Native Americans (and non-Indians) from across the region are invited.

On the Rosebud reservation in South Dakota, the Sicangu Lakota have formed a Center for Permaculture as a Native Science. The Center is a broadening of their Garden for Health program which addresses prevention of diabetes through food gardening and the related strengthening of Spirit connectedness. Enthusiasm for the permaculture framework is leading to Earth restoration within the barren HUD housing clusters and a beginning of community solidarity within the neighborhoods. Permaculture, now accepted by schools as ecological science and by the USDA as an alternative agricultural method, has allowed the Sicangu Lakota to bring their philosophy of complete interrelationship into their schools and to apply for a Sustainable Agriculture Research and Extension (SARE) grant to assist the Center in providing sustainable agriculture/permaculture education.

Another group, called the American Indian Science and Engineering Society (AISES), assists in the promotion and coordination of permaculture as Native Science. Over the winter holidays, AISES sponsored a meeting of Native American permaculturists in which participants developed a draft curriculum guide for use in the winter classroom and between on-site workshops. AISES also provides basic support for permaculture promotion and education, including a Spring '97 workshop on the Rosebud reservation with permaculture teacher Jeff Lawton of Australia. Each issue of their journal *Winds of Change* contains at least one article on permaculture in practice, c.f. Winter 1997, "Traditional Agriculture and Permaculture."

The dissemination of permaculture philosophy and practice is providing opportunity for many non-Indians to come closer to the Native American connections to Earth and Sky. It is also providing Native Americans a framework, acceptable to the non-Indian society, in which to practice and teach Native Science. Δ

Contacts

Clayton Brascoupe, Traditional Native American Farmers Association, PO Box 170, Tesuque, NM 87574.

Justin Willie, Black Mesa Permaculture Project, PO Box 5350, Luepp, AZ 86035.

Ann Krush, Permaculture and Outreach, Sinte Gleska University, PO Box 8, Mission, SD 57555.

Dick Pierce, American Indian Science and Engineering Society, 5661 Airport Blvd., Boulder, CO 80301.

Networks & Resources

Danish Environmental Guild

We are called the Ecological Starters—Eco-Starters for short—and we are a network of different ecological projects in Copenhagen, Denmark. There are currently about 60 people involved in one or more of the five projects. These projects include a restaurant called The Ecological Café; a shop that serves as an educational clearinghouse about ecological living called Green Future; The Wheel Association, which is an old bus connecting the city with the countryside; The Ecological Youth Hostel; and The Urban Garden. Though all the projects are different, we make use of each other's knowledge and experience, help each other, and work together.

We want to make things happen in terms of ecology in the city of Copenhagen. Not only among the people who are comfortably off and hyper-conscious, but also among "ordinary" people in the small districts of Copenhagen. Ecological reorganization demands the engagement and responsibility of the individual.

We want to add a human dimension to ecology and emphasize how I/we/they/you can do something—right here and now, instead of only sitting and waiting for large-scale technical solutions.

We want to show that ecology is not just a question of renunciation, colorlessness, cold apartments, and all the other prejudices. Ecology is in fact a question of culture. We must change our culture in light of ecological imperatives.

The Ecological Starters
Guldbergsgade 8
2200 Copenhagen N.
Denmark
Tel: (+45) 31 35 35 40; Fax: 35 37 41 62

Worm Digest: Worms Deepening Our Connection to Food and Soil

Worm Digest is a quarterly 32-page newspaper packed full of information about worms, worm composting, and worm technologies for organic waste utilization and soil enrichment. It includes Bookworm Reviews, Kid's Corner, CyberWorm (wormformation websites), Worm Workers, Industrious Worm (worms in industry), Hands-On, International Worm News, and more. *Worm Digest* is published by Edible City Resource Center, a non-profit organization that promotes sustainable organic agriculture. To subscribe, send $12 to *Worm Digest*, PO Box 544, Eugene, OR 97440. Their website address ishttp://www.applied3d.com/worm/

Pastured Poultry Farmers

Eleven southern farm families are raising "pastured poultry" through a project to help these limited resource farmers boost incomes and diversify operations by growing, processing, and marketing chickens on their farms. The farmers are also founding members of the new American Pastured Poultry Producers Association (APPPA) which helps producers around the country network with others.

Funded by the USDA's Sustainable Agriculture Research and Education (SARE) program and sponsored by Heifer Project International (HPI), the three-year project employs the proven methods of the Joel and Teresa Salatin family of Swoope, VA, authors of the popular book *Pastured Poultry Profits: Net $25,000 in 6 Months on 20 Acres.*

"In the Salatin pastured poultry model, chickens are raised in floorless pens which are moved daily to fresh pasture," says Anne Fanatico, outreach coordinator for the project. "The chickens receive exercise and fresh air while foraging for plants and insects, and their manure is spread evenly onto the pasture. They are fed a concentrate feed, usually non-medicated."

As a kick-off, the eleven families, from Kentucky, Alabama, Mississippi, Louisiana, and South Carolina, participated in a hands-on training session at the Salatin farm in June 1996. During the three-day workshop, the families learned about brooding, pen-building, processing, food safety, and marketing. A summary of legal regulations affecting on-farm processing was presented, along with a survey of the experiences of producers who have already adopted the Salatin model.

After training, the families received a grant from HPI to help them raise a batch of 100 chickens in 1996 on their farms; to keep a notebook monitoring income, expenses, labor, pasture management, and any difficulties encountered; and to train another farmer in pastured poultry production.

According to preliminary information, production to date has gone well for the farmers. The chickens are processed on-farm and direct-marketed to customers. "Not only did we make a few dollars, but I am very happy that we can open the freezer and see 40 chickens we can eat," farmer Kim Brinson of Livingston, Kentucky, said. Most of the project farmers plan to raise new batches this spring.

Fanatico said over the next two years the the project will incorporate from 10 to 20 new farmers per year, as the first set of farmers help to train the second and third sets. Farmers are being selected from groups that are supported by HPI, and training will resume in spring. Local Extension agents working with the farmers are also trained to provide technical support, and several universities (Kentucky State, Tuskegee, and Southern) are establishing demonstrations. ATTRA (Appropriate Technology Transfer for Rural Areas), a national sustainable agriculture information center, will publish case studies which will be available to the public when the project concludes. HPI, a non-profit development organization which is based in Little Rock, AK, and promotes community development activities through livestock enterprises, sponsors the "Integration of Pastured Poultry Production into the Farming Systems of Limited Resource Farmers." The SARE grant also supports the formation of APPPA.

APPPA publishes a quarterly newsletter to promote the exchange of ideas and information, which includes reviews of legal issues regarding on-farm poultry processing, information on chicken feed, rations, new/used production and processing equipment, marketing, referrals, and sources of chicks. APPPA's database of active pastured poultry producers is useful not only for networking among producers, but also for consumers looking for high-quality chicken products in their area. Anyone interested in pastured poultry production is encouraged to become a member of APPPA. To join, send $20 to APPPA, c/o Diane Kaufmann, 5207 70th Street, Chippewa Falls, WI 54729, telephone: 715-723-2293.

The pastured poultry model was developed in the South, but is used on small farms in other parts of the nation for seasonal production. The book *Pastured Poultry Profits* can be ordered for $30 (+$3.50 postage) from The Stockman Grass Farmer, PO Box 9607, Jackson, MS 39286, telephone: 1-800-748-9808. A video is available for $50 (+$3.50 postage). Δ

Ed.: PCA #32 featured Salatin's pastured poultry method along with a report on his whole farm economy. Available for $5.00 ppd.

Permaculture Community Land Trust Network Proposal

Bruce Shearer

Many of us have valuable land dedicated to permacultural use. Yet it's in private ownership and if disaster should strike, would go on the market for privateering of some kind.

The idea of the Permaculture Community Land Trust Network is to sell private land into trust. The focuses could be 1) permaculture leases only; 2) egalitarian (to be defined) non-violent participation; 3) labor exchange among participant trusts; 4) cooperation (versus competition); 5) green values modified; 6) participant members only; etc.

This would encourage private sanctuary but not private (land) property as condominium does. It would also encourage the permaculture visitor idea.

I suggest a conference for PCLT Net sometime this early summer. Namasté Green offers our site in New Hampshire. (We have a campground that can accommodate 50+ people.) Contact me at Namasté Green, Barnstead, NH 03225.

Native Harvest Designs
Massachusetts and the Northeast

April 25-27. Edible Forest Garden Workshop. New England Small Farm Institute, Belchertown, MA. $150-200 sliding scale. Dave Jacke and Eric Toensmeier.
May 1. Edible Forest Garden Workshop, as part of day long series titled "Gardening As If the World Depended On It," with three other instructors. $69 members/$79 non-members. Contact Worcester Co. Horticultural Society, Tower Hill Botanic Garden, Box 598, Boylston, MA 01505-0598, 508-869-6111 ext 24.
May 9-12. Permaculture: Yoga in the Garden of Eden. Kripalu Center for Yoga and Health, Lenox, MA. $315-660. Dave Jacke and Eric Toensmeier. Contact Kripalu Center, PO Box 793, Lenox, MA 01240, 800-741-7353.
May 31-June 1. Ecological By Design. Yestermorrow Design/Build School, Warren, VT. $250 (not including food or lodging). Dave Jacke. Contact Yestermorrow Design/Build School RR 1 Box 97-5, Warren, VT 05674, 802-496-5545, fax/-5540.
June 5-20. "The Game of Eco-Village": A Permaculture Design Course.
June 5-28. The GeoCommons College Year Summer Institute in Sustainable Living. Gaia Education Outreach Institute, Derbyshire Farm, Temple, NH. The permaculture design course is enfolded in the broader Sustainable Living course. The pc course by itself is $750, the Summer Institute, which is offered through the University of New Hampshire (4 undergrad credits) is $1200. Dave Jacke, Cynthia Edwards, Dan Earle, Bruce Kantner, Dan Greenberg, Leslie Goldstein. Contact GEO, Derbyshire Farm, Temple NH 03084, 603-654-6705, geo@igc.org.
Sept. 6-7. Ecological By Design. See above.
Sept. 19-21. Edible Forest Garden Workshop, location and cost TBA. Dave Jacke and Eric Toensmeier.

Contact: Dave Jacke is an experienced permaculture teacher with a wealth of knowledge about designing for and growing in the US Northeast. For a full description of each course, and further details, contact Dave Jacke, Box 148, Leverett, MA 01054, 413-548-8899.

At Heathcote Community:
Maryland

May 9-11 Forest Gardening
July 12-27 Permaculture Design Course
Sept. 26-28 Perennial Integration
Instructors: Dawn Shiner & guests
Contact: Heathcote Community, 21300 Heathcote Rd., Freeland, MD 21053 410-343-3478

Dates: July 11-26
Location: Arthur, Ontario, Canada (near Guelph)
Description: Situated deep in the heart of farm country, there will be plenty of hands-on experiences sprinkled throughout this intensive course. A subscription to *The Permaculture Activist* is included. Some partial scholarships may be available
Instructors: Gregoire Lamoureux, Cynthia Edwards, and Emilia Hazelip, from France, a student and practitioner of Masanobu Fukuoka's farming methods.
Cost: CDN $700-900 sliding scale, $625 if registered before June 4. Includes food and camping—bring your own tent, etc.
Contact: Permaculture Community Action Worknet, c/o Richard Griffith 104 Bridlewood Blvd. Agincourt, ON, Canada M1T 1R1, 416-497-5746.

Nova Scotia Permaculture Intensive & Workshop

Dates: Workshop July 26-27; Design Intensive July 26-August 3
Location: Pugwash Junction, NS, Canada (on Nova Scotia's beautiful North Shore)
Description: The 2-day workshop will introduce principles and practices of permaculture and then apply them to planting an edible hedgerow. This will be the first two days of the 9-day intensive. Small groups will develop designs for the course location. Talks, field trips and hands-on projects will cover garden design, organic growing, year-round food supply, preserving the harvest, range-fed livestock; ecological forestry, straw-bale building, and local economic structures such as LETS and CSAs.
Instructors: Jerry Heath, Norm Hunter, and Jerry Draheim
Cost: Workshop - CDN $120 ($100 before July1); non-refundable deposit of $25 required by July 1st; Intensive - CDN $700 ($650 before July 1); non-refundable deposit of $100 required by July 1st; fees cover tuition, camping site, meals, and course handouts
Contact: Norm Hunter, PO Box 5, Pugwash, NS, Canada B0K 1M0 902-243-3690, fax/-3260

Networks & Resources

Matching Intentional Communities With New Members

The Northwest Intentional Communities Association (NICA) has started a Membership Information Exchange. People seeking to join communities with openings for new members will be able to connect through this service.

A community seeker should send name, address, phone, any personal information you feel will be helpful, and as much detail as possible about the type of group you would like to join, including preferred location, size, and financial requirements. Please enclose $2 to cover postage and Xerox, etc.

If your community seeks new members, we request that you send us an information sheet describing the location, nature, history, and make-up of the group, qualifications for membership, and any other pertinent information. We will make copies of all information sheets we receive and send them to all prospective member applicants whose criteria match yours.

Contact Howard Wechsler, NICA Membership Committee, Finney Farm, 4004 South Skagit Highway, Sedro Woolley, WA 98284. Phone: 360-826-4004 (callers should leave address for mail response). email: finney@ncia.com.

Michaela Farm Needs Full-Time Farmer

Farmer at Michaela Farm: Full-time position of 300 acre organic farm and ecological education center in southeastern Indiana. Mechanical and organizational skills, oversee and implement building and barnyard maintenance, tool and equipment usage, management of animals, aquaculture and water sources, tree plantings and timber stand improvement. Delegate tasks and collaborate with farm staff, interns, and other workers. Apply permaculture and sustainable agriculture principles. Build community if desired. Send resume immediately to: Sister Anita Brelage, Michaela Farm, PO Box 100, Oldenburg, IN 47036, or call 812-933-0661, 8-5 EST, Monday-Friday.

...and Seasonal Interns

Intern at Michaela Farm: Gain hands-on experience during the growing season (February to October). Three full-time live-in internships are available. Interviews for 1997 are in process now. Learn by working with head gardener, farmer, and other interns in organic gardens and with livestock. In return, receive room and board in a community-living setting at the farm. Contribute to the farm's goals of sustainable agriculture and land renewal efforts and put yourself on a new career path. Resource library, educational programs, and spiritual growth experiences are available through outreach events offered at the farm. Interaction and networking with farm members and others who participate at the farm. Call 812-933-0661 or 934-5016 or write for an application form: address above.

Urban Permaculture Design
Toronto, Canada

Dates: August 8-16
Location: Toronto, Ontario
Description: "Oh, permaculture's all very well if you own land somewhere, but it'll never work downtown. Right? WRONG! It's even more necessary downtown. Join us and learn how to transform your urban landscape into a livable, breathable, exciting place to be. Notify PCAW if you need help finding accommodation in Toronto. A subscription to *The Permaculture Activist* is included. Some partial scholarships may be available.
Instructors: Gregoire Lamoureux, Cynthia Edwards, and Emilia Hazelip, from France, a student and practitioner of Masanobu Fukuoka's farming methods.
Cost: CDN $550-650, sliding scale, $500 if registered before June 4.
Contact: PCAW
c/o Richard Griffith
104 Bridlewood Blvd,
Agincourt, ON M1T 1R1
416-497-5746

Culture's Edge at Earthaven
North Carolina Mountains

May 17-18. Building with Earth and Straw. $95, plus $15-20 for vegetarian food and camping. Paul Caron and Earthaven staff. Learn a variety of techniques, including slip/straw, wattle and daub, cob, earth plasters.
June 14-21. Round Pole Post & Beam Building $600 with food and camping. Paul Caron and Earthaven staff. Learn post and beam timber-framing techniques with round poles on a 13-sided community "meeting barn."

July 6-August 3
Permaculture Apprenticeship Intensive

$1500 Includes camping and all meals. Chuck Marsh, Peter Bane, Patricia Allison, and others. The intensive includes a Fundamentals of Permaculture Course taught on four weekends plus challenging and practical hands-on design projects in Streambank Restoration, Natural Building, Paradise Gardening, Restoration Forestry, Landscape Artistry, Urban Resources, and Consensus Democracy.

Aug 15-17. Straw Bale Workshop $185 with vegetarian food and camping. Paul Caron and Earthaven staff. Fill in the wall for Earthaven's "meeting barn."
Sept 5-7. Living on Earth—In Spirit. Just donation. Patricia Allison. Deepen your spiritual connection with the earth and learn practical skills for living in harmony.
Description: For details of each course, or a full listing of courses, contact Culture's Edge.
Contact: Culture's Edge
1025 Camp Elliott Road
Black Mountain, NC 28711
704-298-2399; maarjuna@aol.com

Fundamentals of Permaculture—Two Courses
Middle Tennessee

Dates: April 4-12; June 20-28
Location: The Ecovillage Training Center, Summertown, Tennessee
Description: These courses offer practical training in permaculture design so that you can begin to meet your basic needs for food, shelter, energy, gainful employment, and supportive community responsibly. They will focus on building the support systems, networks, and alliances we all need in our work as Earth healers. There will be a balance between classroom time, hands-on experiential learning, and personal empowerment work. The Farm, located on 1750 acres, is one of the largest and best known intentional communities in the US. Completion of this course and an additional Design Practicum fulfills the requirements for the Permaculture Design Course Certificate. A Design Practicum will be offered at the EVTC Sept. 12-20, 1997.
Instructors: Peter Bane, publisher of *The Permaculture Activist;* Chuck Marsh, permaculture landscape and village designer; Albert Bates, American secretary of the Global Ecovillage Network, with Patricia Allison, Goodheart Brown, Jillian Hovey, and Bob Kornegay.
Cost: $600 includes tuition, natural whole foods meals, dormitory lodging or camping space, and a subscription to *The Permaculture Activist.* $100 reserves your space (non-refundable). $50 discount for payment in full by March 15 for the spring course, or by June 1 for the summer course.
Contact: The Ecovillage Training Center - Permaculture Course
PO Box 90, Summertown, TN 38383-0090
615-964-4324, email: ecovillage@the farm.org

Sustainable Villages: Fundamentals of Design
Middle Tennessee

Dates: April 14-18, 1997
Location: Summertown, Tennessee
Description: This cutting-edge course on creating sustainable communities will present development models; address challenges of formation, growth, bonding, & renewal; cover financial and economic planning, village ecology, and site design; treat conflict, consensus, and population dynamics; review pattern language and building method, all based on field experience.
Instructors: Peter Bane, Chuck Marsh, Albert Bates, and others
Cost: $300 incl. lodging, meals
Contact: Ecovillage Training Center - Village Design Course
Box 90, Summertown, TN 38383-0090. Tel. 615-964-4324

Permaculture Drylands Institute
Southwest United States

Tucson—
April 19-20. Swale Building and Water Harvesting. $125
April 27. Native Edibles & Medicinals. $60
May 9-11. Roofwater Harvesting & Storage Tank Construction $150.
August 19. Introduction to Permaculture, 7 pm. Free presentation.
August 30. Permaculture Home Tour $50
4 Weekends Basic Permaculture Design, (Sept. 20-21, Oct 4-5, 11-12, 25-26). $495.
Durango
4 Weekends Basic Permaculture Design, (May 31-June 1, 14-15, July 12-13). $495.
Pearce, Arizona Advanced Course
Sept. 11-14. Patterning Intensive. $650
Albuquerque
4 Weekends Basic Permaculture Design, (Sept. 6-7, 20-21, Oct. 4-5, 18-19). $495
Description: Since 1987, PDI has educated more than 3,500 people in permaculture throughout the Southwest and Mexico.
Contact: Permaculture Drylands Inst.
Box 156, Santa Fe, NM 87504
505-983-0663,http://www.amug.org/nshadetre
In Tucson: Barbara Rose, 520-744-9305
In Pearce: Vicki Marvick, 520-824-3465
In Albq., Durango, Santa Fe:
Amy Pilling, 505-988-7018.

Permaculture Design Courses
Colorado

Dates: July 21-August 2, also August 25-September 6
Location: Basalt, CO
Description: These two-week intensive courses will include classroom and hands-on experience at the Central Rocky Mountain Permaculture Institute. CRMPI is a well-established, economically viable high-altitude permaculture system, with greenhouses, fowl, composting toilets, and forest garden. Participants will receive design certificates.
Instructors: Jerome Osentowski, Director of CRMPI; Francis Harwood, Anthropologist, Rio Grande Bioregional Project; John Cruickshank, Appropriate Technology Expert, Sunrise Ranch; Dan Howell, Water Use Expert and Desert Homesteader; Ruth Chalfont, Gardener and Designer; Dennis Stensen, Biodynamic CSA Farmer; Ken Kuhns, CSA Farmer; Diana Christianson, Editor *Communities Magazine*.
Cost: $800 before June 22, $850 after June 21
Contact: CRMPI, Box 631
Basalt, CO 81621
970-927-4158
email: permacul@rof.net

High Altitude Permaculture
Colorado

May 17 High Altitude Gardening
May 31 Mushroom Cultivation
June 14 High Altitude Gardening
Sept. 13-26 **Permaculture Design Certificate Course at Masonville, CO**
$750 if reg. by Aug. 15, $800 if after.

The design course combines hands-on projects, field trips to local farms, Earth-friendly buildings, and great organic food. Sandy Cruz teaches with John Cruickshank, Jean Pless, RC Wittenbaugh, Richard Jones, & Vistara Parham

Contact: High Altitude Permaculture Institute, Box 238
Ward, CO 80481,
Tel. 303-459-3494

1997 Permaculture Courses
Bill Mollison and Scott Pittman
California, USA

Dates: June 16-27 (Southern CA)
July 14-25 (Northern CA)
Locations: June: Santa Barbara (arid)
July: near Half Moon Bay
Instructors: Bill Mollison, Scott Pittman, and David Blume. Bill is the author of three books on permaculture and its foremost proponent. Scott Pittman is an internationally renowned alternative builder/designer, former farmer, and Director of the Permaculture Drylands Institute. David Blume is a CSA farmer, ecologist, and teacher.
Cost: $950 includes all meals. Camping for $75; bunkhouse (limited space) $150, other lodging available.
Contact: 415-365-2993, fax: 366-2241
email: DBLUME@igc.apc.com
Intl. Institute for Ecological Agriculture
834 West California Way, Woodside
CA 94062. (Make check to IIEA-PIUSA.)

Permaculture Intensive Course
Navaho-Hopi Reservation, Arizona

Dates: May 24 - June 1
Location: Navajo-Hopi Rsvn., AZ
Description: A certificate course in Permaculture design. Native Americans attend free. This unique cultural learning experience allows non-indigenous people to help native people in their efforts to retain and regain sustainability on their homelands. The 6000 ft. site (cold nights) requires participants to provide their own food, water, and necessities.
Instructors: Justin Willy, a local Dineh with permaculture and ecoforestry experience; Wayne O'Daniel, a local Dineh working with BMPP in organic gardening; Dan Dorsey, permaculture designer; Henry Soto, a permaculture desert gardener involved with Native Seeds/SEARCH in Tucson.
Contact: Black Mesa Permaculture
PO Box 26195
Tuscon, AZ 85726
520-629-9122

"Designing with the Elements"
Permaculture & Earth Magic
Permaculture Design Course
Northern California

Dates: May 9-23
Location: Humboldt County, CA
Description: Magic is "the art of changing consciousness at will." Penny, Blythe, and Starhawk combine their various expertise in gardening, landscaping, and consciousness change to create a new approach to design. The tools of magic—meditation, visualization, trance, and energy work—deepen our understanding of the natural systems we work with. Hands-on experience planting, pruning, and building teaches the real-life skills we need to ground our visions. This course leads to a Certificate in Permaculture Design.
Instructors: Penny Livingston, Blythe Reis, and Starhawk. Penny directs the Permaculture Institute of No. California. Starhawk is the acclaimed author of *The Fifth Sacred Thing*.
Cost: $900-750 (sliding scale) includes tuition, meals, and housing.
Contact: Sandy Bar Ranch
PO Box 347
Orleans, CA 95556
916-627-3379

Permaculture Institute of Northern California
Courses
Point Reyes Station, California

1st Sunday of Every Month
Introduction to Permaculture $50. Penny Livingston and Friends.
April 5-6. Compost Toilet Extravaganza $100. David Baty and Janice Sanden.
April 12. Permaculture for Kids of All Ages Kids $35, Adults $50. Janice Sanden.
July 5. Creative Cob Construction $50 (kids $25). Penny Livingston, and Kate Munger.
September 6. Water Catchment Systems $50. Penny Livingston.
Contact:
Permaculture Institute of No. California
Box 3421, Point Reyes Station, CA 94956
415-663-9090, pinc@nbn.com

Permaculture Design Courses
Northern California

Dates: June 2-16, also August 8-22
Location: Occidental, CA
Description: This pair of two-week courses offer in-depth, hands-on experience in sustainable systems design. Topics include permaculture principles and ethics, ponds, swales, keyline systems, erosion control, forest management, gardening, mulching, compost, beekeeping, alternative building materials, community economics, and more. Curriculum covers all climate zones with an emphasis on the temperate region. (Contact OAEC for a full listing of courses on gardening, beekeeping, corporations & democracy, bamboo, etc. Tour schedule also available.)
Cost: $750 residential.
Instructors: Penny Livingston and Brock Dolman with diverse guest speakers.
Contact: Occidental Arts & Ecology
15290 Coleman Valley Rd.,
Occidental, CA 95465
707-874-1557, fax /-1558

Lost Valley Educational Ctr.
Western Oregon

April 19-20. Permaculture Design Workshop
June 1-August 29. $1830
Deep AgroEcology Apprenticeship Program
July 20-Aug 2. Sustainable Living Skills Retreat for Young People Ages 16-25. $625-1000.
August 9-11. 10th Annual Women's Herbalist Conference $145-245.
August 12-16. Cob Building Workshop $250-350.
October 10-13. Lost Valley Permaculture Reunion $50-100.
December 1-13 th. Annual Permaculture Design Course $700-900.
Location: Dexter OR.
Description: Lost Valley is well-established, with plenty of skilled folks teaching there and operating it. Food and lodging or camping included in the price of all courses. Sliding scale for all courses.
Contact: Lost Valley Educational Ctr.
81868 Lost Valley Lane
Dexter, OR 97431
541-937-3351

Permaculture Design Course: Molokai, Hawai'i

Dates: November 29 - December 12
Location: Hui Ho'olana, on the island of Molokai
Description: Emphasis will be placed on designing permaculture and agroforestry systems adapted to Hawai'i and other subtropical/tropical oceanic islands. A certificate course.
Instructors: Michael Pilarski has taught permaculture in the USA, British Columbia, Nova Scotia, Belize, Nepal, and Australia, and teaches herbal wildcrafting. Douglas Bullock is a horticulturalist with wide experience in Washington State, California, New Zealand, Australia, and Hawai'i. Bruce Hill was raised in Argentina and lives in Hawai'i. John Valenzuela has experience in Hawai'i and California. The instructors are avid and knowledgeable plantsmen.
Cost: $950, including lodging, meals, materials. Campers pay a reduced fee. Some partial scholarships are available.
Contact: Butch Haase and Joyce Arafeh, PO Box 61, Ho'olehua, Hawai'i 96729
808-567-6403

Permaculture Books

Introduction to Permaculture 22.00

Bill Mollison w/Rene Mia Slay. 2d ed. (1994) 216 pp. paper. illus. The basic argument for permanent agriculture: how to feed and house yourself in any climate with least use of land, energy, and repetitive labor. New material on patterns, cold climate. Supercedes *Pc I & II.*

Permaculture in a Nutshell 9.00

Patrick Whitefield. (1993) 75 pp. paper. illus. A back pocket gem, this book draws on the best examples in Britain and elsewhere to show how and why permaculture works. Excellent primer for introducing to friends.

The Permaculture Designers Manual 55.00

Bill Mollison. (1990) 576 pp. cloth. 450 illus. + 130 color photos. Global treatment of cultivated ecosystems. A resource for all landscapes and climates. Lucid illustrations by Andrew Jeeves bring Mollison's concepts to life. Essential, in-depth treatment of earth repair and practical design.

Earth User's Guide to Permaculture 16.00

Rosemary Morrow (1994) 152 pp. paper. Abundantly and charmingly illus. An informative and practical guide to permaculture, with exercises and real-life examples. Learn how to design a permaculture system on your own land, whether city balcony, suburban garden, or country farm.

The Best of Permaculture: A Collection 18.00

Max O. Lindegger & Robert Tap, eds. (1986) 136 pp. paper. illus. Original essays in building biology, urban forestry, land restoration, health, nutrition, energy. Examples from the field.

Living Communities:

A Permaculture Case Study at Sol y Sombra 13.00

Ben Haggard. (1993) 152 pp. paper. illus. Permaculture through the eyes of a master gardener and the design of a particular place, the Miller estate at Santa Fe, NM. Valuable for its insights into the observation process. Haggard's prose is lyrical and his conclusions reach beyond his desert home.

Restoration Forestry:

A Guide to Sustainable Forestry Practices Worldwide 27.00

Michael Pilarski, ed. (1994) 526 pp. paper. illus. A combination resource guide to organizations and collection of essays on all aspects of sustainable forestry. Undoubtedly the most complete collection of material on the subject to date. Indexed by books, periodicals, articles, and general subjects.

Tree Crops: A Permanent Agriculture 22.00

J. Russell Smith (1987) 408 pp. paper. illus. Reprint of the 1950 ed. with a new intro. by Wendell Berry. First published 1929, and still radical more than 60 years on, Smith's seminal work remains too little heeded. His proposal for "two-story agriculture" is both lively and well researched.

Forest Gardening 18.00

Robert A. de J. Hart. 2d ed. (1996) 256 pp. paper. illus. Revised for No. American gardeners, this classic collection of essays on seven-story permaculture by the grand old man of agroforestry presents a gardener's ecology: water, energy, craft, herbs, health. Hart's tales of tree life and forest cultures thrill to the root.

How to Make a Forest Garden 25.00

Patrick Whitefield. (1996) 192 pp. paper. illus. + 8 color plates. The most comprehensive guide to the subject: clearly written, well organized, and attractive, with British examples. Whitefield details garden design, pest & weed control, and planting techniques for temperate zones. Descriptions of 125 useful plants.

The Flywire House:

A Case Study in Permaculture Design for Fire 10.00

David Holmgren. (1993) 15 pp. paper. illus. spiral-bound. Succinct and illustrated with professional drawings of both building details and landscape plans, this slim volume covers a much-neglected aspect of property design with grace and clarity. Like good insurance, it's worth more than you pay.

The Independent Home: 20.00

Living Well with Power from the Sun, Wind, and Water

Michael Potts. (1993) 300 pp. paper. illus. Weaves 27 inspiring stories of the new energy pioneers and how they did it—nuts and bolts, diagrams & photos. Chapters on siting and building the home, repair & maintenance, economics of permanence, biologic energy, and community cooperation.

The Straw Bale House 30.00

Bill and Athena Swentzell Steen, David Bainbridge, David Eisenberg. (1994) 297 pp + xxii. paper. Extensively illustrated, with hundreds of b/w and 26 color photos. Straw-bale construction is sweeping the country. This book explains why in thorough detail. The best reference we've seen.

☞ New Title! ***Build It With Bales:***

A Step-By-Step Guide to Straw-Bale Construction 20.00

S.O. MacDonald and Matts Myhrman. (1995) 80 pp. paper. A thorough instruction manual. All you need to know to go out and do it, loadbearing or non-loadbearing. Packed with drawings.

Chicken Tractor:

The Gardener's Guide to Happy Hens and Healthy Soil 16.00

Andy Lee. (1994) 230 pp. paper. illus. Chicken tractors are mobile coops, a clever way of using domestic poultry (or other animals) for pest control and garden fertility with very little work on your part. Lee is thorough, witty, and consistently upbeat about the permaculture value of chickens.

Cornucopia: A Sourcebook of Edible Plants 35.00

Stephen Facciola. (1990) 678 pp. paper. Lists over 3,000 species with all commercially available named cultivars, sources of seed, plants, descriptions, uses, cultural notes, food products; indexed by common name, families and genera. A monumental work useful to every garden designer.

Seed to Seed:

Seed Saving Techniques for the Vegetable Gardener 20.00

Suzanne Ashworth. (1991) 222 pp. paper. illus. The best single-volume guide to saving our vegetable heritage. Discusses techniques and references botanical classification, pollination, crossing and isolation, seed production, harvest, processing, and viability for more than 150 vegetables and herbs.

Kiwifruit Enthusiasts Journal Vol. 6 15.00

Michael Pilarski, ed. (1992) 192 pp. paper. illus. A good cross-section of info about fuzzy and fuzzless kiwifruit: Research, plant societies, sources of genetic material, periodicals, commercial growing, economics, propagation, botany, and enthusiasm!

Designing and Maintaining Your Edible Landscape Naturally **25.00**
Robert Kourik. (1986) 370 pp. paper. illus + 19 color photos. Permaculture in the home garden: mulch gardens, double digging, root zones, pruning, companion crops, natural pest control. Excellent diagrams, charts, species lists.

The Permaculture Book of Ferment & Human Nutrition **30.00**
Bill Mollison. (1993) 288 pp. paper. illus. 35 color photos. Comprehensive global survey of methods extending the author's life-long concern with core human survival issues. Treats food storage, preservation, cooking, fungi, yeasts, grain, legumes, roots/bulbs, fruits, flowers, nuts, oils, aguamiels, fish, algae, meats, birds, insects, dairy, beer, wine & beverages, condiments, agricultural ferments, hygiene, food toxins, vitamins, enzymes, trace minerals & nutrient sources, and use of earths to enhance food value.

The Humanure Handbook: A Guide to Composting Human Manure **15.00**
Jos. C. Jenkins (1994) 198 pp. paper. illus. Delves deeply into the ever-present subject of human waste. Examines the various systems for disposal and treatment, and recommends thermophilic (hot) composting as the simplest, cheapest, most ecological method. Writing from personal experience and extensive research, Jenkins answers all the questions you never dared ask!

The Earth Manual: How to Work on Wild Land Without Taming it **16.00**
Malcolm Margolin. (1985) 238 pp. paper. illus. A friendly guide to earth repair in the wild, with chapters on wildlife, tree-planting, felling, pruning and repair, mulch, erosion control, seeding, transplanting, trailmaking, ponds, and doing it all with children. Filled with good common sense.

The Man Who Planted Trees **8.00**
Jean Giono. (1985) 56 pp. paper. This timeless and inspiring tale of one man's dedicated efforts to reverse desolation has been beautifully illustrated with 20 woodcuts by Michael McCurdy. A story for all ages.

Directory of Intentional Communities **21.00**
Newly Revised (1995) 426+ pp. paper. illus. More than 500 North American and 50 international communities, 250 alternative resources, 31 articles on community living. Comprehensive, exciting survey of a maturing movement for cultural transformation.

Reclaiming Our Cities and Towns **13.00**
David Engwicht. (1993) 190 pp. paper. illus. Insightful critique of auto traffic: how it destroys the fabric of urban life. An eco-city design primer linking the built environment with social life.

Urban Permaculture: A Practical Handbook **13.00**
David Watkins. (1993) 152 pp. paper. illus. How-to's of growing food and saving energy in the urban household. Domestic waste, green economics, non-toxic cleaners, garden layouts, species lists, breeds of small animals.

Crystal Waters Village: Conceptual Permaculture Report **17.00**
Max O. Lindegger & Robert Tap. (1989) 80 pp. pap. illus. Advanced proposal for an agricultural economy at the first permaculture village in Australia. Pioneering work.

Boundaries of Home: Mapping for Local Empowerment **10.00**
Doug Aberley, ed. (1993) 138 pp. paper. illus. Mapping is the first step toward reclaiming the territory. How to envision the landscape of home: 19 passionate essays on bioregional mapping, theory & examples from city and country, USA, Canada, Britain. Info on using GIS, resource assessments, review of cartographic sources, many and varied example maps.

New Money for Healthy Communities **16.00**
Thomas H. Greco, Jr. (1994) 201 pp. paper. illus. Demystifies money and describes how it may be transformed to support local economies. Describes L.E.T.S. and other local trading programs, alternative currencies, barter and labor service systems, with historic examples. A prime resource!

Interest and Inflation-Free Money **15.00**
Margrit Kennedy. (1995) 144 pp. paper. illus. Pinpoints interest and compound interest as the fatally flawed assumption which both drives the global economic system and wrecks the earth. Proposes sweeping tax, land, and monetary reforms.

Sacred Land, Sacred Sex: Rapture of the Deep **25.00**
Dolores LaChapelle. (1988) 386 pp. paper. illus. "How do we begin moving toward a real culture? All we have to do is raise one generation of children right--according to the pattern laid down by hundreds of thousands of years of our mammalian ancestors." A manual of deep ecology, a guide to ritual, an essential history of our species.

Prices subject to change
Add 10% shipping to all orders, minimum $2.
N. Carolina residents please add sales tax.

The Permaculture Activist
Post Office Box 1209
Black Mountain NC 28711 USA

Permaculture Videos

Please include $3.00 shipping for one or both films

The Global Gardener **30.00**
120 min. VHS. (1991) Bill Mollison's review of permaculture accomplishments around the world. Made for Australian Broadcasting Corp. and aired to national acclaim. Four half-hour segments highlight subtropical, drylands, temperate, and urban systems with footage from developed sites in India, Southern Africa, Australia, the US Southwest, Pacific NW, California, Europe, the U.K., and New York City.

In Grave Danger of Falling Food **45.00**
56 min. VHS. (1989) A wacky romp through Mollison's life as an outlaw. Cartoon cutaways and bizarre sound effects seem no stranger than Bill loping along the street in front of Aussie suburban sleaze, guerrilla planting hazelnuts. A campy period piece, this film tells the permaculture story with verve and imagination.

LETTERS

Real Laundry Power

Peter et al,

Thought you might want to see the latest of all seed catalogs. New rant in the back, new warning in the front, new varieties, lines, and genepools in the middle.

Also, I have made an important permacultural discovery of interest to all diehards still living off the grid and taking their laundry to the laundromat. After eight years of such foolishness—fostered by having no non-freezing environment for a washing machine—we went out and bought a Maytag and a new Onan generator. I calculate we have more than paid for both, one quarter at a time, since we've lived here. But this was not the surprise discovery. The discovery is that this washing machine powers our entire household! That's right. Because a washing machine uses a lot of power, it's one of those appliances best run by generator rather than battery bank via inverter. Because our batteries are automatically charged whenever the generator is on, and because we have two kids and a lot of dirty business, and because we now have a washing machine, suddenly we have surplus battery power even in the dark depths of an Oregon winter. And I don't have to walk around behind my kids turning off the lights! And, we get paid about $40 per month to make this power at home.

EUREKA!

If anyone wants to buy these groovy like-new solar panels, just let me know. I don't think I'll need 'em anymore since I got my new washing machine.

Another one of those ambient energy flows that permaculturists love to plug into. The dirty clothes cycle.

Anti-entropically yours,
perpetually moving,
Frank Morton

p.s. - Great issue on villages. News item from the radio: Cerro Gordo again in turmoil as lead land manipulators are sued by unhappy investor-settlers. Drums droning.

Editor's Note: Frank wrote a delightful article for Issue #34 "Useful Plants," called "Life in the Wild Garden." He and his wife Karen grow Wild Garden Seed at Shoulder-to Shoulder Farm, Box 1509, Philomath, OR 97370. Their catalog is a treasure of garden diversity and a bargain at $4, especially since they credit that towards your order.

New Village Challenged

Dear Peter Bane,

I very much enjoyed the last issue of *The Permaculture Activist* on communities and village design. I received a complimentary one year subscription after I completed a design course last winter. Find a renewal check enclosed.

I am a natural landscaper, gardener, herbalist, preschool teacher, farmer, and permaculturalist. I have fun doing so many things and my income hovers around the poverty line but the *Activist* teaches me and makes me think...so I give the subscription money willingly and look forward to the next issue!

I am also writing to express my opinion on a basic concept of village design—choosing a site. Reading one of the articles about a place that referred to itself as an "eco-village" (perhaps it was Cerro Gordo or Earthaven) and reading on to find out that within the same article was mention of personal vehicles around the village and of cutting down the trees around the village site disturbed me. There is not anything ecological about a village in this era that seeks out a piece of what little forested land there is left to develop on! A truly ecological village would grow a forest and restore some of what is supposed to be the native ecosystem around them. Even when much of the forest remains as is or is selectively cut or when houses are built with natural materials, the ecosystem that once was is now altered into human habitat. I hope that eco-villages are not modeled entirely on indigenous cultures' lifestyles, but that they take into consideration how different this land is now. We do not have forests we can afford to cut down. Small bits of wild places dot this country and they are what is left of our lungs. We also need to put faith into the emergence of new forests from abandoned cultivated lands, farms, or logged areas that are in the beginnings of recovery in a new succession of shrubs, trees, etc. We need to protect these areas, not develop on them (Except perhaps to utilize some restorative planting methods)!

I believe that as responsible and enlightened stewards of this planet we can do great things. The visions and plans for these villages are so inspiring. Everything about Earthaven as a village makes me want to live there—except that they chose an emerging forest to develop in. I would like to visit and see with my own eyes but one article mentioned many trees being cut. So why build homes among trees if they just have to be cut for fire and storm proofing? Choosing a more open site and planting strategically around homes seems like less of a negative impact (especially if the site is compacted, barren, or otherwise not thriving). Can we not stand to have to wait for private forested abodes to grow? We are definitely a culture used to instant gratification. Our responsibility is to take these model villages into areas that need them-abandoned urban areas or small towns, disturbed/compacted soil sites, places with lost topsoil, farms, clearcuts. I definitely dream of living in greater harmony with nature, tree friends surrounding my humble home out on less densely populated land. However, I don't want to become one of the many, the wave of urban sprawlers moving from the city to the outskirts which gradually become part of the city and so on. A main goal of every permaculturalist should be to break this destructive cycle.

What happened at Cerro Gordo is so unfortunate—a New Age Suburbia built on what once was a thriving green forest in the Pacific Northwest. I am confident that there are people there trying to re-route it back towards its original vision if that is possible. I hope and pray for greater wisdom and stewardship at Earthaven and future "eco"villages.

Thank you very much for hearing my opinion,
Peace,
Jules Bubacz
Eugene, Oregon

West Indies Seeking Pc Information

Dear Sir,

My name is Dudley Slinger. I am a citizen of Trinidad and Tobago, presently visiting England. I am looking for information on permaculture projects/activities in the Caribbean and South America.

I am a self-employed environmental activist interested in developing my practice in permaculture work. To assist me in developing my interests, I would appreciate if you or any of your readers could send me any information on permaculture systems in the Caribbean, including past and present projects both in the Caribbean and South America. Also, please recommend any literature on building with bamboo.

Sincerely,
Dudley Slinger
28 Coblentz Avenue
St. Anns, Port-of-Spain
Trinidad

China Contacts Sought

To the Editor:

As a graduate in Asian studies from the University of Victoria, I am interested in knowing what applications permaculture would have in East Asia, particularly in China. Do you know of training centres for permaculture, especially those whose focus is East Asia? Do you have any contacts in this regard?

Thank you for your time and assistance.
Sincerely,
Douglas Moore

Ed.: Contact Permaculture Asia, 1/F Lot 1969, Tai Wan New Village, D.D. 3 Lamma Island, Hong Kong. See PCA *#31, pg. 21, "Agroforestry in China," also* PCA *(29/30)53, "Development Brings Rapid Cultural Change to South China," (28)44, "The Greening of Business," and (29/30)32, "Feng Shui."*

Metatecture Behind Bars

Dear Friends,

I hope this letter finds you well and in good spirits. My name is Nikolai Zarick, and, unfortunately, I am incarcerated. But I am investing my time by designing an alternative architectonic system called "metatecture." ("Meta:" beyond, both/and, along with, combining form; "tecture" from architecture.) With so many new and revived, high and low tech technologies in use these days, I saw a need to create a new term, for when they are used together. (Feel free to use the term.)

My version of "metatecture" amalgates airform and armature architecture, strawbale, cordwood, rammed earth, adobe, bricolage, soft energy, edible/perennial xeriscaping, treatment wetlands, wattle and daub, forest farming, aquaculture, synchronicity, and other sustainable technologies into a "green," "whole," viable multitudinous intentional community.

I have been desperately struggling to find resources, research, study materials, periodicals (back issues and complimentary subscriptions), or just an encoursging word. I will be eternally grateful for any new or used literature or information in heterogeneous though interconnecting topics. That hopefully you can share with me, or perhaps you know someone who can help me help others through my work.

I apologize for sounding so presumptuous and mendicant, but I am working with a zero budget, and striving against the tides of my imprisonment. I hope that you will open your heart to assist me, but whatever you decide, thank you for your time, and the good work that you are doing.

With admiration,
Nikolai Zarick #162110
C.C.I., 900 Highland Ave.
Cheshire, CT 06410-1698

p.s. — Please address all correspondence with your company/group's name.

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#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 Ed'n; *Feng Shui;* Companion Gdng; Nature Spirits; Wilderness; Biogeog.; Network Theory; Pc Acad.
#31		May '94	Forest Gdng: Energy & Pc; Mushrm Cultn; Robt.Hart's F.G., Spp for N. Cal.; Alders; Agroforestry in Belize, China; Honeylocust; N-fixers
#32		April '95	Animals & Aquaculture: Rare Breeds; Animal Polyculture; Small-scale Cattle; Goat Dairy; Keyline; Ramial Woodchips; Feral Chickens; Bee Plants; Constructed Wetlands; Reed Bed Sewage Treatment
#33		Dec. '95	Cities & Their Regions: Green Cities; Independent Regions; LA Eco-Village; MAGIC Gardens; CoHousing; City Markets; City Animals; Micro-Enterprise Lending; Suburban conversion; Rails-to-Trails
#34		June '96	Useful Plants: Bamboo Polyculture in Vietnam; Medicinal Plants; Pest Control; Root Crops; Oaks; Rob't Hart's Forest Garden; Russian Plants; Autumn Olive; Regional Plant Lists; Seed/Plant Sources
#35		Nov. '96	Village Design: Pattern Language; Consensus Democracy; Conflict; Amana, IA; Cerro Gordo, OR; Arthurdale, WV; Planning for Tribe; Earthaven, NC; Design for Catastrophe; Youth; Village Economics; EcoForestry; Natural Bldg. Matls.; Spirituality; Homeschooling

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Portable Dwelling Info-letter: about living in tents, yurts, domes, trailers, boats, remote cabins, other mobile or quickly-made shelters plus plans for simple low-cost, low-impact comforts and conveniences. Sample $1. Box 190-pa, Philomath OR 97370. -99

Eco-Building Schools Directory, $7 ppd (reviewed in *PCA #35*). New address: Sandra Leibowitz, 3220 "N" Street, NW #218. Washington DC 20007. -36

DRY COUNTRY NEWS #17. Rainwater catchments, desert gardening, cheap land, solar energy, herbs, concrete domes, more! Sample $3, Subscription $10. Box 23-A Radium Springs, NM 88054. -36

Miscellaneous

GREYWATER – I would like to share information on legal and legalizing greywater systems. Howard, 7715 - 236th SW, Edmonds WA 98026. howld@aol.com. -36

Green Goods

SEEDS™ Sustainable Edible Eco-Design Systems. 1000+ plants, design pad, analytical engine. DOS/Windows $35, No-quibble guarantee. Appropriate Systems, 1081 Milky Way, Cupertino CA 95014. -36

Composting toilets at wholesale prices, used 5-horsepower shredder/grinder, earthway seed, Planet Jr. manual cultivator, new. 1-800-536-7899. -36a

Internships

Wanted: Summer Interns – Telluride, Colorado. Ecologically-minded, self-motivated individuals. A new solar-powered Artisan's Guild is preparing to host sustainable building workshops, Summer '97. Room+1meal/day for 20 hrs/week. Send spicy resume to The Steeprock Jointery, Box 306, Placerville CO 81430. We will respond.-36

Apprenticeships

The Institute for Regenerative Agroforestry: Individualized course in Land Stewardship includes: Biodynamic Farming, small-scale crop production, greenhouse management, animal care, forestry, natural building. Modest living quarters, meals, and learning opportunities on 5 campuses in Western Oregon. $350/month. Box 803, Cottage Grove, OR 97424. 541-942-3638. -36a

Paradise gardening. Beyond permaculture. Post Fukuoka. Immortal barefoot Gaian masters blueprinting for the future. 1-6 month apprenticeship. Details: Bocare People, Sneem, Kerry, Ireland. -36a

Help Wanted

Los Angeles Ecovillage Demonstration seeks articulate change-oriented permaculturist to live and work with us in central city, transit-rich neighborhood. Urban farming, CSA, farmers market, teaching, etc. in process and/or planning stages. Twelve-member intentional community. Fluency in Spanish helpful. Diverse opportunities to have a major impact. Make contact, and we'll go from there. Inquiries, references to Lois Arkin, 3551 White House Pl., LA, CA 90004. (213) 738-1254. E-mail: crsp@igc.org; Web page: http://alumni.caltech.edu/~mignon/laev.html. -36

We are offering a position for an apprenticeship/Field Manager on our 30-acre organic farm, emphasizing vegetable/medicinal seed production. Rent-trade and stipend based on applicable experience. Minimum 30 hours/week. May to November, 1997. Apply if you have experience farming, are responsible, motivated, and enthusiatic to learn. Permaculture work-projects in progress. Spanish a plus. Couples may add child-care for trade. No pets. Send resumé/cover letter to Williams Creek Farm, PO Box 292, Williams, Oregon 97544 -36a

Wanted: Organic Greenhouse and outdoor vegetable **Gardener**; Experienced **Ranch Hand**, preferably HRM trained; **Summer Interns.** Ranch (half-irrigated) located in northern New Mexico, south of Chama, striving to be successful permaculture/HRM site. Seek hard-working, joyful, cooperative, ecologically-minded, self-motivated individuals. Summer '97, but may extend. Room + organic food allowance + negotiated salary. Send resumé to Soaring Eagle Ranch, Box 171, Los Ojos, NM 87551. Fax 505-588-7013. email:will_p@verifone.com.-36a

Organic Gardener Wanted. May-Oct. '97, 20 hrs/wk in exchange for room and board. Ten miles south of beautiful Crested Butte, Colorado, at 8,500 ft. Please send letter and resume or call for more information. Round Mountain Organic, 17280 Hwy 135, Altmont, CO 81210. 970-641-4742, Nancy Wicks. -36a

GROWER WANTED immediately.

Lost Valley Educational Center, in Dexter, OR seeking experienced organic grower to join our intentional community and manage 3/4 acres of gardens. Our ideal grower would have experience in biodynamics and permaculture, and interest in teaching and working with apprentices. This position is a wonderful opportunity for someone interested in teaching, growing vegetables, and being part of a community dedicated to deep and loving relationships, personal and spiritual growth, and creation of a sustainable culture. We offer room, board, and a modest salary.

Please call, write, or e-mail for an application or more information. Julianne Ruben, Lost Valley

Educational Center, 81868 Lost Valley Lane, Dexter, OR 97431, 541-937-3351, chaztilt@aol.com. - 36a

Business Opportunities

Finance your permaculture design as a distributor of nutritional blue-green algae wild-harvested in Oregon. Free info. 1-800-927-2527 extn. 08271. -36

Farming partners wanted. Market garden, orchard, livestock. Furnished rooms available in off-the-grid farmhouse. Minimum one-season commitment. Wendy Rowe, Box 425, Boonville, CA 95415. -36

Situations Wanted

Community garden coordinator/ environmental coalition facilitator seeks Permaculture training/internship/ career(?) opportunities. All contacts welcome. John Verin, 200 Midland Ave. Montclair, NJ 07042. - 36

Nature Sanctuary • Wildbird Habitat • Permaculture Ecosystems • • Aqua-Garden Sales •
Seeking to establish small community with mature people to help develop and maintain permaculture gardens and birds. Central Tennessee. phone (615) 379-9222. - 36

Seeking employment/apprenticeship. Interested in seed saving and propagation of heirloom vegetables and rare herbs. Background in CSA and wildcrafting in Northeast. Dina Chiappini, Box 33, Ipswich, MA 01938. - 36a

Seeking apprenticeship with skilled person(s) in old-time foxfire-type woodworking, blacksmithing, homesteading. Rt. 3, Box 232, Lexington, VA 24450. (540) 463-4493. - 36a

Services Offered

1997 Permaculture School Naturist Co-op Camp, May 1 - October 31, 1997. Namasté Green, Barnstead, NH 03225. Featuring earth building and design (cob/strawbale/solar), poly-aquaculture, biodiversity. Seasonal tuition—$500/adult (campsite, workshops, facilities). - 37a

RENEWABLE FUELS, food, fertilizer products. We produce alcohols, gases, spirulina, and tilapia fish from organic waste via closed-loop process. Will build/consult: stills, ponds, biospheres, workshops. Send $3 for info. EcoGenics, Inc. 115 West Loop Road., Sevierville, TN 37862. (423) 908-0023. - 36

TWO-WEEK PERMACULTURE DESIGN COURSE, with certification. Intensive residential program. Multifaceted learning environment, diverse instructors, design work, hands-on projects, field trips, Earth-friendly buildings, great organic food. Sept. 13-26, Masonville, CO. Instruction, room, and board: $750 before 8/15; $800 after. Sandy Cruz, High Altitude Permaculture Institute, Box 238, Ward, CO 80481. 303-459-3494.- 36a

One-day permaculture workshops. Summer '97. For info contact David Vandyke, 314 W. Valley Rd., Maple City, MI 49664. - 36a

Communities

Earthaven Village, a permaculture community and learning center growing in the North Carolina mountains, has home and business sites available for skillful pioneers able to co-create an eco-spiritual, bioregional village near Asheville, NC. Thirty plus members are creating the first housing cluster within the village now! To find out more, send $15 for info packet and 6 mos. newsletter subscription to Box 1107, Black Mtn., NC 28711. - 35a

Permaculture-based intentional community forming in middle Tennessee named Sun Valley. 877 Turkey Branch Rd., Liberty, TN 37095. email: sunvalley@dekalb.net. - 36

Finney Farm Intentional Community, 105-acre land trust in upper Skagit area of Washington State. Lots of forest and ferny glades. Openings for singles or families with skills, experience, and resources to help create self-supporting economy. Our devotion is to land and nature preservation and sustainable, non-discriminating, loving relationships. 4004 S. Skagit Hwy. Sedro Wooley WA 98284. phone (360) 826-4004. email: finney@ncia.com. Callers leaving phone message should include address for mail response. - 36

Circle Up Springs, Moab, Utah. Live with friends as neighbors in a rural, off-grid co-housing community on 124 acres with perennial creeks and springs, arable land at 5,900 feet. Located at base of mountains adjacent to public land. Area characterized by pinyon-juniper forest, cottonwoods, quiet. Mixture of private and community control of land, consensus decisions, balance between group and private life, developing sustainable lifestyles, deepening ties with nature, committment to honest communication. We envision community activities to include gardening, construction, seasonal celebrations and sharing meals. Construction beginning April 1997. Include SASE to "Community, " Box 1171, Moab, Utah 84532. - 36a

Small group of fun-loving, committed Permaculturalists seeks families or individuals to create Eco-Village in Colorado. Please send your vision and brief bio. We'll respond to all replies. John English, 420 E. 7th St., Durango, CO 81301. - 37a

Travellers

Small intensive ecoproject in Colombian mountain forests welcomes participants. Write for free bulletins: Caqueta Rainforest Campaign, AA 895, Neiva, Huila, Colombia. - 36

Personals

SOULMATE WANTED: Late 30's cosmic metaphysician, who dreams of creating a spa based on raw food and permaculture principles. Me: 37, Kiwi - artist - writer. Please send letter and photo to: Jana Dixon, 316 Rancheria St. #6, Santa Barbara, CA 93101. - 36

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CALENDAR

April 14-18. Summertown, TN. Sustainable Villages:Fundamentals of Design. The Ecovillage Training Center (EVTC). PO Box 90, Summertown, TN 38483. 615-964-4324. email: ecovillage@the farm.org.

April 25-30. Washington, DC. Solar Energy Forum: Energy for a Sustainable Prosperity. American Solar Energy Society, 2400 Central Ave. G-1, Boulder, CO 80301. 303-443-3130. fax/-3212. email: ases@ases.org. http://www.ases.org/solar.

April 25-27. Belchertown, MA. Edible Forest Garden Workshop. Dave Jacke, PO Box 148, Leverett, MA 01054. (413) 548-8899. email: DJackeNHD@aol.com. or: Eric Toensmeier, 173 Beech St., Holyoke, MA 01040. (413) 534-9445.

May 9-11; May 12. Ithaca, NY. Introduction to Permaculture Workshop and An Ecological Community Design Charrette. Liz Walker. 607-255-8276. email: ecovillage@cornell.edu.

May 9-11. Freeland, MD. Weekend Workshop: Forest Gardening. Heathcote Community. 21300 Heathcote Rd., Freeland, MD 21053.(410) 343-3478.

May 9-12. Lenox, MA. Permaculture: Yoga in the Garden of Eden. Kripalu Center for Yoga and Health., PO Box 793, Lenox, MA 01240. (800) 741-7353 (Reservations).

May 9-23. Humboldt County, CA. "Permaculture and Earth Magic: Designing With the Elements" Permaculture Design Course with Starhawk. Sandy Bar Ranch, PO Box 347, Orleans, CA 95556. 916-627-3379.

May 22-25. Toronto, ONT. Intl. Conference on Sustainable Urban Food Systems. Mustafa Koc, Centre for Studies in Food Security, Ryerson Polytechnic University, 350 Victoria St., Toronto, Ontario M5B 2K3 Canada. (416) 979-5000, extn: 6210. email: mkoc@acs.ryerson.ca.

May 24-June 1. Navajo-Hopi Reservation, AZ. Permaculture Intensive. Black Mesa Permaculture Project, Box 5350, Luepp, AZ 86035. (520)556-0437.

May 31-June 1. Warren, VT. "Ecological by Design." Yestermorrow Design/Build School, RR 1, Box 97-5, Warren VT 05674. (802) 496-5545, fx/-5540.

May 31-June 1, 14-15, 28-29, July 12-13. Durango, CO. Four Weekends Permaculture Design Course. Permaculture Drylands Institute, Box 156, Santa Fe, NM 87504, or call Amy Pilling (505) 988-7018.

June 1-August 29. Dexter, OR. Deep Agroecology Apprenticeship Program. LVEC. (541) 937-3351. email: lvec@aol.com.

June 2-14. Chelan, WA. Growing and Wildcrafting Medicinal Herbs. Friends of the Trees & Coastal Mountain College of the Healing Arts. Michael Pilarski, Box 4469, Bellingham, WA 98227. (360) 738-4972.

June 2-16. Occidental, CA. Permaculture Design Course. Occidental Arts & Ecology Center. (707) 874-1557, fx/-1558.

June 5-20. Temple, NH. Permaculture Design Course. Gaia Education Outreach Institute. Derbyshire Farm, Temple, NH 03084. (603) 654-6705. geo@igc.apc.org.

June 16-27. Southern California. Permaculture Design Course with Bill Mollison. International Institute for Ecological Agriculture, 834 West California Way, Woodside, CA 94062. 415-365-2993, fax 366-2241. email: DBlume@igc.apc.org.

June 20-28. Summertown, TN. Fundamentals of Permaculture Course. The Ecovillage Training Ctr. (EVTC). 615-964-4324. ecovillage@the farm.org.

June 26-27. Pugwash, Nova Scotia, CANADA. Intro to Permaculture. Permaculture North, 902-243-3690, fx: /-3260. email: visnwrk@istar.ca.

June 26-August 3. Pugwash, Nova Scotia, CANADA. Permaculture Design Intensive. Permaculture North, 902-243-3690, fx: /-3260. email: visnwrk@istar.ca.

July 1-26. Pomona, CA. Aquaculture Ecosystems: An Intl. Training Course. Center for Regenerative Studies, Cal. State Polytechnic Univ., 4105 W. University Ave., Pomona, CA 91768. (909) 468-1705, -3884, fax/-1712. email: aquaculture@csupomona.edu; or crs.@csupomona.edu.

July 2. California. Public Talk by Bill Mollison. David Blume. 415-365-2993.

July 11-26. Arthur, ON, Canada (near Guelph). Permaculture Design Course. Permaculture Community Action Worknet, c/o Richard Griffith, 104 Bridlewood Blvd., Agincourt, ON M1T 1R1 Canada. (416) 497-5746.

July 6-August 3. Black Mountain, NC. Permaculture Apprenticeship Intensive. Culture's Edge at Earthaven, Box 1107, Black Mountain, NC 28711-1107. (704) 298-2399. email: maarjuna@aol.com.

July 12-27. Freeland, MD. Permaculture Design Course. Heathcote Community. (410) 343-3478.

July 14-25. Northern California. Permaculture Design Course with Bill Mollison. I.I.E.A. 415-365-2993, fax 366-2241.email: DBlume@igc.apc.org.

July 18-20. Deer Harbor, WA. 5th Annual Pacific NW Permaculture Rondezvous. The Bullock's, PO Box 107, Deer Harbor, WA, 98243. 360-376-6601, or -2773.

July 21-August 2. Basalt, CO. Permaculture Design Course. Central Rocky Mountain Permaculture Institute, Box 631, Basalt, CO 81621. 970-927-4158. email: permacul@rof.net.

July 27-August 9. Tlaxco, Mexico. Sustainable Rural Development. Ianto Evans, Zopilote Assn., PO Box 123, Cottage Grove, OR 97424. Tel/fax (541) 942-3021, or -2005.

August 7-10. Celo, NC. 4th Annual Permaculture Summer Gathering. Chuck Marsh, 55 Grove Street #15, Asheville, NC 28801. 704-254-5454.

August 8-22. Occidental, CA. Permaculture Design Course. Occidental Arts & Ecology Center. (707) 874-1557, fx/-1558.

August 8-16. Toronto, ONT. Urban Permaculture Course. Permaculture Community Action Worknet, c/o Richard Griffith. (416) 497-5746.

August 16. Seattle, WA. Rooftop Garden Design Workshop. GreenFire Institute, 1509 Queen Anne Ave., North, #606, Seattle, WA 98109. 206-284-7470. email: Ted@balewolf.com.

August 25-September 6. Basalt, CO. Permaculture Design Course. CRMPI. (970) 927-4158. email: permacul@rof.net.

September 5-7, 20-21, October 4-5, 18-19. Washington State. Permaculture Design Course with an Emphasis on Natural Building. GreenFire Institute. 206-284-7470. email: Ted@balewolf.com.

September 5-7. Black Mountain, NC. Living on Earth—In Spirit. Culture's Edge. 704-298-2399.

September 11-14. Pearce, AZ. Patterning Intensive. Vicki Marvick. (520) 824-2465. vmarvick@aol.com.

September 12-20. Summertown, TN. Permaculture Design Practicum. EVTC. 615-964-4324. email: ecovillage@the farm.org

September 13-26. Masonville, CO. Permaculture Design Course. High Altitude Permaculture Institute. Box 238, Ward, CO 80481. (303) 459-3494.

Sept. 20-21, Oct. 4-5, 11-12, 25-26. Tuscon, AZ. Weekend Permaculture Design Course. Barbara Rose, (520)744-9305, or PDI, PO Box 156, Santa Fe, NM 87504. (505)983-0663. http://www.amug.org/nshadetre.

September 26-28. Freeland, MD. Weekend Workshop: Integrating Perennials. Heathcote Community. (410) 343-3478.

October 10-13. Dexter, OR. 1st Annual Lost Valley Permaculture Reunion. LVEC. 541-937-3351

October 21-23. San Marino, CA. The Second International Oak Conference. California Oak Foundation, Int'l Oak Conf., 1212 Broadway, Suite 810, Oakland, CA 94612.

November 29-December 12. Molokai, HI. Permaculture Design Course. Friends of the Trees. 360-738-4972.

December 1-13. Dexter, OR. 7th Annual 2-Week Permaculture Design Course. LVEC. 541-937-3351.

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