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The Permaculture Activist
February 2009 **Issue #71**

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Permaculture Activist welcomes your articles, news items, photos, and other materials of interest. Please contact the Editor in advance of your submissions at editor@permaculturereactivist.net to request writers guidelines and present your ideas.

Upcoming Issues, Themes, & Deadlines

#72	**Permaculture Abroad**	**March 10**
#73	**Bioregionalism**	**June 5**
#74	**The State of Peak Oil**	**September 1**

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

Editor's Edge

The Design Process in Miniature

Scott Horton

I RETURNED TO IDYLLWILD after a long absence to find the aftermath of a big storm written in the earth. An early fall downpour had dumped several inches of rain and hail in a matter of hours, and small walls of organic debris made lobe-shaped patterns in the flatter parts of garden paths. Mini-ravines, the beginnings of erosion, etched a couple of tiny canyons into the main walkway.

Further inspection revealed that the roof gutters of the uphill neighbor's house had overflowed their drain—a pitiful excuse for a culvert. Intended to channel water away from my garage foundation, the poorly designed pipe had backed up severely, causing water to pool dangerously close to the top of the stem wall.

The problem is the solution, solve it from the top down, work with the Earth not against it, get a yield—it all falls into place, almost as second nature, if I pay attention.

There was much work to be done. A permaculture design process in miniature would occupy a couple of days of vacation and remind me how immensely satisfying it is to solve problems with the Earth.

Starting from the top down, I dug, enlarging the natural draw into which the neighbor's downspouts were designed to empty, then lined it with the native granite rip-rap that litters my land and theirs. The roof of the neighbor's 2,000-square-foot, faux-log cabin McMobileHome empties into a tiny parenthesis of concrete that could not have been designed any better to intentionally defy the laws of gravity and fluid dynamics. I made a contour-hugging drystack wall of broken concrete "urbanite" just below the neighbor's concrete folly and lined it with rip-rap and drain rock to hold back the rainwater rapids and channel them away from the foundation and into the draw. Problem solved.

Now to the eroding garden paths below the new check dam. I find it very satisfying laying out contours with an A-frame level, stepping it across the land and flagging the invisible levels. A couple of small swales and slightly off-contour ditches will now gently move water out of the paths and into garden beds, sinking the moisture into the Earth and arresting the erosion process I found on my return.

I have since returned to the Bay Area, but a friend in Idyllwild has checked my work a few times since I did my spade-work. She reports that the foundation is dry, the neighbor's roof water happily sluices into the draw and there is no water visible on the surface of the garden paths when it rains.

It was all accomplished in a couple days with no bulldozers, no engineers, no contractors, no hardhats, and no confrontations with the neighbors. All things considered, a perfect job.

Without a little permaculture training, experience, and learning from others, I am sure I would have had no idea how to deal with the problem—had I even been able to recognize there was one—until much more serious damage had been done. The confidence of observation and self-reliance of design are things that I now treasure in my life.

The problem is the solution, solve it from the top down, work with the Earth not against it, get a yield—it all falls into place, almost as second nature, if I pay attention. Δ

New Feature

A new feature this issue is *From the Blogosphere.* Each issue we will highlight excerpts from the many excellent permaculture and related blogs and websites that spread through the Web like mycelia. If you have a favorite blog or site—perhaps your own?—and would like to share it with other readers, please send us a link to editor@permacultureactivist.net.

Correction

In the table of contents of issue #70, Josh Kearns was misidentified as the author of "The Principle of No Waste." The article's author was in fact Jennifer Dauksha-English, as indicated on page 31. We apologize for the error.

Mounds of Water Management

Barbara Fath and Ted Sunderhaus

PERMACULTURE DESIGNERS HAVE MUCH to learn about earthworks from generations and civilizations that came before. Often problems have been solved again and again with little modern attention paid to how prehistoric peoples worked with the Earth. We live near a large-scale archaeological site that reveals simple yet elegantly interrelated earthworking strategies for managing the benefits and potential hazards of water.

About seven miles from our home in Southwestern Ohio is an extensive prehistoric earthwork complex known as Fort Ancient. This site was occupied from about 500 BC to about 300-400 AD by people we now call Hopewell. Although Fort Ancient's earthworks enclose 126 acres, a nearly equal amount of the surrounding land is also enclosed by a combination of natural and man-made water features and was used for habitation, workshops, and ceremonial purposes. This additional enclosed sacred space is evidenced by a pair of parallel walls extending nearly a quarter mile to the northeast of the site terminating in a looped embankment wall, surrounding a small mound, all surrounded by built water features.

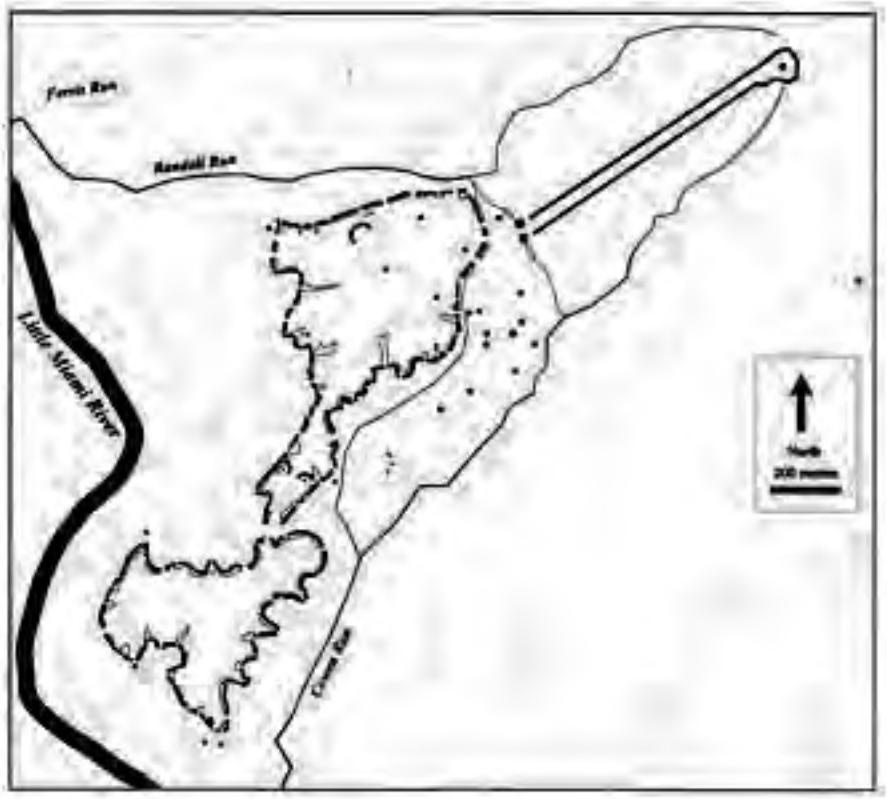
The natural environment on which Fort Ancient was constructed is a deeply dissected upland plateau. Soils over most of the area are 10-15 feet of Illinoian till with a thin layer of "A" horizon supporting oak/hickory forest. The site is next to the valley of the Little Miami River, which is several hundred feet below the upland terrace. The Hopewell constructed earthworks and ponds near the edges of this plateau. The earthworks were built in two major phases with the Southern or South Fort being the first portion constructed. The addition of the North Fort and the parallel walls, and the enclosure of the Eastern Plateau likely took place sometime after 1 AD.

Water flows informed site design

The use of water as an integral part of the built environment, while not unique to this site, is perhaps more in evidence here than at other Hopewell earthworks. An extensive water management system was put in place consisting of approximately 130 excavated and dammed ponds, primarily located on the immediate interior of the walls. This is the most obvious and visible portion of the water management system at the site today, but less obvious techniques were also employed, such as the elimination of gullies and ravines within the earthworks. In at least one instance, a filled ravine was archaeologically

Mounds and other earthworks are still visible after centuries at Fort Ancient, OH. Photo: Nina Harfmann.

tested in the winter of 1996. The prehistoric builders had filled in approximately 100 meters of a spring-fed ravine by constructing a French drain where the initial fill was composed of large quantities of cultural debris, "A" horizon soils, and local limestone slabs. This 50-100 cm deep horizon was then capped with Illinoian till (clay) from the surrounding plateau, producing a moderately level surface landscape and shifting the springhead 100 meters to the southwest of its original location. This same technique was likely used elsewhere within the walls. In addition, smaller ravines without active springs which did not conform to the planned architecture of the site were simply eliminated, being filled with Illinoian till from the surrounding landscape. Other small ravines inside the earthen walls were widened.



A map of Ft. Ancient showing the Eastern Plateau bisected by Hopewell parallel walls to the upper right. The Little Miami River to the left is joined by two tributaries, Randall Run (top) and Cowen Run (lower rt.). This larger triangular space created an outer perimeter to the sacred precincts.

Natural streams within and outside the earthworks were used in two different ways. First, larger ravines that extended from the surrounding streams well into the interior of the earthworks were dammed at the point where earthen walls crossed them, creating large bodies of impounded water within the enclosure. While today all these prehistoric dams have been breached due to natural erosion and lack of maintenance over the past 1000 years, local tradition maintains that one large ravine in the South Fort had an intact and functional dam well into the 19th Century. But before the property was purchased by the State of Ohio that dam was reportedly drained by local farmers using dynamite. Many smaller dammed ravines are still intact at the site creating small ponds within the enclosure, although in most instances these have been somewhat filled in by erosion of the embankment walls and the natural accumulation of leaf and forest litter.

Augmenting natural features

Secondly, natural streams outside Fort Ancient proper were enhanced with man-made additions at their endpoints to define the sacred space of the ceremonial complex. Two main tributaries of the Little Miami River—one bordering the river to the southeast and the second to the north, Cowen Run and Randall Run respectively, enclose a larger space than that contained by the earthen walls. This larger space includes what is known as the Eastern Plateau and the portion of the upland terrace upon which Hopewell parallel walls once stood. These parallel walls may have served to direct people into the site. Several other portions of the constructed walls and associated architecture direct people over, around, and across water features. This guiding may have been part of the ceremonial function of Fort Ancient. At four points, two for each tributary, man-made extensions of these streams were constructed by digging a series of ditches and building a series of dams. The first two and the largest of these ditches and ponds define a primary entrance to the earthworks. This entrance was marked on the landscape by the construction of two large mounds at the south end of the parallel walls. The ditch connected to Cowen Run terminates near the southern of these two mounds; that connected to Randall Run terminates near the northern one. This created an area outside the earthen walls which included one of the primary gateways (gate 1) and the entire Eastern plateau. Immediately west of the Randall Run ditch was a Middle woodland prehistoric stone-lined well partially excavated by state archeologist Louis Henry Morgan in the 1940s. This well, built around a springhead, appears to have supplied water to the Randall Run constructed ditch. No comparable feature is known for the Cowen Run ditch. If one follows both Randall and Cowen Runs to the northeast, they nearly meet at the end of the parallel walls. It is believed that the builders connected the two with a short, open ditch, thus enclosing all of the earthworks with a moat made of natural and constructed water features.

The ground within the earthen walls was, in part, shaped to channel water to the ponds adjoining the interior walls of the ceremonial complex. Where deep ravines at the edge of the complex were dammed, ditches were dug from the inside of the walls into these dammed ravines. These channelled water away from the earthen walls and into the ponds behind the ravine

dams. Today, due to the construction of roads into the site, some abandoned and some currently functional, this prehistoric surface water drainage system has been disrupted, creating swampy areas at the site during the wet season.

There is one other type of man-made water feature at this site. These are individual or paired ponds located on the interior of the sacred space but not adjacent to the embankment walls. In two instances these are associated with other architectural features—stone mounds, circular stone pavements, and stone rings. One of these, a single pond in the North Fort is located adjacent to a stone mound and two stone rings. In a second example, in the Middle Fort, a pair of ponds is also located near a stone mound, several stone rings and circular stone pavements, a flat-topped earth-and-stone mound, and a pair of crescent mounds, which appear to function as a funnel device to direct people from the North and Middle Forts into the South Fort.

One thing that should be clear from the previous description of this earthwork is that a huge amount of soil and stone was moved to construct the site, a volume much greater than that used in the walls. This was accomplished with the use of wood, stone, shell, and basket tools and took approximately 400 years to complete.

Modern interference

During the Great Depression, a Civilian Conservation Corps (CCC) was stationed at Fort Ancient in order to build park facilities and make large portions of the site accessible to the public.

The ground within the earthen walls was, in part, shaped to channel water to the ponds adjoining the interior walls of the ceremonial complex.

Unfortunately, this included a project to drain all ponds at the site in a misguided attempt to eliminate a mosquito problem (this attempt has failed as any visitor to the site during the summer months could attest). Interestingly, the large ravine tested during the construction of a new waterline in 1996 was also filled by the CCC. Today that 1930s tile system has collapsed throughout most of the site and no longer functions, including one above the previously mentioned Hopewell French drain. While this 20th Century drain technique failed, the 2000-year old Hopewell French drain still operates today.

Many, possibly most, of the ponds adjacent to the embankment walls have associated stone pavements extending down into them and bordering them on the interior side, and the embankment walls themselves are faced with limestone on the exterior side at least on the lower reaches and in certain instances to very near the top. In addition, the local fossiliferous limestone was used to construct gateways through the earthen walls by building short, stepped retaining walls within those gateways and pavements through them. This was likely done in order to better define these architectural features and to prevent the walls from eroding and filling the gateways.

Pollen studies done from core samples extracted from some of the ponds on the interior of the earthworks revealed that during the Middle Woodland period (200 BC-500 AD) much of the surrounding hillside and interior of the earthworks were deforested by the builders of the earthworks. Some of this timber certainly went toward construction of wooden features at this site like the recently discovered Moorehead circle in the North Fort and the many house-like structures discovered near the current museum and adjacent to the parallel walls.

There are several instances of earthworks being used as astronomical calendars, including those at Fort Ancient involving the Solstices and minimum and maximum moon rise, in which the back site is a stone

Subtly shaped earthworks gently move water where the Hopewell designer/builders wanted. Photo: Nina Harfmann.

mound in the North Fort and the front sites are three consecutive gateways in the Northeast corner of the embankment walls.
The Hopewell people also had an extensive trade network which extended into the Deep South—where alligator teeth, tortoise shell, and marine shells were obtained, as far north as Michigan—where raw native copper was collected, and as far east as the Carolina mountains—where mica (cut and used for ornaments) and quartz crystals were acquired. Knife river chalcedony from North Dakota and obsidian from the Yellowstone area were some of the products acquired from the west, and there is even evidence of the trade network extending to the West Coast where abalone shells were acquired. Chert or flint from Tennessee, Wisconsin, Illinois, Missouri, Kentucky, Indiana, Ohio, and elsewhere are commonly found on Hopewell sites across the southern half of the state, and were used to make specialized ceremonial objects found at Ft. Ancient and other Hopewell sites.
The builders of Fort Ancient were hunter/gatherers just at the beginning of horticulture. Pollen analysis revealed domesticated varieties of goosefoot, knotweed, may grass, and squash. These plants comprise a portion of prehistoric early domesticates known as the Eastern Agricultural Complex. The Hopewell were also forest farmers.
Fort Ancient presents much of value to modern permaculture designers to observe and from which to learn. Δ

Barb & Ted live on 10 acres near Fort Ancient in the Little Miami River watershed. They have been developing a permaculture site at their home for almost 20 years. Ted is a research adjunct at the Cincinnati Museum Center. He has conducted numerous archaeological excavations at Fort Ancient, and published several articles on the subject.

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Going Deep in Belize

Albert Bates

WATCHING THE WORLD SPIN out of control (and recognizing that control is illusory anyway) the soul yearns to touch the truly authentic, to caress it just once more, perhaps to say goodbye. I have a friend who lives in the Yucatan jungle and talks to birds. After rising at first light and listening to one morning's conversation, I asked him what they had to say.

"They are sad," he said. "Nostalgic for what was, but is gone. Each year there are fewer of them, and they want the world put back the way it had been. They are a bit frightened at the unfamiliarity of everything now. The seasons have changed. Everything has changed. They are sad."

It was very strange that we were having this conversation while standing in one of the richest concentrations of biodiversity on the planet, a broadnecked peninsula at midpoint on the migratory flyway between the Southern and Northern Hemispheres. I think it rang true for me, though. I also miss the familiar, and I am worried for the planet, if not for my own family, my remaining years here, and what will unfold in this century to come. That is why I welcome the opportunity to return to Belize each March.

Belize has a diverse society, comprising many cultures and speaking many languages. Because of its British heritage and Commonwealth status, English is the official language, although only about half the people of Belize speak it and for more than half of those it is a second language. Kriol, Spanish, and at least three Mayan languages are more common to most children. With only 320,000 people, Belize's population density is the lowest in Central America—comparable to Iceland. Fewer people live here today than during the classic Maya period. Unfortunately, as a Catholic country with easy immigration, the population growth rate is 2.21 percent, one of the highest in the Western Hemisphere. Given its natural wealth, that is small wonder.

When Christopher Nesbitt invited Andrew Goodheart Brown and me to teach the annual Permaculture Design Course at the Maya Mountain Research Farm, I immediately agreed. The course had been taught in the past by many wonderful teachers — Penny Livingston, Larry Santoyo, Toby Hemenway—and my previous forays into the neighborhood, including a visit to the Belize Agroforestry Research Center back in 1991, told me that this would be a very special location.

Andrew, myself and a team of special guest instructors—Andrew Leslie Phillips, Maria Martinez Ros, and Hector Reyes—are returning on the Vernal Equinox of 2009 to teach another PDC in this wonderful environment.

Getting to the Research Farm is its own wild side adventure. You can fly or bus to Punta Gorda Town on the coast—I recommend the 8-seat air shuttle from Belize City that takes about 45 minutes with 3 stops along the way—and then by bus (daily at noon) or taxi up to San Pedro Columbia, the little village in the highlands of the Maya Mountains that is the jumping off point for the river travel up to MMRF.

Maya Mountain Research Farm is located in an area of Belize that has been inhabited for centuries, as evidenced by the nearby Maya ruins of Lubaantun.

Toledo, with a population of 27,000, is the least globalized and most rustic district in Belize. The pyramid city of Lubaantun,

near San Pedro Colombia, is a Late Classic Mayan ceremonial and commerce center where, reportedly, the famous crystal skull was found by the teenage daughter of archaeologist F.A. Mitchell-Hedges in 1926.

The next stage of the trip travels up river past Lubaantun by the Columbia Branch of the Rio Grande. A boy with a dugout "dory" canoe takes you up river for $10 Belize dollars—US $5 —per person. All of the dory men know the location, two miles (one hour) up river at the shallow bend with the tall stands of bamboo on the starboard shore. Alternatively, with the help of a hired guide, you can take the rugged mountain trail there.

The river's source is a massive spring that bursts from the ground a quarter-mile up river from that bamboo bend. It emerges from a vast underground river system that drains the 100,000-acre Columbia River Forest Reserve, a uniquely pristine natural area of broadleaf tropical forest, replete with howler monkeys, jaguars, monarch butterflies, and birds of paradise. The Reserve continues rising up the slopes of the Maya Mountains until they spill over into Guatemala. The landscape is strongly karstified, riddled with caves and some of the largest *cenotes* in the country (one is 800 feet deep and 1/4 mile wide). Shallow caverns of quartz-rich rocks provide breeding habitat for many animal populations.

Space for gardens is historically carved out of the forest, and plots are rotated for productivity.

Christopher Nesbitt had come to Belize at age 19 and decided to emigrate and buy a piece of land on the river two years later in 1988. At the time, the land was in cattle and citrus, as are many of his neighbor's farms today. Chris is a sort of lanky John Malkovich with a scraggly beard and a wry sense of humor. His former partner, Dawn Dean, and he have two beautiful and resourceful children, Esperanza and Zephir.

Social entrepreneurs in agroforestry

Dawn, like Christopher, is an ethnobotanist, with a specialty in vanilla to complement Chris's interest in cacao. Dawn wants to establish an organic vanilla industry in the Toledo District, in order to empower women, maintain the viability of the traditional village lifestyle, and promote agriculture that provides ecological services while increasing the income return to small farmers.

Christopher worked for Green & Black's (the organic and fair-trade chocolate producer) at Toledo Cacao Growers Association from 1997 to 2004. His job was to manage an extension program that would help smallholders develop strategies of agroforestry that would favor both biodiversity and cacao production. During this period he also worked for Plenty Belize doing solar power installations and as a trainer for Peace Corps volunteers in the region.

In 2004, Christopher, Dawn, and a board of directors comprising Belizeans working in agriculture formed a non-profit organization and made the Research Farm its principal asset. After years of gathering specimens of vanilla, they established a gene bank of 250 wild vanilla plants and began keeping growth records on them. This, along with an extended literature review and site visits to growers in Mexico, Guatemala, and Colombia, prepared them for their current work, an extension service and pilot project for vanilla cultivation and marketing. The success of this project, and the enthusiasm it has generated are so high, that in December of 2007, they decided to form and register the Organic Vanilla Association (OVA) which Dawn now directs.

Vanilla—the extract of which we buy in little brown bottles or eat in ice cream—is the cured, fermented fruit of the perennial hemi-epiphytic orchid *Vanilla planifolia,* a rare endemic found in the understory of lowland forests of Central America. Although it was a crop enjoyed and traded by the ancient Maya, there is no commercial vanilla being grown today in Belize.

Owing to a combination of hybridization and the loss of native bees, the production of vanilla fruits (called beans) requires the hand-pollination of each vanilla flower. The resulting bean must remain nine months on the vine to reach full maturity. At the time of harvest, vanillin, vanilla's primary flavor component, is not yet present. It develops in the beans during the curing process which comprises scalding, sunning/sweating, drying, and conditioning. This curing process can take up to nine months to complete, and in most countries is done in a centralized curing facility.

The majority of the world's vanilla is produced in

Madagascar, Indonesia, Uganda, Mexico, and Papua New Guinea, although it is consumed primarily in North America and Europe. The world market price for vanilla fluctuates, and is currently trading at an historic low of US$10 per kilo for top-grade cured vanilla beans. By contrast, in 2003, vanilla prices were at US$500 per kilo. What changed was that the high prices brought new artificial vanillas to market, driving out the original.

Yoking livelihood and restoration

Even at the lower prices, cultivation and production of vanilla is a non-gender specific activity that can create alternative livelihoods for those who grow and sell vanilla, and also for those in the vanilla-based industry, which includes many speciality products.

Because of the careful attention and specific horticultural technique required, the best vanilla production is achieved by farmers personally acquainted with each plant, rather than on plantations. For this reason, most of the world's commercial vanilla is grown by farmers owning less than five acres.

Christopher is demonstrating how vanilla can be grown most profitably in the way that the ancient Maya did it, as part of an agroforestry polyculture. His hillside landscape is a tree-based agricultural system that resembles the structure, complexity, and interconnectivity of the native ecosystem, providing ecological services such as erosion control, air purification, soil and water retention, and wildlife habitat.

In Belize, as in other parts of the world, wild vanilla stands have been decimated, and untold genotypes lost. With its low population density, Toledo District still has many wild remnant stands. Dawn has identified 27 distinct species so far, including a self-pollinating variety.

As Christopher takes our small class on a walk around the hillside above the river, we are shown the products of two decades of careful plantings. Christopher divides his new seedlings into three categories, depending on when they can be harvested. The near-term pioneer crops are the annuals like corn and beans, or the pineapple, pigeon pea, squash, and melons planted between the corn contours, along with perennials like nopal cactus, yam, purslane, basil, amaranth, and gourds. The intermediate crops are perennials like avocado, golden plum, sapote, sea almond, allspice, bamboo, palms, breadfruit, coconut, coffee, coco-yam, banana, citrus, mango, cacao, papaya, tea tree, euphorbia, noni, blackberries, gooseberry, chaya, ginger, and pineapple. They will yield sweet fruits, jams, wines, basket-fiber, soaps, beverages, and medicines after a few years of fast growth. The long-term crops are samwood, mahogany, cedar, teak, Malabar chestnut, sea chestnut, and other slow-growing trees that will close the over-story and send Esperanza and Zephir through college when they are ready. All of these species provide additional services to the ecosystem not usually calculated in the university agronomist's bottom line.

An important feature of this tropical landscape design is a means for the creation of soil. Here in the equatorial latitudes much of the nutrient value of soils is carried in the standing plants, and the process of transmitting soil elements through decomposers and carriers to next year's crops is very fast. Loss of soil by over-exposure, short swidden cycles (15 years was traditional but population pressure has been collapsing rest periods to no more than five years), and erosion during the intense rainy season, is the normal pattern on most farms, and many farmers struggle to supplant those losses by increasing fertilizer applications, at unreckoned cost both to farm profits and the soil.

In Belize, as in other parts of the world, wild vanilla stands have been decimated, and untold genotypes lost.

Many of the Research Farm's neighbors in the Toledo District have been mis-educated in government-run ag schools subsidized by seed and chemical companies. They see trees and farm crops as in opposition—one or the other, but not both. Through the work with the cacao cooperative, and now in creating the vanilla co-op, MMRF is spreading an old meme—resiliency and profit from polyculture agroforestry.

Christopher pauses in the shade of a large avocado he planted in 1989. "More avocados than can be eaten by one family," he says, pointing upwards. He plans to build a piggery and a goat shed and to feed the pigs and goats the surplus avocados. He wants to use their manure to make methane for his kitchen. He also plans a tank and pond aquaculture system.

Cacao as keystone species

After taking a permaculture design course in 1991, Christopher put swales across his hillsides and added a number of ground-hugging plants and vines to keep the soils shaded and protected from erosion. For him, cacao was the keystone plant in the system, and there was good reason that the Maya placed a high social value on it, beyond its health and nutritional qualities. The scientific name *Theobroma* means "food of the gods."

Raw cacao beans contain magnesium, copper, iron, phosphorus, calcium, anandamide, phenylethylamine, arginine, polyphenols, epicatechins, potassium, procyanidins, flavanols, and vitamins A, B, C, D, and E. Long before Belgian chocolate, the ancients mixed it with maize, chili, vanilla, peanut butter, and honey to make beverages and confections. The Aztec and Maya cultures used the beans as currency, a practice that persisted out in the Yucatan until the 1840s. Given world prices in the range of US $1200 (industrial grade) to $5000 (fair trade organic) per

metric ton range, the beans are a form of currency still.

When Maya women go into labor they are given a big thick mug of toasted cacao, cane sugar, and hot water. Because it is rich in calories and healthful, that big mug can see them through days of labor and the recovery afterwards.

While many of the world's flowers are pollinated by bees (Hymenoptera) or butterflies and moths (Lepidoptera), cacao flowers are pollinated by tiny flies, midges in the order Diptera. This makes cacao less vulnerable to some of the problems associated with other pollinators. Cacao trees do not require fertilizer or other agro-chemical inputs, and are only rarely attacked by blights, fungi, and viruses in small holdings. Moreover, every time an old cacao tree falls over, it throws out a new main stem; so many trees in Belize that are now in production are original stock—centuries old.

On the stones outside the kitchen, under the roof and out of the rain, Christopher has a bowl of cacao beans fermenting. They are left there for a week and grow a fine white spiderweb of hyphae as they incubate. He didn't need any starter; the airborne yeasts did the job. After seven days, the fermented beans are rinsed, ground, and toasted.

Self-suffiency a way of life

When I first visited there in early 2008, the Research Farm was already fully self-sufficient. You could live quite comfortably on the breadnuts, avocados, corn, bananas, coffee, fish, beans, and all the rest. You could drink from the river, although Christopher harvests water for the kitchen from a spring farther uphill. As I glanced around the open-air kitchen, the purchased cans and jars contained items like powdered milk, granulated sugar, olive oil, foreign teas, iodized salt, and baking soda. These are all part of a Western diet, but for the most part, they are luxuries.

Most of the rain in southern Belize falls in July and August—hurricane season—then tapers off through December. They get 100 to 160 inches in that period. The Research Farm has been known to get abrupt heavy rains in late February or June, so Christopher has learned to hold the permaculture design course well into March, when the dry season has established itself, the river is lower and tamer for taxi traffic, and the trails to Lubaantun are more easily negotiated.

Belize has 574 reliably reported species of birds. About half never leave the tropics. The chorus around us varied through the course of a day, but it never ended from dawn until dusk. At night the predators come out of the forest, so Christopher has to put the chickens into the coop and latch the door. They do well feeding on the leaf cutter ants during the day, but they are domestic creatures, and this is still a jungle.

Seventy-five percent of Belize is native forest and savannah, and half of the country's land and water is in protected status of some form. This does not mean that these large tracts are uninhabited, like a big national park. Quite the contrary—Mayan and Garinigu villages are found inside most of the reserves.

For more than two thousand years the Maya of Central America practiced a *milpa*-style swidden agriculture, something that has gotten a bad name ("slash-and-burn") but was actually a very effective and productive way to farm in the tropics while building soil and sequestering carbon. As Toby Hemenway described in *PcActivist* #51, *milpa* starts with clearing a forest plot, taking out most of the trees, but leaving some nitrogen fixers, timber trees, or other valued species. The Maya, like the Amazonian creators of the *terra preta* soils and the Aborigines of Australia, fired the remaining brush, which had the added benefit of depositing char, nutrient-rich ash, and curing firewood and construction-grade trees. The short-term annuals then filled much of the opened space for the first two-to-four years while seedlings of plantains, avocados, fruits, and fiber plants are set in place and mulched, and leguminous trees and bushes and cacao are stump-sprouted. Over the next five-to-eight years the pioneer canopy closes and the farmers stop planting annuals and start training vanilla and interspersing coffee, ginger, allspice, and other understory plants. Cattle and poultry forage between the emergent trees.

For more than two thousand years the Maya of Central American practiced a milpa-style swidden agriculture, something that has gotten a bad name ("slash-and-burn") . . .

The closed-canopy, managed-forest stage completed the succession, and typically ran 15 years, but it could last twice that time in a *milpa* of particularly fruitful serendipity. The managed-forest stage is the most productive part of the cycle. Then the land was cleared, and—soils renewed—the cycle resumed.

In sharp contrast to traditional practice, today's farmers employ a modified *milpa* that burns the corn and rice fields every year, goes for the highest-paying crops to the exclusion of nitrogen-fixers and wildlife habitat, and plants into steep terrain without swales or terracing. It is these kinds of farming practices that nearly erased the Maya Mountain Research Farm from the map in 2008.

Fire threatens the Farm

On the evening of May 19th, Christopher and Dawn saw a glow on the horizon. The absentee landowner, the Tropical Conservation Foundation, based in Ohio, had allowed their tenants to burn off farming stubble, and two hills over, those neighbors had lit their annual fire to clear the ground for rice. By the next night, the fire was only one hill away. The following afternoon, it crested the hill above MMRF and began moving down to the classroom and staff housing. Buckets of water, machetes to chop firebreaks, and hot, hard work without pause saved the structures. By 11 p.m. they ate and fell asleep, exhausted.

The next afternoon, the far end of the pasture caught fire. Floating embers ignited spot fires throughout the farm. By 3:30 Christopher and his fellow fire-fighters had to acknowledge defeat and evacuate to the river. Amazingly, though the fire then swept across the farm, the solar and wind-powered buildings and most cultivated areas were spared. Spot fires continued to spark up until, on the seventh day, it finally rained.

This uncontrolled *milpa* fire burned an estimated 300-400 acres. Of the 70 acres of MMRF, a little over 50 acres were completely burned, leaving mostly ash and open sky. The fire spared MMRF's cultivated areas, which had been surrounded by fuelwood-managed sectors that deprived the fire of fuel and held moisture in the ground, but they lost coconuts, cacao, pineapples, some large teak trees and many other species. The fire burned the natural remnant forest and destroyed thousands of young timber trees that had been planted. With the canopy opened and the native habitat destroyed, wildlife was forced to migrate elsewhere for food—toucans have since been coming right inside the kitchen to eat bananas. Jaguar, brocket deer, peccary, ocelots, tayra, and other animals that had used the forest cover to access water in the dry season became threatened and left. When the rains came in July, the soils washed downhill, silting two small creeks and displacing still more wildlife.

Dense rainforest surrounds Maya Mountain Research Farm in Belize.

Restoration after the fire is ongoing. Five acres of corn were planted and a mix of other plants followed between corn patches, including timber species, leguminous species, fruit trees, and bio-mass accumulators. Christopher says no one on site has experience in restoration of tropical ecosystems devastated by fire, and he would welcome anyone with interest or expertise in this area. Seeds for reforestation are being generously provided by Trees for the Future.

Pioneer species like banana, vetiver grass, pigeon pea, corn, and a mixture of timber trees have been seeded out into the areas adjacent to the buildings. Christopher wants to replace the flammable heliconias, which were part of why the fire traveled so easily. Thousands of linear feet of vetiver rows have been planted on contour to control erosion in a part of the land that was damaged. Thousands of trees and pineapples were planted out between the rows of vetiver.

Swales and terracing have stopped the worst effects of erosion during the rainy period and when we start the next course March 20 we will be well into the dry season again. There will be lots of opportunities to seed out fresh *milpas,* and plenty of food ready to be harvested again.

Whether you already have a design certificate or diploma, or are just interested in coming back in touch with the inner heart of nature, give a thought to traveling to beyond the beyond with us. Back to the source. Our mother needs help there, and you will be in good company.

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Creating Fluid Capital in A Community

Building the Road to "Lotta Water"

Peter Bane

EARTHMOVING IS AN ENERGY-INTENSIVE process that requires either a lot of human labor and persistence or the use of modern machinery and fossil fuels. Intermediate technologies employ animals such as horses, mules, and oxen to magnify human energies through the use of plows, scoops, and drag shovels. (1) The choice of technologies today is largely a choice between high-tech and low- because intermediate technologies have mostly vanished. We will have to reclaim them as future limits on fossil energy push us back down the technological mountain. For now it is usually "hire a machine" or "dig with shovels." Humans know well how to dig in the earth and with our 225 watt-hours per day of output; we can move a lot of soil if we have learned to use our bodies efficiently. But few know much about moving the earth with machines. Let us consider the options.

The great mounds and monuments of the Ohio and Mississippi Valleys, many of them hundreds of feet long and containing thousands of cubic yards of soil, were built by the incidental surplus labor of agricultural and woodland village societies. Crews of no more than a few dozen at a time working sporadically over a few years with baskets, tumplines, and wooden and stone tools would have been able to accomplish these impressive works. (2) It did not require the intervention of space aliens, but it did take a culture where people were used to working in groups. In the modern world the social and cultural capital required to equip and coordinate dozens of workers has been eroded so that we find it easier to delegate earthworking to a small cadre of specialists (engineers) working with large and powerful machinery.

The author examines the pond's drainage line during installation. Rectangular baffles along the pipe will prevent laminar flow of water and potential failure of the dam.

Permaculture designers have begun to reclaim some of our earthmoving heritage by inspiring and instructing small work parties to dig backyard ponds for water storage, amenity, and aquaculture. I have initiated a number of such projects. With ten or a dozen friends or a willing workshop group, a few shovels and mattocks, and a little rhythmic singing, a pond of 1000-2000 gallons can be dug in an afternoon. These experiences are inevitably empowering for everyone involved, and the resulting structures can make a significant contribution to household-level food and water security. No great amount of expertise is required to launch such an effort. A brief study of the literature can provide the necessary tips for shaping and lining, along with design guidelines for enhancing biological activity, or water quality according to need. (3, 4) To achieve optimum placement, it is helpful to understand overland wind and water flow in the area and to plan to use and accommodate this in relation to existing buildings, trees, crops, and pathways.

Elsewhere I have described the process for lining small ponds (5), and Max Lindegger has given an overview of pond construction for aquaculture (6), so that anyone thinking of adding a backyard pond might be able to do so rather simply. But the engineering and execution of larger-scale earthworks require

different technologies and other design considerations.

In a post-petroleum future we may find that the early modern innovations of yokes and harnesses for masses of equines and bovines will again be important to us for shaping the earth (Before his entry into politics, the acme of Ronald Reagan's television career was his role narrating a western series sponsored by "20-Mule Team Boraxo." Presumably the cleanser burnished its image by associating with this symbol of animal vigor.) But for a little while longer, we will continue to have the use of bulldozers, excavators, backhoes, and other machines to help us create roads, ponds, and dams. Managing the work of these great mechanized blades requires careful planning, constant vigilance during the operations, and a large enough crew of laborers to repair quickly the significant damage that the machines leave in their tracks. To acquire the experience of managing large earthworks is not easy outside the professional arenas of civil engineering and the large construction firms that dominate public projects. However, in rural areas especially, many landowners are in a position to improve their property by construction of ponds and other earthworks, or may be involved in constructing, extending, or improving a road or driveway.

How to begin

I entered into the road-building business rather abruptly in the early autumn of 1998. At the time I was living in Asheville, North Carolina, and was involved in the planning and development of Earthaven Ecovillage, then four years old. Eager to move our village project forward, freshly released from some planning constraints, and encouraged by group approval to open up sections of the community for new neighborhoods, I interviewed a local equipment operator who agreed to start "within a few weeks" on a project to push a new access road about 900 feet onto a low plateau along the main valley of our mountain property. It was late August and I had been told that there would be a small window of opportunity in the early fall to establish plant cover on the earth that would soon be disturbed. Like many of the members that year, I was also driven by apprehensions over possible millennial economic breakdown, and was eager to improve our possibilities for settlement in this remote wooded valley.

The ideal starting time in mid-September came and went and the operator still demurred. He was involved in another project that couldn't be wound up yet. The weather had been fairly dry (another consideration), but October would bring cooler temperatures for sure, and I fretted as I waited for his call. October 1st the bulldozer arrived, and we were off. Working with my partner Keith Johnson, and a small crew of paid and volunteer helpers, we began, which meant following in the wake of about eight tons of noisy, foul-smelling steel as it ground up the hill. The operator, a large and even-tempered man, was very experienced, but more importantly, he knew when to ask questions, and when to seek direction. I was lucky.

The temperament and personality of the machine operator are among the most important factors determining success, or difficulty, with earthworks. Most operators are men, and usually self-employed, owning their own machines, but the range of competence and of disposition in the field is considerable. Find someone who is well-recommended, view some his previous work if you can, and talk with him in advance, asking as many thoughtful questions as you can about the job. If the operator is responsive and forthcoming, you will likely be on safe ground. Any evidence of intemperance, stubbornness, or of poor abilities to listen and communicate should set off alarm bells and send you looking somewhere else.

My first project was a modest one, bigger than an average driveway by an order of magnitude, but there was only one small dry ravine to be crossed—requiring a 15-foot dam—and the total elevation change was about 30 feet over 900, so the grades were not steep. Most of the road was level and it had few curves. We installed no culverts, instead managing all the surface runoff with ditches. And we had five days without rain at the very beginning that allowed us to get most of the work done in optimal conditions. Nevertheless, over the course of the next three weeks, I put in over 130 hours following the machine. It was a physical and psychological workout, during which I learned a huge amount.

We were putting the road into wooded terrain, but were resolved both to spare as many trees as possible, and to salvage all of the material from those that did come down. The operator was often able to push over trees with his blade, saving us some of the dangerous work of felling them, but we still had to scramble to cut up the tops, buck the logs, and direct him to move them to landings along the road. It was exhilarating but also grueling.

We were fortunate on that first job in having no accidents and no injuries, in completing the work in about 80 hours of machine time, within budget, and with a good standard of work. It took about 330 hours of human labor to do the tree felling, brush handling, and subsequent erosion control that followed the mechanical earth work, validating the landscaper's rule-of-thumb that it takes four hours of labor for every hour of machine time.

I think this relative success disposed me to consider repeating the process, so when the community three years later needed a water reservoir built on a hill behind the main neighborhood, I volunteered to oversee that project.

Piled higher and deeper

The roadbuilding had introduced me to the differences between bulldozers and excavators, two similar machines with different capacities and purposes. Our operator had brought both, and used them to advantage. An excavator looks much like a bulldozer, with a big blade in front and huge chassis and engine centered over two tracks, but on an excavator, the blade will move up and down and is hinged like a jaw so that it can open to pull soil from a bank, as well as push it. The jaw can also "bite" a big log or tree rootball and lift or pull it. The bulldozer on the other hand, has a fixed blade (sometimes they are articulated so as to cut deeper on one side or the other), and can push a lot of earth or scrape a surface with great precision, and is used to shape the finished soil grade so that it will handle runoff well.

Some jobs require other types of equipment, such as backhoes, draglines, or for compacting dams and berms, a sheepsfoot roller, but many roads and ponds can be built with just the excavator and bulldozer. Of course, these come in many sizes with different capacities, so you have to consider the type of equipment that will be needed for your particular conditions.

Planning the work

The most important strategic lesson I learned about earthworking in the mountains involved planning for tree removal, as this was the most physically demanding and dangerous phase of any job. As much as possible this should be accomplished in advance, for despite the ease with which a big machine can push over a large tree, the number of fallen trees that a small crew can cut up and process in a short time is limited. And a tree, which when vertical, takes up very little space, occupies a lot of ground when it has fallen. Bring down two at a time and you have just about stopped everything else in the area from moving. Logging crews are not cheap to operate either. And when the machine is running, everything and everyone is under great pressure. Danger is ever present, noise and fumes subvert clear thinking, inattention can lead to serious and expensive mistakes, and the clock is running at $70-$120/hour depending on the local market. Earth, once cut, can sometimes not be easily restored to its original condition, so you want to make sure that every move of the blade counts. Mix in chainsaws and falling trees weighing several tons, and you have a recipe for disaster. Forestalling and easing these pressures is imperative.

However, the design of the earthworks needs to precede even the articulation of strategy. Because earthworking is costly and potentially hazardous, and because it is not easy to orchestrate the machines, crews, engineer(s), weather, and finance to employ them successfully, in the design one should seek to achieve the most benefits from the work

Handling water

I also learned something of the theory and application of various drainage patterns for roadways. The ideal road route would follow a long, flat ridge, so that the road surface would have to shed very little water. But of course, these conditions rarely obtain. The game with road design is balancing length (and thus cost) with grade (steepness). The shorter the travelway, the steeper the grade (if there is any elevation change at all), and thus the more problematic will be the runoff.

Water travels across roads as well as along their length. All of it has to be shed to prevent softening and ultimately erosion of the road base. A good road should always be crowned in the middle to shed water from the center to both sides, but if the road is not on a ridge, then the water drained to the uphill side must ultimately be released somewhere through a culvert under the road. Culverts are made of concrete, metal, or plastic, and are expensive to buy and to install. The steeper the road climbs (or falls) along its length the faster water will run in its ditches, and thus the more frequently will culverts be needed to divert the runoff to prevent it scouring or even blowing out the ditches.

There are, however, other methods for shedding water across a road. A level road can be graded outboard, allowing water to be drained across it. This is usually done in conjunction with a broad and barely detectable dip in the roadbed itself that allows water running across or down the road to accumulate at intervals in the shallow “valleys” thus created. These are designed to drain to the downhill side. By this artful grading of the road surface itself, in favorable conditions culverts can be avoided without unduly jeopardizing the road’s longevity or its cost of maintenance.

Gravel pavements

I also learned about the nature of various surfacing materials and the sequence of laying them down. When built on fresh earth, a road needs a base. The topsoil, with its spongy organic content, is scraped aside (and should be stockpiled for restoration work or spread over untraveled areas). Then the subsoil, which is usually firm clay of some sort, is shaped and graded to best handle local drainage. After this phase of the earthwork is complete, large trucks bring in loads of crushed rock. The first layers put down should be of larger stone. On good clay beds, stones of about 3” dimension are used. Sometimes this is called “ballast,” as it is the same grade of stone used as ballast under railroad ties. In other places this is identified by other names or numbers. Soft or boggy conditions may first require larger rock such as rip-rap (rough cobbles from 4”-8”); though such soil conditions should usually be avoided if at all possible by redirecting the route. A 17-ton load of base stone (delivered in a truck with a tandem axle) will cover about 80 feet of travelway ten feet wide in a single layer.

After the base gravel is poured (and a good truck driver can lay it down very evenly), it is usually run over by one of the tracked machines to press the stone into the clay. If the operator is not present to do this, wheeled vehicles can be used, and indeed regular traffic can be helpful in settling the road bed in advance of final surfacing, especially if time permits.

Once the base is compacted from traffic, a surfacing layer of smaller gravel is applied. This can be 3/4” or 1” washed stone or a mix of smaller gravels with fines. This latter is especially useful if the source rock is limestone, as the softer calcareous stone will crush and pack into place. The presence of fines and smaller rock hastens this process.

Threading the needle

In the case of Earthaven’s water reservoir, the stakes were high. Growth of the village was dependent on a secure and adequate water supply. Population was increasing, but on a very tenuous physical basis. Certainly new members would be difficult to recruit if we could not show our capacity to provide a stable resource base for housing. Failure to achieve this threatened to undermine the entire venture, which had already consumed a half a million dollars in investment capital by the year 2000.

The village was off-grid and the members were determined

to keep it that way, so pumping water was not an option. Fortunately, the land had a number of springs at relatively high elevation compared to its primary settlement areas. Taking advantage of the elevation of this water was another matter. The flow from the spring that was easiest to tap was modest, so a large storage tank would be required to provide the kind of supply that would sustain numerous households running water simultaneously. And during winter, the 4000' of plastic pipe that moved the spring water out of the valley where it originated and down into the more settled and public area of the land was subject to freezing because it lay on the surface, followed constricted stream courses through narrow and shaded ravines, and could never be complete buried because in numerous places it passed directly over exposed rocks or gravel stream beds. This leant further weight to the consideration to build a 10,000-gallon ferrocement cistern and to place it on a hill above the main housing area.

Context for the design

A cylindrical tank of this capacity contains about four yards of concrete and cement and a half a ton of steel. When complete and full of water, the tank will weigh close to 50 tons. It measures 16 feet in diameter and almost 7 feet high. Such a structure can only be built in place, so the materials have to be moved to the site. They are heavy and bulky, so in this day and age that means there has to be a road right to the site that can be negotiated by a large dump truck (to bring sand), and a long flatbed (delivering steel rebar), as well as by smaller pickups carrying bags of cement and miscellaneous tools, and towing a cement mixer. The road would have to be surfaced in gravel so that it would not erode (since it wasn't on flat ground, but rather in steep, rainy mountainous country). And since the design criteria specified that water should flow by gravity both into the tank and out of it to points of use, the tank's elevation would have to be determined very carefully, and its location would have to minimize the length of plumbing runs while being consistent with the engineering possibilities of a rugged landscape.

We needed a tank on a hill, so we had to build a road up the hill to get it there. This was a big and expensive undertaking. It made sense to consider what other values we could serve by doing all this work.

The south-facing hill on which the community had built its first settlement opened onto a small bottom near the center of the land. Numerous small areas with housing and agricultural potential were located nearby, strung out along both sides of the meandering road that followed our main creek. As complex and challenging as this landscape may have been, it held the best possibility for settling 150 people within walking distance of each other, a key element of the village vision. Several large benches above the main streams offered about ten acres of mostly level land suitable for gardens, homes, and common buildings. Within a few years of purchasing the land, we had tapped a good spring at the back of the property and brought its water into this area, but we lacked any significant storage capacity, so every winter the settlement was threatened with crisis from about mid-

December—when the water system froze up—through sometime in February, when it began to flow again. This was also the season of greatest fire danger (due to burning by not always sober amateurs in poor stoves and in lax structural conditions).

The job takes shape

A number of possibilities suggested themselves. It seemed just barely possible to snake a road up behind the little cluster of cabins that formed the heart of the village. It would be steep, but the grade could probably be limited to 12% or less. We owned a rather nice but then inaccessible section of ridge high above the valley facing south, and if a road could be gotten to the end of that ridge at a gentle enough grade, driveways could be extended up the ridge (which flattened out near the top), and some additional choice home sites could be created in its warm microclimate. Also, a large erosion gully had formed on the same hill some decades earlier, probably as a result of 1920s logging, and it appeared possible that by extending the road some 50 feet beyond the proposed tank site, the gully could be dammed to create an even larger surface water reservoir to hold runoff as a potential fire-fighting source. This was of no little concern since the dry summer of 1998 had shown us fires throughout the mountains, and careless handling of ashes in the village had already led to the outbreak of accidental fire (fortunately contained). For a community that was five miles from its fire station by winding mountain roads, and which heated with wood in old stoves in yurts and wooden cabins, a fire-control reservoir seemed almost as important as a drinking and bathing water supply.

The prospect of multiple yields helped make more sense of the difficulties that would be entailed in creating a large gravity-flow ferrocement tank to ensure the village water supply.

The prospect of multiple yields helped make more sense of the difficulties that would be entailed in creating a large gravity-flow ferrocement tank to ensure the village water supply. The road, as it would turn out, not only allowed us to build the water tank, access new housing sites, and dam the gully for a fire reservoir, but it created an unexpected pond near its base in the valley bottom (when we had to borrow fill for a large ramp at the start of the road), and it allowed several people who had wanted to live in the little neighborhood of cabins to tuck yurt platforms and tiny houses in along its verge as it climbed the hill. These *pieds-a-terre* gained breathtaking views out over the earlier layers of settlement, the creeks, and the hills across the valley, and soon became choice real estate in their own right, with some very sophisticated huts being built on ground no one had thought could ever be reached.

Looking forward, looking back

Most of these outcomes, however, were months to years downstream of the work, and a community of people living hand-to-mouth had a hard time appreciating all of the value that it would receive. Controversy dogged the project from start to finish as arguments raged over what route the road should follow, which method of construction should be emphasized, and whether "extras" should be included in the scope of the project. People were asked to volunteer labor for "Lotta Water," but most understood that to mean helping to build the tank itself. That days, even weeks of felling trees, trimming limbs, bucking fallen logs, and moving and mulching brush would be required to prepare the way for the tank construction seemed beyond the comprehension of most of the members. Perhaps the silent refusal to assist with this necessary work was a form of passive aggression by those who disagreed with one or another aspect of the project's design. It seems as meaningless now as it was painfully incomprehensible at the time.

Honoring the trees, dishonoring the logger

Forestry work in advance of earthworking is an opportunity to salvage the components of the forest for their highest use. Most of Earthaven's timber was third growth hardwood about 50-70 years old. The Lotta Water tank project yielded some large sawlogs of red and white oak, tulip poplar, and red maple, and many smaller lengths of limbs and tops for mushroom log inoculation and firewood. The smallest parts of the trees were of course returned to the forest floor as mulch to help control erosion or create wildlife habitat. Even smallish trees have large amounts of brushy top material that can be difficult to handle. Many operators, working on their own, simply burn this material and even the logs of trees that are felled. We were most unusual in holding to a no-burn policy, trying to use everything to its highest potential, and keeping the biomass on site. Still, ideals were sometimes difficult for the community to translate into practice. The disconnection between urban-dwellers living in the woods and their environment became manifest as the forestry work concluded and a controversy broke out about the allocation of logs. Were these privileged goods? Shouldn't everyone have an equal chance at using them? In the end, this block to rational

action led to the logs being wasted for any purpose other than firewood, and some were never used for that either.

Earthworking with machines tends to be shocking to people's senses. It's loud, smelly, and we instinctively understand that it's dangerous. This often puts people off of making rational decisions about the use of these technologies. Bulldozers are a mature expression of our industrial/fossil fuel civilization. They have been used for many horrible acts of ecocide (as for clearing trees in Australia by dragging a chain between two machines, making wheat fields that will probably become salted desert in another 50 years). Yet they can also be used with intelligence to build swales and dams that store large volumes of water, thus enhancing life, and to create efficient travelways that reduce erosion. Modern humans are largely defined as the species that has reshaped the surface of the earth. Our descendants a century from now may be unable to employ these powerful means. We should consider what legacy they might want us to leave them from our unique historical moment.

The give and take of moving dirt

The most basic law of earthworking is that every cut is also a fill. In other words, whenever you dig a hole you have to put that soil somewhere. Conversely, if you need soil to make a berm, build a cob wall or house, or impound water, you have to borrow it from somewhere. In flat country like Illinois and northern Indiana where we live now, the interstate highways are dotted with small ponds which began life as "borrow pits," places where clay subsoil was mined to build up approach ramps for bridges, exits, and entrances to the road. Planning for earthworks is much about where to take the soil from and where to put it.

In the case of the Lotta Water road, it climbed about 70 feet above the valley bottom to reach its destination at the tank site. In order to have a moderate grade (<12% or 12 vertical feet in each 100 horizontal feet), the road needed to be at least 600 feet long. Unfortunately, the width of the hill that lay on our property was only about 500 feet. That meant that a switchback or an extension would be needed to keep the grade manageable. We actually used both. What we did was to turn the road at the bottom by making a right-angle extension out from the face of the hill into part of the valley bottom. Of course, that meant that the road had to begin climbing even before it reached the edge of the hill. And for that we needed a lot of fill dirt, layers of clay that could be put down to build up the travelway. It was this aspect of the project that led us to dig the lowest pond, the one we hadn't initially planned on. We made it in such a way that the dam that created the pond became the base of the road.

Many hours of human labor and machine time are required to prepare a site and to build a dam and pond. Recognizing this and carefully planning all resources is key to the flow of work and ultimately to success.

Putting a road over a dam can often be a creative way to solve several problems with one action. Building a dam in a narrow valley and running a road over it can both store water behind the dam and can provide access to connect two more level upland areas (the adjoining ridges).

With Lotta Water, the low pond was a byproduct. We had to dig it in order to raise the road, and wrapping the road around

the pond as it began to climb the hill created a tight little corner that challenged every driver who attempted it. Nevertheless, the design worked for a lane that was never meant to carry heavy traffic, but to provide minimal access for moving building materials up to several sites.

The switchback came at the top. As the road reached the far western edge of the hill, it reversed direction around to the right and climbed the last few feet to the tank site. Already the upper part of the hill was flattening out in that area, so in the crook of the road bend, we were able to create a turnaround for trucks, and a parking area for marshalling the construction materials.

Repairing an old scar

The last piece of the design to be executed was the high pond for fire control. We faced several difficulties. The erosion gully was narrow and its sides were steep. Although this meant that the dam across it didn't need to be very long, it also meant that it was harder for the excavator to shape it. Our operator carved out both sides of the gully to widen the pond area behind the dam, but as he did so, his blade cut into a hillside pocket of chalky sand that would obviously not hold water. We had to press clay from farther down the gully up against this side of the pond to try to seal it. We also ran into a vein of rock, and the operator spent several hours digging large stones (3'-5' across) out of the area that was to hold the dam and laying them out of harm's way in what became the spillway for the pond. Any earthen dam, of course, must be made of compacted clay, its ends keyed into the sides of the valley, and its core tied into the subsoil beneath the valley floor. Large stones in the dam will weaken it, and each 4"-6" layer of clay needs to be compacted as it's laid in place.

Design for safety

Every water impoundment, whether a simple swale meant to infiltrate water to the ground, or a pond meant to hold surface water must have a spillway so that it can overflow safely when rains or runoff are heavy. The spillway level is set for the maximum safe level of the pond. This should be at least three feet below the top of the dam. This difference is called "freeboard," and it ensures that even under extraordinary conditions, water should not overtop the dam.

If we had any doubts about the rationale for this recommendation, they were laid to rest a few years later when floodwaters of Hurricane Francis filled up the Bee Tree Reservoir above Asheville, North Carolina in September of 2004 and overtopped the dam. It was reported that 17" of rain fell in a few hours in that area, and though the dam wasn't destroyed, water going over it burst the supply pipes carrying water to the city, leaving residents without mains water for nearly a week in the wake of the storm.

Our purpose in building the upper reservoir at Lotta Water was to create a high storage that could be tapped for fire control, water that could flow by gravity to where it was needed. For this, we needed a large pipe coming out of the pond and running down the hill. It would have been simple to put a hose and a pump down into the reservoir and extract water that way, but you can't count on having power during a fire, or on being able to run up the road with a pump and a hose, or with a fire engine in the moment of danger. So we designed an exit pipe that passed through the dam as the most expeditious way to get water to flow by gravity out of the pond.

Whenever a pipe is laid through a dam, it's necessary to provide it with collars or baffles. These are tight-fitting barriers that ring the pipe and stop laminar flow along its length. The other element that the pipe needed was a control valve on the pond side of the dam—a way to hold back the accumulating runoff until all the downstream plumbing could be completed later. We installed two baffles on a six-inch pipe through the dam and had the operator carefully bury these. Then we attached a simple sluice-type valve in a sleeve at the pond end of the pipe and connected this to a long handle that could be operated from the bank. This would enable us to collect water and fill the pond while the community made other decisions about how to distribute the fire control water, where to place hydrants, etc.

Realizing the design aims of the Lotta Water project was very satisfying, as it provided a durable engineered solution to several crucial survival issues for the Earthaven community: all-season water supply, increased density in the village center, better land use, fire security, and an increase in the revenue potential of the property through adding leasable sites. The cash outlay for the road, ponds, and tank came to about $10,000, about 60% of the cost of a member site lease at the time, or about 0.7% of the community's projected long-term public investment. Of course, almost all of the labor for the road and tank construction was provided by community members under their service obligations. Though not a trivial sum of money, as I look back on it now, it still seems an extraordinary bargain. Some 750 hours of labor were required to build the road and the tank, of which my own contribution was about one-third. Some additional hours of effort were needed to connect the tank to the community's spring water line and also to the use points below in the village, perhaps another 50 hours. It would be wonderful to report that this was well received and accomplished with goodwill all around, but to say so would be only part of the story.

Delving deeper

The strains showed up in three areas. Too few people turned out for the preparatory phase of tree removal and brush clearing. It fell on myself and my partner Keith to do the risky and arduous work of felling several dozen trees and removing their limbs and stems from the area of the roadway. This work was made more difficult by the need to fell trees quite near to small cabins and yurts below the road. We avoided damage to any structures and were not injured ourselves, but there was, shall we say, a lot of drama in doing so.

The second problem was also unexpected, but emerged when one of the Earthaven members, in charge of the community's small trackhoe, involved himself in the road construction in an

uncoordinated way. He felt that he could accomplish most of the roadbuilding work by the use of the smaller machine alone, and began trying to do so. This conflict reached a head when he and the hired bulldozer operator, normally a very temperate fellow, came close to blows, while I was put in the awkward position of mediating between them, diesel engines at the ready. We got through the day of dueling machines and lived to tell about it.

The third focus of difficulty came after the physical work ended, in the accounting for the budget. Community members felt that too much had been spent. Earthaven had been burned by insincere interest from possible members in the run-up to Y2K, so it had closed its doors to new member candidates for a period just before the millennial turnover. This led to a squeeze on finances in the following year, when the tank project was brought forward. It seems laughable now to talk about $10,000 as too much money for what was done, but in that little fish tank, in a time long ago, people took umbrage at the cost.

Group successes

Though I came away from Lotta Water not only with valuable experience, but also with emotional wounds, two areas of conspicuous success marked this large and complex process. The community came together in very heartening ways to build a fine ferrocement tank, never having done so before. For four weeks in October and November about 25 members took roles large and small in mixing and pouring cement, tying steel and wire, and plastering stucco mix onto the shell. We completed the last coat of plaster just a couple of days before the season's first hard freeze.

Less visible, but to my mind just as important, numerous villagers turned out to help implement erosion control on the job following completion of the machine work. Many hands helped lay silt fencing, spread straw, seed, and fertilizer, and make brush berms and bundles to ensure that our hillside wouldn't wash away in the winter rains.

Our small efforts of 2001 were lost to the public eye in year marked by spectacular deception and violence, sweeping political changes, and a carefully calculated march to war, but I am proud to note that they were in keeping with the great tradition of citizen action which in the 1930s a public-spirited federal administration had successfully summoned forth through the WPA. Many more such projects are needed today, and we can hope that a newly elected government will have the wit and the leadership to put its citizens back to work to repair both the country and our democracy.

Notes

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3. Lindegger, Max. "From Source to Sink: Planning Watershed Development," in *Permaculture Activist* 47:13. May 2002.

4. Doherty, Darren. "Design and Construction of Earth Dams," in *Permaculture Activist* 44: 11. Nov. 2000.

5. Bane, P. "I'll Have a Carpet Sandwich Please—Hold the Water," in *Permaculture Activist* 44:22. Nov. 2000.

6. Lindegger, Max. "Designing Ponds for Life," in *Permaculture Activis*t 52:8. May 2004.

Peter Bane was a founding member of Earthaven Ecovillage, and at various times served it as principal site planner, President, Treasurer, and chairman of the board of the community-based educational charity Culture's Edge. He lived in the village from 2000-2006. With partner Keith Johnson he is now building a small suburban farm on the edge of Bloomington, Indiana where he teaches permaculture design for Indiana University. www.permacultureactivist.net.

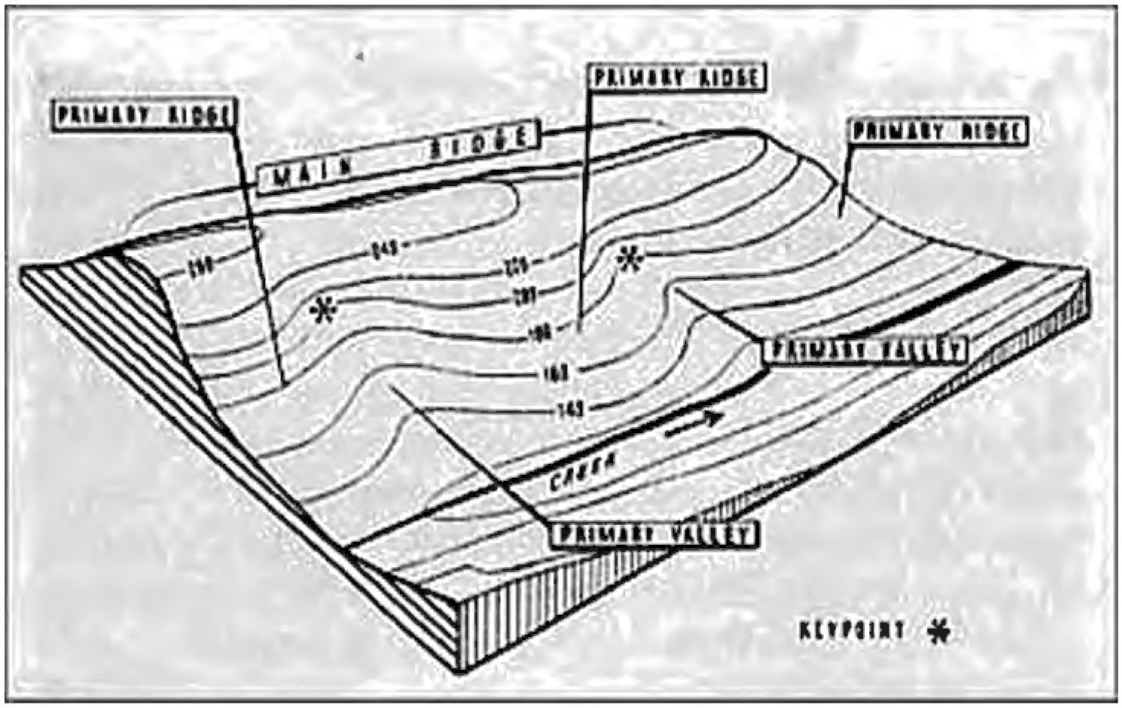
A well-designed and graded road manages water as well as it facilitates transportation.

Soil, Water & Carbon for Every Farm

Abe Collins & Darren J. Doherty

KEYLINE DEIGN IS A COMPREHENSIVE design strategy for agricultural and urban development based on fundamental, repeating land shapes that have been created by water.

The Keyline Plan



Key components:

• Rapid development of biologically active, fertile soil within a systematically designed landscape. During an average three-year conversion phase, four to six inches of new topsoil are typically formed each year. This new topsoil stores large quantities of water in the landscape.

• Design for the harvest, storage, and distribution of water on the landscape forms the foundation of the Keyline Plan.

• Run-off water is stored in dams. This water is later released for rapid, gravity-powered flood-irrigation.

• Roads, forests, buildings, and fencing follow primary water layout and fit together within the lay of the land.

• The Keyline landscape is a permanent landscape in which every infrastructure component helps ensure the maintenance and renewal of the topsoil within it.

"The hallmarks on the properties of successful Keyline farmers are lakes with water birds, contour and ridge line roads and contoured strip forests, dark fertile soil, luxuriant healthy green crops and feed." Ken Yeomans (1)

New topsoil can be created quickly

Factors that determine soil fertility:

• The mineralogical and structural framework

• The prevailing climate

• The soil's biotic associations

Soil has a life and environment of its own. The biotic community can be enhanced by modifying the soil microclimate.

Soil life responds dramatically to ideal air, moisture, food, and temperature conditions. These conditions are simple to create with grazing, subsoiling, and dependable rainfall or irrigation. Life begets life. Plants, their roots and attendant exudates are the solar harvesters and the raw food of soil life. Grazing animals are "biological accelerators." They are the most effective tool we can use to speed mineral cycling, and grazers affect enough land to make a large impact.

Grazers can build topsoil more quickly than anyone else on earth!

The work of the Yeomans Family, their forebears and contemporaries, Allan Savory and more recently author Collins, Dr. Llewellen Manske (2), and others have clearly demonstrated a variety of means available to increase air, water, and organic materials: only the scientists whom policy-makers have chosen to heed need convincing.

Keyline planning is based on permanence, beginning with the two most permanent features of the landscape:

1. Climate, which has molded and created the topography. Of the dominant climatic factors: temperature, wind, annual distribution of humidity, and rainfall, water is the easiest to work with ("control") and gain benefit from.
2. Existing Land Form (Topography) including underlying geology.

Combining Holistic Management with Keyline Planning

Steps:
1. Form a Holistic Goal, including a detailed land and ecosystem process description in the Future Resource Base.
2. Get Topographical Maps. Analyze landscape using Keyline insights. Identify Keypoints, Keylines, ideal water storage areas, water diversion lines, possible irrigable areas, road layouts, tree lines, etc.
3. Gather all pertinent information, study, and prepare maps and overlays. Take a year or two.
4. Brainstorm many possible layouts for the planned developments.
5. Create the ideal plan based on the best ideas.
6. Develop the plan gradually through Holistic Management.
7. Plan financing so that each investment makes rather than costs money.

Holistic Management Planned Grazing and Keyline Soilbuilding go hand in hand. The growing season grazing plan gives you a structured, holistic framework to plan the use of tools (grazing animal impact, subsoiler plow) in the soilbuilding project.

Natural water lines:
Water flowing over land has a pattern of flow and predictable path lines of movement. Principal among these are:
• The contour line: the edge of a lake is a true contour line. Flow is perpendicular to the contour, forming shallow S-curves from the ridge to the valley.
• Water drainage lines: streams of all sizes.
• Water divide lines: "watersheds" formed by main ridge crests.

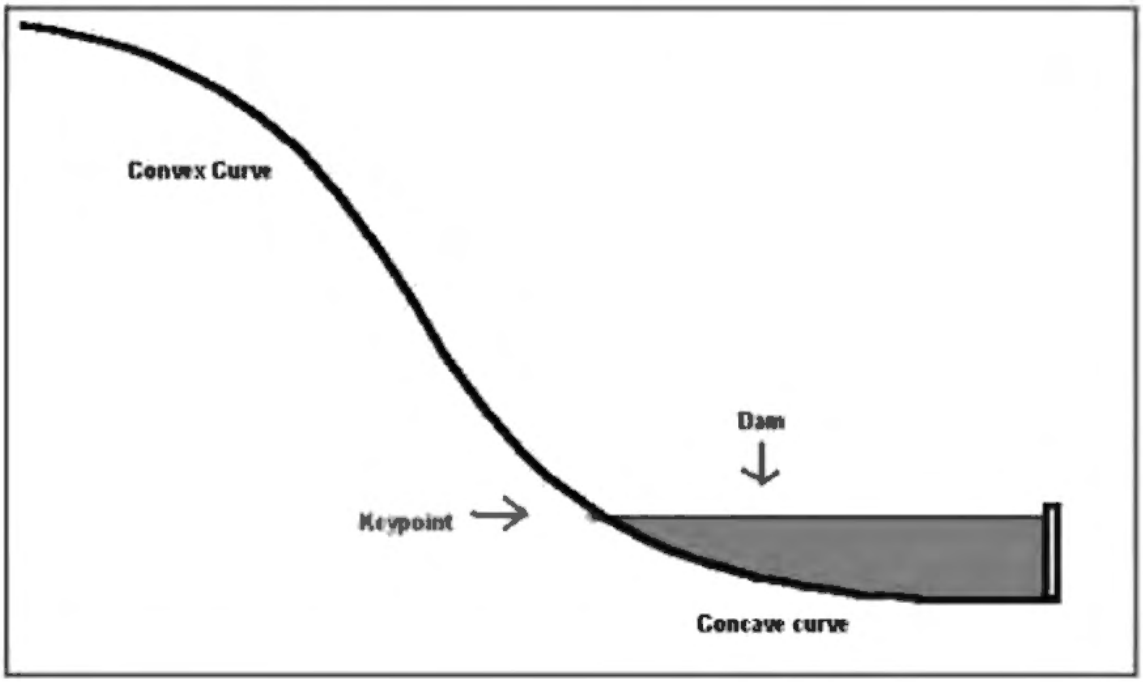
Artificial water lines:
Human earthworks that influence the flow of water, and store water.

Identifying the keypoint in a landscape for use in water management.

Water control is paramount

Water and rainfall determine land development. We have to get water right to get everything else right—design follows water. New, "artificial"water lines—diversions, dam walls, channels—become permanent land features. Other infrastructure components follow.

Direct rainfall and irrigation water are spread evenly on the land by a unique cultivation pattern, which is an artificial water line—Keyline Cultivation.



• Diversion drains, irrigation channels, dams, the Keyline Cultivation pattern, swales. (Also, drainage ditches, which are not central to Keyline.)

Artificial water lines in Keyline are designed for the most efficient water resource development.

The proper design of farms and cities must fit within the existing pattern of the natural landscape.

The geography of landscape

Three water lines, three land forms, and one special pattern.

#1 LANDSCAPE DESIGN LINE
The Contour Water Line
The shore of a lake. A level line running across the landscape, a set vertical distance from the next contour line. Water will always run perpendicular to the contour.

#2 LANDSCAPE DESIGN LINE
The Water Drainage Line
The centerline of watercourses: streams, rivers, and drainage lines of the land. Visible as dendritic (branching) patterns.

#3 THE WATER DIVIDE LINE
The Crests of Main & Primary Ridges

Vegetation slows the movement of water over and through the land. Vegetation, its variety or its absence, and soil organisms stabilize soil and land shapes.
In a stabilized landscape, there are three land shapes we consider in relation to Keyline development:
1. The main ridge
2. The primary valley
3. The primary ridge

The **Main Ridge** is the first land form. It begins at the convergence of two water drainage lines. Look around—it is the horizon. The crest of a ridge is synonymous with a water divide line. The crest of a ridge is usually less steep than the sides of the ridge.
Main ridges are a reverse image of the dendritic branching of water drainage lines (streams/rivers). You could follow main ridges around the world, except where they go in circles around lakes. The interplay of main ridges and water drainage lines are the anatomy of the landscape.
Walk up from the end of a main ridge, (above the confluence of two streams) and it eventually runs into another ridge—you can go left or right on a main ridge. This pattern repeats endlessly. It almost seems designed to shed water. It is primarily the result of the underlying geological skeleton, the urge of water to get back to the sea (water flows downhill), and the moderating influence of vegetation and soil life.
Primary Valleys form in (erode into) the sides of Main Ridges. Primary Valleys are divided from each other by **Primary Ridges.** A primary valley has a primary ridge on either side, so there is always one more primary ridge than primary valleys in a main ridge system.
Primary Valleys are the first place water flows in a rainstorm.
Primary valleys are the smallest of the three land forms. They are the only true "valley" shapes in the landscape. (Big valleys are actually watersheds.) The centerline of a primary valley is usually less steep than the sides of the valley.
Where a primary valley intrudes far into a main ridge, you have:
A saddle. Roads usually cross over main ridge crests across saddles. Next to a saddle are two hills.
Lakes and ponds are located in depressions in the landscape.
Fragments Between:
• Tidal Areas
• Flood Plains

The Keypoint

Every primary valley has a keypoint. It is the point at which the primary valley gets suddenly steeper. The steepest slopes in the landscape usually occur in the centre of the valley above the Keypoint—. between the Keypoint and the top of the main ridge.
The Keyline is a contour line carried in both directions from the Keypoint, in the valley shape, but not extending out onto the ridges. Below the Keyline, the accompanying (next-door) primary ridge center is steeper than the primary valley center. Above the Keyline, the primary

The landscape after keyline ploughing.

valley center is steeper than the primary ridge center.

The Main Ridge

Main ridges occupy the most land in the landscape. They are not level, but slope. This creates a rising relationship in the Keypoints of adjacent primary valleys.

Contour maps are basic to understanding keyline

Contour maps show the above land features clearly. Contours are level lines, a set vertical distance from each other. Close lines indicate steep land, more widely spaced lines indicate less steep land.
With a good contour map and the farmer to provide details, we can design a landscape which will include:
• water diversion, storage, irrigation channels, irrigable land, and water control structures
• catchment size
• slope indices
• size of dam walls.
• areas to leave, plant, cut trees.
• sites for farm buildings
• location of subdivision fences, stock watering points, paddock layout.
Contour maps from government sources, especially of rural landscapes, only provide contour intervals of 10-20+m. Surveyor-produced contour maps are more expensive but are very accurate and provide contour intervals of between 100mm (very flat landscapes) and 1-2m for more undulating or steep landscapes.
Overlaying contours onto an Aerial Photo provides an advanced base to design a landscape with. Using Geographic Information System (GIS) and Computer Aided Design (CAD) software can really enhance the design and development potential of a landscape and form a base from which to easily create a "Bill of Quantities" for all aspects of the landscape and its development.

Types and qualities of available water

• Absorbed Rainfall—high quality, low price. Good soil holds great quantities of water. Developing topsoil is probably the most cost-effective way to enhance the water cycle and store water on the farm.
• Runoff from rain falling on the farm. Rainfall has exceeded the field capacity of the soil, and runs off. Poor design will accelerate this.
• External sources of surface water. This is all forms of water flowing onto the farm.
• Ground water—may be pumped or spring-fed.

Designing for the environment

Understand the basic land shapes and design in accordance with enhancement of the water cycle by primarily slowing the movement of water over the land. (That is what life does, too.) Start as high as possible, by increasing the fertility and water-holding capacity of the primary valleys and ridges. Maintain or develop productive or revegetation forests along the ridges and creek lines for landscape protection and to optimize nutrient or energy cycling, flows, and utilization.
Introduce artificial water lines: the diversion channel, the dam wall, the irrigation channel. Again incorporate productive or revegetation forest strips and plantings with these features.

Keylines always follow the countours of the land.

Contours / Keylines

The Keyline is the contour line drawn through the keypoint. Remember! Keylines do not usually wrap continuously from one primary valley to the next. They have a rising relationship as one moves from one primary ridge to another.
On a contour map, the Keypoint is apparent, because the contour lines are closer together above it, and further apart below it. On a primary ridge, the center of the ridge is typically flatter than the sides of the ridge, closer to the valley. (Contour lines are further

apart in the center, closer on the sides.) As the contour lines change direction and head into the valley, the lines will diverge if they are below the Keyline and converge if they are above the Keyline.
Water always flows perpendicular to the contour. This can be understood when we observe the heavier flow in the valleys, and the drier ridges.

Keyline pattern cultivation

Introducing this causes water to drift away from valley centers and toward ridge crests, where it is held until it soaks in. Rainfall and irrigation water are thus spread evenly over undulating land. The simplest way to accomplish this, either using equipment with an internal laser guidance system, or just a good feel for slope, is to plough slightly downhill from a given point in a valley center out onto the accompanying ridge.
In primary valleys, we cultivate parallel to the Keyline above it and below it. Above it, it is often too steep for ploughing, but not always. The point at which we shift from valley pattern to ridge pattern cultivation, below the Keyline, is located where the valley floor becomes the ridge wall, or where the contour line shifts direction, in going from primary valley to primary ridge shape. This ploughing pattern will quickly become quite steep or angular, at which point a new contour line should be marked and ploughed parallel to and downward.
Anywhere lower in the primary valley, we cultivate parallel to and below a contour guideline.
On primary ridges, we cultivate parallel and upwards from any contour guideline. It's good to stake a number of guidelines, i.e., not plough mindlessly too far from a guideline.
In practice, one would lay out the Keyline across the primary valley, then carry that contour line out onto and around both ridges, then cultivate upward from that in long plough passes. You would then plough lines moving downward from that line, restricting yourself to the valley shape. (The ridges would be ploughed parallel and upward from a lower contour guideline. In tighter valleys, there are tricks for simplifying difficult ploughing. However, the basic principles must be stuck by, or water will flow the wrong way, concentrating in the wrong places.
The Keyline Scale of Permanence:
1. Climate
2. Land Form
3. Water
4. Roads
5. Trees
6. Buildings
7. Subdivision
8. Soil

Water

Water has two costs.
• Cost in money: the cost of improving soils, building dams, and irrigation layout; the cost of irrigation operations.
• Cost in Water itself: i.e., it is expensive to have water always available. More cost effective is to have water to bring you through dry times—100% drought-proofing would cost a fortune.

Stored water: a second savings account

Water in a dam can be traded for, say, a crop of pasture. A full dam, and dry fields in a drought is a sign of failure. Use water in dams for irrigation whenever necessary. Dams can and should be designed to be interlinked so as to be able to move water where it is needed during prolonged dry periods.

Farm dams

Keyline dams always have a large pipe with baffle plates and a valve, through the bottom, for irrigation and control purposes. Good sites for valley dams generally have:

Water and rainfall determine land development. We have to get water right to get everything else right—design follows water.

• A flatter valley floor slope, backing water up further with less wall.
• A short wall site.
• Width of valley behind the dam wall.
• Suitable location for spillway.
• Suitable soils (will hold water).
• Suitable foundation material.

The highest site for a storage dam wall in a primary valley is below the Keypoint. This is called a Keypoint Dam. The Keyline is the top water level of the dam. Other types of dams include: Saddle Dams, Turkey Nests, and Contour or Ridge Dams.

The water levels of dams can be connected by a diversion, falling at 1:400+. Or, water from the lockpipe of one dam can be carried by a diversion to the Keyline of another Keypoint Dam. Sometimes, a dam lower than at the Keypoint is desirable for a whole range of factors.

When developing the water resources of a farm, there are two primary water channels:
1. For collecting and diverting runoff, stream flow, or pumped water into a dam. Called a diversion or catchment drain, these generally slope at 1:400+.
2. For carrying irrigation water.
a. The irrigation channel is an important artificial water line. Above it pasture is rain-fed, below it pasture is irrigated.
b. On hilly land, these are dug into the ground at slopes of 1:400+.
c. On flat land, they are generally flat, built above ground with two banks, called the flood-flow irrigation channel.
d. Related water control lines are steering banks, perpendicular to contour.
3. Drainage ditches are also water channels, but they are not central to Keyline.

The Keypoints of successive primary valleys will often have a rising/falling relationship. Keypoint dams can be connected by diversion channels. If the fall of the diversion is less than the fall of the water drainage line (stream) an increasingly large area of land will be irrigable between the dams and the water drainage line. We design accordingly.

Irrigation

On Hillsides we use Keyline Pattern Irrigation. Flood irrigation of hilly land is made possible by the Keyline Cultivation Pattern. Water is stored in large dams, released through large pipes in the base of the dams, and is moved in irrigation channels dug into the ground. These channels must have a fall of at least 1:300. Flags are positioned in the ditches, and spill water onto the land below the irrigation channel.

• Ploughing must be continued indefinitely to spread water evenly.
• Irrigation can be done at rates of up to eight acres per hour, with one-person control.

Flat Land—Keyline Flood-flow irrigation. Water is stored in even larger dams, which tend to be shallower. Water is released through large (2') pipes in the base of the dam. Water is moved in channels which are contained between berms and are above the surface of the land. The channel is generally level. Gates in the channel sides are opened, and water spreads in a wide sheet across the land in irrigation bays. Irrigation bays are bounded by "steering banks,"which run perpendicular to contour.

• Water can be applied at 20-50 acres per hour.
• Cultivation need only happen during the soil-building, conversion period of three years.

Traditional Irrigation:
• Border Check Irrigation—similar to flood flow, but slow.
• Contour Bay Irrigation—Rice Paddies.
• Furrow Irrigation—common for vegetables and orchards.
• Spray Irrigation—common, expensive, lots of machinery.
• Drip tape—vegetables. Not a broad-acre

strategy. Lots of plastic.
Slow irrigation drowns soil aerobes. Slow irrigation is not generally sustainable. No conventionally irrigated civilization has ever survived.

Roads

Roads on contour require less energy to travel. They do not erode easily or concentrate run-off. Roads are built in relation to water control lines.
Possible locations of roads:

1. Along boundary lines. Generally not on contour, often difficult to maintain, tend to self-destruct. Useful for fence maintenance. I wouldn't invest much in these roads, if at all. Use a flail mower to maintain them.
2. On ridge crests (watershed lines, main ridge centers). High, dry, easy to maintain. These are good sites for a main road.
3. Located by water channels: diversion channels, irrigation channels, irrigation areas.
    a. Below diversions—dry, cross dams that cross valleys.
    b. Above irrigation channels in hilly country—bridges are often necessary.
    c. Below Flood-flow irrigation channels.
    d. At low end of irrigation area.
    e. Along streams.

Trees

Tree locations fall into place when the first four factors have been considered. Clearing of trees and planting of trees should be considered in light of the four first landscape design considerations.

Contour Strip Forests—generally follow the patterns of water harvesting/distribution channels, as well as the roads. Trees usually border roads, and are located above irrigation channels. It is good to plant trees along riparian corridors and around lakes and ponds. Pasture and crop land are separated by contoured tree lines. In the long run, trees do not interfere with productive crop land, they enhance it. Trees:

- act as mineral pumps,
- reduce the effects of wind,
- give edge effect,
- can be designed to provide browse,
- provide wildlife habitat,
- provide shelter.

Buildings

Buildings should be placed to optimize the potential energy flows, for example:

a. Avoid exposed high places. The best view is a often a costly one from an energy consumption perspective.

b. Site for good solar access to enable energy-efficient house and building design.

c. Place buildings to afford them topographic protection from prevailing wind direction(s).

d. Build your shed higher than the house so as to use the shed water tank for gravity-fed water to the house.

e. Build on a slope to allow good air and water drainage, gain gravity potential, and be out of danger from floods.

Water always flows perpendicular to the contour. This can be understood when we observe the heavier flow in the valleys, and the drier ridges.

Fences

Follow all of the other infrastructure layout. It is good to have many paddocks. Temporary fences offers flexibility. Fences should be built according to natural and artificial water lines. My rule of thumb is to build fences:

a. Along creeks, drainage lines, and main ridge crests so as to create drainage line protection and to connect or allow flows of wildlife from the bottom to the top of landscapes.

b. Use lightweight electric internal fencing according to stock type for planned or management-intensive grazing.

c. Around all dams and open water bodies to prevent stock access.

d. Along shelterbelts, strip forests, forest plantations, and revegetation forests or areas of natural significance that need protection.

Soil

Subsoil can be quickly turned into topsoil. Development and maintenance of soil fertility is a product of management.
Good grazing gives the greatest return for the least energy input in increasing soil fertility. The subsoiler greatly accelerates normal topsoil formation under pasture. Conversion of subsoil to topsoil involves creating repeated biological climaxes. Soil

life requires air, moisture, warmth, space, and plenty of high energy, high protein food. Create these conditions, & soil life will respond, transforming some portion (often about 10%) of plant exudates and sloughed grass roots into humus. Create these conditions repeatedly, and subsoil will be "permanently" transformed into topsoil.

Urban design

The "Keyline Scale of Permanence" can be applied to urban design in a way that ensures the water supply is clean and perpetual, transport uses minimal energy as roads are located on or close to contours, and wastewater is used to "irrigate" city forests.

• Most useful in the design of new cities.
• Dams are located with water lines at the Keyline.
• Roads are laid out in relation to water control lines.
• Cities are designed from the crest of main ridges downward.
• Trees are planted or left in relation to water control lines
• City Forests provide cleansing and valuable construction materials.

Urban subdivision design

Yobarnie Urban Retrofit—In early 2007 we were advised that "Yobarnie," P.A. Yeoman's estate, was sold for a rumoured sale price of AUD$40 million by the family who bought the property in the late 1960s off of the Yeomans family. At this price "Yobarnie" is unlikely to remain in agriculture. I have redesigned property as a peri-urban/rural residential low-density subdivision, this landscape according to the design principles outlined in P.A. Yeomans' 1971 tome, *The City Forest.* Δ

Key Resources

Information on Keyline
• Keyline Designs—Ken B. Yeomans—www.Keyline.com.au
• Yeomans Keyline Plows—Allan J. Yeomans—www.yeomansplows.com.au
• Broadacre Permaculture Design & Development—Darren J. Doherty—www.permaculture.biz
• On line Books—Soil & Health Library—www.soilandhealth.org

**Slow irrigation drowns soil aerobes.
Slow irrigation is not generally sustainable.
No conventionally irrigated civilization
has ever survived.**

Carbon Farming
• Carbon Farmers of America—Abe Collins—www.carbonfarmersofamerica.com
• Amazing Carbon—Dr. Christine Jones—www.amazingcarbon.com.au
• Carbon Coalition—Michael Kiely—www.carboncoalition.com.au
• Soil Food Web Institute—www.soilfoodweb.com

Holistic Management
• Publisher of *In Practice* newsletter, Holistic Management Resources & Certified Educator Program—Holistic Management International—www.holisticmanagement.org

Of Interest
• Publisher of "Stipa" newsletter—Native Grass Association Inc–www.stipa.com.au
• Peter Andrews work—Natural Sequence Farming—www.nsfarming.com
• International Permaculture Courses & Forum—Permaculture Research Institute—www.permaculture.org.au
• Integrated value-added family farm operation—Polyface Farm—Joel Salatin & Family—www.polyface.com
• Great grass farming newspaper—*The Stockman Grass Farmer*—www.stockmangrassfarmer.com

Gardening Lessons from the Past

Laura Donohue

IF WE HOPE TO SPREAD PERMACULTURE throughout our contemporary landscape, and to incorporate into it related techniques observed and adapted from other cultures, regions, and times, then "gardening" people and communities will be as important as our husbandry of the Earth. A network of communities in the Pacific Northwest is promulgating permaculture ethics and principles on a broadening scale as it adopts and adapts indigenous cultural practices.

Learning from precolonial polycultures

Forest gardening as practiced in "home gardens" in tropical and population dense regions such as Kerala, India, and the island of Java is very different from the food gathering practices of the Native Americans of our continent. However, there have been examples of perennial polyculture in temperate regions for millennia. Historical accounts of indigenous intensification methods (enhancing the productivity of native food harvests), burning practices, and more familiar forms of cultivation in pre- and post-colonial North America are just joining the academic mainstream.

Getting friends and neighbors involved is the first step to "forest gardening" community.

Using our area as an example, the historic and present climax ecosystem for much of Cascadia (the bioregional name for the Pacific Northwest of North America) is a dense temperate rainforest. Nearly any small patch or large plot of land left unattended will be colonized by forest. Though most of this bioregion receives average amounts of rainfall, we experience a seasonal summer drought. Because water is necessary to photosynthesis, deciduous trees have a tough time competing with coniferous trees which are able to photosynthesize during the winter when nearly everything else is dormant, light is modestly available, and moisture is plentiful. With most open areas predisposed to succeed to forest, and with most of the new growth (i.e. food for somebody) and light to be found in the canopy, it is open spaces, access to light, low-growing edible parts, and heat which are lacking in our bioregion.

In response to these ecological lacks and surpluses, many tribes of our area burned favored food-producing landscapes every one-to-four years following harvest in the weeks before the fall rains began. This kept the forest at bay on the glacial-outwash "prairies" and sub-alpine meadows that yielded nutritionally valuable starchy roots and berries, and attracted herbivores to the new growth. The scraps of hunting and fishing were used to fertilize prized patches of salal berries, camas bulbs, and other foods. These techniques, which were used in both broad landscapes and more intensively monitored patches, served to increase the size, quality, ease of harvest, and reproductive success of the species of interest. The stewardship responsibilities and first harvesting rights to these patches were passed down through families, but others were allowed to harvest, and surpluses were often redistributed to the wider community through potlatches.

It may not seem at first glance that these ways are applicable to our modern lives. For example, the deliberate burning of landscapes is an alarming concept to most communities. Semi-nomadic harvesting regimes are problematic due to land-use regulations, the loss of traditional harvesting knowledge and sustainable technologies, decreased diversity, declining plant and animal populations, and even extinctions. The cultural presumption of ownership and the enforcement of private property laws affect where and how we garden, steward,

wildcraft, and hunt. Human and wind-powered water transport and the coastal and riverine trading systems dependent on it have been displaced by petroleum-fueled commerce. But I believe that valuable insights remain to be gathered. Many permaculture practices and communal living techniques mimic these indigenous activities and serve to re-wild our bodies, souls, and communities.

Political, communal, and physical changes

In investigating traditional cultural practices, we must recognize that the indigenous peoples of North America have been and continue to be ruthlessly suppressed and their rights, practices, and worldviews persecuted. Their land has been usurped and their traditional knowledge ignored or derided. However, the timing, patterns, techniques, and ecological intuitiveness of the "perennial polyculture" practiced by the first peoples of this continent have not been entirely lost, though both ecological conditions and the rules for cultural survival have greatly changed.

Indigenous species and technologies

Over the generations, as native peoples refined their harvesting techniques and cultural structures, the health of crop patches and other wild food resources was (for the most part) maintained sustainably throughout Cascadia. The lessons we can take from this for contemporary permaculture would affect our management of zones 3-5—the land we cultivate or resources we tend or harvest away from the immediate environs of the dwelling. Indigenous peoples in this region intensified harvesting of, or in some cases actually cultivated native plants or analog species (those ecologically similar to the native species). Using indigenous cultivation techniques can enhance the potential of native harvests that we might otherwise overlook in the design of an edible forest garden. In this way, our household economies could be more fully harmonized with the bioregions in which we live.

Yet with erosion of the practices and the loss of relationships of intensification, it is my belief that these once-tended plants have lost some of their human-added value. Absent the familial tending of patches, fruits may now be smaller and less predictable in distribution. Less useful plants may have come to populate areas that had once been intensified for favored plants (e.g., conifer trees invading camas prairie).

There is little published literature on adapting these native practices, where they are even documented at all (see the end of this article for some suggested readings). But read what is available, learn the history of your area, and ask elders who may have knowledge. And remember to offer help or gifts to those who give share knowledge with you, for cultural technologies are very valuable! By making use of native species and practices we may be able to offer the coming generations an invaluable legacy; it's the job of our time to build bridges between pre- and post-industrial cultures.

If you extend your view of cultivation technologies to include the redistribution of surplus, then we may learn something from Wayne Suttles' description of the coast peoples' potlatch system of festivious wealth redistribution in *Affinal Ties, Subsistence, and Prestige among the Coast Salish:*

Dave Sansone teaches people the right way to plant a bare root tree.

"Since wealth is indirectly or directly obtainable through food, then inequalities in food production will be translated into inequalities in wealth. If one community over a period of several years were to produce more food than its neighbors, it might come to have a greater part of the society's wealth. Under such circumstances the less productive communities might become unable to give wealth back in exchange for further gifts of food from the more productive one. If amassing wealth were an end in itself the process of sharing surplus food might thus break down. But wealth, in the Native view, is only a means to high status achieved through the giving of it…The potlatchers have converted their surplus wealth into high status. High status in turn enables the potlatchers to establish wider ties, make better marriages with more distant villages, and thus extend the process further."

In restoring functional ecosystems, we should not try to re-create landscapes that have existed in earlier times, worldviews, or ecologies. The greatest potential for "forest gardening" lies

in using analogs that help us mimic the natural forest, in more senses than ecosystem composition and plant selection. Not only should we consider all kinds of useful plants from comparable ecosystems, but we should also consider analogous production practices. We should look at what indigenous peoples of our bioregion have done, and also those of similar bioregions. We should consider what ecological, philosophical, and jurisdictional changes have occurred since people lived primarily off the land

The model that Pat and Michael used was just standard grassroots organizing adapted to the current conditions of urban and suburban Olympia

in that area, and look at technologies—ancient, traditional, and modern—which address the difference in conditions between then and now.

We should look at cultivation practices from more populated areas: thus the "home garden" template from tropical agriculture has been transposed for temperate cultivation. We can also learn a lot from old European cultivation processes: coppicing, productive hedgerows, perennial vegetable production, and grazed orchards. The key is to expand our horizons and look at similar societal survival techniques.

Local urban and suburban examples

Envisioning all of the potential that is to be found in the suburban wilderness, local activists in the Skagit Valley and in Olympia, Washington have been working to spread forest gardening as a practice throughout our area using grassroots organizing and community building techniques. In particular, they have paid attention to the cultural climate and the characteristics of the community-as-ecosystem. We can learn from their example.

David Sansone, a long-time environmental activist from Bellingham, had spent several years studying permaculture, forest gardening practices, and the cultivation of rare perennial edibles in the Skagit. He was involved (with others) in studying how to reestablish perennial edibles—rare and not—in the wild. The research design was simple: minimize inputs of material and effort, and note which species and varieties survived and thrived. He amassed the results of this research, creating plant lists of perennial vegetables suitable for and accessible in our bioregion. He presented slideshows picturing the species, and set out his research principles in many lectures and workshops all over Washington. Pat Rasmussen (another long-time environmental activist and elder) and Olympia community organizer Michael Kelly were inspired by Dave's work. Everywhere they went, they began to see yards and lawns not as dysfunctional but as pure potential for the healing of little plots of Earth.

These ornamental, grass-filled suburban yards just needed to be converted into young forest gardens with fruit and nut trees, berry bushes, vines, ground cover fruits and perennial vegetables: walnut, chestnut, hazelnut, apple, pear, peach, plum, elderberry, kiwi, serviceberry, currant, blueberry, raspberry, rugosa rose, strawberry, Jerusalem artichoke, Good King Henry, and others.

Pat and Michael used a standard grassroots organizing model adapted to the current conditions of urban and suburban Olympia to propagate the forest gardening meme. They reinvigorated a local non-profit, Terra Commons, that had been inactive for several years. Then, in order to help people climb the steep learning curve of a new and complex idea, they began hosting various permaculture teachers to educate the community. With each event, they collected names for their e-mail list, and began to network. Contacting 32 neighborhood associations, they proposed that each group poll its residents seeking potential sites for community forest garden workshops.

When I became involved with Terra Commons, its efforts had already focused on sites owned by rooted residents, most of whom were not already avid gardeners, but who had needs for an edible landscape. We had learned that the best possible sites were houses with large sections of lawn that could be easily sheet mulched—preferably with an East, South, or West exposure, high visibility, and accessibility to the neighborhood. The plantings were seen as part of a process of cultural succession. The forest gardens would establish themselves in open (disturbed) ground just like weeds. And like weeds, which are often medicinal, they would spread the meme among the people as they healed both land and community.

In advance of each installation workshop, we would send out announcements to the neighborhood using community lists, blogs, and other means. Those who couldn't come for the whole day were encouraged to drop in when they could, and those who couldn't volunteer with the actual work were nevertheless invited to watch and ask questions.

The day of the installation is always a busy one. The mulching and planting process is announced at the beginning, with more explanations offered whenever others arrive or as questions are asked. During the event contact information is collected, and networking connections are made. Trees and shrubs are planted first, and a group of volunteers is set to stripping cardboard of staples and tape. At least three, better four, layers of overlapping cardboard are put down around the new plantings to suppress the grass. Anything less is not worth the time and effort.

A portion of the sheet mulch is usually inoculated with mushroom spawn to promote soil healing, enhance nutrient and water cycling, and to provide yet another edible or medicinal crop. Most often oyster mushrooms are used because they are very adaptable and edible. In Olympia, we used Fungi Perfecti

(www.fungi.com), a local company, as our source for mushroom kits, but other companies sell similar products. Mycelia quickly spread through and along the corrugation of the cardboard in the sheet-mulched area. The microscopic pattern of the wood fibers of cardboard is similar in form and believed also to be encouraging to mycelial expansion.

After the cardboard is prepared, laid, and inoculated, we apply wood chips or sometimes straw over the top. We have found wood chips to be better all around because they look neater, hold down the cardboard better, stay put, and provide long-term food for mushrooms, the soil, and surrounding plants, with the caution that strongly antimicrobial wood (such as Western red cedar, *Thuja plicata,* in our region) shouldn't be a dominant ingredient in the mixture. Straw rots faster, but generally people are more accustomed to seeing wood chips. The transition from lawn to trees and shrubs with wood chips is not a tragic one.

The timing patterns, techniques, and ecological intuitiveness of the "perennial polyculture" practiced by the first peoples of this continent have not entirely been lost.

One year into the process, some of our older sites are ready to plant with perennial vegetables, as the sheet mulch has rotted sufficiently, and the soils have improved. Good King Henry *(Chenopodium bonus-henricus),* a perennial spinach, and the self-seeding annual corn salad *(Valerianella locusta)* have proven to be very useful plants for this purpose, and the author is working at the time of writing to research and propagate perennial vegetables of these and other species.

Through this strategy of accessible demonstrations, the interest in forest gardening has spread exponentially, and there are now forest gardens all over the city of Olympia, many of the owners of which have opened them to the community. Terra Commons plans to issue a self-guided tour map this spring.

Becoming native to our places

Many specific Native American intensification techniques, such as burning, remain impractical to implement at our installations, as we are just beginning the process of land and cultural healing

and transformation. Permaculture has been creating a template for the renewal of healthy cultures and ecosystems within the industrial world, but the work is still in its infancy. Nevertheless, the principles of permaculture comprise our most accessible re-indigenizing practices thus far. Right now we are fostering economies of gift and trade, potlucks and community building, intergenerational education, place-based rootedness, and shared tending responsibilities. We are creating common wealth. But as these projects mature within their communities, we can hope to explore more bioregionally-specific intensification techniques, and technological analogs of other traditional practices.

Design from your community's cultural ecology

Just as species form indicates niche, so can aspects of our community influence the viability of projects and technological analogs. Begin to consider these features. Is the area in question primarily urban, suburban, rural, or very remote? What are the dominant features of transportation and commerce? How would political leanings, funding, and regulation affect your project? You might also want to consider the worldview and political climate that surround each potentially analogous practice *in situ* as you evaluate whether the practice in question might be successfully transferred. How would land ownership affect intended projects, and how do people relate to ownership? Do people already cooperate across property lines? Many older European communities held land in common, a tradition well known to the native communities of North America. However, the land management practices they once used might not work here and now unless community ties are first forged across fences.

Community rootedness

Is the community composed mainly of settled old-timers, or is it a transient college town? How accepting of change are the residents? What length of project and management intensity are likely to be successful given the demographic of interested and affected parties? How might community gardens benefit and create stronger social ties and cultural bridges amongst and between the marginal communities?

Olympia is a college town, a state capitol, a port, and is near an army base. A lot of political and scientific debate and development occur here. Ideas that we present here find a lot of fertile cultural ground, varying by neighborhood. Most of our installations have occurred in older neighborhoods with more tolerant attitudes toward yard aesthetics and a higher likelihood of neighborly interaction. Starting in places with a higher potential for success allows us to seed the idea around town. Eventually we will reach all the newer suburban developments as well. Our workshops teach and rely on the volunteer efforts of scores of students and local young adults who most often don't own property in the area, but who may plant or tend perennial gardens at rental locations or with their families in the near or distant future. Our workshops are always open to children with adult mentors present, and are valuable learning experiences for the generations who will inherit the earth after us.

Permaculture: one step at a time

What are the needs of the human members of the community, and what steps can they take to meet those needs? Encouraging neighborhoods to think of their yards as part of a large orchard with many different useful trees is a powerful idea, even if permaculture approaches to gardening are not yet well understood. When the residents share surpluses and grow food, the community is making huge steps in the right direction, whatever their gardening practices. When Terra Commons visits neighborhood associations and proposes a community forest garden installation, it also asks that the neighborhood identify the resources each house may have, and evaluate all possible sites, in order to encourage local food production, volunteerism, and sharing. Agreements can be made between owners of neglected orchard trees and those who could use, trade for, or help maintain these valuable local resources.

Leading and spreading by example

What forms of leading by example might be heartening to the community? When we engage the community in a group effort to install even one garden, word gets around, and afterwards there remains a physical example of the learning opportunity. Those who volunteer at the workshops, often residents of the same neighborhood, learn the techniques used on the day of the workshop. Ties are made between neighbors, and those who were initially unavailable or not interested can gain benefit by seeing the forest gardens as they grow and develop.

Respecting neighborhood aesthetic values

What are the aesthetic values of the area you intend to affect? An example is the use of straw to sheet mulch in more manicured neighborhoods. Some neighbors just might not be willing to look at a scene that looks like a barn exploded next to them. Forcing aesthetics upon others in the neighborhood is not likely to be beneficial to community ties in the long run. Encourage those within more conservative communities to keep this in mind as they redefine what is acceptable, beneficial, and aesthetically pleasing.

Power within the community

What grassroots entities can be used to organize and empower the community? Terra Commons was greatly assisted by several small grants from the Community Sustaining Fund to help it get off the ground and running. Though modest, this funding, fed by community collection efforts, was given at just the right times to help the organization move its program along. What existing community structures (such as a grange or church) could be improved (i.e. with an inviting community garden with picnic tables and collection and maintenance parties) for even stronger

organizing and producing capabilities. We have done installations at one church and school, and other churches and schools are looking to the outcome of these first projects as we propose more. Hundreds of people pass by these places. The positive power of thoughtful placement is immense.

Though Terra Commons has much work to do, we are only a year and a half into the forest gardening project, and have already made significant impact within the community. We hope that neighbors spread these ideas to neighbors, that church potlucks share freshly grown raspberries, that school kids grow up learning how to plant and care for trees, that people will teach each other what they have learned: that if only in a small way, our seed, like corn salad, will wander around and beyond the garden farther than where our shadow walks and long after our influence has passed. Δ

Laura Donohue has been an intern for Terra Commons and is a Senior attending The Evergreen State College.

For more information about Terra Commons and other efforts in Cascadia see www.terracommons.us.

For more information on Native American land management and intensification regimes within and beyond Cascadia, see the following books:

Anderson, M. Kat. *Tending the Wild: Native American Knowledge and the Management of California's Natural Resources*. New York. University of California Press. 2006.

Boyd, Robert. *Indians, Fire, and the Land in the Pacific Northwest.* Corvallis. University of Oregon Press. 1999.

Deur, Douglas, and Nancy J. Turner, eds. *Keeping It Living : Traditions of Plant Use and Cultivation on the Northwest Coast of North America*. New York. University of Washington Press. 2006.

Permaculture and the Landscape Architect

Andrew Millison

THERE MAY BE NO DISCERNABLE DIFFERENCE today between many ecologically progressive landscape architects and those who consider themselves permaculturists. Both disciplines design sustainable landscapes that respond to the strained conditions of our environment and material resources, and create new paradigms of land use to benefit present and future generations. This article seeks to articulate ways in which permaculture design principles may differ from and inform the field of landscape architecture.

I am an outsider to this field, who now finds himself working as a designer and draftsman in a landscape architecture office in the arid mountain town of Prescott, Arizona. I came to the fascinating art of land design through my studies of permaculture, and it's apparent that there are a lot of lessons to be learned and shared by both disciplines. Permaculture has become a major buzz-word throughout the design world, as all gazes are shifting toward "green."

This author-designed vineyard clings to arid hillsides in Jerome, AZ.

In the Zones

My first opportunity to practice permaculture intensively was when I was hired to manage the farm at Arcosanti, architect Paolo Soleri's experimental city near Cordes Junction in the Arizona desert 70 miles north of Phoenix. The farm is an educational component of Arcosanti as well as a food producer for the residents and an on-site cafe. I was also expected to be a teacher and was encouraged to experiment and improve the farm as I saw fit.

What I found when I arrived at Arcosanti was a fragmented design, with weedy gardens separated from hungry chickens, away from the orchards, and far from the fields. So I spent my efforts creating a functional core. I brought the chickens close to the garden and within the orchard, where they helped to control pests and weeds, and to fertilize the soil. I wrapped the chicken run around the main garden, and then planted a windbreak around the chicken run comprised of chicken forage and beneficial insect-attracting plants. The garden became circled by a chicken moat, which was circled by a food- and shade-producing windbreak, which was surrounded by a growing forest of fruit trees and herbs. The chickens could be concentrated directly in the garden when it wasn't cropped, or forage in the adjacent orchard. The chickens were put to work, and the amount of maintenance and watering required by the garden was greatly reduced, creating a functional "Zone 1" core and freeing up time to move into the peach orchard and cropped fields that lay within a larger planted windbreak separating them from the unmanaged Agua Fria River valley beyond.

From Arcosanti, I went back to Prescott to begin installing permaculture designs. I obtained my landscape contractor's license and established a design/build company. My designs often included rainwater harvesting, greywater recycling, and edible landscaping in an organic forest garden pattern. I installed a two-and-a-half-year, $1 million project including a permaculture forest garden and orchard, and then a terraced vineyard, all on very steep slopes in Jerome, Arizona. I always made sure that my clients could harvest plenty of food, water, and materials throughout their landscapes. I set these food systems up in a way that they would be supercharged during rain events, and receive the benefits of companion planting with nitrogen fixers, living mulch, and insectary plants. I worked closely with clients to meet their needs for sustenance and the level of maintenance and interaction that they wanted in their landscape. Often the design would evolve through the construction process, as more ideas took shape between the client and me. Often I returned again and again to work on other areas of the property, following a loose and evolving pattern for it.

Some designs I installed are now ten years old, and thriving with little care or irrigation in this harsh, dry environment.

Obtain a Yield

Permaculture design looks to the forest and the prairie to see how they work, and how they were managed by indigenous people.

In *Permaculture: A Designer's Manual*, Bill Mollison defines permaculture as "the harmonious integration of landscape and people, providing their food, energy, shelter, and other material and non-material needs in a sustainable way." In the permaculture perspective of what a sustainable human society looks like, the means for our survival are close at hand, and mass transport of goods over long distances is minimized. This highlights the importance of productive landscapes that produce a yield: our local land base must provide for our needs. This is one area where we may find a difference between permaculture and ecologically-oriented landscape architecture: permaculture's directive to obtain a yield from a landscape.

The problems associated with long-distance importation of food and fuel are surfacing, as swiftly rising costs of basic necessities make the headlines. The energy/food/water/population crunch has been in the sights of permaculture designers since before permaculture's inception in the early 1970s. Creating local sources of sustenance while maintaining a thriving and protected natural environment is the key. We must work to restore the land within the existing human footprint to maximize yields without encroaching on functioning natural systems.

Permaculture design looks to the forest and the prairie to see how they work, and how they were managed by indigenous peoples. The beneficial patterns and interactions that are observed in nature are then mimicked throughout a landscape design, so it embodies the same diversity and resilience of a natural system.

The problem is the solution

Permaculturists always state that "the problem is the solution," and Tucson's storm water drainage "problem" now feeds a growing forest garden from it's 12" of annual precipitation. This is happening with the help of Brad Lancaster, dedicated permaculturist and author of *Rainwater Harvesting for Drylands* (Volumes 1 & 2). Brad harvests more than 100,000 gallons of water annually on a 1/8 acre lot and surrounding public right-of-way, using water-harvesting earthworks such as sunken mulched basins and collection into a cistern. He harvests runoff from the roads to grow mesquite trees and other edible natives that shade the asphalt and provide wildlife habitat. Mesquite beans can be ground into flour, as indigenous people have done, and Brad has initiated a community effort to use this hardy food crop with his organization, Desert Harvesters.

Lancaster is not only establishing neighborhood food security, but is also addressing the urban heat island effect. The mesquite orchard keeps his house and vicinity ten degrees cooler than bare surrounding streets. This cooling effect will increase as the trees continue to grow to their mature size, with increasing food yields as well. The mesquite also provides pollen for Lancaster's bee hive, and wood to heat his house. The local water table is growing to the benefit of all the plantings. It is an investment with continually rising returns.

Brad Lancaster's AZ home garden combines the best of landscape design and permaculture principles.

Community example

Ecologically progressive landscape architects and permaculturists are closing the water loops in design, by retaining all rainwater on-site and reusing waste water. Closing water, food, and energy loops is part of any permaculture design with the guiding principle: Catch and Store Energy.

Brad Lancaster also played a role in the design of Milagro Cohousing, a community of 28 homes developed with permaculture principles, in Tucson. Two rows of adjoined homes face south for winter solar gain, forming a canyon-like landscape between. This area collects the roof runoff from the structures into cisterns and a series of interconnected mulched planting basins or bioswales that teem with fruiting and flowering trees,

Function, art, conservation, and education combine in this water catchment demonstration site the author designed for the Santa Fe Children's Museum.

shrubs, and herbs. These landscaped micro-basins also double as the site's multi-functional flood control system. The productive exotic plantings thrive in the canyon oasis where pedestrian traffic is concentrated, while the area outside the enclosure is a native Sonoran Desert preserve. The residents may harvest cultivated food plants within the enclosure and native food plants without. The structures are built of locally-made adobe brick. Waste water is treated on site using a constructed wetland, and then pumped subsurface through the common landscape to supplement the harvested rainwater. As a result, no potable water is needed for landscape use, while in conventional developments of a similar size 30 to 50 percent of potable water use is for landscape irrigation.

The feedback loop and evolving design

Permaculture by nature is a grassroots movement for ecological and social change. Therefore it is a bottom-up more than top-down endeavor. The permaculture movement advocates that a swarm of individuals changing personal habits through design can adapt to new conditions much more effectively than a large bureaucratic organization or governmental body. The permaculture movement seeks to educate and empower individuals and communities to take control of their sustenance and manage their resources in a sustainable way. In the standard landscape architecture process a client hires a designer and comes out with a finished plan. Permaculture principles dictate that every plan is subject to changes based upon a continual feedback loop of further observation.

Just as thoughtful observation and a thorough site assessment should yield a harmonious design, continued observation and response to system feedback should evolve and perfect the design over time. This means that clients or designers or both need to be involved over time, and the initial design should be considered a first step in the long life of an evolving project.

The success of this process is evident at the Santa Fe Children's Museum located in Santa Fe, New Mexico. Sixteen years worth of living design evolution has shown why the evolving landscape with a continual feedback loop is a crucial element of a permaculture design.

The original 1992 site design was a group effort, led by Anne Nelson, a landscape architect familiar with permaculture, with the museum's directors. There were initial budgetary constraints and the design needed to be built in phases. As time went on and children interacted with the landscape, the paper design was shelved and a living design emerged that interacted with the way the children played on the site. Over time, and with a tremendous amount of community involvement and many contributions, the area has become an evolving landscape, changing year to year with the cultural changes reflected in the children's play. As garden manager Jason Scott expressed: "Some years the kids just need more wildness than others."

The Earthworks Outdoor Learning Landscape at the Santa Fe Children's Museum is a high-profile public permaculture site that gets an enormous amount of use. More than 70,000 children visit the bountiful one-acre landscape of meandering paths, ponds, and interactive exhibits each year. The landscape absorbs runoff from the museum's 25,000 square-foot parking lot, which soaks through swales and basins defining the landform and planting areas. A 10,000-gallon cistern harvests water from the 6,000 square-foot roof of the museum for gravity-fed irrigation. Children explore endlessly in this biodiverse, productive, and habitat-enhancing oasis. A greenhouse sunken into the earth and interspersed vegetable gardens make this site a magical landscape in which children play and learn.

Anne Nelson has said it was a good thing that no single person had power over the idea because the space needed time to adapt. Many of the original designs put down on paper

never came to fruition. Fresh ideas built from observations and experiences of children in the space created a deeper design than could have ever been conceptualized initially.

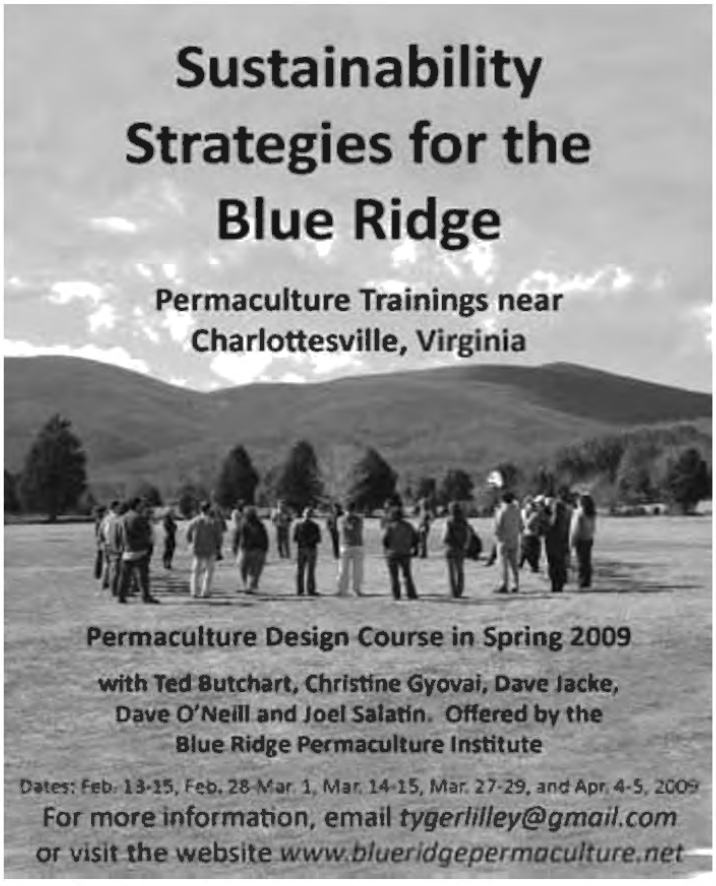
Moving forward

Just as thoughtful observation and a thorough site assessment should yield a harmonious design, continued observation and response to system feedback should evolve and perfect the design over time.

A permaculturist is by nature interdisciplinary, because permaculture design includes so many different elements, from landscape and gardening to home design, animal husbandry, transportation, forestry, education, social networking, and more. Landscape architects are in a good position to have a beneficial influence as permaculturists, not only in the designs they produce but also in the ways those designs come about, and are organized, installed, and improved over time.

Ways that a landscape architect may integrate permaculture into design practice are plentiful, from plant choices to client interviews, water systems, construction administration, and follow-up observations. The integration of permaculture principles into landscape architecture promises to be a fertile field. The forms can be as diverse and abundant as a forest. As time goes on and landscapes are fully recognized for their survival value, the permaculturist landscape architect will play an important role in guiding the transition. Future generations will thank us for our foresight.Δ

Andrew Millison now lives in Corvallis, Oregon, in the Willamette valley, where he is continuing to design, teach, and practice Permaculture. He can be reached at amillison@gmail.com.



One Solution to the Problem of Inadequate Shelter

Earthbag Building

Jeff Bosquet

HUMANS NEED SHELTER for happy healthy lives. Around the world people suffer because they lack the know-how to construct their own shelter. This is true of both rich and poor nations. Where people lack wealth, they end up living in shanties that fall apart when violent natural events occur. On the flip side, the relatively wealthy of the industrialized world can spend decades working to pay for houses that still have a high likelihood of failure when faced with a natural disturbance. People in both scenarios become trapped because they do not know how to design and construct healthy homes that enhance life.

Building with the Earth makes ecological and economic sense. Just about anyone can easily learn earthbag building methods to create homes that share the Earth harmoniously with nature. This style of building fits well into permaculture design. When done correctly, we end up with a house that cares for the earth, cares for people, and returns any surplus.

It can take tens of thousands of hours of work to pay for the typical wood-frame house based on a salary of $30,000 a year. A crew of four people can build an entire Earthbag house with water and electric services in about six months, or roughly 4000 hours. Material costs can be quite variable. The other systems in the structure take the bulk of the monetary resources. A simple structure can be constructed for as little as $20,000. Think about how much that can free a person from wage slavery.

The skeleton of the house costs relatively little. A very simple and safe structure can be built for just about nothing if the builder is resourceful. For an emergency structure, all you need are polypropylene bags, barbed wire, and the earth beneath your feet. In Nader Khalili's book *Emergency Sandbag Shelter*, he shows every necessary tool and step to build an emergency shelter in two pages. A group of 12 Calearth apprentices constructed an eight foot diameter dome in just under two hours.

Earthbag building provides one answer to some of the world's shelter problems. Architect Nader Khalili thought of the earthbag process to answer NASA's call for ideas on building moon structures. He founded the Calearth Institute in Hesperia, California. This organization focuses primarily on devising strategies for sheltering the poor of the world and on getting these structures approved by the building code. People come from

Photos accompanying this article are of the late Nader Khalili's CalEarth site in Hesperia, CA.

all over to apprentice with them in earthen building. CalEarth researches and innovates new and better ways of working with earth building technologies.

Earthbag homes can take many shapes and sizes. Dome structures use no wood whatsoever in the finished building. They can be built very quickly and efficiently using a compass to guide the walls as they rise. Arch forms create openings for windows, much like in masonry building. Domes will stay intact during wind, fire, water, and earthshaking events. Earthbag structures need not only be domes. Any shape can be constructed as long as some basic structural principles are heeded. The walls are strong enough to hold up almost any conventional roofing system.

A person learns the earthbag process quickly and simply. The earth builder fills polypropylene or burlap sacks in place with a sand and clay mixture. The bags are placed in rows and compacted with the help of a tamper. Four-point barbed wire is used to sandwich the layers and lock the courses of bags in place. Helpers work to get the earth to the person laying the bags.

Building with Earth allows us to use the most local material of all, that which we find right beneath our feet. Not all places have an adequate composition of earth to build with. Usually though, materials are not all that far away. Especially when one compares this to the distance that wood travels. Using unpolluted earth creates a non-toxic home. There is no wood to treat or vinyl to off-gas.

The ideal fill material is an adobe-like mixture of 70% sand to 30% clay, but this ratio has some flexibility. Problems may arise if there is a disproportion of sand to clay. This may require bringing in material from an external source. Dense-grade lime dust is a really good soil amendment. It compacts well and bonds very nicely with clay. Each place has different materials to work with and the importance of knowing the surroundings is paramount to a successful earthen building. As a worst-case scenario, cement can stabilize the mixture. Cement is nasty stuff though, and we do not care for the Earth when we use it unnecessarily.

A shell of some sort covers the bag structure to protect it from elemental forces. The design of the shell must be well thought out. Research is needed about how to waterproof the skin of these structures in varying climates. In an arid desert for instance, one would do well with an earthen plaster alone. Lime plaster holds up better in wetter climates. In a more humid place, we consider using plastic lining as waterproofing. Another method may be to cover the structure with ceramic tile. There is a plethora of options. Time and experimentation will solve any water leakage issues.

The design must be in harmony with the place where the structure lives. A house in Maine has different needs than a house in Florida. There is no one "fit-all" formula for houses. Permaculture requires us to listen and feel the space, letting nature be the guide. We examine the space, finding solutions to the specific problems or issues that the climate and locale provide. A shelter is the primary space where individuals care for or disrupt the balances of the Earth. Great thought needs to be put into the way our homes are designed and constructed. Too many houses today become shells of waste. Everything about them pushes the inhabitants towards greater harm of the planet.

Our shelter's design ideally leads the dwellers to a mindset of conservation.

Also think about the flow of energy and motion through the site in design. Every extra unneeded step taken during building adds cost. The site must be well thought out with adequate pathways and piles of earth strategically located around the building. Do not just try to build without thinking about the work space. It will pay off in monetary savings and will also save your back from a lot of stress. Earthbag building is quite rewarding, but it is quite physically intense. As the building gets higher, the work becomes more dangerous, creating another design issue to weigh.

The simplicity of this building style allows people to take the matter of their shelter in their own hands. After a few days of teaching, the students have learned enough to go off and build for themselves, and they have acquired the ability to teach others. This opens the door for the exponential growth of people helping people. This is the model that we need to encourage to aid the poor and the wealthy of the world. Every one must be empowered to provide for themselves and those around them in a way that helps nature. For true progress to occur, our systems need to be decentralized. Earthbag building is simple enough to shift the construction from the paid contractor to the homeowner.

Earthbags have many uses other than as shelters. A super solid wall can block noise and unwanted visitors. It can flow in a serpentine fashion, creating a beautiful aesthetic. The shores of lakes and ponds can be "stabilized" to stop erosion. People use the earthbags to protect against flooding. Natural swimming pools can use earthbags to separate different spaces in the pond. The form the earth can take is limited only by the imagination.

Two recommended books for anyone considering designing or building a sandbag house are *Emergency Sandbag Shelter* by Nader Khalili and *Earthbag Building: The Tool, Tricks, and Techniques* by Kaki Hunter and Donald Kiffmeyer. Another really good resource is Kelly Hart's site earthbagbuilding.com.

Working with the earth stimulates the imagination. It's humbling to understand that the Earth provides for us all. Our problems of shelter stem from lack of knowledge and poor design. We need to design shelters that withstand natural events, use little energy, and create a safe place where the inhabitants can grow and thrive. There are many wonderful alternative building methods out there. Earthbag building allows us to use simple materials from the building site itself. The less petroleum we use to create our homes, the healthier the planet will be. Humanity is bonded with Earth, and we would be wise to discover the many treasures it holds for us. Mr. Khalili loved quoting the mystic poet Rumi. He said, "Earth turns to gold in the hands of the wise."

Δ

A Fridge That Takes Only 0.1 kW a Day

Tom Chalko

THERE IS NO MISTAKE IN THE TITLE. This article describes an inexpensive fridge that is 10 to 20 times more energy efficient than an average fridge on the market. It also demonstrates that the biggest limitations to conserving energy are our habits and mediocre attitudes, not technology or cost.

My dream is to live a near-zero emission life. Step by step I come closer to bringing this dream into reality. After all, the rainforest here at Mt. Best is so beautiful and so unique that I hesitate to disturb it with any kind of pollution.

Insulating and double-glazing my RAL home reduced my winter energy requirement to about 20 watts per square meter of floor area. *(Ed. note: RAL homes are pre-fabricated quonset-like Australian-made kit homes.)*I do not like "star ratings." I think they are misleading and promote ignorance rather than an understanding of energy efficiency.

Reflective solar heating (described in issue 88 of *Renew)* nearly halved my heating energy (and the thus firewood) needs in winter. However, to achieve near-zero emissions I needed to find a clean, renewable source of energy to replace the firewood altogether. The system of choice became a geothermal storage heat pump that will be described in my next article. However, since I generate my own electricity from wind and sun, I needed to save some energy to run the heat pump.

For almost two years I tolerated a fridge that I did not like one little tiny bit. The list of things I did not like about it is too long to mention here. I realized that if I could eliminate that fridge, I would have enough energy to run the heat pump…

Chest fridge

Comparing the energy consumption of various refrigeration devices available on the market, I noticed that well-designed chest freezers actually consume less electricity than fridges of comparable volume, even though freezers maintain much colder temperatures inside. While chest freezers typically have better thermal insulation than fridges, there is another reason for their efficiency.

Vertical doors in refrigeration devices are inherently inefficient. As soon as you open a vertical fridge door—the cold air escapes, simply because it is heavier than the warmer air in the room. When you open a chest freezer—the cool air stays inside, just because it's heavy. Any leak or wear in a vertical door seal (no seal is perfect) causes significant loss of efficiency. On the other hand, even if you leave the chest freezer door wide open, the heavy cool air will still remain inside. Have you ever wondered why chest freezers in supermarkets have their doors either wide open or not thermally insulated?

Designing refrigeration devices with vertical doors is clearly an act against the Nature of Cold Air. Shouldn't we cooperate with Nature rather than work against it?

I become really curious: Just how efficient could a chest fridge be? After contacting some leading fridge manufacturers and discovering that no one has ever made and tested a chest fridge, I decided to make my own test. I bought a good chest freezer and turned it into a fridge.

Turning a chest freezer into a chest fridge

The main difference between a freezer and a fridge is the temperature maintained inside. Freezers maintain sub-zero (freezing) temperatures down to -25°C (-13°F), while fridges operate somewhere between +4° and +10°C (39°-50°F).

Hence, turning a freezer into a fridge meant changing the

temperature control. Rather than interfering with the mediocre thermostat of the freezer, I decided to install an external thermostat to cut the power off when the temperature of my choice has been reached.

For my research I bought a Vestfrost SE255 chest freezer with 600a refrigerant and a $40 battery-powered thermostat equipped with digital temperature display and an internal 5A/240V latching relay. The main feature of the latching relay is that it consumes battery power only during actual switching so that the thermostat equipped with it is a true micro-power device and its two AAA batteries last for many months.

Connection is really simple. The thermostat relay cuts the power to the freezer, much like a light switch cuts the power to a lamp. The thermistor (the temperature sensor) is placed inside the freezer at the end of a thin 2-wire flexible cable. I used the freezer drain hole to pass the thermistor cable inside the cooling compartment. An alternative is to insert it from the top via the chest door. If the thermistor is left near the bottom of the chest fridge—the minimum fridge temperature is controlled by thermostat. If the thermistor is located near the top of the cooling compartment—the thermostat will control the maximum temperature there. The best position for the thermistor is somewhere in the middle.

It took me about 30 minutes to make all connections. The most time-consuming part was removing the thermistor from inside the thermostat (I cut it out from the circuit board using wire clippers) and soldering it at the end of a thin two-wire flexible cable. I protected the thermistor from moisture and mechanical damage using shrink-wrap tubing and a tiny bit of silicone.

The external thermostat can be installed anywhere on the fridge or outside it. I decided to place it on the wall behind the fridge, so that the temperature display is easy to read at eye-level.

I have also removed the interior light bulb, rated 15 watts, because I avoid using energy-wasting devices as a matter of principle. I will consider installing LED interior illumination if I find a reason for opening my fridge in the dark.

When I finished my connections I had a chest fridge with a digital temperature display and a temperature control at my fingertips.

Performance

I set the thermostat to +7°C (46°F) and switched on the AC power through an energy measurement gadget called Sparometer. After about two minutes my thermostat displayed +6.5°C and the power to the freezer was cut off. The temperature continued to drop down to about +4°C. I thought that there was something wrong with the digital display, because everything happened too quickly. I took another thermometer, and to my surprise, it confirmed readings of the thermostat.

I watched the system for a few hours and then decided to move the contents of my old fridge to the new one that I had just made. Since I have never had a chest fridge in my life, it took me some time to arrange the baskets and their contents inside. I placed the most frequently used items in top baskets that slide on top edges of the fridge walls. It turned out to be a very practical idea. Not only are they very handy there, but also I can take out the entire basket, rather than taking out one item at a time (a typical case with a vertical-door fridge).

In the first 24 hours my new chest fridge took 103 Wh (0.103 kWh) of energy. About 30% of this energy was consumed during

the initial power up and re-arranging of the fridge content. The room temperature varied from 21°C (70°F) during the day to 15°C (61°F) at night. The fridge interior temperature was kept between +4° and +7°C. The fridge compressor was working only for about 90 seconds per hour. When the thermostat intervened—the fridge consumed ZERO power. The only active part was a battery powered temperature display.

Results of my experiment exceeded all my expectations. My chest fridge consumes as much energy in 24 hours as a 100w light bulb does in just an hour. Not only it is energy efficient, but I have never seen a fridge that was SO quiet. It only works 90 seconds or so every hour. At all other times it is perfectly quiet and consumes no power whatsoever. My wind and solar system batteries and the power sensing inverter simply love it. With my new chest fridge I have power to spare and I can use it to warm up my house in winter with a heat pump. I wonder why no one has ever thought of a chest fridge controlled by a digital thermostat?

What performance can I expect from my chest fridge during hot summer days? In principle, the energy consumption should be proportional to thermal losses of the fridge, which in turn are proportional to the temperature difference between the inside and outside of the fridge. A vertical door fridge has large additional losses caused by opening the door and the associated loss of cold air

The power consumption data for my chest fridge was measured for average 5°C (41°F) internal and about 18°C (64°F) average ambient temperature (13°C difference). If the average ambient temperature rose to 31°C (88°F), the temperature difference will double to 26°C. This in turn should double the thermal losses and hence the energy consumption. In this case I expect my fridge to work about three minutes per hour.

In reality, doubling the temperature difference causes slightly

more than doubling of the energy consumption, due to the reduced thermal efficiency of the fridge heat pump (compressor system). The larger the temperature difference between the heat source and the heat sink, the less efficient is the heat pump.

Fortunately for those who rely on solar power, in hot summer months there is also more solar energy to power the fridge.

It is obvious that a truly energy-efficient fridge does not cost any more money than a mediocre one. It actually costs less. It also has extra features, such as a digital temperature display that gives you full control over the temperature settings. So why are mediocre fridges being made? Why do people continue to buy and use energy wasting devices? Does anyone care?

Nearly every household in the developed world has a fridge that wastes at least 1 kWh of energy a day (365 kWh a year). How much of a reduction in greenhouse emissions can we achieve by banning just ONE inefficient household device in just ONE country? How many politicians debating for how many years will it take to achieve such a ban? Rather than waiting for someone to do something I would like to volunteer to supply modified chest freezers or freezer modification kits to environmentally conscious people in Australia. Let's do

Excavation (top left photo, p.42) and after-installation (above) views of underground water storage that provides geothermal mass to system.

something in the right direction right now.

Geothermal heat pump

After replacing my standard fridge with ultra-efficient chest fridge I have some power to spare that I can use to warm up my house in winter with a heat pump, especially on windy winter days.

The crucial part of a heat pump system is the source of heat. In our case it is 10,000 liters of water stored in a pressurized underground tank.

In winter, we take heat energy from this water (we cool it down) and deliver this energy at a suitable temperature to the house interior.

Water in the tank is heated by two sources: the Earth interior and our custom-made low-temperature polyethylene solar collectors.

Why is this system energy efficient?

To begin with, the system is designed (with Dr. Mirek Piechowski from MP Energy Consulting, who holds a PhD in thermal sciences) to operate at very low heat source temperatures (4-10°C/38-50°F).

In this temperature range, the earth actually heats the water in the underground tank, because underground soil temperatures are higher. We turned heat storage loss into heat gain. Isn't that an intelligent choice?

Secondly, on sunny winter days our solar collectors warm up our 5°C/41°F water to higher temperatures; this works even on partly cloudy days.

Since solar collectors operate at very low water temperatures (5-10°C), heat losses due to convection are minimal. On a sunny winter day we once managed to capture 57kWh from our 24m^2 collectors. Who needs fossil fuels?

Thirdly, our heat pump has a COP (coefficient of performance) between 4 and 6 in the temperature range of our heat source.

This means that for every 1 kWh of electricity we use to run the heat pump, we transport 3 to 5 kWh of heat from the underground water tank to the house interior.

Lastly, the electrical energy we use to operate the entire system comes from renewable sources (wind and solar), predominantly from wind.

That way the entire heating system produces NO emissions whatsoever when it operates.

Underground tank installation

It is very important to note, that a 1 kW heat pump is enough to warm up our entire 20-square (2000sf) house ONLY because the house is well insulated and has double glazed windows.

This seems like magic. Imagine trying to use a 1kW heater (or 10 light bulbs of 100w each) to warm up the entire house. Good luck!

And yet, we tested our system and it works fine. Just 1 kW of power applied to our heat pump warmed up the entire house interior by 2°C/3.6°F in just one hour. If I hadn't seen it I would not have believed it.

By monitoring heat pump parameters we established that our house needs 16.3 watts per square meter of living area to maintain the interior temperature 12°C/22°F higher than outside.

Our geothermal heat pump system is not the only heating source we have. On sunny days our solar reflective heating warms up the entire house and minimizes our need for heat energy.

Low temperature collectors capture maximum amount of solar heat with minimal losses. Δ

Tom Chalko, Mt. Best, Australia, mtbest.net

From the Regions

Rainwater Catchment in Liberia

Warren Brush

RAINWATER MAY BE THE ONLY RELIABLE and healthful source of water for most of us around the world as pollution, toxicity, disease, and its scarcity plague our water supplies not only in the "Two-Thirds world" but, increasingly in the ecologically impoverished industrial world. I am here in northern Liberia with good friend and Permaculture colleague, Paul Swenson, where we have just finished teaching a two-week intensive training for ex-combatants and war-affected young and old from many of the local tribes. The people of this region have recently found peace after a brutal civil war that lasted for nearly 14 years. Everyday Gandhis, a peace-building organization, has graciously brought us here once again to weave permaculture into the fabric of their work. The training was both physically and mentally intensive. We designed and built a 1,250 gallon ferrocement rainwater harvest storage tank. We also designed and built rainwater harvesting bio-swales as part of a larger on-the-ground exercise in designing a two-acre farm. Over 100+ inches of rain fall here in the wet season, but for many months no rain falls at all. So water management is critical to living through the long dry season. We learned together how to work with water and understand its many uses and functions. We looked at how practically to slow water's traverse down the face of the landscape by spreading it widely and then sinking it into the ground using contour swales, mulch, and appropriate plantings.

Paul Swenson (r) and Jolla working the rendering process on the inside of the tank.

During the wet season, cholera is a life-threatening reality that flows with the effluent entering the water stream under daily downpours. Up until now, the United Nations has been putting millions of dollars into early warning and treatment of cholera, but only a pittance toward clean drinking water systems. It is ironic that while the cleanest water available to us is abundant many die and suffer from lack of healthy drinking water. This design flaw is easily ameliorated by the sensible design of simple rainwater collection systems coupled with composting toilets that turn waste into food, not into pollution.

This training gave nearly twenty people the opportunity to learn how to design, site, and build a tank that could last up to fifty years in providing for their community's health, well-being, and stability.

We ran out of time this trip to teach compost toilet building but are hopeful that we will return in the spring to teach another hands-on workshop on how to build a simple thermophyllic system to handle the toilet nutrients so they become useful in the soil building processes, rather than producing disease in their communities.

We hope our work with Everyday Gandhis, our sponsoring organization, will continue to provide Permaculture training for this region of the world as part of their overall peace-building strategy for the region. It is through their generosity and community connection that Permaculture has been able to set its roots in this remote community in Northern Liberia.

Both Paul and I extend our gratitude to the people of Voinjama, Liberia, for their incredible kindness, graciousness and willingness to embrace Permaculture while teaching us so much

The people of this region have recently found peace after a brutal civil war that lasted for nearly 14 years…

Putting on the render coat, Lassana Kamara was our quality control man for this process of the tank construction.

about culture and community. Water is life and we hope that our work in helping to store this precious resource in your community has honored your traditions and magnanimous hospitality.

Warren Brush w@quailsprings.org

Framing the inner structure for the ferrocement cistern.

Washington State Permaculturists Meet

THE WASHINGTON STATE PERMACULTURE Convergence (WSPC) was a wonderful event, with 23 workshops, presentations, and focalized discussions! Many balls were sent rolling which will yield results for years to come. A spirit of excitement and cooperation were in the air. This was the first Washington Pc gathering in many years and it was well received.

Toby Hemenway's great keynote talk on Friday and the many images he presented to us tied together the theme of the "horticultural" societies that existed between the hunter-gatherer and agricultural eras. This was a period of time when humans invented many useful strategies to co-create bountiful ecosystems with nature. Toby is well known as the author of the great permaculture book, *Gaia's Garden*. Over half the convergence participants had read his book and the high regard in which we hold Toby was reflected in the substantial applause he received.

Dave Boehnlein gave a noteworthy presentation on "Large-Scale Permaculture Projects." Dave is one of the team members of Exos Design which does permaculture consulting. Doug Bullock is also one of the team members and Dave lives and works at the Bullock Brothers Homestead on Orcas Island. Dave brought final reports from several of their jobs. The reports were finely bound, the size of substantial books, and included colorful charts, photos, drawings, species lists, etc, etc. The quality of their design presentation has to rank among the best in the world.

Regional meetings were held on Sunday morning and we expect to see increased regional collaboration and organization as a result.

A website is in the works which will enable Washington's permaculture community to communicate with each other and the greater world. The website names of www.washingtonpermaculture.com and www.washingtonpermaculture.org were secured by John Cruickshank during the convergence.

We had a period where people could announce upcoming permaculture design courses being offered over the next year and it looks like Washington will have its largest number of courses ever offered in one year. They will be announced on the website once it is set up. The website will offer a way for people to list permaculture courses and workshops in Washington State.

Marisha Auerbach led a discussion on permaculture internships, Chris Chisholm led one on finding partners for permaculture ventures and Sam Benowitz led a discussion on how to pass on one's life work and permaculture living situations for old age. Participants of the latter discussion will write up some of their ideas for the website.

Participants included many of the most active permaculturists in the state both old and new. Participants included some of the earliest people to promote permaculture in the state such as Mike Maki, founder of the Maritime Permaculture Institute circa 1981; Sam Benowitz of Raintree Nursery had the largest turnout of any workshop for his talk on fruits for the Northwest; Forest Shomer of Inside Passage Seeds and founder of Abundant Life Seed Foundation gave a seed collecting walk; and Michael Pilarski kept up his reputation as a song and dance leader.

As befitting even a regional permaculture event there was an international presence as well. People representing India, Uruguay, Australia, New Zealand, Canada, Mexico, China, England, and Native American tribes were in attendance. Participants from other states included Oregon, California, Montana, Alaska, Kansas, Minnesota, and Louisiana.

Based on the enthusiastic response a 2nd WSPC has been scheduled for September 11-13, 2009.

We were pleased to have Native American emissaries Lisa Powers and her daughter Bibiana join us and make a presentation on Native American prophecies for this time. They bring word from various international indigenous gatherings and left us a song. Lisa and Bibiana live and work on the Tulalip Reservation. Creating more interchanges and information sharing between permaculturists and Native Americans in Washington state was discussed and we hope will lead to more interaction.

Albert Postema's power-point presentation on large-scale earthworks had to have the most images per hour of any show ever. The large machinery of his business, Earthworks Excavation, allows Albert to implement huge *hugelkulturs,* spirals, and other earthworks. It was hard to tell at first if Albert's initial photo of his acres-wide, bermed spiral was permaculture or the aftermath of strip-mining. It will be something to see once the plantings take hold.

Based on the enthusiastic response a 2nd WSPC has been scheduled for September 11-13, 2009. The Sahale Learning Center was a great spot for this year's WSPC and so we will be meeting there again next year. We expect the gathering to increase in size next year. Registration details will be forthcoming at a later date. We hope to see everyone back again next year and many more.

Best wishes to all from the Washington State permaculture community.

Δ

Reported by Michael Pilarski

Movement Musings

Wholely Cow

Max O. Lindegger

DURING ABOUT FOUR MONTHS of 2008 we kept a cow. The exercise was much more focused on animal-human relationships and animal husbandry than the products. But the Ecovillage Design Education Program here at Ecological Solutions is an exercise in sustainability and the products were also important, as is the routine of milking the cow. Being with an animal, getting to know it really well—and it getting to know you as well—is wonderful.

There is a meditative side to milking, watching the sun come up over the ridges or the moon slowly turning full, and becoming aware of the solar and lunar cycles and how the positions changes every morning and every evening. The warmth of the animal on a chilly morning is comforting. You can't rush an animal. You need to be calm and focused or things will simply not work out. We also had some wet and chilly mornings but in a way they were not a bad way to wake up either. While I would not want to do this type of work for the rest of my life I must say that I enjoyed the experience. It had been many years since I milked regularly and my hands were a different size then. As a child I imagine that I had a bit of a problem getting my fingers around the teats where now I wished my fingers where not quite so long!

There is also a social side to milking. On many a morning there would be six of us hanging out around the cow and calf and there was not always a lot of discussion going on. There was Sam singing hymns in Korean or Ed telling yarns—or silence—because words were not necessary. We don't have much silence in our lives full of phones and MP3 players. It is a great way to preview a busy day ahead or review a day nearly gone.

"B," our cow, is not actually a milking cow. She has a bit of a mixed pedigree and looks more like a beef cow. She happened to have a calf at the beginning of the course and she has a lovely temperament. She had never been milked previously. We walked the cow and calf (Miss "B") from Ed's place to Crystal Waters. This alone was quite an experience. Cows or calves don't naturally lead and need to be coaxed, trained, and encouraged. And it was raining! And the distance is about 10 km and so the outing could hardly be described as a Sunday picnic. But I think we all enjoyed it. It will be one experience we all will not forget too quickly.

When we walked them over, the calf was only very young and the long distance must have been tiring to it. Anyway, both cow and calf survived without any damage and eventually settled in.

Ed came every day to train the cow and calf to a routine but slowly some of us started to learn the ropes. Initially milking was a 6:30 morning event which was repeated again late in the afternoon. After each milking the calf would be re-united with her mother for about an hour and then separated again. Without the separation there would have been no milk for us.

In "normal" dairy set-up the calf is separated from its mother immediately after birth. This way most of the milk can be sold and it is the way a farmer can make an income. Some of the milk is fed back to the calf.

By keeping a calf, a lot more work and management is

The author leads a cow and calf with other community members on a long walk to neighboring Crystal Waters Village.

involved in getting a share of the milk. It sounds all lovely but is only possible with a lot more work and on a small scale.

From the beginning we had to be aware how much milk we could take for our purposes and how much had to be left for the calf. It needs some knowledge and a lot of observation of the cow and calf and also of the pasture and the weather. All aspects have some influence.

Initially we would take up to eight liters of milk, but towards the latter part of the time we would leave the cow and calf together all day, separated in the evening, and get only about two liters. This was plenty for our needs and it allowed the calf to grow beautiful and strong. We had no health problems with cow or calf as evidenced by daily inspections of both animals.

We rotated "B" and Miss "B" carefully around about 4000 square meters of fairly average pasture. In addition, the cow was given about 750 g of feed grain daily.

A cow needs access to good water at all times. She will produce approximately 31 kg of wet manure per day (about 65-70% of which is water). This is a valuable resource and there are 101 uses for this manure (from fertilizer to tooth brushes! Google for more information) the land she was kept on (and the trees) will greatly benefit from the added nutrients. The manure could be collected and turned into top-quality compost. It is simply a work and logistics issue. This amount of manure could make any garden and orchard look like a million dollars without purchased fertilizers of any sort. The cow's urine together with legumes should be sufficient to maintain the fertility of the pastures.

Better pasture or more feed grain would result in a lot more milk. We often had a surplus (the group did not drink much milk) and made wonderful yoghurt and a little cheese. The calf could be slaughtered for meat (we would not do this) and eventually the cow, too, could be used for meat.

There is also a down side to keeping a cow for milking: we had to import grain. I'm sure that we could grow some here or find a substitute. In Switzerland the cows were never fed grain but top quality grass (cut by hand!) and this could also be done here.

Milk is highly perishable and the temperature needs to be brought down to 5°C (41°F) as quickly as possible. Straight after milking (into a stainless steel bucket) the milk was strained through a double thickness of cheese cloth, and then bottled into slim containers. We preferred glass bottles as they are easier to keep clean than plastic. The bottles were first chilled in a freezer for one hour and then refrigerated. (I don't know how much energy is required for this chilling process but it would be quite considerable and fairly expensive.) A lot of hot water is required to wash and rinse the milking bucket, the cheese cloth and the bottles. We also used warm water to wash the udder before milking. Hygiene issues are very important as drinking un-pasteurized milk could potentially carry pathogens; we had no health issues at all.

There is a meditative side to milking, watching the sun come up over the ridges or the moon, slowly turning full, and becoming aware of the solar and lunar cycles. . .

In days gone by the milk would have been poured into a container which was standing in very chilly, flowing, spring water. Not a realistic possibility here in Queensland. The hot water was boiled on a wood fire. OK if you have the time!

I'm also a little concerned about the accumulation of nutrients around the milking area. Our cow seemed to have the habit of dropping her manure and urine very close to the milking area. There is only so much nutrient soil can take. We did spread the manure around but the urine will potentially find its way into the subsoil and potentially the ground water.

There is also a time issue: Preparing to milk (e.g. rinsing con-tainers), walking to the milking area, milking, walking back, bottling, and cleaning up would take between 45 and 60 minutes.

Cows have a real place in a sustainable system. Milk and milk products are obvious yields but we should not underestimate the value of the manure and indeed the learning, social, and spiritual values.

Δ

Max Lindegger lives and teaches at Crystal Waters Ecovillage in NE Australia. Visit www.ecologicalsolutions.com.au for further information or contact the author at office@ecologicalsolutions.com.au.

Beyond Permaculture?

Rosemary Morrow

IN THE LATE 1980S WHEN I STARTED teaching in Viet Nam, permaculture was the perfect instrument for rebuilding a country which was recovering from protracted war. A social-collective culture was reverting to private land management, and had a need to regain its past knowledge and skills, as well as to add new ones.

Permaculture escaped, and it is all but impossible to follow its many paths into the organizations of Viet Nam, especially as people began to travel and TV and radio picked up many of its principles and strategies.

From around 80% of the population living with hunger to the less than 25% today, Viet Nam has lived another, more peaceful revolution. The people are charming, hardworking, intelligent, and confident. (When a small agrarian nation defeats the French, the Chinese, and the USA, perhaps it helps their confidence.)

Permaculture was a powerful tool because it applied its designs to small land areas over an enormous variety of landscapes, and it added to historical knowledge. The Vietnamese had been "gardeners" rather than farmers for about 3,000 years on blocks of land about one-quarter of an acre plus rice fields. So we westerners have a lot to learn from them and some to give.

The syllabus and content of the PDC was effective as a framework, reassuring people that they were on the right path in that time of post-war reconstruction. And we introduced some of the first in-service training in the country to all the provinces through VACVINA and the agriculture department while several INGOs and NGOs such as FAO, UNICEF, and UNDP sent their local officers.

Permaculture escaped, and it is all but impossible to follow its many paths into the organizations of Viet Nam, especially as people began to travel and TV and radio picked up many of its principles and strategies.

Last year I was invited by Quakers Viet Nam, supported by AFSC (American Friends Service Committee) to assist in a needs survey of some of the poorest 25% of the people.

We selected one of the poorest provinces, went to the poorest districts and communes, and then interviewed the poorest farmers. A detailed report exists of this Needs Study. We asked women and men at each level why they considered they were poor and how poverty bit into their lives.

Whereas in the 1990s and early 2000s, food security and sovereignty would have been paramount, by 2007 this was still so, but new non-agricultural factors had entered their lives.

Families were still hungry and they lacked techniques to increase their food supplies. However, the new factors seem to be beyond the ability of permaculture to ameliorate their poverty. To keep this article short, I have listed these main interrelated issues, but not in order of priority:

• Climate change with wide and damaging swings between floods and periods of previously unknown drought.

• Progressively smaller land size because the Napoleon Code divides land equally among family members, and the holdings are thus reduced each generation as the population increases.

• Earlier 1990s land division no longer meets present needs.

For example, a person with a reasonable commune holding may now be living in Ha Noi and yet villagers need extra land to make it economic to farm.

• Financial problems as the cash economy has increased the need for money for basic services such as health at clinics, medicines, and education, and farm inputs—chiefly from the Green Revolution in chemicals taking place (of course polluting water sources and soils).

• Debt often breaks very poor rural families, and with interest rates as high as 10% per month and farming always risky with its many variables, farmers go bankrupt. Local moneylenders feed off the needs of the rural poor.

• Debt and extreme money shortages fueled by increasing costs and the lure of local and overseas industry providing steady wages has caused the external and internal drift of men and women in search of paid work.

This is very often disastrous because farmers are not warned about doubtful contracts in which the middle "men"—and it is predominantly men—take out money for fares, food accommodation, visas, repatriating money, and every last detail of the immigrant's life. I have several case histories of families utterly broken after working away from home, sometimes for years, and at the end return home in debt and often lose their land to a family breakup.

As a result villages are often emptied of the labor of women and young men, much needed to continue to grow food.

And finally, HIV and other contagious diseases are brought back to these poorest villages where money for health treatment and education is lacking. It is yet another burden for the very poor.

So globalisation has not brought relief to a significant number of very poor people who already suffered from lack of food and water sovereignty which permaculture would have eased. Now they have these extra burdens and instead of feeling proud and confident under hardship, which I think of as a Viet Namese characteristic, they are feeling extremely powerless.

Some ways forward

I have become convinced that in our permaculture Care for People, we facilitators who work where these conditions are prevalent need to offer a wider curriculum and add to our present one the knowledge of HIV, budgeting, and terms of external work so people can have the choices which we westerners have, to make informed decisions about their lives.

Evidently, this is a special situation for Viet Nam, however, in each country where there is significant poverty for whatever reasons, people need extra information on how the outside world will and does impinge on their lives.

I am committed to working where food and water are seriously limited and permaculture can substantially turn this around, however, it is now the global problems which I believe we must address.

Given the moment of the world financial crisis, it seems to me that solid financial advice could be added to our curriculum.

I offer this article for comment from other permaculture facilitators who may have had similar experiences to mine, and would like to discuss them. Δ

Rosemary Morrow may be contacted at rowe@lisp.au.

From the Blogosphere

Notes from Amanda Malachesky

AMANDA LIVES IN THE MATTOLE RIVER Watershed in coastal far northern California. Amanda cultivates a keen sense of observation and journaling as indispensable design tools and enlists the senses and sensibilities of her husband, Drew, and toddler, Ella, in creating a dynamic, internal chronicle of land- and seascape near their home.

The following are year-end entries in her blog, http://eastmillcreek.blogspot.com/

Thursday, December 11, 2008
Full Moon . . . .

With all this clear weather as of late, we've had an amazing string of moony nights here on the Lost Coast. Crystal clear, twinkling stars, frosty grass, and white liquid moonlight spilling all over everything. No need for headlamps, and it shines in on our faces through the skylight while we sleep in our cozy yurt loft. Yesterday afternoon, we were returning from town and took a pit stop while on the Wildcat (the road between Ferndale and Petrolia), and as I chanced a look behind me to the east, a giant, transparent moon was just above the golden horizon. Oh, it makes the heart sing! And tonight, as the sun was setting, there it comes again, hovering over the dip in the ridge to the northeast.

The neat thing about the solstice full moon is that it describes the path of the summer sun. In other words, where the moon came up tonight is where the sun rises on summer solstice. This is a valuable piece of design information, if you want to get a sense of where the sun is on your site and you don't have access to other kinds of tools.

Friday, December 26, 2008
Sit Spot: A New Year/Solstice Resolution

Today dawned with more blue sky than clouds, at last. It's been many days since we've had a day so nice! It was the perfect day to introduce Ella to the "Sit Spot" routine! Over the last several years, I have off-and-on been pursuing a self-guided natural history curriculum, called Kamana, offered through the Wilderness Awareness School in Duvall, Washington. I've fallen off the wagon several times, the most recent fall being due to our move here coupled with giving birth to Ella.

But thanks to Drew, I am climbing back on, in pursuit of that elusive goal that I can feel but can't see, out there in the forest ether. It is a goal that is something like wanting to feel myself part of the fabric of animals, birds, plants, water, and everything else that converges on our specific place here, to be able to hear a sound and know that it means a coyote is slinking through the underbrush, or to be able to find food in any season or weather. I'm looking for indigenous knowing of this land, and all its faces.

The Sit Spot routine is the core of the Kamana program, and basically involves choosing a place, close to your home, that you can visit every single day, in all kinds of weather, at all times of year. You go there and practice awareness exercises. Over time, you begin to have some odd, and at first, seemingly random

The blogger's daughter, Ella, often accompanies her in the wild.

experiences. Though I've not yet mastered the routine, and have always had trouble going every day, I did it enough at one time to begin to have strange and coincidental encounters with animals, like deer, squirrels, chickarees, and birds. You begin to notice things you somehow missed before.

So this morning, I asked Ella to go on a special walk with me to a sit spot. We talked about being quiet and listening and feeling, and smelling and looking at everything. And we walked quietly to the spot I've chosen, down the hill behind the yurt, into the forest, next to an old charred log, next to a bay tree, with a wonderful view of the lower meadow by the creek, and the wet seepy area below one of our springs. It's perfect. We crept in there, and sat together, listening for birds, drinking in the rushing sound of the full creek after all the rain of the last few days. We touched some yellow jelly fungus, and some stiff capped mushrooms that were growing out of the log. And after she got bored and couldn't sit still, we went on a little walkabout, to look for some deer, to play in the creek, and to see what else we could find. It was lovely, to wander with no agenda, and to find unmelted hail unexpectedly, and to follow a deer trail, hoping to find them. Ella was remarkably quiet and attentive the whole time. I would call it, unabashedly, a complete success.

So we'll be sit spotting every day, from now on. Who wants to join me?

A Winter Solstice bonfire on California's Lost Coast

Saturday, December 27, 2008
Frogs and Skunk Cabbage and Wild Ginger

It feels so wonderful to have new momentum with the sit spot routine, an excuse to leave the house, whatever the weather, and to explore and learn about our back yard! Ella and I bundled up to brave the slow, weeping rain to visit our little log backrest in the dripping, moist, and mossy forest. Ella ventured to touch the mushrooms we found yesterday, again. We heard a small feeding flock of chickadees and maybe other birds pass overhead while we whispered to each other.

After only about eight minutes, Ella said she wanted to go home, so I took her back, and asked Drew if he would watch Ella so I could go back out. I had a more adult sit, and I centered and grounded into the earth, said my thanksgiving address, and dropped into my awareness exercises. I began to notice some details about where I was sitting. I had thought the log against which I rested was an old, burned fir tree, but I realized it is a bay log. And the stump to my northwest is the bay stump from which it came! And there are not one, not two, but three wood rat nests within sight of the spot.

After a long collection of minutes, I decided to wander a little, to look at our northern spring. As I crept through the damp leaf litter and the overhanging sword ferns, I noticed the first leaf buds of the skunk cabbage emerging from the moist earth, and a quick look underneath the spade-shaped wild ginger leaves revealed its tightly curled flower buds. Ah, the very first evidence of spring approaching! Not sure if this is earlier than is should be, but hey.

And finally, I first noticed on Christmas Day the song of the tree frog, a joyful response to the wetness we are at last experiencing. And not a day later, I have begun to hear them here, in the swamp, and even right close to the yurt, I believe in the garden. I'll let you all know if I locate the little singer. Δ

Have a Favorite Blog?

Let us know about a favorite blog you'd like to see excerpted in our pages in this new feature, send us a link at editor@permacutlureactivist.net.

www.permacultureactivist.net

Reviews

Advanced Sandbox
Review by Peter Bane

BRAD LANCASTER
Rainwater Harvesting for Drylands and Beyond, Vol. 2 Water-Harvesting Earthworks
Rainsource Press. Tucson. 2008. 417 pp. paper. illus. $32.95.

How he ever imagined it would fit into one book is beyond me. In this second of three planned volumes on rainwater harvesting, Brad Lancaster brings together a vast array of information on practical, small-scale earthworks, much of it heretofore unavailable outside of specialized literature aimed at development and aid workers in majority-world countries. Volume 1 of this series sets out design criteria for creating rainwater harvesting systems. Volume 3 promises information on roofwater catchment and cisterns. This volume provides the berms and basins of low-cost structures to intercept overland flow and deploy surplus tank and roofwater. It augments these bioengineering approaches with excellent information on greywater use and appropriate vegetation for drylands.

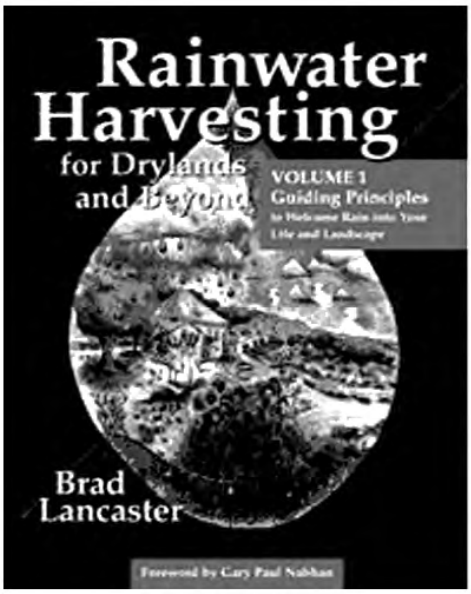
Although the focus of these works is on the desert Southwest US, Brad has traveled extensively to research worldwide strategies for drylands (which cover almost half the planet). A most inspiring story of a village in Rajasthan, India that has made water harvesting the basis for its economic and cultural renewal opens the book, and pictures and examples from Mexico, Peru, Zimbabwe, and other dry regions of the world pepper the subsequent chapters. Readers from humid climates will find most of the basic engineering of swales, terraces, french drains, diversions, porous pavement, and greywater distribution directly applicable; the book's title phrase, "...and Beyond" represents its content fairly.

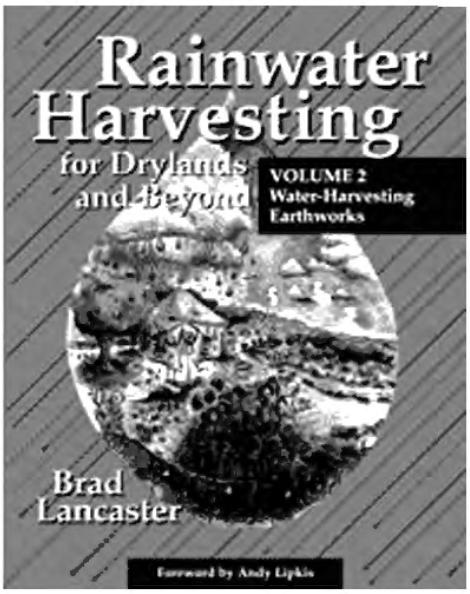
After the useful and inspiring preface, which sets out principles and ethics for water harvesting, explains for whom the book was written, and sets this volume in context with its preceding and following volumes, an Introduction to Earthworks follows which provides historical and cross-cultural context and places Earthworks in the broader design framework for sustainability. Twelve chapters make up the meat of the book: the first explains site assessment, how to read slope and water flow patterns, sets out a choice of strategies and structures, and provides basic tips appropriate for all kinds of earthwork. Subsequent chapters cover what Brad calls "berms 'n basins," (and what much of the permaculture community knows as swales), terraces, french drains, infiltration basins, imprinting (a broadscale technique for creating dimpled surfaces over relatively level ground), mulching, permeable paving and de-paving, diversion drains, check dams, vegetation, and greywater re-use.

This book, like the first volume, is dense with information, but Brad is both a good writer and a good teacher, so the book's structure helps the reader get the basic points easily and aids in referring back to specifics. Although dauntingly thick, the book is lavishly illustrated with black and white photos and charming and clear line drawings on every page—hundreds in all, making it as much a visual guide as a textbook. A good layout with lots of bold and clear subheads and ample white space around text blocks allows easy navigation through the dense material. You can get the basic argument simply by reading through the subheads.

Although many of the particulars covered by the book may be unfamiliar to readers, everything is carefully explained with good and thorough references to illustrations in the book and to other texts. Brad uses stories, vignettes, and analogies to explain the logic of the methods and structures he describes, so that anyone could understand and undertake to use the information he provides. In addition, each of these chapters ends with several real life examples of the strategies explained within. So we get to see how these are

Earthworks are indeed the foundation of any sustainable landscape design, and our homes, gardens, farms, neighborhoods, and town- and cityscapes need the work that is so amply described in this attractive volume.





done and what the results may be in practice. Where applications may cross legal or regulatory boundaries, the author provides clear guidance about what to avoid, how to proceed, and what to watch out for. He also lets us know that the greywater applications he describes are sanctioned in the state of Arizona and may be adopted elsewhere. As a permaculture teacher, Brad is always keen to explain how everything works in many ways and through time, so throughout the book we get a systemic and holistic understanding of the function of earthworks and water harvesting.

Volume 2 of *Rainwater Harvesting* is designed as a first-class information resource, so it provides useful tools for the reader, including a detailed list of illustrations, a listing of tabled and boxed information throughout the book, and six appendices. These summarize the various techniques and situations in which earthworks might be applied, explain how to make and use bunyip water levels and A-frame levels, collect all the equations in the book that allow you to calculate flows for designing earthworks, give example plant lists for Tucson, Arizona with water requirements, and provide a schematic and details of the kitchen resource drain greywater system. There is also an ample collection of resources for further study. Brad lists his references, and provides both a glossary and an index.

Earthworks are indeed the foundation of any sustainable landscape design, and our homes, gardens, farms, neighborhoods, and town- and cityscapes need the work that is so amply described in this attractive volume. As an author, Brad Lancaster has made his mark in the permaculture world and beyond. Land managers across the semi-arid world will find value in this work, as will homeowners and town planners from across the continent. *RHv.2* is certainly good value for money given the size of the book (417 pp at 8.5x11), the number of illustrations, the clear design, excellent reader references, and high quality information. Clear, inspired writing, a strong sense of passion in the author, wonderful stories, and a meticulous attention to detail ensure that this will be a standard item for every permaculture library for at least a generation. Δ

All the Food that Fits

Review by Peter Bane

R.J. RUPPENTHAL

Fresh Food From Small Spaces

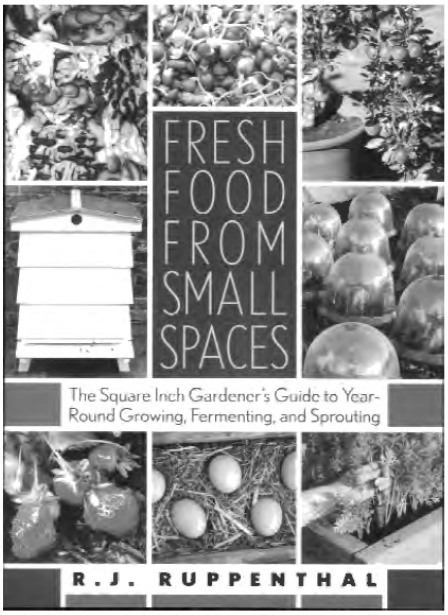
The square-inch gardener's guide to year-round growing, fermenting, and sprouting

Chelsea Green Publishing.
White River Jct. VT. 2008.
178 pp. paper. illustrated. $24.95.

This is a book for beginning gardeners and those constrained by lack of land. You won't need any Latin to make use of it. The author is an attorney and professor in northern California. He's lived almost exclusively in apartments, townhouses with tiny lots, and other kinds of tight squeezes, whether from lack of income or perhaps lately by choice, but has retained a passion for growing things. As a result, he's applied his household ingenuity to raising more food in less space than most people could imagine. Since his career work requires logic and careful explanation to others, and luckily, he has a little style and humor, *Small Spaces* came out very clearly written and friendly to the first-time gardener. It's nicely laid out and peppered with lots of black-and-white photos, a few charts, and some recipes.

Ruppenthal is a bit of a tinkerer. Despite his cherubic face and mild persona (making him seem like the perfect sitcom dad), he seems to have the instincts of a farmer. Noteworthy in the text are sections explaining various container growing systems, including self-watering planter boxes, a technique for the gardener with no land at all—just put them in front of a sunny window or out on the balcony. R.J. has made his own and he gives us the down-and-dirty on how to do it cheaply with off-the-shelf parts from the hardware or variety store. We also learn about hanging pots and other ways to use vertical space, clever tricks for trellising (plant in rows but make a "V" of strings or wires for peas or beans, with every other plant leaning the opposite direction), and other bits of magic like espalier training of fruits. If you want to grow food in small spaces, it's apparent that you should get comfortable with the extra manipulations required to fit the garden into your available footprint.

This book gives urban residents a great deal of hope for enhancing both nutrition and food security from their own efforts, though Ruppenthal is careful not to set the bar of expectation too high. He suggests that raising 10-15% of your food is easily achieved by anyone with even a very tiny yard, and that apartment dwellers can also



make an important, if smaller contribution to their health and well-being. Since the range of strategies applicable to tiny spaces is inherently limited, the design aspects of a small-scale urban home food system are in many ways cut-and-dried, so do not look to this book for a wide-ranging discussion of ecological design. That sort of thinking is subsumed in the author's worldview and analysis, which he shares with us in the Introduction—covering Peak Oil and Climate Change, and in the concluding chapters on preparing for resource shortages and a

sustainable future. We're all going to have to do more with less, more for ourselves and for others around us, and we'd better start doing it now, or events may just make it painful to climb the learning curve. The book's title is its concession to strategic thinking: the text of*Fresh Food From Small Spaces* zooms in on details for a well-selected set of techniques.

The word "permaculture" is absent from the author's vocabulary—for that reason I prefer the more Pc-informed work of Michael Guerra, *The Edible Container Garden,* but alas, that fine book has gone out of print. Nevertheless, city dwellers who set out to grow more food with *F3S2* in hand will come out the other end of the process much closer to permaculture than if they didn't have it. Though there's plenty here on compost, R.J. slips in a slightly sneaky section on sheet mulch—and even how to do it on concrete. One failing is the author's apparent aversion to humanure composting. He mentions it in passing with a reference to true closed-loop sustainability—which is perhaps all that's culturally acceptable for a writer who's got his hands all over the food—but honestly, people I know do it in cities all over the country without causing any riots or spreading cholera. They enrich their garden but attract no attention. We'll have to start eventually and might as well get used to it. And what, by the way, were we to do with those buckets for "emergency toilets" that he recommends in the last chapter? I mention this in part because so many of his references are to other books by his publisher, which proudly displays *The Humanure Handbook* in its catalog (not to mention a raft of permaculture titles).

Self-reliance, however, is an aim not wholly achievable in the urban setting. Ruppenthal has, agreeably enough, settled on expanding resilience. As an example, the author writes quite a bit about seeds: how to raise your own plants from seed, when to use seeds and when to transplant, how to sprout seeds in order to eat fresh, nutritious live food when you have no soil or little time, and what kinds of seed to buy, but he talks very little about saving seed. Okay, understood. Most people won't, and you don't have to save seed to have a fine little garden. But in the larger picture, someone has to save seed, and if many gardeners don't, then the food system becomes more fragile. Still, if many more people would garden (and it's the book's and presumably the author's aim to get them to do so), some of them will save seed, even if only by accident, and we'll be better off on all counts. The permaculture designer with a neighborhood of people working out of this book, would of course, organize a seed swap or start a seed company.

This book gives urban residents a great deal of hope for enhancing both nutrition and food security from their own efforts, though Ruppenthal is careful not to set the bar of expectation too high.

And speaking of swaps, there's a brief mention at the beginning of choosing to grow everything or the virtues of specializing and trading surpluses—this would seem to be Economics 101—but not much else about working over the fence with your neighbors. It may be that this is but a variant of the California problem: too much wealth and an unquestioned faith in the American Dream of every man a king in his castle. Or perhaps it was just too much of a stretch to talk about sharing the harvest when there's so little of it to begin with. The issue looming large—who eats?—is still apparently beyond the pale, even in a book about food.

Also, there's talk about animals with chapters on keeping chickens and raising bees in the city. These are practical beginning steps with big payoffs. But if chickens aren't quite right for you, or they are prohibited in your town, you won't find so much as a suggestion to keep rabbits, or guinea pigs, or bantam ducks on a little pond, let alone information on raising frogs in a kiddie pool. Wildlife come into the picture chiefly as potential competitors for your scraps (get a compost bin to keep the scene clean and discourage rodents…). Nor is there any intrinsic linking of animal proteins and fats with health and nutrition, though a deeper analysis of human culture would at least suggest this. Other than by honeybees, which do their own and share, foraging, gleaning, and wildcrafting all get short shrift here, though these strategies could potentially extend the urban household foodshed significantly. These are not condemnations of the book, just a recognition of its limits.

At the other end of the scale, Ruppenthal goes far into microbes, with a good discussion of various ferments: kefir, yogurt, sauerkraut, and kimchi. These are excellent ways to enhance nutrition, prolong freshness in stored food, and spice up the diet. And, as mentioned above, he devotes many pages to seed sprouting as a quick and easy way to add fresh food to the menu anywhere, anytime. There's also a chapter on mushrooms: how to grow them on logs, in bags, or in milk cartons. Because they don't need light to flourish, mushrooms are a very useful way to take advantage of dark corners, basements, spaces under porches and stairs, and other neglected real estate.

Perhaps the least expected and, in a way, the most exciting chapter of the book is one on tree fruits and berries, which despite its large subject and unlikely appearance in a book on "square-inch" gardening, is surprisingly useful. Besides covering the gamut of species from potted cherry tomatoes to dwarf apples and pears, the author gives us charts that show pollenizer varieties for the common tree crops. Being a Californian, he's also aware of the potential for many parts of the country to grow subtropical fruits such as fig, loquat, feijoa (pineapple guava), and citrus, so these help expand the book's range and will be increasingly useful as climate shift opens us all to new crops. He also discusses a useful technique for growing many varieties of fruit in a very small space so that one could have, for example, fresh plums or pears over three

months instead of three weeks. Again, intensive management is the key, but one can expect to achieve that in a small space without burdensome demands on time.

The chief design criteria Ruppenthal does discuss are adaptations to light. Every kind of crop or food he talks about is evaluated for its needs for light: full-sun, partial shade, full shade, vegetables, fruits, indoor crops, even seedlings are considered. He expands on ways to enhance light (light paint, reflectors, etc.). Though recognizing that sprouting is a kind of hydroponic growing system, he generally frowns on the use of artificial light, with the only exceptions being for seedlings to transplant (light levels are low almost everywhere in January and February—what can you do?), and for improving egg production from hens in winter. Otherwise, he points out, electricity use for food production needs to be limited, since fossil fuels are going away.

Though I wanted to read a clearer argument for what is most important in a small-scale food system, and why—a case I have often made to my own students, at least Ruppenthal has gotten the "what" right. Even if he doesn't offer the whole-system explanation for "why" this and not that, leaving choices instead in the somewhat breezy atmosphere of "consumer preference," most of the clues are here, and if you follow his suggestions, you'll be on track to a healthier and more resilient household.

Photos in the book are in many cases generic and stock images, though clear and adequate to purpose. The editing and composition are good, and the author gives a lot of footnotes, so you can follow his argument to its sources. There is a list of resources appended including selected seed houses and nurseries; suppliers and important books for further reading are cited throughout the body of the text. There is not, however, any index. That's probably not a major failing for a small and relatively straightforward book such as this. You can find most of what you might need by flipping through it.

A faithful guide to practical systems for raising food in small spaces, *F3S2* fills the niche for a wave of new urban and first-time gardeners, and offers more than a few tips and spins for veterans needing to adapt to smaller digs. Δ

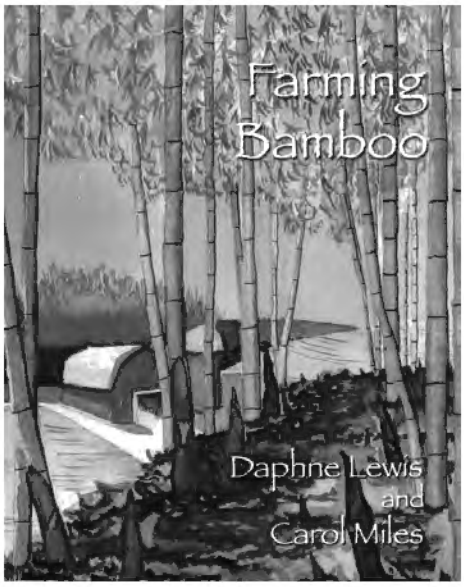
Farming a Mob
Review by Zach Mermel

DAPHNE LEWIS & CAROL MILES
Farming Bamboo
Self-published. Seattle, WA. 2007.
www.dogscooter.com.
204 pp. paper. illustrated. $27.00.

Most permaculturists are aware of the outstanding beauty and utility of bamboo. Regrettably, there are few commercial bamboo operations in non-Asiatic regions, such as the United States. Rarer still are books on the integration of bamboo into a farmscape. David Farrelly's *Book of Bamboo,* long an authoritative text for "bambuseros" (bamboo enthusiasts), contains only one chapter on the cultivation, harvest, and curing of bamboo. What is needed is a handbook for those seeking to establish their own commercial bamboo operations. Enter: *Farming Bamboo.*

There is no question that the authors are thoroughly knowledgeable about the subject of bamboo. Daphne Lewis, the principal author, is a well-regarded bambusero throughout the Pacific Northwest, having written *Bamboo on the Farm* in 1995 (a less detailed version of *Farming Bamboo).* Co-author and scientist Carol Miles is a fruit and vegetable specialist for Washington State University. Lewis and Miles blend their own wisdom with that of other bamboo experts from across the United States (including well-known permaculturists Adam and Sue Turtle and Rick Valley), in a manner that is accessible to readers who do not have a background in botany. Most of the numerous illustrations are either computer-rendered landscape graphics or hand-drawn illustrations. These are clear and easy to interpret. Actual photographs are few.

Though bearing the implied authorship of Lewis and Miles on its cover, *Farming Bamboo* credits eleven editors with its composition. The collaboration is clearly a strength in as much as it enabled Lewis and Miles to draw on a wealth of knowledge, but they seem not to have succeeded in wielding authorial or managerial discipline over this exuberant mob. The book's organization is weak. Individual chapters are rich in detail and adhere to their themes, but the reader getting halfway through the book may come to the unwelcome realization that there is no step-by-step process unfolding toward establishment of a bamboo farm. *Farming Bamboo* is replete with evidence of scientific research into bamboo botany and cultural studies; the individual contributors have given generously of



hard-won experience and information wrested from research into obscure texts, yet the book as a whole lacks any systematic framework in agronomy, ecology, or business management. That is not to say that one cannot farm bamboo successfully. Indeed, the passion and thoroughness of the book's contributors speaks volumes about their individual successes. But the integration of this body of knowledge is left to the explorations of the reader.

What the book lacks in holism is balanced by a trove of pragmatic advice among its parts for making bamboo farming a resilient and profitable

enterprise. Guidance on site selection, planting, bamboo identification, fertilizing, pest management, and controlling bamboo are covered in detail. I particularly enjoyed learning about the many varieties of bamboo-harvesting tools (would you have imagined using a cordless Sawzall?), which often vary substantially from one bambusero to another. Inventive business strategies for marketing bamboo shoots cover an entire chapter, with other suggestions sprinkled throughout the book. Another chapter focuses on gastronomic ventures: food preservation techniques, nutritional content, and general cooking advice, along with nearly a dozen flavorful recipes from China, the United States, and Australia.

The latter half of the book consists of an abbreviated encyclopedia. Though not fully encyclopedic, this section does cover the identification traits, growth characteristics, cultivation requirements, and assorted uses for 20 species of cold-hardy Phyllostachys bamboo, presumably a selection well suited to temperate climates in North America. The last three pages of the book offer a very useful annotated bibliography.

Despite significant contributions from Tennessee and Texas, *Farming Bamboo* appears to have been written chiefly for bamboo growers in the Pacific Northwest region of the United States. The irrigation section of the book provides details on the Northwest's precipitation patterns, but neglects to mention rainfall for other regions, while the soil and nutrition chapter relies a bit too heavily on the authors' experiences in Washington and Oregon. This regional bias notwithstanding, many of the strategies for interacting with bamboo are directly applicable to other regions.

As is the case with many self-published books, *Farming Bamboo* is in dire need of better text editing. Spelling and grammatical errors abound. In one instance a paragraph is repeated twice in two pages. In addition, the image quality of practically all the photographs is substandard. Conventional publishing data such as publisher's location, subtitle, and even publication date are either omitted or confused; prefatory pages are unnumbered. If a subsequent edition of *Farming Bamboo* is released, higher-quality photographs and better editing for both grammar and content would help the book appeal to a wider audience, but the most compelling need is not, I think, as the authors claim in their introduction, for reports of new discoveries or an expansion of knowledge, but for an integrated treatment of this important subject.

If you are stewarding, or planning to steward, a farmscape and are considering bamboo as a crop, I suggest reading the first 13 chapters of *Farming Bamboo.* This will give you a sense of whether bamboo is an appropriate addition to your property, on what might be called, "the weight of the evidence." However, for those just starting to explore this multifunctional grass, I would point again to Farrelly's highly-readable *Book of Bamboo* as the best place to begin. Δ

Individual chapters are rich in detail and adhere to their themes, but the reader getting halfway through the book may come to the unwelcome realization that there is no step-by-step process unfolding toward establishment of a bamboo farm.

Through the Glass Brightly
Review by Peter Bane

IAN LILLINGTON
The Holistic Life: Sustainability through Permaculture
Axiom Australia. Sydney. 2007.
axiompublishing.com.au
144 pp. paper. color plates.
AUD$24.95.

Permaculture originated in Australia and all of its first texts originated there. Only in the 1990s did we begin to get books in English by British and American authors. Now, the field, while not exhaustively covered, has a wide range of entries, but many of them, like this fine effort, are still coming from down under. Though Ian Lillington grew up in Britain, he emigrated to Australia to settle and raise a family almost 20 years ago. What the Aussie permaculture books have in common is a certain brightness. Oz has a young culture, little more than a century post-colonial, and the permaculture lens developed there—arguably one of Australia's most important intellectual exports—carries the sunny optimism of "the lucky country": damaged landscapes can be healed, urban wastelands can be made productive, there's nary a cloud in the sky (pray for rain…) Hooroo!

The Holistic Life is attractive, colorful, easily read, and sincere. It is also a personal book with pictures of the author and his family, their home, and their story generously woven through. Color jumps up from every page, and photographs fill half the book, two or three on each spread. The text is simply written, with large subheads, in a none-too-polished style that conveys the breezy, "good on ya mate," sense of vernacular Strine, in which a dropped conjugation or a mildly run-on sentence just seems part of the flavor. The message, though upbeat, is not dumbed down. Instead it conveys the sobering but optimistic insights of a world-changing synthetic culture, braiding sophisticated concepts such as eMergy (eMbedded enERGY) and ecological footprints with plain post-modern common sense: 'find your own level of greywater re-use' but remember, "releasing greasy muck or spilling sewage onto your neighbor's place is not sustainable."

Intellectually rich concepts integral to permaculture such as ethics, renewable energy flows, or Chilean economist Manfred Max-Neef's economics of well-being are introduced, discussed, and integrated into a congenial picture of modern domesticity. The message is clear without being at all preachy: We have a

responsibility to regulate our way of living so that it does less harm and ultimately becomes a way of healing the earth we have damaged by mindless industrial consumerism. Permaculture is ethical and systematic, part yoga or mindfulness meditation, part practical planning, climate science, and clever horticulture. Here's how my family's done its part. We know it's not enough yet, but we're way ahead of most westerners and we have a good life. Get on board. The next bit will be more challenging.

Lillington is a third-wave permaculture teacher, whose introduction to the field came in the post-Montreal world. Armageddon and collapse were still over the horizon, but ozone depletion and early hot flashes of Gaia's distress had given us a scary glimpse of humanity's heavy footprints on the planet. He traces his roots in the holistic science of landscapes and cultures (geography), through his experience helping to retrofit old houses for energy efficiency, and makes of his own life story a bridge between the old world and the new. He grew to maturity and was educated in Britain, but then stepped out of the familiar toward a new and more hopeful future in the Antipodes, a place where permaculture had already taken root, spread, and flowered.

The family of images and ideas to which permaculture belongs is here on display like icons in the memory palace of a far-flung clan. City farms, solar panels, community-supported agriculture, and worm bins join mandala gardens, workbikes, and recycling depots in a colorful panoply of sustainable strategies. Uncle Ian is our friendly raconteur and guide, moving comfortably from the technical to the philosophical and back again. (And thanks Ian, for the time capsule of the Swedish Convergence at IPC-5. It's humbling to look back from 56 at a confident 40-year old self relaxed and secure among his peers. If I'd known then what was coming…)

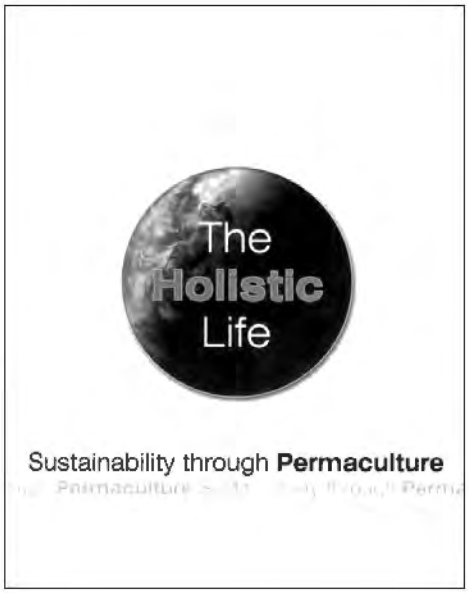
The book eases us into the context of permaculture thinking with a frank discussion of limits to growth, consumer addiction, and what some other pathways forward might look like. Quality of life, he points out, peaked about 35-40 years ago in the developed world, unlike material output, which has continued to climb, and which now moves inversely to happiness. Permaculture represents a set of choices toward life, abundance for all, and accepting a greater closeness to nature and to our local places. Lillington then develops his own story and that of his family and his modest passive solar home in an ecological village near Adelaide. This personal story becomes the teaching vehicle for lessons on water, waste, energy, food and diet, gardening, animals, local money, public transport, appropriate technology, new villages in old cities, and finally to bioregional self-reliance and broadacre farming and landcare.

Only after walking his talk in this extensive manner does the author lay out the 12 design principles by which permaculture systems can be consciously created. Happily, and not surprisingly—for the two authors are close, he uses David Holmgren's excellent scheme and Richard Telford's inspired iconography to convey these. This section, about a quarter of the book, offers a thumbnail of Holmgren's arguments as developed in *Permaculture Principles and Pathways Beyond Sustainability* (2002), bringing *The Holistic Life* to closure on a solid intellectual foundation, and offering the reader an invitation to explore further.

My reservations are few and predictable: quandongs, bush tucker, and the sun in the north (*south for Northern Hemispherians)—kilos, litres, and labour. Five to 10 degrees Celsius (41°-50°) is "pretty cold winter." Loquats, avocados, and citrus will coincide with American assumptions about local vegetation in southern California, Florida, and the islands. Ian's claim that permaculture can work even in cool climates (not just in the subtropics and desert regions) won't win over North American skeptics regardless his anodyne and humble manner of writing. This beautifully illustrated guide to an ordinary permaculture life is—like its cover—very white. Two cameo appearances by an aboriginal elder do not a multi-cultural society make. America needs more. I welcome this new addition to the permaculture literature and celebrate its excellent design, yet must await (just a little bit longer…) the arrival of a fully appropriate translation for the schizophrenic climate and rapidly ramifying cultures of the Mississippi Valley and adjacent regions.

Fully suitable for high-school students as well as adult readers, *The Holistic Life* fills in important niche in the emerging ecosystem of permaculture books and tools. Δ

The family of images and ideas to which permaculture belongs is here on display like icons in the memory palace of a far-flung clan. City farms, solar panels, community-supported agriculture, and worm bins join mandala gardens, workbikes, and recycling depots in a colorful panoply of sustainable strategies.



EVENTS

9th International Permaculture Conference (IPC 9)
Southern Africa

Dates: October-November, 2009
Location: Southern Africa
Description: Permaculture Design Course, Harare, Zimbabwe; Conference in Pretoria, South Africa; Convergence in Mulanje, Malawi. Dates in Calendar.
Contact: IPC-9 Secretariat
c/o The Regional Schools and Colleges Permaculture (RESCOPE) Programme
P.O. Box 32280
Chichiri, Blantyre 3
Malawi, Africa
+2651 831373
+2651 831363
secretariat@ipcon.org
www.ipcon.org
sbpcnet@silcom.com

Permaculture Design Course
Northern California

Dates: March 7-20, 2009
Location: Occidental, CA
Description: A residential course in land-use design covering principles, food diversity, soil enrichment, water use, erosion control, natural building, organic gardening, forest farming, alternative energy, community building, and more. The Occidental site is one of the country's premier permaculture demonstrations with a heritage of over 30 years of organic gardening.
Instructors: Brock Dolman and others.
Cost: $1400 includes lodging & meals; $100 discount for registration before February 21.
Contact: 707-874-1557 x. 201
oaec@oaec.org

6th Annual
Permaculture Design Course
Central America

Dates: February 3-17, 2009
Location: Project Bona Fide, Isla Ometepe, Nicaragua
Description: Join our fully bilingual, simultaneously translated, 100-hour Certificated Permaculture Design Course. Project Bona Fide, the 26-acre demonstration site, is a non-profit dedicated to the communities of the Maderas volcano region through workshops, seed banks, multi-use trees for agro-forestry, regenerative food production systems, natural building, off the grid living, and appropriate technologies such as: ferro-cement, drip irrigation, on-site metal working, bamboo technologies, and innovative water pumping/storage solutions. Participants will be living and learning in a rural setting where most folk are subsistence farmers. This course will be taught through the language of the land, the culture of the place, and its living systems.
Instructors: Chris Shanks, Michael Judd, Andrea Calfuquir, Katherine Young, and Hannah Roessler. Interpreter: Christopher Fallas.
Cost: $1250.
Contact: Chris Shanks
chris@projectbonafide.com
www.projectbonafide.com

Four-Season
Permaculture Design Course
Northern California

Dates: March 2009-Feb. 2010
One Saturday per month.
Location: Bolinas, CA
Description: This course teaches Permaculture Design over a full year of nature's rhythms. You will learn to observe and apply ecological principles to create integrated homes and gardens, energy systems, and water supplies, healthy communities, meaningful and fulfilling work, ecological economies, and global political movements for change. The course connects the principles and practices of permaculture with wilderness awareness. Learn bird language, tracking, and participate in activities that deepen your awareness and intimacy with the rest of the natural world.
Instructors: Penny Livingston-Stark.
Cost: $1100. Early bird and family discounts available.
Contact: Regenerative Design Inst.
Box 923, Bolinas CA 94924
415-868 9681
info@regenerativedesign.org
www.regenerativedesign.org

Ecovillage Design Intensive
Australia

Dates: March 31-May 11, 2009
Location: Maleny, Queensland
Description: Live within an established ecovillage for six weeks, and experience the Ecovillage Design curriculum with a focus on food production, sustainability, and design. We will go beyond theory to cement new knowledge into reality. The program is limited to 8-10 participants to ensure personalised learning and mentoring.
Instructors: Max Lindegger
Contact: EcoLogical Solutions
59 Crystal Waters, 65 Kilcoy Lane,
Conondale Qld 4552, Australia
+61 (0)7 5494 4741, Fx/-4578
max@ecologicalsolutions.com.au
www.ecologicalsolutions.com.au

Permaculture Fundamentals
Island of Kauai

Dates: March 21-27
Location: Island of Kauai, HI
Description: First half of the permaculture design course.
Instructors: Michael Pilarski, Gary Seals, Ray Maki.
Cost: $400 plus food costs
Contact: Cristal Harmony, 808-634-0292, unityfire888@yahoo.com; or Deborah 808-651-4534. www.activatekauai.org

Permaculture Design Course
Puget Sound, Washington

Dates: February 22-March 8
Location: Belfair, WA
Description: Held at the Sahale Learning Center in the lower Tahuya Valley, this course will will emphasize family and local food security while delivering the permaculture design curriculum. The venue is within easy reach of the Olympic Peninsula, Seattle, Tacoma, and Portland, Oregon by car.
Instructors: Michael Pilarski, Laura Sweany, Larry Korn, Marisha Auerbach, Albert Postema, Jenny Pell, John Henrikson, and John Hoff plus guests.
Cost: Tuition $700 plus accommodation. $250 deposit required ($100 non-refundable).
Contact: Laura Sweany
13425 - 43rd Ave S.
Tukwila, WA 98168
lauraflora@msn.com
206-369-7590.
www.friendsofthetrees.net

Earth Activist Training
New England

Dates: June 21-July 5
Unity, Maine
Description: A permaculture design certificate course with a grounding in earth-based spirituality, and a focus on organizing, activism, and social permaculture as well as urban and rural land-based systems. Learn how to heal soil and cleanse water, how to design human systems that mimic natural systems, using a minimum of energy and resources and creating real abundance and social justice. Explore the strategies and organizing tools we need to make our visions real, and the daily practice, magic and rituals that can sustain our spirits. Participatory, hands-on teaching with lots of ritual, games, projects, songs, and laughs along with an intensive curriculum in ecological design.
Instructors: Starhawk and guests.
Cost: $1400-$1800 sliding scale, includes all food and dorm accommodations or camping. Work trade and scholarships avail.
Contact: 800-381-7940
info@earthactivisttraining.org
www.earthactivisttraining.org

Gaia University Programs - USA

Accredited BSc and MSc degree and pre- and post-Masters Graduate Diploma programs.
1.MSc and Graduate Diplomas in *Integrative Ecosocial Design*.
2. BSc in *Integrative Ecosocial Design.*
3. MSc and Graduate Diplomas in *"Open Topic"* (You design and name your project and program in any area of sustainability/ regeneration).

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

Taught by GU founders Andy Langford and Liora Adler with assistance from other international and local teachers. Application forms and further information available online.
www.gaiauniversity.org, info@gaiauniversity.org

Permaculture Design Course Through the Seasons
Colorado Front Range

Dates: March 21-October 18, 2009
Third weekend of each mo.
Location: Boulder, CO
Description: Third annual locally-based 8-weekend design course. Observe the seasons unfold in Front Range cities, high plains, and mountains through the lens of Permaculture, giving depth and perspective in learning to work with Nature. Participants will tour various sites, engage in hands-on seasonal projects, create designs for resilient local systems, explore "permanent culture," and take tangible steps towards sustainable food, shelter, energy, and community. The longer course allows time to digest concepts, and creates a foundation for community projects.
Instructors: Sandy Cruz, Becky Elder, Marco Chung-Shu Lam, Jerome Osentowski.
Cost: $950 registered before 1/21
$1050 < 2/21, $1200 > 2/21
Some work/study available
Contact: Sandy Cruz
303-459-3494
sandy@hialtpc.org

Permaculture Design Course
Western Nebraska

Dates: Apr. 2-9 & Oct. 7-13
Location: Lewellen, NE
Description: Garden County, Nebraska is a farming and ranching community on the edge of rural poverty. Real need exists here for water conservation and management, and soil building strategies based on perennial cropping and landcare systems. This course will engage local residents and visitors in a pilot community gardening project based on student designs and inputs. The full permaculture curriculum covering ecological design skills and sustainable living strategies will be taught in two sessions, spring and fall.
Instructors: Sandy Cruz, Becky Elder.
Cost: <3/10/09 - $700 tuition, $50 camping or $400 room; ≥3/10/09 - $950 tuition, $100 camping or $500 room. Some work/study assistance and local half-scholarships available.
Contact: Jean Jensen
308-778-5548
voa@lakemac.net

Permaculture Teacher Training
Colorado Western Slope

Dates: September 12-16
Location: Basalt, CO
Description: A five-day intensive and practical course emphasizing professional development and diverse skills for teaching permaculture, expanding outreach, and organizing events. Come and learn with a supportive group of peers and elders amidst the splendor of Colorado's autumn color and abundance. The instructors have nearly 40 years of experience teaching permaculture in all climates and many cultures, and combine complementary and powerful approachs to transformation.
Instructors: Peter Bane and Sandy Cruz.
Cost: $550; discounts for early registration and for couples.
Contact: Jerome Osentowski
970-927-4158
jerome@crmpi.org

23rd Annual CRMPI

Permaculture Design Course
Central Rocky Mountains

Dates: June 8-20
September 19 - October 1
Location: Basalt, CO
Description: We are offering our best-selling annual design course twice this year in recognition of the tremendous growth in permaculture in Colorado and the mountain region. The newly regenerated Phoenix greenhouse with its 21st century innovations is a gem crowning the glory of one of the continent's finest and most venerable forest gardens. High-altitude and dryland strategies combine with cold-climate insights to inform this top-notch training. Come to the mountains and learn from the masters, sing and dance with us in circles, follow the turkeys through the canyons, eat fresh salad, berries, plums, and figs. Permaculture is here to be experienced.
Instructors: Peter Bane, Andrew Goodheart Brown, Becky Elder, Jerome Osentowski, Sandy Cruz.
Cost: $1250; discounts for early registration and for couples.
Contact: Jerome Osentowski
970-927-4158
jerome@crmpi.org

Send Event and Calendar Listings for Issue #72 (Permaculture Abroad) for the March 10th, '09 deadline to:

NEW Address: events@permaculturereactivist.net

7th Annual

Permaculture Design Course

Southern Indiana

Dates: June 7-21
Location: Paoli, IN
Description: Join us in the Hoosier National Forest for two weeks of permaculture instruction. The Lazy Black Bear Lodge encompasses, art, activism, and agriculture (organic, local, solar-powered), and provides the setting for this very successful and popular event. Solar showers, gravity-flow water systems, composting toilets, and a magnificent open-air dining hall enable us to enjoy life beneath the tree canopy while dancing under the stars. The full permaculture design curriculum is enriched by hands-on farm experiences and local field trips.
Instructors: Peter Bane, Keith Johnson, Rhonda Baird, and David Haberman.
Cost: $1000 includes meals and camping.
Contact: Andy Mahler
812-723-2430
andy@blueriver.net

14th Annual

Permaculture Design Course

Desert Southwest USA

Dates: February-March, 2009
Five weekends
Location: Tucson, AZ
Description: This course covers the core topics of Permaculture and sustainable design with an emphasis on Southwest Drylands, and it leads to a certificate in Permaculture Design. Using dynamic exercises that encourage pattern recognition, students are encouraged to notice the links between plants, animals, climate, and landforms that make up natural ecosystems, and how these links and patterns are the key to effective Permaculture design.
Cost: $650.
Contact: Dan Dorsey
Sonoran Permaculture Guild
520-624-8030
dorsey@dakotacom.net
www.sonoranpermaculturegild.org

Five Weekends

Permaculture Design Course

Central Virginia Blue Ridge

Dates: Feb. 14-15, Feb. 28-Mar. 1, March 27-29, April 4-5
Location: Charlottesville, VA
Description: Nationally recognized experts Dave Jacke and Joel Salatin bring specialty skills in forest gardening, landscape design, and integrated grazing management to enhance the permaculture curriculum taught by a strong local team experienced in natural building, holistic health, market farming, and environmental education. We will see well-established examples of small-farm permaculture systems and will emphasize appropriate strategies for the urban region. Taught over five weekends with special attention paid to connecting the participants outside the classroom. Join more than 50 graduates in the central Virginia bioregion and help us continue to evolve sustainable strategies for the Blue Ridge.
Instructors: Dave Jacke, Dave O'Neill, Christine Gyovai, Ted Butchart, Joel Salatin, and local guests.
Cost: $895.
Contact: Terry Lilly
tygerlilly@gmail.com
www.blueridgepermaculture.net

LETTERBOX

Cistern & Peak Oil Query

Dear Peter & Keith,

I've finally had some time to catch up with reading and have gleaned so much helpful info from the Fall issue of *PA.* All of this issue has helped me decide to focus on homestead improvement projects for water and apple storage, garden irrigation as well as being engaged in our local community's efforts to make plans for Peak Oil and local production, i.e., raising awareness and implementing strategies that may be developed.

The article about your efforts at Renaissance Farm and your city's Task Force on Peak Oil has prompted me to write for some advice.

The last two years here have been dismal for the water supply from the spring-fed creek. It has been dry for the last four months. I have been considering building a cistern and wonder if you could send me plans for the one you built. Did they come from Art Ludwig's book *Water Storage?*

I have enclosed diagrams of my building in relation to where I think the cistern could go— a fairly level area in a mostly sloping landscape. The roofs are all metal—old and rusty, and in the case of the house, new or used galvanized metal that has creosote stains below the stove pipe on the north side of the house and some of south side roof as well. The roof was painted once with aluminum paint.

Are there filters that I could use that would make water collected from the roof safe to drink? How is the roof attached to the cistern? How is water pumped?

I would also like to build an enclosure to the cistern to serve as insulation and use the thermal mass for apple storage for my harvest. Could you send me the plans for the extension you mentioned that you are building around your cistern?

Final request and question: Could you send me any information you have so far from your city's Task Force on Peak Oil, especially relating to farming and market initiatives?

Thank you so much for your valuable work.

Pat Tompkins
Bakersville, NC

The builders reply:

Our tank building has been a process of experiential learning for the most part. We started with some basic procedures acquired from printed sources, and have refined our knowledge by practice, now covering eight tanks in three states: California, North Carolina, and Indiana. This spans the range of most US climates except the extreme cold of northern regions.

Art Ludwig's book Water Storage *provides good basic information on the subject. Brad Lancaster's 3rd volume in the* Rainwater Harvesting *series (forthcoming) will also cover tank construction.*

We did not work from plans for our most recent tanks, and have not drawn any since constructing them. With a cylindrical tank, the geometry is very regular and simple; the main concerns lie in achieving good working process. One must pay attention to getting a level pad, making the slab/wall joint snug and tight, tying tight connections for all the steel, and doing a thorough application of cement in all the coats. There are a few tricks hard-won from experience that you should get by consulting with a builder on your particular project. Mixing the right consistency of concrete for the slab and cement-mortar for the walls and roof is a matter of feel. We found it useful to add an acrylic-type binder to the cement to increase adhesion and waterproofing. Like any large construction project, it is best to have someone

Continued next page—>

Cisterns & Peak Oil Reply

Continued from page 61—

experienced on site for the building of a ferrocement cistern.

The location of the cistern on our property (which is very level by most standards), is on a high corner. This very slight elevation allows us to direct water from the roofs into the tank by gravity and out from the tank to hydrants and other use points by gravity. We do not pump. This was by design. The elevation changes are quite small—a matter of feet and inches. Try to place your cistern where it can both receive and dispense water by gravity. This is easier in the mountains than on flat land. If you must pump, I suggest a submersible well pump inside the tank.

We use a two-fold filtering mechanism. The first is a plumbing design that diverts the first few gallons of water during each rainstorm to a holding pipe. This is later released and applied incidentally to gardens. This "first-flush" carries most of the airborne contaminants off the roof: dust, pollen, insect frass, pollution, and leaf fragments. Of course our gutters are screened. The second filter consists of a double stainless colander (one inside another). Both are within a collecting column of water, and lining the lower stainless vessel is a filter fabric. We use spun-bonded polyester, available as floating row cover from horticultural suppliers. We rinse this fabric at least monthly during the warm season and replace it every year or so.

This combined filtration ensures that the water in the tank is free of most macro-scale sediment. Rainwater is among the cleanest sources of water available today. Yours may nevertheless carry trace amounts of dissolved air pollution. But in a sealed tank from which light and insects are excluded there should be little opportunity for bioconcentration of harmful elements such as mercury (from coal plant emissions) or pesticides (seasonally problematic in the Corn and Cotton Belts). We do not need to drink our tank water here, though occasionally we do so and find it very palatable. In North Carolina we drank our tank water for six years with no ill effects.

I should say that before we began collecting our roof water here or in North Carolina, we installed enameled metal roofing. Your stained, aluminum painted roofing would be less than ideal for drinking water, but you could certainly use this water for almost all your other needs with no concerns. Filtering it for drinking would be a matter of using a good reverse osmosis or similar filter.

Our four gutters from two buildings empty into three standing columns made out of corrugated plastic culverts. The filter baskets rest in the tops of these. The vertical culvert pipes are sealed by a concrete base at the bottom into which enters a PVC pipe connecting them to a plumbing network buried beneath our frost line and running underground to the tank, where a pipe enters through the slab and rises to just above the level of the overflow. Water collected by the roofs flows into the gutters and from there to the downspouts which empty into the standing culverts. These always hold water at the same level as the water in the pipe inside the tank. When the culverts fill during a rain, the column in the tank rises, then overflows inside the tank, filling it. When the tank is full it overflows through a pipe in the sidewall at a level just below the entry pipe. Thus, water can never backflow from the tank into the collecting system. Water to the hydrants is taken out through a separate pipe in the floor of the tank. This is set at a level just above the slab, so that any remaining sediment in the tankwater may settle out and not pass into the distribution lines.

The above-ground root cellar described in the article in PcA *#69, is still unfinished this winter. We are building it using similar principles to those by which we built the tank.*

The cellar is connected to the tank by wiring rebar roofing and wall struts to short stubs of rebar that were left sticking out of the top of the tank wall. (It looked like it had a partial crown of thorns when we finished it.) The bottoms of these wall-and-roof members are buried in a concrete footer that forms the outer foundation wall of the cellar. The rest of the structure is built by tying cross members onto the uprights, adding 6x6 reinforcing mesh and expanded metal lath over them, and stuccoeing both sides. We will include a layer of foam insulation in the walls/roof to provide greater thermal protection to the "cave."

Lastly, the Bloomington Peak Oil Task Force on which Peter serves is not finished with its work, and the conclusions it may reach would be too extensive to summarize here. Both Portland, Oregon and Oakland, California have already published documents that may be of use to you. The greatest challenge we face is convincing a public raised on the narcotic of cornucopian assumptions that economic life has now changed irrevocably. We have only a very short time in which to mobilize resources to make our future somewhat less difficult than it promises to be.

Local food production and processing, electrified transport, renewable biomass and energy flows, and local currencies will provide the best means for our future local economies to survive and thrive in the hard times ahead.

Peter Bane & Keith Johnson
Bloomington, Indiana

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Partners Wanted

Retired academic permaculturist seeks mature lady permaculturist to share in 5-acre project. Contact Dr. Hugh Skinner, c/o Ajoupa Pottery, Chicklands Main Rd. via Freeport, Trinidad & Tobago. -71

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#37 Sept.'97 **Tools & Appropriate Technology:** Dowsing, Workbikes, New Energy, Scythes, Japanese Saws, Nursery, Ferrocement, Greywater, A-frame & Bunyip Levels, Ram Pump, Solar Toilet, Log Yoke, Cookstoves
#38* Feb. '98 **Economic Transformation:** Speculation, No Middle Class; Coops, WWOOF, Glob. Warmg, Holistic Financ. Plan'g., Land Use, Adopt-A-Hive
#39 July '98 **Knowledge, Pattern & Design:** Pc Way of Seeing, Native Consvn Sand Dunes, Language Worldview & Gender; Patterning Process, Land-Use Planning; Teaching Pc; Vietnam; Holmgren on Pc
#40* Dec. '98 **New Forestry:** Regl. Devlpmt., Horselogging, Menominee Reserv'n, Forest Investing, Restoration, Old Growth, Homestead Tenure, Forest Soils, Forest Farming, Woody Agric., Rainforests, Windbreaks, Coppice
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#42 Dec. '99 **Self-Reliance & Community Cooperation:** Co-Intelligence & Self-Orgn., Archetype Design, Sovereignty, Samoa, Mondragon, Natural Hsg, Comm. Gdns., Zone Zero, Solar Electric Tractor, Beekeeping
#43 June '00 **Food & Fiber:** Hunger, Ferments, Seasons Salads, Heirlooms, Fencing, Self-Fertile Gdns, Rice Revolution, Cold-climate Food, Edible Insects, Chilies, Food Origins, Garlic, Ethnobotany, Wild Food, Bamboo, Hemp
#44 Nov.'00 **Earthworks & Energy:** Spreader Drain, Horse Swales, Earth Dams, Machinery, Carpet-lined Ponds, Constr. Wetlands, Biogas, Windmills…
#45 Mar. '01 **Medicine & Health:** World & Self, Healthy Home, Designing Care, Ayurveda, Agents of Decay, Comm. Health Centres, Women Trad. Med 4th World Apothecary, Healing Weeds, Medicinal Crops, Hawaiian Bot'ls.
#46 Jul. '01 **Good Work & Right Livelihood:** Pc Golf Course, Downsize Cost of Living, New Forest Economy, Energy Currency, Buddhist Mkting., End Wage Slavery, What's Surplus?, Urban Community, Enterprise Facil'n.
#47 Jun. '02 **Watersheds:** Water4Sale, Basins o'Relations; Watershed Devl., Gabions Urban Runoff; Beavers; Skywater Ctr., Consvn.Investmt, Peat Bogs, Rabbits.
#48 Sept.'02 **Making Changes:** Co-Intelligent Activism, Webs of Power, Urban Food, How to Change, Teaching for Change, Global Transformation, City Repair, Escaping Job Trap, Argentine Recovery, Costa Rica Pc
#49 Dec. '02 **Where is Permaculture?** Land-Rent Reform; 10 N. American sites Cuban Agric.; Beauty+Sustainability in NZ; Cacti/Succulent Plants; Animal Self-Medication; Challenge to Pc Movement
#50 May '03 **Ecosystems:** Holmgren on Pc Mvmt; E. Hazelip & Syng. Agric. Chestnuts/Pigeons; Oak Savannas; Root Crop Polycultrs.; Alders Fungal Ecosys.; Humans & Wildn; Indoor Ecos.; Humid Tropics.
#51 Jan '04 **Trad'l .Knowledge & Regeneration:** Cataclysm& Collective Memory Wisdom of Genome; *Waru Waru;* Biosculpture; Inuit Medc.; Fermented Stimulants
#52 May '04 **Aquaculture:** Ecological Aquac.; Fish4Health; Dowsing; Pond Design Greywater Biotreatment; N. Amer. Polyculture; Mgmt. for Nattive Spp; Integrated Village Fisheries; Vietnam.
#53 Aug. '04 **Education:** Life-long Learning; Edge-ucation; The Albany Free School; Indigenous Educ. & Ecology; Ecocentric Pedagogy; School Gdn. & Dances; Ecology of Learning; Brain Gym.
#54 Nov. '04 **Fire & Catastrophe:** Designing Beyond Disaster; Opportunity; Rise of Globalization; Invasion Biology; Street Orchards; Community Food Security; Floodwater Rising; Disrupted Climates.
#55 Feb. '05 **Learning from Our Mistakes:** Petroleum Dependence;Village Design; Australian Lessons; Read the F'g Manl; Trial&Error; Forestry Experiments; Owner-Builder; 10 Mistaken Ideas in Pc.
#56 May '05 **Tree Crops & Guilds:** Pine Nuts; Tree Vege; Acorns; Amer. Chestnut; Honeylocust Silvopasture; Broadscale Agroforestry; Bamboo; Willow; Social Forestry.
#57 Aug. '05 **20th Anniv. Issue:** Challenges; Remembrance; Pc in USA; Hawai'i Retrospect; Pc Changes; Permatecture; Pc's Soft Edge; Gaia Univ.; PINC; Oil Depletion; IPC-7; Retrofitting Suburbs.
#58 Nov. '05 **Urban Permaculture:** Urban/Rural Futures; City Zones & Sectors; Growing Food; Detroit Visionaries; Rebldg. New Orleans & Everytown; Transforming a Military Base; Workers Co-op; Energy Descent.
#59 Feb. '06 **Peak Oil:** Peak Oil & Pc; Ecological Collapse & Trauma Theory; Thom Hartmann; Pathways for Energy Descent; How Cuba Survived; Oil & Food; Biofuels; Cultivating Algae for Fuel; Relocalize.
#60 May '06 **Land Use Past & Present:** Sust. Ag an Oxymoron?; Negev's Bedouin; Eastern Woodlands Agroforestry; Pc Heals in India; Arcosanti Land Planning; Pop. Growth/Land Hunger; Mexican Reforest; Rocky Mtns.
#61 Aug. '06 **Unseen Kin-doms:** Observation as Design Tool; Soil Food Web; Bees; Mycelial Internet; D-I-Y Mycorrhizal Inoculum; Cover Crops as Bee Forage; Earth Energies; Local Currencies; Dead Zones; Birds at Risk.
#62 Nov. '06 **The Art of Permaculture:** Painting,Writing & Pc; Ecoartists; Art, Activism & Cmty; Street Theatre; Art & Bioremediation; LivingWillow; Body as Zone 0; Art of the Found;Water Magic; Pc in Pop Culture.
#63 Feb. '07 **Building & Technology:** How to Dwell?; Natural Bldg & Legal; Bldg. Code; Strawbale in China; Cob in Armenia; Integrated Solar Heating, Cooking, Pumping; Self-Build; Nation-Scale Pc in Brazil.
#64 May'07 **Waste = Food:** Throwaway Economy; Strategy of Salvage; Peak Soil; Pigs & Intgrtd. Waste Mgmt.; Bicycles, Soil & Garbage; Farm as Organism; Opportunistic Plants?; Simple Biodigester; Waters of Spain; Vermiculture.
#65 Aug.'07 **Climate Change:** Shrinking Seas; Forests' Role in Climate; Urban Forest; Making Trees Pay; Rainwater Harvesting; Indoor Gardens; Water Filtration; Changing Human Climate; De-Stabilizing Climate.
#66 Nov.'07 **Animals in Design:** Jumbo Shrimp; Pawpaw Patch; Alpaca; Insects as Food; Bees; Integrated NH Farm; Pastured Poultry and Rabbits; Urban Livestock; Predator Restoration; Complementary Animals; Agrichar.
#67 Feb. '08 **Kids in Permaculture:** School as Ecosystem; PC Education; Pc to H.S. Students; Tlaxcalan Kids make Seedballs; Gardening Kids; Fostering Research Skills; Bottled Water Boycotts; Feeding 8 Billion.
#68 May '08 **Plants on the Move:** Rethinking Non-Natives; Forest Migration; Black Walnuts; Saving Seed Savers; Grow a Community Gdn; Neighborhood Greening; Healthy Honeybees; Grain for Cars & High Food Prices.
#69 Aug '08 **Permaculture at Home:** Hawai'ian Community; London Forest Garden; Suburban Renaissance; California Campus; Philadelphia Orchards; Drinking Roof Water; Floating Islands; Bicycles Trans.; Mississippi Pc.
#70 Nov '08 **Ethics at Work:** BAU is the Enemy; 13 Princ. of People Care; Pc in Business; Ecovillages; White Man in India; Uganda Boarding School; No Waste Principle; Qual. Control; City Farming w/Runoff; Amaranth

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CALENDAR

February 3-17, 2009 NICARAGUA. Permaculture Design Course. Chris Shanks. chris@projectbonafide.com, www.projectbonafide.com

February-March, 2009. Tucson, AZ. Permaculture Design Course. Dan Dorsey, Sonoran Permaculture Guild. 520-624-8030. dorsey@dakotacom.net, www.sonoranpermaculturegild.org.

February 14-15, Feb. 28-March 1, March 27-29, April 4-5. Charlottesville, VA. Weekend Permaculture Design Course. Terry Lilley. tygerlilley@gmail.com.

February 22-March 8. Belfair, WA. Permaculture Design Course. Laura Sweany. 206-369-7590. lauraflora@msn.com. www.friendsofthetrees.net.

Permaculture Design Course. March 7-20, 2009. Occidental, CA. Permaculture Design Course. Occidental Arts & Ecology Ctr. 707-874-1557. oaec@oaec.org. **March 21-27. Kauai, HI. Permaculture Fundamentals Course.** Cristal Harmony. 808-634-0292. unityfire888@yahoo.com. www.activatekauai.org.

Mar 21-22, Apr 18-19, May 16-17, Jun 20-21, Jul 18-19, Aug 15-16, Sep 19-20, Oct 17-18, 2009. Boulder, CO. Permaculture Design Course. Sandy Cruz, 303-459-3494.

March 2009-February 2010. Bolinas, CA. Four Seasons Permaculture Design Course. Regenerative Design Institute. PO Box 923. Bolinas, CA 94924. 415-868 9681. info@regenerativedesign.org, www.regenerativedesign.org.

March 31-May 11, 2009. Australia. Ecovillage Design Education Intensive. Crystal Waters Ecovillage, Queensland. EcoLogical Solutions. 59 Crystal Waters, 65 Kilcoy Lane, Conondale Qld 4552, Australia. +61 (0)7 5494 4741, fx/-4578. max@ecologicalsolutions.com.au, www.ecologicalsolutions.com.au.

April 2-9. Lewellen, NE. Permaculture Design Course (1st half). Jean Jensen. 308-778-5548. voa@lakemac.net.

June 7-21. Paoli, IN. Permaculture Design Course. Andy Mahler. 812-723-2430. andy@blueriver.net.

June 8-20. Basalt, CO. Permaculture Design Course. Jerome Osentowski, Central Rocky Mountain Permaculture Institute. 970-927-4158. jerome@crmpi.org.

June 21-July 5, 2009. Unity, ME. Earth Activist Training. 800-381-7940. www.earthactivisttraining.org. info@earthactivisttraining.org.

September 12-16. Basalt, CO. Permaculture Teacher Training. Jerome Osentowski, CRMPI. 970-927-4158. jerome@crmpi.org.

September 19-October 1. Basalt, CO. Permaculture Design Course. Jerome Osentowski, Central Rocky Mountain Permaculture Institute. 970-927-4158. jerome@crmpi.org.

October 7-13. Lewellen, NE. Permaculture Design Course (2nd half). Jean Jensen. 308-778-5548. voa@lakemac.net.

October 11-23, 2009. IPC 9 Harare, ZIMBABWE. Permaculture Design Course.

October 26-28, 2009. Pretoria, SOUTH AFRICA. Permaculture Conference (IPC 9)

November 2-7, 2009. Mulanje, MALAWI. Permaculture Convergence (IPC 9). IPC9 Secretariat, c/o The Regional Schools and Colleges Permaculture (RESCOPE) Programme. P.O. Box 32280. Chichiri, Blantyre 3. Malawi, Africa. +2651 831373. +2651 831363. secretariat@ipcon.org, www.ipcon.org.

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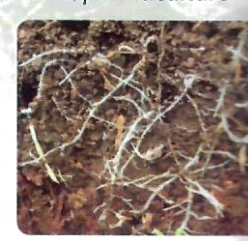

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