

P E R M A C U L T U R E

 **DRYLANDS**
Journal



"AGAVE 1"

BETSY BAUER ©

• *Agave* 3 • *Guild* 10 • *Burial* 14 • *Development* 16 • *Solar Oven* 18 • *Cover Crop* 20 • *Visit* 22
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Permaculture

is a design system that reconciles human communities with the ecological imperatives of a living planet. Permaculture design may be used to restore ecosystems, create sustainable farms and healthy towns, and promote economic systems that support earth care.

Permaculture provides an ethical and holistic foundation for sustainable culture.

Permaculture principles are derived from three basic ethics:

Care for the earth.

Care for people.

Limit needs and reinvest in the future.

The core emphasis of permaculture is that landscapes are complex and integrated wholes. Ecosystems are healthy and relatively stable when their parts are connected into a diverse web of relationships.

In a permaculture design, decisions flow naturally from observations of these relationships.

Decisions that arise from connection

are inherently functional

and frequently beautiful.

Permaculture uses the energies of wind, sun, water, soil and the myriad biological processes of the world's organisms. These powerful energies, appropriately used, can reverse desertification.

Soils are reclaimed.

Forests, prairies, and river systems regenerate.

Waste products are minimized and reused.

Human communities provide for their own needs

in small, efficient farms and gardens,

allowing the broad landscape to return to health.

Permaculture is a body of knowledge, susceptible to learning and teaching.

But permaculture is also a way of organizing knowledge,

a connecting system that integrates science, art,

politics, anthropology, sociology, and psychology,

the diverse experiences and resources available in any community.

Excerpted and adapted from
Living Community: A Permaculture Case Study at Sol y Sombra
by Ben Haggard

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information about Betsy and her
artwork.

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Guest Editor Meg Keoppen Clarke in her garden

Twenty years ago I hitched a ride 2300 miles across the U.S. to get to a place I had heard of only in stories. It was an odd love-at-first-site affair and I've been here in the desert ever since. My days then were spent in the process of trimming and simplifying in order to live in this remote spot. The words recycle, thrift store, cooperative, home birth, water harvesting, self-sufficiency, drought tolerant, photovoltaic, edible and medicinal wild plants, milk goats, and mulch were soon added to my vocabulary.

In 1988, I was formally introduced to permaculture and was delighted to recognize kindred spirits. I met people who wanted to reconnect with the land and sink roots into the good earth again.

We must not let ideas for sustainable living languish in books on the shelf. We must practice what we preach and practice well. It is essential work. Know that while the world is ever more firmly in the grip of multinational corporations, we don't have to buy into that fantasy. We have it in our hands to own our lives.

Meg Keoppen Clarke

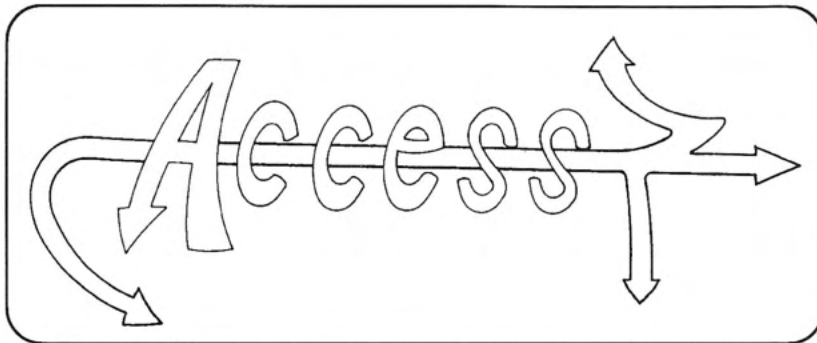
Guest Editor
Arivaca, Arizona

For several years, while serving as a full-time editor of this journal, PDJ was my baby. Now that I have a real baby (excuse me—toddler), PDJ still inspires the fondness of a doting parent. It's been a great pleasure to diverge from the joys of parenting, gardening, and goat milking to work on this issue with Meg and Ann.

Victor D. Mirovich

Guest Designer
Pearce, Arizona

Cover Artist, Betsy Bauer uses oil paint and mixed media to create rich, engaging surfaces. Her images of plants and natural forms are collected from botanical references, southwestern deserts, Mexican jungles and her own garden. After spending a decade in New York, Betsy has lived in Santa Fe for the past eight years. For more information on her work, Betsy can be contacted at her Santa Fe studio at (505) 986-3471.



The permaculture movement is a decentralized, worldwide network. A number of journals and newsletters cover permaculture topics. The journals listed here are the most inclusive and can direct you to other information sources and course listings.

Permaculture Journals

The Permaculture Activist An independent publication serving the permaculture movement in North America. Published quarterly by Peter Bane. Prints North American course listings. P.O. Box 1209, Black Mountain, NC 28711

The Permaculture Edge Published quarterly, providing international information geared toward a professional readership. In North America, order through *The Permaculture Activist* (see address above).

Permaculture Magazine: Solutions for Sustainable Living A quarterly journal published in cooperation with the Permaculture Association (Britain). Prints British course listings. Permanent Publications, Hyden House Limited, Little Hyden Lane, Clanfield, Hampshire PO8 0RU, England

Permaculture International Journal The quarterly journal of Permaculture International Limited, a networking organization for groups and individuals around the world interested and active in earth care. Prints international course listings. In North America, order through *The Permaculture Activist* (see address above).

Permaculture Book Sources

Mail-Order Sources

Permaculture Resources Mail-order catalog listing of books and videos. 56 Farmersville Road, Califon, NJ 07830 (800/832-6285)

Ag Access Mail-order catalog listing of books and videos. P.O. Box 2008, Davis, CA 95617 (916/756-7177)

Out on Bale, (un)Ltd. Strawbale-construction information. 1037 E. Linden Street, Tucson, AZ 85719 (520/624-1673)

Sustainable Systems Support Strawbale-construction information. P.O. Box 318, Bisbee, AZ 85603 (520/432-4292)

Permaculture International, Ltd. Mail-order catalog listing of books and videos. P.O. Box 6039, South Lismore, NSW 2480, Australia

Book Stores

The Ark 133 Romero, Santa Fe, NM 87501 (505/988-3709)

Moby Dickens 124 A Bent Street, Taos, NM 87571 (505/758-3050)

Changing Hands 414 Mill Avenue, Tempe, AZ 85281 (602/966-0203)

The Living Batch Bookstore 106 Cornell Drive SE, Albuquerque, NM 87106 (505/262-1619)

Satisfied Mind 113 W. Goodwin, Prescott, AZ 86303 (520/776-9766)

Silverbell Trading 7007 North Oracle Road, Tucson, AZ 85704 (520/797-9766 days); 8501 North Silverbell Road, Tucson, AZ 85743 (520/744-3443 evenings)

Finding the Hidden Garden

by Gary Paul Nabhan

Murrieta, California, April 8, 1993: I stared at the hole in the ground in front of me, a hole in the manicured grass. Above it hovered the huge box holding one of my heroes inside it, Howard Scott Gentry. He hated green grass, preferring to sow wild, unruly native plants wherever he lived. It was not only his preference but his trade as well. He was a plant explorer who had spent more than half a century roaming the desert border states, collecting agaves and other wild plants with promise, many of which he brought into cultivation for the first time.

As of April Fool's Day, he was done roaming; this would be the last time he was headed for new ground. His daughters, his wife, his Mexican sidekick Juanito, and many old friends were there to see him off. Some of us served as pallbearers. Others just stood back and cried.

They were ready to lower him into the grave, but I was not ready to let him go. I wished I had one last chance to "talk agave" with him. It would have been too hard to tell him all that he meant to me. Instead, I simply wanted to tell him that I had recently found people still growing, eating, and celebrating the Hohokam century plant, *Agave murpheyi*, a rarity that had posed an unsolved riddle for him for almost thirty years.

When he and I "talked agave," it seemed that the rest of the world stood still. I could listen to that old man tell me of his plant-exploring adventures for hours. It was odd that we were completely on the same wavelength on that one subject, because whenever we talked about anything else—farming, business, politics, love, marriage, the work of friends, or even the origins of beans—we seldom saw eye to eye. He was forty-nine years my senior, and we had come from different cultures. And yet, we had ended up loving some of the very same things: the smoky taste of home-brewed mescal, the sound of *campesinos* tending maguey, and the diversity of shapes, sizes, and circumstances in which agaves grew.

Once I had invited him down from his home so that he could "talk agave" to a bunch of my friends in a desert garden at night. We sat and drank the fermented, distilled juices of the very plant that was the subject of his rambling lecture. He spoke within the shadow of a giant maguey, and near the end of his talk he glanced over his shoulder at it and declared that, "being a man, I think and speak as a man, but today I also speak for agave. You see me held in the arms of this giant maguey. I am a son of Mayahuel, the goddess of maguey. What I have told you today is what she told me to tell you."

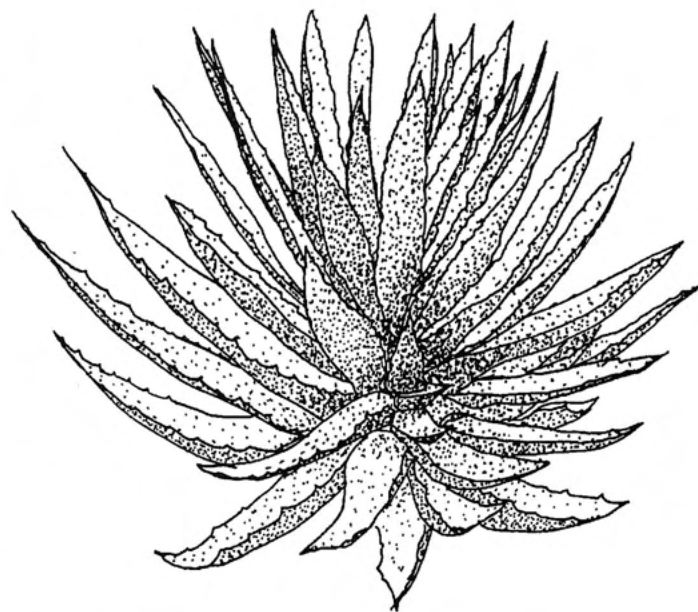
And so old Howard baptized me into some ancient rite, not by water but by firewater—a shot of bootleg *mescal bacanora* distilled from wild desert agaves. Howard became a father figure to me, one whom I sometimes saw as legendary, other times as limited by his own flaws. In turn, I became one of the many grandsons of that Native American goddess, Mayahuel.

I was adopted into Mayahuel's family not long after I left my boyhood home for good, and not too long before my own father

died. I had been cooped up on the midwestern farm where I had been working, so I moved to the Sonoran Desert with the hope of devoting my life to tracing the natural history of its plants in the wild. I can now confess I had no idea how I would ever make a living doing such a thing, but I tried. The first regional field guide I purchased after my arrival was a peculiar little book written by Dr. Gentry in 1972: *The Agave Family in Sonora*. I hoped that it would lend me some of the confidence that I sorely needed at the time.

Using it on a hike down the southern slopes of Bradshaw Mountains late in the winter of 1975, I easily identified the first two agaves I encountered at higher elevations. I then came on a third that somewhat fit one of Gentry's descriptions but didn't jibe with the distribution map for the same species.

Instead of having flowers on its stalk, it had a bunch of miniature plantlets called bulbils. Judging from what Gentry had written, bulbils seemed to occur regularly only on one species within the Sonoran region, *Agave murpheyi*. However, that species was apparently not known from the lower elevations of the Bradshaws at the time. And so I pressed a specimen, dried it, and sent it off to Gentry a few weeks later. I had learned in the meantime that he had "retired" to Arizona, leaving the U.S. Department of Agriculture as its chief plant explorer to take on the somewhat honorary position as senior research scientist at the Desert Botanical Garden [in Phoenix].



Agave murpheyi growth after 9 years. Plant approximately 85 cm tall and 120 cm wide (about 33 in. by 120 in.) Agave illustration series by Ann Audrey, based on photographs and measurement data in "How does our Agave grow? An illustrated record of *Agave murpheyi* bulbil development in a residential backyard in southern Arizona." by Karen R. Adams and Rex K. Adams, December 6, 1993.

This story is reprinted from *Desert Legends: Re-Storying the Sonoran Borderlands*. Stories by Gary Paul Nabhan, Photographs by Mark Klett. New York: Henry Holt & Co. 1994. \$45, with author's permission.

Within a week of sending off the specimen, I received a letter from Gentry on some self-designed stationary embellished with the sketch of a flowering maguey: "Welcome to the Agave Family!" he proclaimed.

His letter went on to inform me that if a certain kind of agave is damaged by freezes as it begins to flower, it will abort its blossoms and reproduce vegetatively, spawning through bulbils like the ones I saw. "I don't think it would be much fun if we could replicate ourselves that way," he added dryly. In short, the identity of my plant was not definite: it could be *Agave murpheyi*, or a related species that didn't normally produce bulbils. Gentry encouraged me to make more collections at the same site. In that way, we could verify whether or not bulbils were characteristic of the entire population. He also invited me to pay him a visit sometime. I did.

Within a year of that first dispatch from the old man, I embarked on my own agave-collecting trips in Sonora and tasted bootleg mescal for the first time. My father had died while I was out of reach, in Mexico. After the funeral I took my dried plants to Gentry, to see if the master would help me interpret their value. We soon found something to talk about on a fairly regular basis. Within another year, I took a few weeks off to work with him. We began by drinking tequila in an agave patch on a Fourth of July evening and stayed together until the end of the summer, when I left for more plant collecting. We split our time between two places, the Desert Botanical Garden in Phoenix and his family's homestead in Murrieta, nestled within the Sierra foothills an hour south of Los Angeles.

That summer, ethnobotany and the horticulture of native plants became more than technical sciences to me: they harbored a reservoir of stories about rural peoples and their ties with the natural world. Nearly everywhere in the American deserts, agave fibers formed the rope that secured those ties. Gentry considered this link a "mutualism between two disparate organisms"—a true symbiosis—for without agaves as his companions in the desert, "man would be a lone egocentric without a single other organism in the whole world to counsel him."

The old man would draw upon the council of mescal or scotch each afternoon before wandering off to his bedroom for a siesta, or falling asleep, glass still in hand, in his easy chair on the patio. He always kept a good field hat on while he was outside and often kept a little wild stubble on his chin to go along with it. Lubricated by his afternoon drink, he might recall the views of scholars (Webb, Sauer, or Xolocotzi) on some arcane horticultural practice of Mexican Indians. Then he might give me an Indian perspective on the same practice, by referring to a conversation he had with a Guarijio, Mayo, or Tarahumara elder forty years before. If I was lucky, he might recall one of his adventures while out exploring the sierras with Juanito Arguelles, who had often traveled with Gentry as his *mozo*, or errand boy. Arguelles has ended up being the second most prolific collector of agaves in the history of northern Mexico, but the collections with his name on them hardly rival the twenty-five thousand or so that bear Gentry's name. A fourteen-year-old when

Gentry first met him in San Bernardo, Sonora, in 1933, Juanito learned to take care of Gentry's mules and plant presses. He later moved to Murrieta and found jobs tending cutting horses; he decided to retire years before his former boss had to force himself to stop working.

Once Gentry began his stories from the trail, they would unwind naturally. He often returned to a point he had wanted to demonstrate to me earlier in the day. When recording folk taxonomies for plants, he insisted, be careful of *campesinos* making up provisional names for plants in areas unfamiliar to them. Then he would laugh heartily and confess that in 1951, he had provisionally named one species *Agave jaiboli* after what he thought was an Indian name. In the Sierra de la Ventana, he had encountered a *gente de razon* (non-Indian) who told him that a fine distilled drink could be made from this unusually sweet plant. The mad had called the distilled drink *jaiboli*, to distinguish it from the mescal that the Guarijio Indians made from *temeshi*, another local agave.

Fourteen years later, Gentry ran into the man again and learned that he had worked as a wetback years before on the U.S. side of the border. While in the United States, the man had taken a liking to the highballs that the Gringos made with their liquor. "*Aqui, hacemos jaibolis con mescal*," he told Gentry, who belatedly realized that *jaiboli* was no Indian word at all. The name stuck nonetheless, and Gentry used it for the official scientific name when describing the plant as a new species in 1972.

While we were over in California, Gentry took me for my first drive through the heart of Los Angeles. We were on our way to the Huntington Beach Botanical Gardens, one of the most heavily visited horticultural displays on the West Coast. There in the middle of its outdoor exhibit, the old man pulled out a rope and made it into a lasso. He deftly tossed the loop over a twenty-foot-high agave stalk in flower and fruit. Once he caught its candelabra bouquet, we wrestled it down to the ground, much to the horror of the tourists passing by.

"I've been waiting for this plant to flower damn near since the year you were born," he said, taking his hat off and wiping the sweat from his brow on his shirtsleeve. Gentry had planted dozens of seedlings of unknown species at Huntington in 1951 and 1952, but

it took some of them another quarter century to flower for the first time. It was only then that he could fully describe them.

"Take my machete," he ordered, "and cut three or four of those leaves off. Skin 'em out and section them so that they fit into the plant press. I'll finish up pickling the flowers while you're doing that." The entire effort took nearly two hours and filled an entire plant press. Every day the following week, I swabbed each leaf section with alcohol to keep it from molding and dried the blotters out in the sun. After waiting twenty-five years to finish his work on this collection, Gentry was not about to let a specimen go to waste.

Hundreds of such specimens informed his 670-page masterwork, *Agaves of Continental North America*, which was finally published in 1982 nearly fifty years after Gentry had begun his first agave collections. By that time, the old man seemed tired and frustrated by what he had done. "It only makes evident how little I know," he said

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sadly. "But I just can't do any more. These damn plants have nearly killed me. It's up to you young lads and lassies now."

Even before he reached this stage of exhaustion, he had encouraged me to ask O'odham friends questions he himself had not resolved. He was especially curious about their knowledge about *Agave murpheyi*, because its distribution puzzled him. He'd seen it just north of Phoenix, then not again until one hundred miles south in an O'odham Indian village, and then not for another hundred and fifty miles southwest in Sonora, near another O'odham village. His masterwork contained just three cryptic lines about its origin and distribution: "...*murpheyi* has never been observed in extensive or dense populations. Some of the clones appear to have been associated with old Indian living sites. The propagules are easily transported and transplanted."

The plant happened to grow in the garden of Laura Kerman, the namesake and godmother of my daughter. Laura was an O'odham potter, teacher, and storyteller who was older than Gentry but just as horticulturally curious. When I asked her about the origins of her plants, she nodded toward the Baboquivari Mountains.

"When I was a little girl, we would stay with my grandmother back in those mountains during the dry season. We took these plants from there. There used to be hundreds of them up in the canyons, and that is what my people would harvest to eat. They would dig them up, chop off the long leaves, roast them in a pit overnight."

Her eyes would get wide as she began to visualize scenes from her childhood. "Next day, they opened the pit to take them out. If the coals were still warm, they took the leaves they had cut earlier and dried them over the coals. Then they would make rope or other weavings out of the fibers taken from the leaves. We never made mescal to drink, like the Mexicans do, although some of the old man would buy it from the Mexicans and then get drunk. We just ate it and used it to make rope."

Then she looked at me, blinking. "You take me up to the mountains for a picnic, and I'll show you those plants."

One summer, I did take Laura up to the canyon home of her grandmother. We had a picnic with a small band of Pima, Papago, and Navajo friends, then she sent us up the slopes looking for plants. But as we scrambled around the abandoned village, we could find only the more common species of desert agave, no *murpheyi*.

I was sure that she had not confused the two. She simply called the common desert agave *a'ud* but knew the one in her yard as *a'ud nonhakam*, "the agave that has eggs or progeny." In fifteen years of hiking the Baboquivaris, I had found only a single *murpheyi*-like plant that had "progeny" or bulbils on its stalk where flowers might otherwise be. As with the first agave I ever collected, I could not be sure of its identity by this one trait alone. Its leaves were too dried

Because we all owe the land and its plants our lives, such stories speak for all of us. They must reach from the past into the present, to hook farmers and ranchers and even suburban gardeners, linking them to what nourishes us and inspires us.

to allow for identification. My only guess is that Laura's ancestors had cultivated this special agave around their homes in the last century, but it had not survived the droughts, freezes, cows, or harvesters. Its fiber and food qualities were so superior to those of *Agave deserti* that younger O'odham harvesters may have finished off (or transplanted to their own homes) the plants their forefathers had tended.

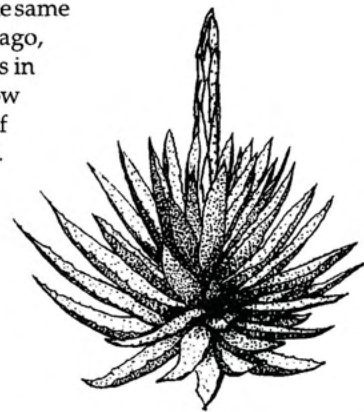
I later decided to return to the only area in Sonora where Gentry had seen *murpheyi* growing. It was an area that I knew had old, mostly abandoned O'odham villages and ancient hillside terraces nearby. Gentry had found *murpheyi* cultivated in a yard across from a truck stop, but its owner claimed that it came from the nearby hills where it grew wild. And yet, when Gentry got up to go explore the hills, the Sonoran dissuaded him, saying that the plants there had already been cut for eating and for making bootleg mescal.

It seemed easy enough to travel forty miles south of the border and explore the hills surrounding San Luisito to find what might be a truly wild population of the plant. But, like Gentry, I would not see any plants in the hills. As my friends and I drove into San Luisito one summer day, a roadblock loomed up just fifty years past the garden where the plants grew. Since we weren't going any farther south, I pulled into the truck stop rather than driving right up to the Federales and their barriers. Unfortunately they thought I was dodging them.

The next thing I knew, five Uzi machine guns were pointed at me, and two other armed guards had me up against the hood, frisking the daylight out of me. Two hours later, after my Jeep Cherokee had been scoured for every smidgen of plant debris, and each leaf analyzed for traces of drugs, the narcotics squad released me and my friends.

"This is drug country, why did you come down here anyway?" the *jefe* asked me. I pulled out Gentry's *Agave Family in Sonora* and showed him a picture taken in the garden across the road some twenty years before. He was not impressed. He doubted that I had any legitimate reason to be there and discouraged us from wandering around in the hills nearby. "There are drug traffickers who think they can go around us. They are not the kind of people who will like you getting in the way."

The following winter, after I had heard that drug running through that part of Sonora had waned, I did find four or five more ranchos with little patches of *a'ud nonhakam* in their yards. Always, the O'odham and mestizo cowboys would tell me the same thing they told Gentry. Years ago, they had brought these plants in from ones in the hills, but now they were no longer sure if there were any left in the wild.



Agave murpheyi growth about two weeks after authors Karen and Rex Adams noticed emergence of main stalk. Height approximately 113 cm from ground surface to top of stalk (about 45 in.)

About that time, however, word came in from a friend in New River, Arizona, that caught me off guard. I had begun to work at the Desert Botanical Garden, joining Gentry's department. Another one of Gentry's understudies, Wendy Hodgson, had been collaborating with an amateur botanist, Rick DeLamater, tracking the distribution of agaves in central Arizona. One day Rick heard me complain to Wendy about my trouble finding truly *wild* populations of *Agave murpheyi* anywhere on the O'odham Reservation or in Sonora.

"Crap, I know where a bunch of wild *murphs* are right by my home. You know Encima de la Mesa near New River?" Rick said casually.

"There are prehistoric terraces all over there!" I blurted.

Rick didn't follow me. "What do terraces have to do with it?"

"There's this archaeologist named George Gumerman who had a big project up there in the seventies, and I went up there with him one time. He had a whole team of students mapping hundreds of terraces and rock alignments built prehistorically, thinking that they might have been used for agriculture. Funny thing was, in all their excavations and analyses of pollen and soil, they never figured out what people could have been growing up there. You haven't seen any prehistoric agricultural features where the agaves are?"

Rick looked at Wendy and scratched his beard. "All I know is where the plants are. And where a few hilltop ruins are above them. I wouldn't know a prehistoric agricultural feature if it reared up and bit me on the . . ."

By the end of the week, Wendy, Rick, and I went up to New River with some biologists visiting from Mexico and the Navajo Reservation. As we walked out across the *bajada* toward the plants, I began to see rock pile after rock pile, rock alignments, check dams, terraces, and stone tools. Rick led us to one particularly large clone of agaves. There in the middle of it was a prehistoric agave knife, the same kind that had been found near agave roasting pits throughout the Southwest for decades. And there, beneath the *a'ud nonhakam*, was the lip of a cobblestone border that had been put there to slow the flow of water down the slope at least five or six centuries before.

The hidden garden. There, amid the paloverde and mesquite, the bur sage and the barrel cacti, a prehistoric Hohokam crop had persisted at least half a millennium after being last tended. The same plant—the identical genetic stock that had been transplanted here in prehistoric times—had reproduced vegetatively on its own, clinging to the same terrace where it had been originally placed. Rick had discovered the hidden garden, a horticultural experiment so well adapted to the desert that it ultimately needed no human intervention to keep it going.

By that time, we knew that tens of thousands of acres of similar rock-pile fields, cobblestone alignments, and terraces had been found between Tucson and Phoenix by Paul and Suzanne Fish. At

first, they too were baffled because Suzanne's pollen analysis revealed no obvious candidate for the crop that the Hohokam had grown there.

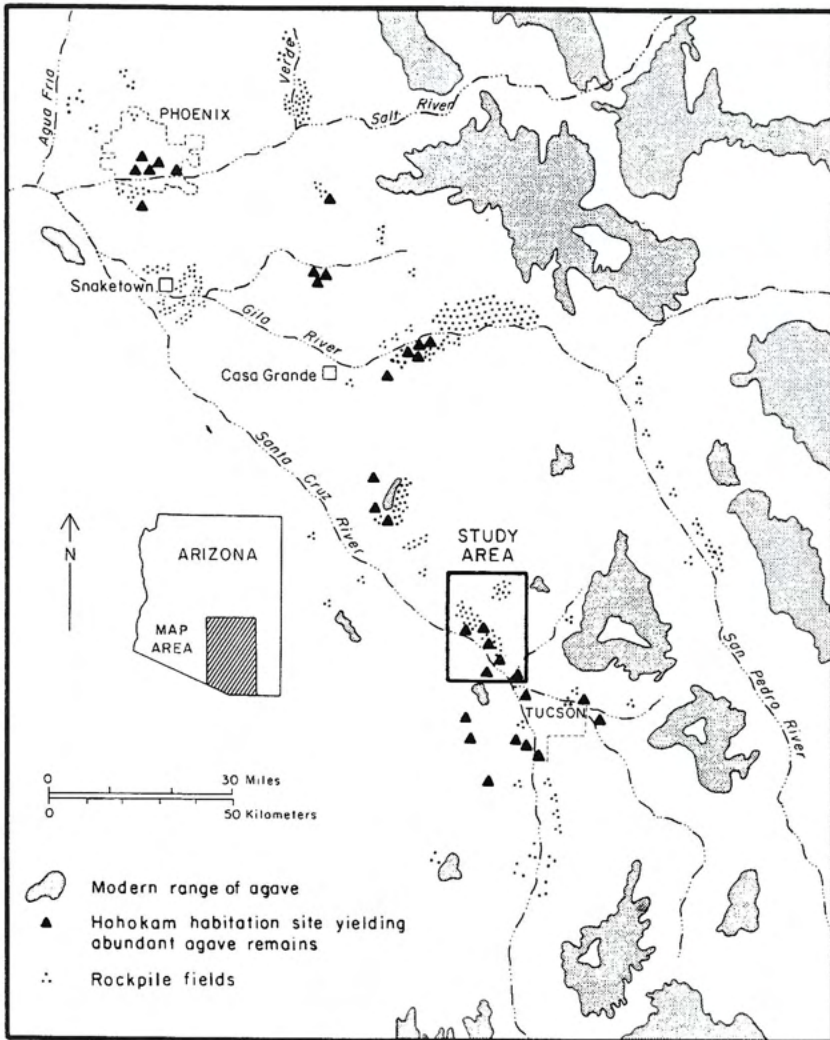
Then one day, Paul's survey team stopped to eat lunch on the *bajada* slope. Nudging his bootheel into the slope overlooking a wash, one of them noticed that they were sitting on ash and charcoal, not soil. The team had stumbled upon a huge roasting pit, and within a few weeks their coworker Charlie Miksicek had sorted out fragments of agave leaves mixed with the ash. The leaves were too beat-up to identify, but when Charlie heard of Rick finding *Agave murpheyi* up at New River, it didn't surprise him. Most of the agaves would have been cut and roasted before they flowered anyway. If *murpheyi* aborted its flowers so early, it's no wonder that Suzanne could find little pollen where Charlie had found an abundance of charred leaves.

Suzanne, Paul, and Charlie gradually fleshed out the details of a prehistoric horticultural tradition in North America. It was a tradition that had escaped the notice of dozens of archaeologists who had worked in the same region over the last century. They had presumed that agaves were aboriginally cultivated nowhere north of Mesoamerica. Paul and Suzanne Fish have now shown otherwise, that agaves have been intentionally cultivated in Arizona since A.D. 600. The one hundred fifty square miles of rock piles on the middle *bajada* above Marana [Arizona] captured and conserved water for each vegetative transplant, augmenting food production in an area too high and dry for conventional irrigation agriculture.

The agaves grown from Marana to New River were not simply transplanted wild species but specially selected variants. They had all the characteristics of other domesticated plants such as the maize and thornless prickly pear brought in from Mesoamerica. The Hohokam leaders living down near the better-watered ceremonial centers had likely grubstaked workers to cultivate agaves, offering them maize and beans grown on rich floodplain soils in exchange for mescal and fiber. Thus, the scenario that Gentry had earlier imagined for prehistoric agave cultivation in Mesoamerica rang true for arid America as well:

There, amid the paloverde and mesquite, the bur sage and the barrel cacti, a prehistoric Hohokam crop had persisted at least half a millennium after being last tended. The same plant—the identical genetic stock that had been transplanted here in prehistoric times—had reproduced vegetatively on its own, clinging to the same terrace where it had been originally placed.

They cleared wild land and put agave into it. They opened up new niches for the random variants of the gene-rich agave...They selected the genetic deviants of high production by planting vegetative offsets. Generally, this is what man did for agave in this Mesoamerican symbiosis. In return agave has nurtured man. During the several thousand years that man and agave have lived together, agave has been a renewable resource for food, drink, and artifact.... As man settled into communities...agave fostered the settled habit, attention to cultivation, and the steadfast purpose through years and life spans, all virtues required by civilization....Agave civilized man.



hidden garden could get along with or without the intervening hand of Hohokam horticulturalists.

In the end, that is what Dr. Gentry let us do. He never intervened with our agave studies, all of them ultimately grounded in his own. He never expressed any worry over whether younger investigators would come along to revise parts of the story that he had spent most of his life compiling. He encouraged Mexicans as well as North Americans to get out into the field and prove him right, wrong, or somewhere in between. After he retired, he would still listen to our new reports as they came in, but he would never try to give these new details his own spin. He would shift uneasily between his respirator and his afternoon drink, then mutter in his throaty voice, "Pshaw, laddie, you've come up with something there that I would have never expected!"

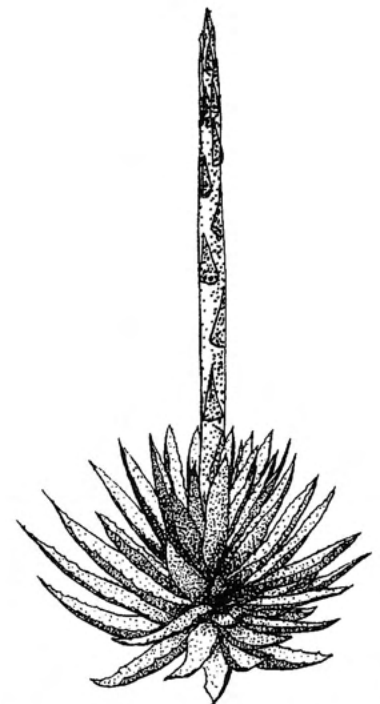
The last couple years of his life, I saw the old man less than I had seen him over the previous fifteen years. He could no longer get out into the field with any frequency, and I guessed that confinement killed his spirit. I could not stand to see him captive in a domestic scene—a field man relegated to the subtle insults of idle retirement, nursing homes, or hospitals. Instead, I took the memory of him into the field with me, trying to seek out the kind of *campesinos* with whom he had loved to talk since he first crossed into Mexico sixty years before.

Left: A comparison of the modern range of agave species with evidence for prehistoric production and use in southern Arizona. Reprinted with permission from "Evidence for Large-scale Agave Cultivation in the Marana Community" by SK Fish, PR Fish and JH Madson. In *The Marana Community in the Hohokam World*, Anthropologic Papers of the University of Arizona, No. 56, Editors SK Fish, PR Fish and JH Madson. 1992. © The University of Arizona Press, Tucson.

It is even more amazing that the agaves did not become civilized. The *a'ud nonhakam* had never lost its capacity to survive, to thrive in desert climes without the aid of irrigation or gardeners.

Over the following years, Rick DeLamater and Wendy Hodgson found remnants of more than fifty previously neglected stands of *Agave murpheyi* in the forests, parks and ranchlands of central Arizona. Rick's eye for this plant became legendary. Every once in a while, he would come into our office, sure that he had found a truly wild population. On further inspection, Rick, Wendy, or I would find artifacts, rock alignments, and other cultural remains to indicate prehistoric cultivation. I found another five sites in Sonora on my own, but all of them were associated with historic homesteads and prehistoric settlements. They could persist amid wild vegetation by were never found in "pristine wilderness"—their presence always spoke of earlier cultural presences, of man-made desert gardens from long ago.

Even their genetic history showed human imprints. We sent leaf samples to geneticist James Hickey, who discovered that all the plants had the same chemical markers regardless of whether they came from Sonora, Papaguería, or New River—they had none of the heterogeneity from site to site found in wild agaves. Perhaps they were all of one clone, transported and then transplanted over hundreds of square miles in the heart of the Sonoran Desert. And yet, they all took that desert to heart, adapting to its droughts and freezes, resisting its pests and plagues in a way that few of today's pampered crops could if cut loose from human attention. The



Main stalk after about 1 month of growth; height approximately 197 cm (about 78 in.)

Francisco Gamez Valenzuela was one such man, the kind of Sonoran that Gentry would have fallen in with—two kindred spirits. I rounded a corner in Querobabi, Sonora, one summer day, and there was this yard, spilling over with all kinds of desert plants, including a long hedgerow of *Agave murpheyi*. I stopped my van in the middle of the road and looked around to see if anyone was hidden within all that verdure, working in the yard. And these were Francisco [Gamez Valenzuela], who was more than willing to talk about the plants he called his *lechuguilla*.

"Hace diez años que se transplantó aquí. Se crece en las lomas de piedra cerca de Ranchos San Jacinto, El Saucito, La Sesma..." he told me, rattling off the names of abandoned historic outposts from which he had salvaged these plants a decade ago. I asked him if they were truly wild, or whether they appear to have been associated with the former plantings of his *antepasados*.

"Pues, se crece silvestre, pero hay corrales de piedras, trincheras, y rastras de minería en aquellos cerros." With cobblestone corrals, terraces, and remnants of rustic mining operations, the sites could have been from the colonial period, if not earlier.

Francisco told me how he occasionally roasted a single plant into the smoky caramelized foodstuff called *mescal tatemada*. He also loved to join forces with an elderly neighbor now and then to pit-roast twenty to forty "pineapples," then distill them into *mescal lechuguilla*. I took a look at his hedgerow. It was obvious that he took good care of the plants—they were deep blue-green and stood waist high.

I asked him if they needed much pampering. The answer he gave me made me realize that *Agave murpheyi* would still do fine long after Howard, Francisco, and I were long gone. I thought about it long after translating it in my head: "Oddly enough, it produces much better during the drought than it does during wet years," he said, tipping his cowboy hat back on his head.

"What?" I'd never heard of such a thing for a domesticated plant.

"Pues, sí, durante la sequía, se da mas ley." During the hardest of times, a Sonoran folk-saying goes, a good plant still "gives the law." The Law of the Desert. Not only had *Agave murpheyi* persisted as part of local diet and drink, it also remained strongly rooted in the folk expressions of the village.

When I returned to visit Francisco the following December, I was just in time to catch the Hohokam agave resurrected in a new spiritual role. As I entered Querobabi, I began to notice shrines erected for the Virgin of Guadalupe, who was honored during a series of processions culminating on her feast day of December twelfth. The families in Querobabi had each constructed what looked like miniature desert gardens in front [of] their homes, replicas of the hill of Tepeyac, where the Virgin communicated with the Mexican Indian Juan Diego in December of 1521. There on the little hills erected around the village, *Agave murpheyi* rosettes stood alongside pictures and statues of the Virgin.

According to legend, Juan Diego had converted to Catholicism from his native religion but still felt that this was not the path for all his people. As he climbed a hill one day, the Virgin appeared in order to assure him that she would remain within his indigenous community. He went down into the Valley of Mexico and spoke of his vision to Bishop Zumarraga, who refused to believe that the Mother of Christ would offer anything of import to a lowly Indian.

Juan Diego prayed to the Virgin to receive some sign that he could take to Zumarraga, to convince the bishop of the veracity of his claim. This is when the Virgin appeared again, urging Juan Diego to climb to the very top of the Loma de Tepeyac to pick flowers for the bishop. Juan Diego hesitated, knowing that few flowers grew on the arid, rain-shadow slopes of the valley in winter. Nevertheless, he decided to follow her instructions.

By all accounts, he found Roses of Castille "growing in a place where Nature produces only cactus and maguey." He wrapped

these domestic roses of European civilization in his cloak, and when he offered them to the bishop, he found the miraculous image of the Virgin imprinted on the inside of his serape. This began the veneration of the Virgin of Guadalupe as the matron of Mexican Indians, a tradition that became strongly rooted as far north as Sonora by 1740.

In the Sonoran folk tradition, cacti and agaves from the local desert are transplanted into shrines for the Virgin to commemorate the arid landscape where she first made contact with their people. Organ pipe, fishhook, and pincushion cacti are nestled side by side with the *lechuguilla* offshoots taken from Francisco's hedgerow, and visited by the processions for the week prior to the Virgin's feast. Then, crepe paper flowers of the Castilian Rose are added to the shrines, while the matron of all indigenous peoples sees her miracle observed once again.

From the embrace of the goddess of Mayahuel to that of La Virgin de Guadalupe, this native plant had somehow survived the collapse of the Hohokam ceremonial life to be resurrected and integrated into the folk Catholicism of Sonora.

From deep in my memory, I heard Gentry's prophetic words:

As civilization and religion increased, the nurturing agave became a symbol, until with its stimulating juice man made a god of it...Mayahuel, the principal goddess of agave, slaked the parched throat, relieved the duty pressures, altered the spirit, provided at least temporary surcease from hard life, and, being god-like, protected the home. Altogether, this was another contribution of agave to man during the centuries of the symbiosis.

It seemed the agaves joined with the Virgin in desert gardens to produce many of the same effects. Mayahuel now stood in the background, but her work, too, was being carried on.

In April 1993 Mayahuel witnessed one of her sons rejoin the earth—one who felt more comfortable on the cactus-and-maguey-stippled slopes of Mexico than in the suburbs of the United States. He was buried in one of those suburbs, and neither Mayahuel nor the Virgin were being mentioned in the funeral service. I stood in the back row, listening to the cadence of the ceremony, scanning the surroundings. The memorial service was not all that different from those offered for other well-respected elderly men in Protestant enclaves within southern California. As the minister closed his hymnal, and the audience began to stir, I felt crestfallen, as though something were desperately missing.

Marie Gentry, his widow, must have sensed that same feeling, because she stopped us all dead in our tracks right as the service ended.

"Thank you, all of you, for being here with us for this service. But because it has all been offered in English, someone who is here was not able to share in the eulogies. It is someone who spent nearly as much time as I spent with Howard in those early days, and because Spanish is his native tongue. I would like to ask Juan Arguelles to say something in Spanish before we all go, *por favor*..."

There were a few Spanish speakers among us, but this request caught most of the crowd off guard—they shifted uneasily in their Sunday clothes as Juan moved forward through the crowd. He came to the hole in the earth and spoke to it, as if beginning a slow but steady mouth-to-mouth resuscitation.

"Pues este viejito—es uno de mis grandes amigos. Con este señor, he caminado a todos partes de la sierra, buscando para plantas..."

And from that first step, Dr. Gentry's sidekick began to conjure up the trails they had traveled together, on horse, on foot, in Model T; he told of the amazing plants they had discovered, the mescal they had sampled; he called up the campfires they had hovered around and the stories they had heard there—stories that had never been written down, but had been passed from mouth to mouth, campfire

to campfire, for centuries, and still no doubt lived on wherever Mayos, Guarijios, Tarahumaras, and others came together around a mescal pit in the dry sierras.

And that was when I remembered that ethnobotany is not just a science. It's a reservoir of stories that link humankind with the verdant earth, a reservoir of legends we need to dip into now and again. The stories are not restricted to indigenous peoples. They honor the spirited plants they relied on for food, for drink, for miracle. Because we all owe the land and its plants our lives, such stories speak for all of us. They must reach from the past into the present, to hook farmers and ranchers and even suburban gardeners, linking them to what nourishes and inspires us. The best remind us of that capacity for symbiosis, a capacity one old crusty ethnobotanist found in the legend of Mayahuel. If we leave behind that capacity to be part of mutualisms larger than ourselves, then the rest homes, suburbs, and plant engineering labs will turn darker and lonelier, more sterile than ever before.

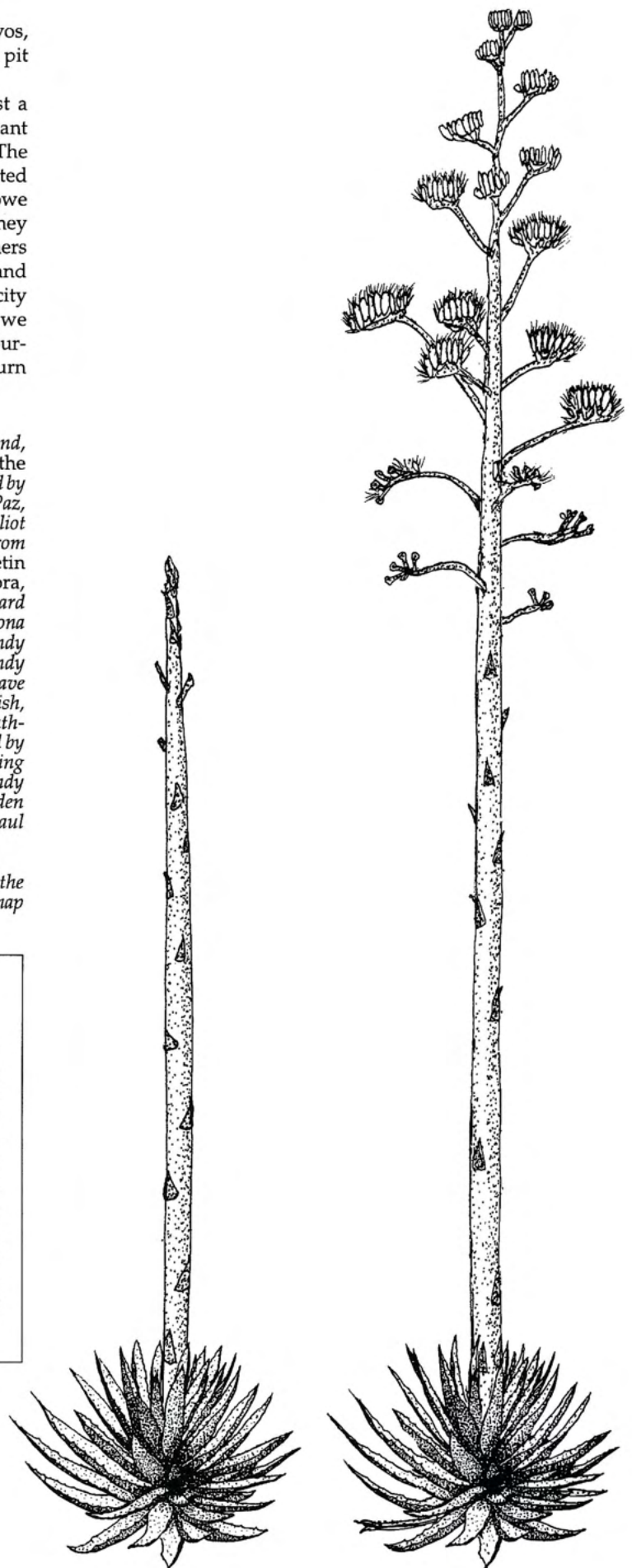
Notes

The epigrams are quotes from Jimmie Dale Gilmore and David Hammond, "Where Are You Going?" on the Gilmore recording *Spinning Around the Sun* (Electra/Warner Brothers, New York, 1993)—the lyrics are copyrighted by Jade EG Music and Hydra's Teeth Music, BMI—and from Octavio Paz, "Piedra del Sol/Sunstone," in *The Collected Poems of Octavio Paz*, ed. Eliot Weinburger (New Directions, New York, 1987), p. 3. I have also drawn from Howard Scott Gentry, "The Man/Agave Symbiosis," *Saguaroland Bulletin* 29, no. 7 (1975): 80-84; Howard Scott Gentry, *The Agave Family in Sonora*, USDA Agricultural Handbook No. 399 (Beltsville, Md., 1972); and Howard Scott Gentry, *Agaves of Continental North America* (University of Arizona Press, Tucson, 1982). Much of the *Agave murpheyi* work with Wendy Hodgson and others remains in press, but we have published one article: Wendy Hodgson, Gary Paul Nabhan, and Liz Ecker, "Conserving Rediscovered Agave Cultivars," *Agave* 3 (1989): 9-11. See also Suzanne R. Fish, Paul R. Fish, Charles Miksicek, and John Madsen, "Prehistoric Agave Cultivation in Southern Arizona," *Desert Plants* 7, no. 2 (1985): 107-12. A volume being edited by Suzanne Fish and James Parsons on agave uses in the Americas is forthcoming from the University of Arizona Press and includes definitive data from Wendy Hodgson, Rick DeLamater, James Hickey, and me. With regard to "hidden gardens" in American wilderness areas, see Kat Anderson and Gary Paul Nabhan, "Gardeners in Eden," *Wilderness* 55, no. 184 (1991): 27-31.

PDJ Editor's Note: For additional information on *Agave* cultivation in the southwest, see also the 1992 publication by Fish et al. referenced in the map caption on page 7 of this article

GROW YOUR OWN AGAVE PLANTATION

Agave murpheyi growing in the wild should not be disturbed. But, if you would like to grow your own *Agave murpheyi* there is a way! The *murpheyi* portrayed in this series of drawings produced an incredible 359 offspring. A hundred of these have been potted at the Desert Survivors Nursery in Tucson, Arizona, and are available to the public. Desert Survivors Nursery is a nonprofit organization providing employment and life-enhancing experiences to developmentally challenged adults while providing drought tolerant native plants to the public. Desert Survivors can be reached at (520)791-9309 and is located at 1020 West 22nd Street in Tucson. Your *Agave murpheyi* will produce pups even before sending up stalks, so just one plant can become the foundation of an agave plantation in a relatively short time (in *Agave* terms).



Near right: Main stalk after about 2 months growth; height approximately 345 cm (about 136 in.)

Far right: Main stalk after about 4 months of growth with flowers in various stages of development from oldest at bottom to youngest at top. Height approximately 508 cm (about 200 in.)

Pinyon-Juniper

by Ben Haggard

Pinyon-juniper (PJ) forests in northern New Mexico are frequently impoverished landscapes, susceptible to erosion and with a minimum of understory species. Frequently, the poor condition of the land is blamed on the pinyon. But based on my observations, I suspect it is the result of larger historical trends in the region. Many of these forests are a recent successional stage, having followed logging and sheep grazing, two highly destabilizing influences in the desert southwest. The junipers, followed by the pines, have colonized eroded and eroding sites and are in some instances the only vegetative cover serving to prevent further soil loss. I believe that the process of desertification is caused primarily by human activity, not by trees.

Most natural systems depend on cooperation and mutually beneficial association for their function. Stability derives from the diversity of connections among members of natural communities. A web of mutually beneficial connections among species, usually organized around one or two significant elements (such as trees), is defined as a guild. In general these webs or guilds will include nutrient accumulators, such as nitrogen fixers. They will include insectary species and insects. Fungi, bacteria, and other microorganisms serve as nutrient translators. Animals garden the system, turning the earth, pruning, planting, fertilizing.

Pinyons and junipers form the backbone of a classic guild system. Although the PJ forests in the state are generally fairly barren landscapes, a number of healthy situations can still be found, especially in favored or inaccessible sites. In one instance I am familiar with in Santa Fe, a large juniper (*J. monosperma*) grows in a small basin, fed by a drainage of several square yards. Growing up through its branches, on the north side where they are usually found, is a sapling pinyon (*P. cembroides*) of perhaps twelve feet. In the shade of these trees grow Fendler's bluegrass (*Poa fendleri*), prickly pear (*Opuntia* sp.), cholla (*O. imbricata*), wolfberry (*Lycium pallidum*), mullein (*Verbascum thapsus*), fleabane (*Erigeron* sp.), sage (*Artemisia* sp.), lamb's quarters (*Chenopodium* sp.), and a variety of other annual grasses and weeds. At the edges of this grouping, where the sun is stronger, can be found rabbitbrush (*Chrysothamnus nauseosus*), Apache plume (*Fallugia paradoxa*), dropseed (*Sporobolus* sp.), blue grama (*Bouteloua gracilis*), soapweed yucca (*Y. glauca*), and other hardy native shrubs, grasses, and forbs. Mistletoe sprouts from many of the juniper's limbs and lichen can be found on the bark of its main trunk. Taken together, this one grouping of plants is like a template, a shopping list for anyone wishing to nurture the PJ forests of the high desert back to health.

Within this same guild, evidence of animal activity is plentiful. Ant hills and gopher burrows appear under or at the edge of the trees. Bird droppings add fertility to the soil. Bees visit the flowering species. Towhees spread the mistletoe seeds when they eat its sticky fruits. Jays and squirrels visit the pinyon. Coyotes eat the juniper fruits, leaving behind a characteristic, crumbly scat filled

with acid treated seed ready to germinate. Rabbit droppings are common, and occasionally the feces of an animal (perhaps fox) who has been eating rabbits. Beetles and other insects are everywhere.

This partnership of plant and animal life results in a rich black layer of duff, shot through with fungal mycelia. In the wet months, mushroom fruiting bodies appear—another source of protein for the community. Microphytic crusts cover the ground between plants. A carpet of organic material holds moisture, recycles nutrients, and resists erosion. The soil is continually enriched by a rain of dust and pollen, bits of plant material, and animal and insect feces and bodies.

I have seen many such PJ guilds—hunting for them is a hobby of mine. They can include all of the plants listed above, as well as wax and golden currants (*Ribes cereum* and *R. aureum*), silver lupine (*L. argenteus*), New Mexico locust (*Robinia neomexicana*), Gambel's oak (*Quercus gambellii*), wavy leaf oak (*Q. undulata*), shrub oak (*Q. turbinella*), 3 leaf sumac (*Rhus trilobata*), mountain mahogany (*Cercocarpus montana*), banana yucca (*Y. baccata*), wild four o'clock (*Mirabilis multiflora*), blue gilia (*Gilia longiflora*), scarlet bugler (*Penstemon barbatus*), Crandall's penstemon (*P. crandallii*), wandbloom penstemon (*P. virgatus*), claret cup (*Echinocereus triglochidiatus*), wild buckwheat (*Eriogonum jamesii*), and on and on and on.

At slightly higher elevations or in moister microclimates, the pinyon and juniper blend into the ponderosa pine/Gambel's oak/Rocky Mountain juniper guild (*P. ponderosa*, *Q. gambellii*, *J. scopulorum*.) At these transitions, the weave becomes particularly rich, with all of the species listed above mixing it up with chokecherry (*Prunus virginiana*), wild grape (*Vitis arizonica*), mountain spirea (*Ceanothus fendleri*), creeping Oregon grape (*Mahonia repens*), and mockorange (*Philadelphus microphyllus*.) Finding such a guild is a pretty good indication of a favorable microclimate.

Functional guilds are characterized as much by diverse connections between species as by the numbers of species themselves. Gophers till soil, creating ideal sites for establishment of seedlings. The juniper is the nurse for many of these seedlings, providing a toehold against wind and water erosion, suitable soils, and protection from browsing. Towhees introduce mistletoe into the maturing juniper, helping to pave the way for its eventual succession. The juniper and other woody plants provide food, scaffolding, and nesting sites for a variety of animals. All of the plant species serve to create microclimates, and gradually shift the type and variety of microclimates available. Animals serve as mobile components of the guild, planting, fertilizing, dispersing seed and plant material, and extending the edge of the forest.

A number of species found in this guild are nitrogen fixers: mountain mahogany, apache plume, New Mexico locust, mountain spirea, lupine, and microphytic crusts. Nitrogen fixers are common in desert climates, where nutrients are scarce, and they introduce this important element into the whole system to be cycled by other microorganisms, plants, and animals.

Fungi and bacteria break down organic material and serve as translators, providing nutrients in assimilable form to plants and soil fauna. These in turn translate nutrients into assimilable form for other animals. Rodents eat the fruiting bodies of fungus, combining

This article is excerpted and adapted from a paper originally presented at the New Mexico State Land Office Conference on Pinyon Management. Illustration by Ann Audrey.

Guild Associations

spores with sugars from plants and depositing them in favorable locations in neatly packaged "nutrient bundles." Predators may also assist in distributing fungal spores by harvesting rodents and converting them into even larger nutrient bundles. In this way, animals are not only responsible for distributing seeds, but also for distributing fungi and nutrients essential for healthy plants. Bill Isaacs, a Santa Fe mycologist and native plant expert, has observed rabbits eating mushrooms under pinyons, then defecating into the grasses a few feet out from the trees.

In places where guild systems survive, a healthy diversity of plant and animal species is the norm. Soils are productive and rich in organic content. Total biomass is high, particularly since guilds based on woody species are layered, using available space very efficiently. Nutrient cycling is optimized due to concentration of species, habitats, and niches. Guilds make excellent use of available flows of nutrients and energies in the landscape. They represent an evolutionary strategy of cooperation among species.

Many of the plants associated with the PJ guild are edible and have been harvested by people for millennia. Pine nuts and acorns are delicious high protein perennial crops. Currants, sumac, wolfberries, yucca, Oregon grape, wild grape, and juniper all produce edible fruits. (Wolfberries are often used by archaeologists as indicator plants for finding ancient settlements.) These fruits are also forage for wild turkeys—an important, though no longer common, source of food for indigenous people. Other plants are harvested as potherbs. Many have medicinal uses. This prevalence of useful species may indicate human intervention in the ecosystem in selecting for preferred plants.

The usefulness of wild species points the way to possible sustainable commercial yields from the PJ forest. Currently, pinyon is cut and sold for firewood and the remaining grass grazed by cattle at very low rates of stocking. Junipers are chained off with bulldozers and burned as trash. This is a poor use of the energy, genetic resource and biomass represented by such a system. Many of the species in

this guild have a potentially higher dollar value per acre than any of the uses (except, perhaps, real estate development) to which this ecosystem is currently put. Pine nuts were once an important cash crop in New Mexico. Acorn flour is delicious, highly nutritious, and only requires appropriate packaging and marketing to establish new commercial opportunities. Wild four o'clock is a highly valued

medicinal herb for which demand continually outstrips supply. Wild fruits are enjoyed by connoisseurs and command high prices in gourmet markets and restaurants.

Healthy PJ woodlands are aesthetically appealing and form the basis for a growing demand for native plants. The market for seeds and live plant material continues to be greater than growers can supply. A single major revegetation project can seriously deplete stock of most of the native plant growers in the southwest, and more and more landscape architects are including natives in their specifications. The single most valuable harvest of a landscape could well be its seeds.

The uses I have described for products of a PJ ecosystem are consistent with the concept of sustainable yield. Products can be harvested without damaging the living guild. In fact, if these products are demonstrably important commercial crops, they could form the basis for broadscale investment in stabilizing and revitalizing this ecosystem. Nor do they necessarily preclude careful extraction of firewood, grazing, and other harvests, so long as such management supports and furthers the health of the ecosystem.

Priority needs to be placed on the intrinsic value of natural systems, rather than on their exploitation for economic ends. If we are to realize a healthy land-based economy, we must do so by doing it smarter—by diversifying and spreading the risk of crop failure over a multiplicity of potential yields. This way of life was familiar to our ancestors. Our failure to pay

attention to basic principles of natural systems when designing our economic strategies has resulted in widespread ecological deterioration. Pinyon juniper woodlands, a guild system of the high desert, provide models worth preserving and emulating.



1995 Basic Permaculture Design Courses

Permaculture Drylands Institute **Basic Permaculture Design Courses** cover all aspects of permaculture design in drylands. They consist of a balance between hands-on experience, classroom time and design practicum. Dynamic exercises encourage pattern recognition—noticing the links between plants, animals, climate, landforms and all of the other elements that make up natural and man-made systems. These patterns are then used as the basis for design work.

The courses focus on dryland communities, addressing existing neighborhood “problems” such as stormwater flooding. Students learn to “read” the landscape, to map and analyze energies affecting a site, and to develop integrated designs for sustainable systems. The weekend format of the courses promotes integration of course material into students’ daily lives and allows hands-on design work in their respective homes.

Course Topics:

- Agroforestry**
- Appropriate Technology**
- Building Design**
- Design Principles and Patterning**
- Dryland Gardening Principles**
- Ecosystem Restoration**
- Energy Conservation**
- Home Garden Design**
- Observation and Site Analysis**
- Permaculture Philosophy and Ethics**
- Regenerative Economics**
- Soils and Erosion Control**
- Village Design**
- Water Harvesting, Use and Re-use**

Basic Permaculture Design Course Schedule

Basic Permaculture Design Courses meet all day Saturday and Sunday, generally every other weekend over a period of eight weeks. The course fee is \$450.

Arizona

Patagonia-Fall: August 12-13, 26-27, September 9-10, 23-24. Contact Kate Tieman (520/394-2754).

Tucson-Fall: September 23-24, October 7-8, 21-22, November 4-5. Contact Barbara Rose (520/744-9305).

Phoenix-Fall: November 4-5, 18-19, December 2-3, 16-17. Contact Greg Peterson (602/279-3713).

1996 Courses: Contact Barbara Rose (520/744-9305) for information on dates and locations.

New Mexico

Albuquerque-Summer: August 26-27, September 9-10, 23-24, October 7-8. Contact Karen Brooks (505/281-8425).

1996 Courses: Contact Karen Brooks (505/281-8425) for information on dates and locations.

Advanced Permaculture Design Course

Arizona

Advanced Permaculture Design Course: November 11-17. Pearce, Arizona. This course provides intensive instruction in the philosophy and techniques of ecological design. The course builds on the material presented in the Basic Permaculture Design Course and readies the student for professional design work. Taught by the experienced team of permaculture designers and teachers, Ben Haggard and Tim Murphy, the course will address:

- Broad scale land-use planning for drylands
- Advanced pattern application
- Site assessment
- Ecological village design
- Establishment of a functional, ethical business
- Development of a professional design and report
- Relations with clients, the public and zoning authorities
- Advanced techniques including keyline, innovative applications of reclamation structures such as gabions and swales, constructed wetlands, architecture, etc.

The course will be held at SunGlow Ranch, a retreat center near Tim Murphy's home and working permaculture site in Pearce, Arizona, approximately 2 hours southeast of Tucson. Tim's site demonstrates strawbale housing, broadscale and household water harvesting strategies, small animal systems, and dryland gardens. SunGlow Ranch is nestled in the "sky island" biotic communities of the Chiricahua Mountains, one of the most biologically diverse areas of the southwest.

Prerequisite: Basic Permaculture Design Course. Contact Karen Brooks (505/281-8425). \$450; campsite and all meals included.

Workshops

Arizona

Earth Plasters: September 30. Tucson. Instructors: Barbara Rose and Brad Lancaster. Earth, lime and gypsum plasters are durable and don't trap moisture in the middle of the wall as does cement. This class will provide hands-on experience with earth and lime exterior stucco, earth and gypsum interior plastering; and strawbale, adobe and cob walls. Contact Barbara Rose (520/744-9305). \$60; lunches included.

Patterning Intensive: February 10-13. Rock Creek Small Farm, Pearce. Instructor: Tim Murphy. This intensive course will enhance the patterning skills of permaculture designers and teachers. The course will focus on pattern observation, recognition, and extrapolation, and on application of patterning to site assessment and design development. *Prerequisite:* Basic Permaculture Design Course. Contact Vicki Marvick or Tim Murphy (520/824-3465). \$360; all meals and campsite included.

Memento Mori

by Emma Hardesty

There is an important area overlooked in community and village planning these days—and over the past centuries—provision for appropriate human burial. Any community planned as sustainable needs burial grounds to be complete. Without them, a lot of elderly permaculturalists will realize at the eleventh hour that we have overlooked the ultimate use of our own bodies in the cycle of earth forms. Appropriate burial is part of patterning and we leave a gap if we ignore the proper disposal of our bodies, even as much as we practice proper disposal of living human refuse.

In any US city we find acres of heavily manicured and watered land, quickly filling up with those who came before. There is a cemetery in Jamestown, Virginia, containing graves going back to the 1630s; it is the same style of cemetery we see today. If you have ever crossed the Queensboro Bridge into Manhattan you will recall the stunning sight of the acres of densely-packed cemeteries there. Necessarily, the dead outnumber the living and cemeteries take more than they give. Modern grave yards lack comfort and privacy; they are not personal and they are not attractive. We have the odd situation where synthetic flowers are permitted but real flowers are not.

Why do we continue to bury our dead—bury ourselves—in a manner determined by mortuary requirements which fail to bind a community and nurture the earth, and do little to help assuage grief? The fashion of modern burial is as excessive as most modern fashions, containing useless stipulations to support a slew of businesses. Why not look instead at the methods used many hundreds of years ago, on this continent and others, which aimed for and achieved efficient decomposition? In cultures as diverse, and similar, as Indo-European, Incan, or Aleutian, and certainly Egyptian, there are famous instances of what might be called “over burial”, yet the great majority of burials have been simple.

Many Things—are fruitless—
'Tis a Baffling Earth—
But there is no Gratitude
Like the Grace—of Death

If the frequent dashes don't identify the writer of that ditty, then realize it came from a woman fairly obsessed with birds, flowers, and certainly death: Emily Dickinson. Where is the Grace to be found in death?

Consider this:

A three-year old sustainable community loses a member to death. She died in her home. Shortly after death occurred, the County Medical Examiner is summoned to confirm the death was natural. In the meantime, the local midwife and two others from near neighborhoods come to the home to help the family prepare the body. Other neighbors arrive from work to take over the needs of the family during this time, cooking, cleaning, feeding the animals, et cetera. A woodworking friend comes by to gain measurement for a coffin. The family of the deceased is continually being assisted, consoled, and helped in accepting the reality of a beloved aunt's

death. Other neighbors come by to talk with the family about the location for the burial and leave to dig the grave. Another close friend goes to get the ironwood seedling which the deceased had already specified.

Children in the community note the actions of the grownups as they quit work or come home early to share in the death of a community member. Some children help dig, others help cook, others decide on special artwork for the funeral. All of the kids are aware that something fundamental has occurred. For most of them, this is the first time they have known someone who died.

By the next afternoon, with or without a wake, neighbors carry the coffin the few blocks to the burial lands: several acres with a few old trees which are already being coppiced. With or without a ceremony—following the preferences of the family—the simple coffin is lowered into a grave prepared by many of the neighbors, which is filled in by these same neighbors and any family members who want to help in this final emotional act. The hardwood tree is planted over the grave with a sturdy rock mulch. Any settling of the gravesite will be looked after by the family, mainly to ensure the success of the tree. So passes a graceful handling of death.

For the next several months, members of the community recall this burial each time they walk through the grounds. They note that the young tree is doing fine and they recall that another of their neighbors is reaching the end of his life. This elder recalls the burial too and finds plenty to think about in the peaceful handling of his days beyond days. Some of the kids think about it now and then; the burial forest is not spooky.

None of the above is dogma; it is what can happen when a community must bury a member. It is what happened in days gone by and is logical for a sustainable community. While this is but one, clean, scenario, it points the way to use death as an advisor to our actions:

- Costs associated with burial would be low, since the coffin would be the only costly item, and it would not be very costly because it would be simply constructed and paid for in cash or trade. Unlike current mortuary requirements, no special clothing, refrigeration of the body, autopsies, embalming, fancy caskets, liners, vaults, monuments, or markers would be needed. There would be no charge for the “opening and closing” of the gravesite and no fee for “cleaning” a grave marker before it could be replaced. No fee for a hearse.

- The entire community would be involved and ties would thereby be strengthened as people realized the need of helping each other during this time. Children would not be removed from death. Speculation and wonder would be around them. There would be much talking and gathering at this time, as stories of the deceased were recounted.

- The coffin and body would disintegrate quickly, the tree and flowers planted over the grave would be well-nourished and provide the most beautiful of grave-markers. No other designation would be needed. In *The Dancing Healers*, Carl Hammerslag describes a Mohave cremation and says “...there was no engraved immortality.

One returned to the earth, the eternal source, to become a part of it, to nurture those coming after." That is as much as anyone needs for a legacy.

- The burial forest would be carefully situated for shade, wind-break, and beauty. Squeamishness over groundwater contamination would be answered by community rainwater catchment for potable water, and by carefully siting the forest in relation to the depth to groundwater and direction of groundwater flow to avoid leaching into any nearby wells. In former times in this country, family burial plots were situated on a nearby knoll, one site to consider for placement.

- The burial forest would become hallowed ground in a personal way for each individual, whether formally blessed or not, and thus help restore the sacred to community life. The forest would be a useful place for picnics, meditation, love, and walks, where, over time, clusters of small forests in clusters of small communities would affect year-round precipitation.

- Within two hundred years of any death, direct emotional ties would be lessened or gone and the mature tree could be harvested for its timber and used within the community for furnishings, construction, and heating fuel. The grove of trees would become a small forest, since care would be taken to plant in a natural pattern, following the lay of the land, using trees proper to the area, encouraging the spontaneous and planned introduction of shrubs and wildflowers, and encouraging the appearance of small wildlife, mainly birds, bats, and bees, which are essential to an agrarian community. Mushrooms would abound in such a place, their mycelium holding the forest floor in a rich bacterial mat of decomposition.

Where are ancient samples of appropriate burial? They are in the ancient history of all of us; all races share a tribal past with similar burial techniques: the Norse tribes practiced earth and platform burial; burial in mounds, middens, boats real or symbolic, in coffins of wood, woven mats or clay; and within chambers elaborate or simple, as well as cremation. American Indians used these techniques also. These were good methods and could be used today.

Many cultures had, and have, traditions of not mentioning the dead, and of properly distributing, burning or burying their possessions, and these elements aid in the acceptance of death. Western culture seems now to pretend that death is unsightly, yet modern burial creates a subtle idea of preserving bodies for as long as possible by the use of vaults, liners and the massive appearance of the typical casket—and these costly items are mandated. Families are removed from the simple act of preparing the body or holding wakes, and the possessions of the deceased often become a problem. There also seems to be a fear that copious sadness is not normal and necessary and should be avoided in this dry handling of death, but sadness is normal and necessary to healing.

I personally view cremation as a misuse of fuel and an example of over-processing, yet several cultures require it and many are in the habit of it. This does not mean it should be perpetuated as a common type of burial. Compared to the expensive and showy choice of a modern casket burial today, cremation does seem best, yet it is the burial act itself which we need to experience hands-on. Cremation undoubtedly has its place in certain instances of death where it becomes the best way to dispose of a body due to contagion, late burial, or massive injury.

Simple community burial, where all deaths are handled alike, helps to break down class distinctions, which probably need as much breaking down as they can get. The soothing fitness and beauty of simple burial relays a message to all—so that we become aware of our mortality and become more responsible because of the awareness. If we are continually reminded of our death then we become better at community, compassion, and introspection. We

become neighbors.

The use of lumber associated directly with the living bodies of our ancestors completes a pattern of spiritual awareness usually missing from modern society. The lack of headstones or engraved markers creates a situation where one must be able to identify different kinds of trees to locate the spot they want to visit and creates complete awareness of the time and requirements of a grand, viable tree and the species it attracts, the guilds it creates.

These tangible and ethical gifts are valuable to an agrarian community and comprise usable education. Children would grow up with the trees of the burial forest, recalling burials throughout their lives of friends and family, burials they had assisted in, which create a tie to the land. This would aid in people remaining within their community, creating a permanent culture. Good, appropriate burial is not for the dead but for those left behind. As Hammerslag wrote, "Previous lives, like the land, were a gift to unborn generations."

In 1963 Jessica Mitford wrote *The American Way of Death*, and not much has changed since then. Mitford warned that anyone choosing to "tamper with the fundamental beliefs and ancient traditions of a society . . . had better think twice."

Let us, by all means, always think twice. Burial seems to have been forgotten in the winds of change but no area dealing intimately with Earth can be overlooked without grave harm to any society. Our bodies, like all bodies, are meant to return as sources of nutrients to the earth. In pondering what good we humans do in the scheme of things, this is certainly one of them.

There is much to be learned in accepting that we are mortal; the idea of adjudging our acts for the effects they will have on the seventh generation following us becomes an understandable concept and provides us with some of that old-time-religion of Live and Let Live. May death be your advisor; thou too must die.

References

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Illustration by Emma Hardesty



Permaculture and Participatory Development

by Kathleen Thompson

The Farmer-to-Farmer Volunteer Program "ain't no vacation." Just ask Dan Dorsey whose 7-day assignment supervising construction of a strawbale meeting facility sparked a technological revolution on the outskirts of Ciudad Obregón. Ask Bill and Athena Steen who speak of being "swallowed up" by the combination of need, enthusiasm, and community spirit of the Sonoran neighborhood of Aves del Castillo. Or ask Joseph Hickey who has traveled both to India and Mexico on behalf of the University of Arizona-based Farmer-to-Farmer program. All can attest to the hard work involved in a program which promotes sustainability in the developing world through the technical assistance of skilled volunteers in a highly participatory, hands-on process.

Introducing people to concepts of permaculture requires a lot of hard work—some of it physically taxing like heaving strawbales around in 100 degree temperatures. The other part of the hard work equation is the equally taxing mental and emotional effort required in order to listen, observe, understand, educate, encourage, persuade. All of that and more is required when we take seriously the cultural dimension of permaculture. In short, the knowledge and technologies which we introduce to promote sustainability can only *be* sustainable if they become an integral and permanent part of the culture of a population. That means working in a participatory fashion with and through other people. It means matching *our* pace and *our* knowledge with that of people we are trying to help. And sometimes, it means waiting. But, the rewards are more than we dream.

This is the story of one community, one project of a U.S. Agency for International Development (USAID) program administered by the Bureau of Applied Research in Anthropology at the University of Arizona, and some of the volunteers who helped translate dreams into reality.

The Community

Aves del Castillo is a marginalized settlement on the outskirts of Ciudad Obregón, an urban community of approximately 400,000 in Sonora, Mexico. The smaller community, with around 5000 inhabitants, extends like a peninsula from the urban area, and is surrounded on three sides by a broad agricultural region. Wheat and soybeans are the two principal crops in the area, grown for use in Mexico itself. Following the harvest, farmers burn the fields to get rid of the waste straw, creating great clouds of smoke and soot. During this time, which lasts for several weeks, Aves del Castillo residents are beset with respiratory problems and eye irritation. While the health problems have long been recognized, the practice of burning straw is traditional and has been difficult to control.

People in Aves del Castillo are poor and generally cannot afford the materials to build effective shelter. Currently, most homes are built with whatever is available—usually a combination of corrugated tin, used boards, old signs, and other found materials. Blankets are frequently used for doors and windows, while insulation is virtually non-existent. Homes are cramped for space; hot in summer and cold in winter. Many leak. Heat is a particular problem in an area where summertime temperatures can soar to well over one hundred, and aside from pervasive discomfort, represents a



Mexican villagers learn from Farmer-to-Farmer volunteers how to convert agricultural waste products into efficient and affordable housing.

health problem for the very old and very young.

It was in this context that the Farmer-to-Farmer Program began working with the Mexico-based Save the Children Foundation, conducted a preliminary community needs assessment, and decided that strawbale housing might be a very salable lead technology in a comprehensive package of sustainable development activities. Dan Dorsey was recruited to get the process kicked off and made his first visit to the area in October 1992.

Matching the Pace

Things moved slowly at first. People were interested in the talks Dan gave about strawbale, but in spite of the horrendous condition of existing homes, community members were reluctant to consider it seriously. Many were unwilling to trust the long-term viability of a technology so different from what they grew up with. With others found it hard to abandon their dreams of someday being able to afford the traditional-style house of the Mexican middle class. Farmer-to-Farmer staff turned their attention to other projects, checked back with Save the Children occasionally, and waited. Dan's first visit to Sonora was followed some months later by a trip to Tucson by Save the Children staff. They toured strawbale structures here. More interest. More waiting. Dan made a second trip to

Sonora in January 1993. Talk, talk, talk. But this time a women's organization, *Mujeres Activas*, was ready to begin planning construction of a strawbale community meeting facility. Blueprints were drawn up with input from the villagers to ensure appropriateness of design, to ensure materials were locally available, and to take advantage of local skills.

At last, from May 9 through May 18, 1993, the community of Aves del Castillo came together with a Farmer-to-Farmer team, under the leadership of Dan Dorsey, and constructed the strawbale meeting facility. From the outset it was clear that the benefits from this introduced technology would be multiple ones. It provided shelter at less than half the cost of traditional Mexican homes of comparable size. It was also energy efficient. Construction took place during the torrid heat of June, and temperatures inside the strawbale were noticeably cooler than outside—and far more comfortable than other buildings in the community. While the technology represented a wide departure from traditional buildings, it also provided numerous opportunities for encouraging the use of local skills (i.e. stucco workers, roofers, cement workers, etc.). The building provided a functional demonstration site for members of the community and for visitors to the area. Finally, by demonstrating a marketable use for baled straw, it opened the possibility of reducing the pollution caused by burning straw in the fields.

Getting Everyone Involved

Participatory development is a great way to maximize exposure to a good idea and to build momentum for change. The project brought together people from both sides of the Mexican-American border, combining limited resources of government and non-government organizations, a technical training institute, community members, and private enterprise. Farmer-to-Farmer Program coordinated assistance from the United States, while Save the Children and *Mujeres Activas* coordinated community efforts. Donations of land were made by the municipal government of Ciudad Obregon. The General Agency for Agricultural and Technical Education supplied the bales of straw. Both local businesses and individuals from the community donated other materials used in construction.

A core group of approximately 10-20 people from the community attended the workshop sessions and assisted with the labor all day, every day. Significantly, this core group included as many women as men. Many individuals who did not have time to attend all of the workshop sessions saw the potential benefits of the project and showed up to help when they had time.

Save the Children contacted the media, government officials and other non-governmental organizations in Mexico to advise them of the workshop. As a result, there were numerous visitors to the project site both during and after construction. Additionally, news cameras and reporters captured the salient points of construction and cost, and presented them to the public.

Building the Momentum

During the weeks immediately following the workshop, community members remained organized to complete the model strawbale house, installing a door and windows, pouring a floor, and stuccoing walls. A "ventana de verdad" ("truth window"), was left to expose a small section of straw beneath glass so that visitors can see that the building was indeed built of straw.

The first strawbale structure was built for community use because most people did not feel comfortable with the unfamiliar type of construction. But the seed had taken root. The second structure was built by a member of the community who had attended all the workshops. He incorporated some of his own ideas into the housing design, constructing the roof from beer boxes stuffed with straw and embedded in a grid of rebar, cement and chicken wire. Working with a design provided by another Farmer-to-Farmer program volunteer, Teodoro combined new technologies, installing a solar

cooker so it could be accessed from inside the house. When a hurricane struck later in the year, 40 people huddled inside the strawbale home of Teodoro Inojoso. The community had a new champion, and a renewed interest in the possibilities of strawbale construction.

By the time the Mexican government came through with funds to construct 17 additional strawbale homes in Aves, willingness to experiment with sustainable technologies was growing stronger by the day. Bill and Athena Steen gave the concept of experimentation a real boost. Beginning in November 1994, in a series of volunteer expeditions for FTF, they worked not only with strawbales, but introduced sand bag construction, built-in seating (bancos), "rammed straw," and countless other technologies for building and mixtures for plastering walls. The combinations of volunteer-introduced and community-generated ideas have become countless. Ideas like using locally available bamboo instead of rebar and finding less expensive substitutes for cement, have brought the price of straw construction from \$5000 for a full-size house to just over \$200. Save the Children staff from urban areas like Puebla, Mexico City and Guanajuato have inquired about using rice straw, soy stubble or pinto bean straw. New social structures emerged, tying the technology to cultural ideas of equitable distribution of benefits—people formed work groups to assist less able members of the community in building their homes.

In March 1995, FTF volunteer Lucia Hoerr helped install demonstration vegetable gardens near the original strawbale meeting facility. She also trained women in composting and solar drying of food. The women of Aves came up with a brilliant, inexpensive, and washable, substitute for wire-mesh screen in solar food dryers: tulle. The nearby community of Robles and a local school also set up demonstration gardens. Kenny Dessain, this time with his wife, Maggie, returned to focus on making and using soy products with solar cookers, and to introduce composting toilets.

Each introduced technology, as it becomes appropriated by members of the community, provides additional possibilities for microenterprise, expanding the opportunities for both men and women to remain in the community and make a living. Identifying and developing a market use for straw, long-considered a "waste product" of the region, opens up income-generating possibilities in agriculture, baling and transporting straw, production of twine for straw, and building trades, to name a few. Women have been talking about solar drying fruits and selling them to the children at school, a nutritious and less expensive option to candy. In June, Farmer-to-Farmer will begin collaborating with Solar Energy International to explore the possibilities of a commercial-size solar oven and the potential of photovoltaic use in Sonora.

There is an enormous amount of work left to be done. For every person who now has adequate shelter, dozens more remain in simple shacks with dirt floors. Electricity is far too expensive for most budgets, hot water is still just a dream, and the sewage problem, like population in the area, continues to grow. Farmer-to-Farmer, Save the Children, and people in communities like Aves del Castillo, need more time and more help and more resources than current political realities will allow. But progress, after all, is about heading in the right direction, and about rekindling hopes, and about people who care. If we can sustain that, the hard work is most definitely worth it.

People interested in knowing more about the Farmer-to-Farmer Program may contact Thoric Cederstrom or Kathy Thompson at (520) 622-5546.

Simple Solar Oven

by Dan Dorsey

The oven described here is easy and inexpensive to build. Its shape is a triangle with 30, 60, and 90 degree angles. This design allows the oven to be used at high and low sun angles. Around the winter solstice, or late in the afternoon, the oven is placed with the 60 degree angle on the bottom. At summer solstice, the 30 degree angle is on the bottom to capture the high sun.

This solar oven will reach 200 to 225 degrees Fahrenheit on a good day, high enough to bake just about anything. If a recipe calls for 350 degrees, the dish will still bake, only it will take longer to cook. An increase in temperature can be obtained by substituting more expensive materials. For example, the outside box could be built from plywood, and rigid commercial insulation could be used instead of cardboard. (I recommend experimenting with cheaper materials first.) My aim was to use the most inexpensive materials available while still developing a durable product.

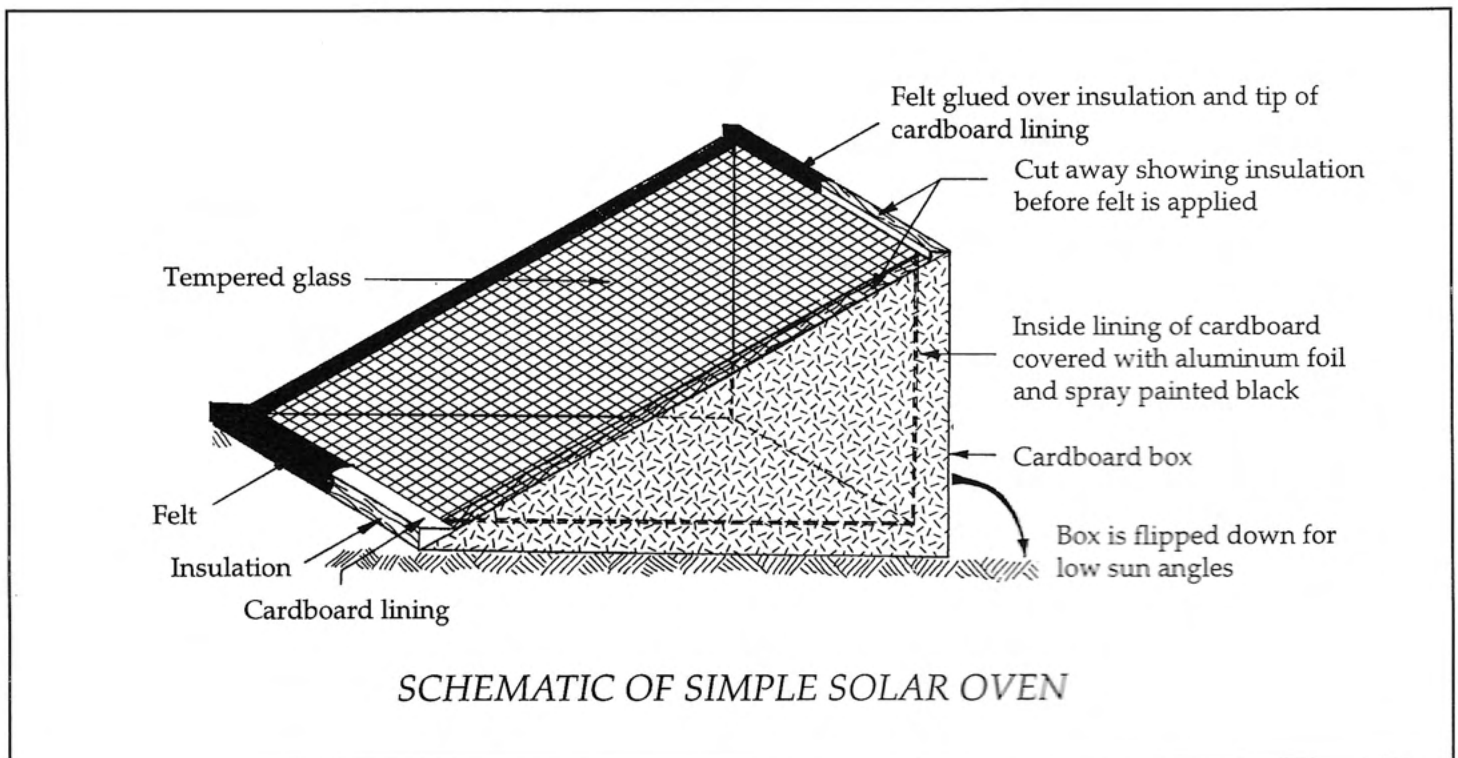
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The oven needs to be moved periodically to track the sun as it moves east to west. If I am going to be gone for the day, I position the oven slightly west of south, and my meal is usually cooked by evening.

The solar oven has other uses. Since drying is an excellent way to store excess fruits and vegetables in drylands, I have used mine as a food drier. Just grate or cut food into small pieces and dry at low heat. 125 degrees Fahrenheit is the optimum temperature to dry fruit. By leaving the glass slightly open, a lower temperature can be maintained. Check it often to prevent burning.

The oven could be built to fit into a south facing window where it would double as a solar collector in the winter. A door could be cut into the back, and a small photovoltaic-powered fan could blow hot air from the oven into the house. Finally, the oven provides a surface for culturally relevant information, such as pictures of friends and family, flyers about upcoming events, radical manifestos, and notations on the amount of rainfall received each summer.

A solar oven is one small step in creating a sustainable way of living. By combining small steps into beneficial and overlapping strategies, we create sustainable living systems



MATERIALS AND TOOLS NEEDED FOR SOLAR OVEN CONSTRUCTION

- | | | |
|---|---|---|
| <ul style="list-style-type: none"> •sturdy cardboard box •extra cardboard or newspapers •heavy-duty aluminum foil •high temperature black paint •sheet of tempered glass | <ul style="list-style-type: none"> •strips of felt •carpenter's wood glue •high temperature caulk •oven thermometer •caulk gun | <ul style="list-style-type: none"> •sharp x-acto knife •straight edge (yardstick) •scissors •protractor |
|---|---|---|

How to build a simple solar oven

Step 1: Find a sturdy cardboard box about 2 feet by 2-1/2 feet or larger, and remove the top.

Step 2: Cut the sides of the box into a 30/60/90 degree triangle. (Use a protractor to mark off degrees on the box.) Try to get clean even cuts with the x-acto knife and straight edge.

Step 3: Using extra cardboard or newspapers, line the sides, bottom, and back of the box with an inch or more of insulation.

Step 4: Create the inner lining of the oven by cutting pieces of cardboard to fit the sides, bottom, and back. Glue aluminum foil to one side of these pieces. The best way to do this is to lay a square of aluminum foil down on a hard surface, apply glue to it, then press the pre-cut cardboard shapes down onto the foil. Weight the cardboard until the glue dries. The edges can then be trimmed with the x-acto knife or scissors.

Step 5: Put the cardboard pieces in the oven with the foil side facing into the oven. Caulk all seams and allow to dry. Spray paint the interior black.

Step 6: After trimming away any excess insulation or cardboard sticking above the top, bottom, and sides of the box, glue felt strips over the insulation and inner edges of the cardboard pieces. Take care to get a smooth surface along the slanted sides where the glass will rest.

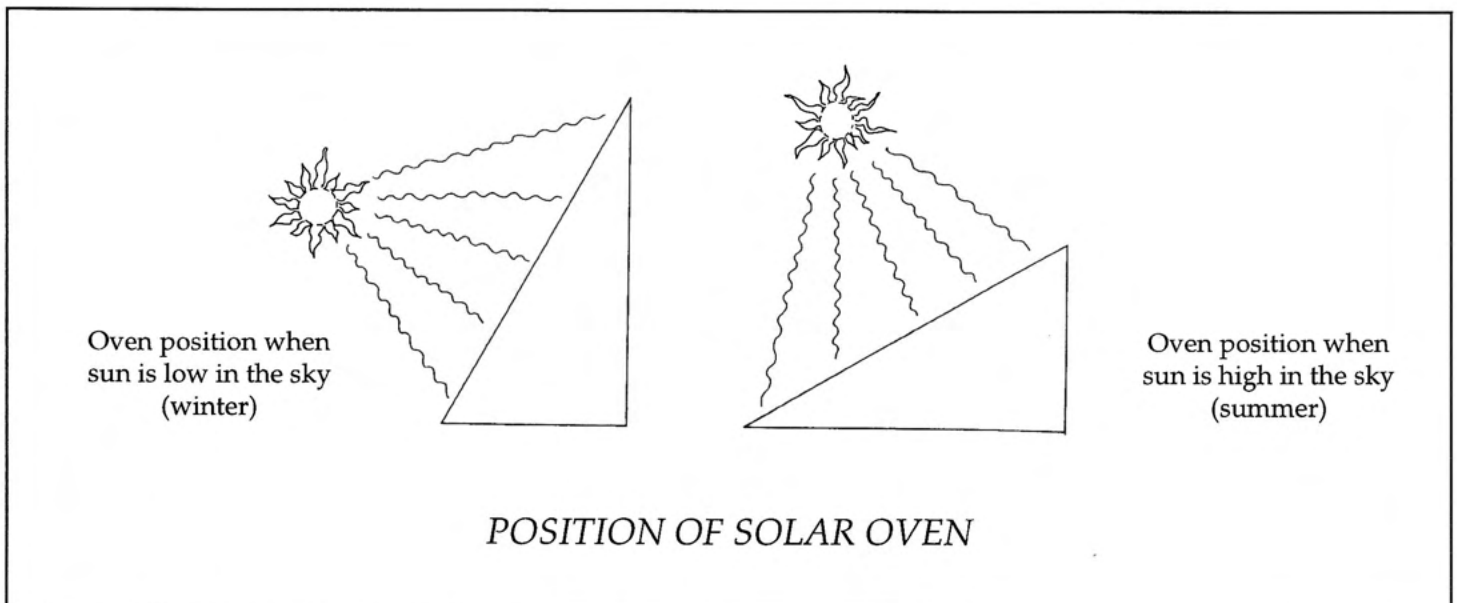
Step 7: Measure the dimensions for the sheet of tempered glass to fit over the box. Note from the diagrams how the glass fits the

oven. The width dimension is measured from the *outside* of the box to the *outside* of the box. The length dimension is measured from the *inside* of the insulation on top to the *inside* of the insulation on the bottom. Have the glass edges smoothed by the glass cutter to prevent cuts during frequent handling.

Step 8: Place the oven thermometer inside to test how hot the oven will get. Put the glass over the oven and face the oven south. Read the thermometer between noon and 2:00 pm. The temperature should be between 150 and 175 degrees Fahrenheit. If it is not, check for any places hot air may be escaping and try plugging these gaps with small pieces of felt.

Step 9: If your food doesn't cook, reflectors can be added to the sides of the oven to increase solar gain and temperature. An angle of 110 degrees from the surface of the glass works well. Cut the reflectors the same shape as the sides. Glue aluminum foil to the reflective surface using the same procedure described in Step 4.

Step 10: You're ready to cook. Set your oven in its "flat" position in the summer when the sun is high in the sky. Set it in its "tall" position in the winter when the sun is low in the sky. Since the glass piece is not anchored to the box, you will need to use care when opening it to put in an take out food. **When your oven is hot, so is the glass; use a hot pad to handle it if necessary!** While special cookbooks for solar ovens exist, generally, any recipe will do well. Heavy, dark colored pots (black) work best. Keep the oven facing toward the sun by periodically turning it to track the sun.



Enriching Soil Through Cover Cropping

by *Kate Tieman*

Bare earth under a canopy of orchard contrasts sharply with lush stands carpeted with vegetation, alive with the hum of insects, the flutter of butterflies and the song of birds.

The ancient practice of cover cropping creates these lush carpets. Cover cropping performs many functions: protecting the soil from erosion and the harshness of the sun, tilting the soil, harvesting nutrients, providing habitat for beneficial insects, building organic matter, attracting and keeping damaging insects off other crops—the list of benefits goes on.

Incorporating the crop into the soil, it becomes “green manure”; when interplanted with a main crop, a “living mulch”; a “smother crop” when used to choke out weeds; a “nurse crop” when saved to help establish a planting, as a quick temporary cover—a “catch crop”; and harvested, it can be made into compost.

Healthy food producing systems depend on living soil, whether it's a tiny tray of sprouts in your kitchen window or 1000 acres of crop. Vibrant, alive soils produce vibrant plants that resist disease and pest predation, which in turn enhance the well being of those that consume them—an interrelated, life enhancing web, each element supporting, and contributing to, the other.

Fertile topsoil contains an abundance of soil life. In a handful of rich friable soil, larger soil animals may be evident including worms, grubs and myriad others. Invisible in this same handful of soil are the microorganisms that are the basis of the entire food chain; the primary workers in the decomposition of organic matter into available nutrients for plant growth. They are not only in the soil, but of it. The microflora in just one gram of soil includes over a billion bacteria, millions of fungi, hundreds of millions of actinomycetes and more than a hundred thousand algae. The same gram also contains microfauna. These microbes are extremely susceptible to soil conditions such as oxygen availability, pH, moisture, temperature, and quality of organic matter. Responding to the incorporation of cover crop residues, the bacteria may double their numbers in 30 minutes.

Humus is a structure of slowly decaying compounds synthesized biochemically or modified from organic matter by soil microorganisms. Humus is a dark brown spongy medium whose structure allows for increased root growth and provides a beneficial microhabitat with a vast interior surface area. It is able to absorb 80 to 90 percent of its weight in water. This moisture-holding capacity alone may make the difference between a successful and unsuccessful crop in a dry year. In addition, humic acid eats away at the rocks and stones in the soil releasing the minerals for plant consumption and increasing soil formation.

A key to soil humification is the stage of growth at which the green manure crop is incorporated into the soil. Mature stalks and stems at the early bloom stage contribute the most to humus buildup. The carbon-to-nitrogen ratio is fairly narrow, meaning that there is enough nitrogen in the residues to facilitate the break-

down of organic matter without drawing excessively on the soil's own reserves.

In our humus-poor drylands, a simple and effective way of developing soils combines sheet mulching and cover cropping. This system has been used successfully to heal areas damaged by overgrazing, ravaged building sites without top soil, and areas where soils have been so compacted, rainwater no longer penetrates.

No preparation of the site is required, though the sheet mulch/cover crop process is enhanced by pre-irrigating the area. Sheet mulch layers of varying thicknesses are placed on the surface and seeds are sown into the manure or compost layer. If straw is used as the top layer of mulch, it often contains sufficient seed to germinate a partial crop (placing a cardboard layer under the mulch is not recommended for a seed sowing regime). Plan this approach to coincide with the rainy season if there is sufficient and consistent enough rainfall to allow for the needs of germinating and developing seeds. Supplemental irrigation may be required.

The choice of cover crop to be sown depends on the desired outcome. Is nitrogen building needed? Is mining of phosphorus or calcium from deeper horizons of the soil desired? Do you need to break up clayey soils? When will the crop be sown—warm or cool season? Is irrigation an issue? Is it a problem if the crop goes to seed? Will there be root competition (as in a young developing orchard)? Are perennial plants or weeds to be used as the crop?

I have found that choosing a guild of plants for cover cropping serves more functions than a limited monocrop system. Guild elements include plants whose deep tap roots break down, impregnating the soil with organic matter deep into the strata. Leguminous plants, in symbiotic relationship with rhizobium bacteria, fix nitrogen on their roots. Fibrous rooted plants have a root mass which will provide an abundance of organic matter in the soil's upper horizon. These same crops in their flowering phase will attract a vast number of beneficial insects (including pollinators and parasitic wasps) which in turn attract bird populations who leave behind phosphorus rich droppings—and occasional seeds—further enhancing diversity and function.

As the cover crop comes to maturation—when seed formation is imminent—it is time to harvest the crop. A tremendous amount of available nutrient and plant vitality goes into the production of seed for annual crops, so if the desired outcome is to make this nutrient available to the soil, it is important to harvest prior to seed production. Conversely, if the goal is to continue cover cropping over a longer period of time, the plants can be left to go to seed to produce crops in ensuing years.

On-site composting, and sheet mulching over a cover crop, can occur simultaneously simply by cutting the crop while green, leaving it in place, then covering it with several inches of dried material such as straw, oak leaves, etc. The roots break down in the soil and the surface mulch is enriched and enlivened with high

nitrogen organic matter. With nitrogen fixing plants, full benefits from the nitrogen nodulation of the rhizobium bacteria is attained only if the roots are separated from the vegetative growth and allowed to decay in the soil.

Bare soil is unnatural. Nature is a passion of creation; her evi-

dence is all about us. Every square inch of earth supports life; only the availability of water and soil limit how much. By feeding the soil, applying the age old tradition of cover cropping, we help sustain ourselves and myriad other creatures both visible and invisible, thereby increasing diversity and enhancing the web of life.

SUGGESTIONS FOR COVER CROPS

Austrian Winter Peas (*Pisum sativum*)

- Legume, fixes nitrogen up to 70 to 125 pounds per acre • attracts beneficial insects • cold hardy • competes with weeds • does well in heavy soils • use in soup • sprouts are edible

Bell Bean, (smaller seeded version of *Vicia faba*)

- legume, fixes nitrogen up to 150 pounds per acre • open soils with its strong root system • attracts beneficial insect • creates lots of biomass

Lab Lab Hyacinth Beans (*Dolichos soudanensis*)

- legume, fixes nitrogen up to 150 pounds per acre • warm weather crop • flowers have insect-repellent qualities • edible substitute for garbanzo beans • will grow with little irrigation

Fava/Broad Beans (*Vicia faba*)

- legume, fixes nitrogen up to 150 pounds per acre • attracts beneficial insects • deep rooted • cool/cold weather crop • protein-rich, edible large seed

Fenugreek (*Trigonella foenum-graceum*)

- legume • cold weather crop • medicinal • excellent for opening heavy soils • aromatic herbage

Lupine (*Lupinus albus*)

- legume, fixes nitrogen up to 50 to 125 pounds per acre • long tap root aerates soil • accumulates soluble phosphorus • attracts bees, beneficial insects • can tolerate any soil except heavy adobe • needs 15+ inches of rainfall • hardy to 16 degrees

Buckwheat (*Fagopyrum esculentum*)

- hot weather crop • smothers weeds • good biomass production • accumulates soluble phosphorus • trap crop for thrips during bloom of fruits, vines • attracts beneficial insects • edible sprouts • quick crop • great orchard use • flour production

Buffalo Grass (*Buchloe dactyloides*)

- warm season crop • sod-forming • minimum rainfall 12 inches annually • good for erosion control • spreads and seeds well

Meadow Barley (*Hordeum brachyantherum*)

- short-lived perennial • good orchard use • erosion control characteristics • pioneer plant which gradually gives way to other grasses as site improves • excellent nurse crop • tolerates drought, alkaline soils, infertile and compacted soils

Mustard (*Brassica rapa and Sinapis alba*)

- tremendous root system opens heavy and compacted soils • "mines" calcium from subsoil • will grow in low fertility soils • attracts beneficial insects • cool weather crop

Oil Seed Radish (*Raphanus sativus*)

- active against cyst and string nematodes • oil producing • attracts beneficial insects

Rape (*Brassica napus*)

- breaks up clay soils—strong tap root • dense growth chokes out weeds • turned under has some nematocidal effect • oil producing • attracts bees and beneficial insects

Vetches (*Vicia dasycarpa/Vicia villosa*)

- legume, very high levels of nitrogen fixation • produces substantial amounts of organic matter • chokes out weeds • attracts beneficial insects

Comfrey (*Symphytum officinale*)

- perennial • produces great biomass • large tap root accumulates phosphorus • attracts beneficial insects • medicinal • Beware! every little piece of root will grow another plant. Gophers can spread it into unwanted parts of the landscape

Clovers (*Trifolium spp.*)

- excellent in specific situations, but can be too water demanding

NOTE:

Don't overlook the value of "weeds" as a cover crop. Dig out plants and look at their root structure. Tap roots penetrate deep into a soil layer, collecting nutrients, creating channels for organic matter, and aerating the soil as they decompose. Fibrous roots provide an abundance of organic matter close to the soil surface (one cubic inch of soil planted to rye contains 1300 feet of roots and root hairs), and accumulate nutrients in the soils upper horizons. They are particularly good systems for erosion control.

SOURCE FOR COVER CROPS:

Happy Valley Farm Supply (great catalog)
PO Box 2209, Grass Valley, California 95945
(916) 272-4769

A Visit to "Running Rain Society"

by Roxanne Swentzell

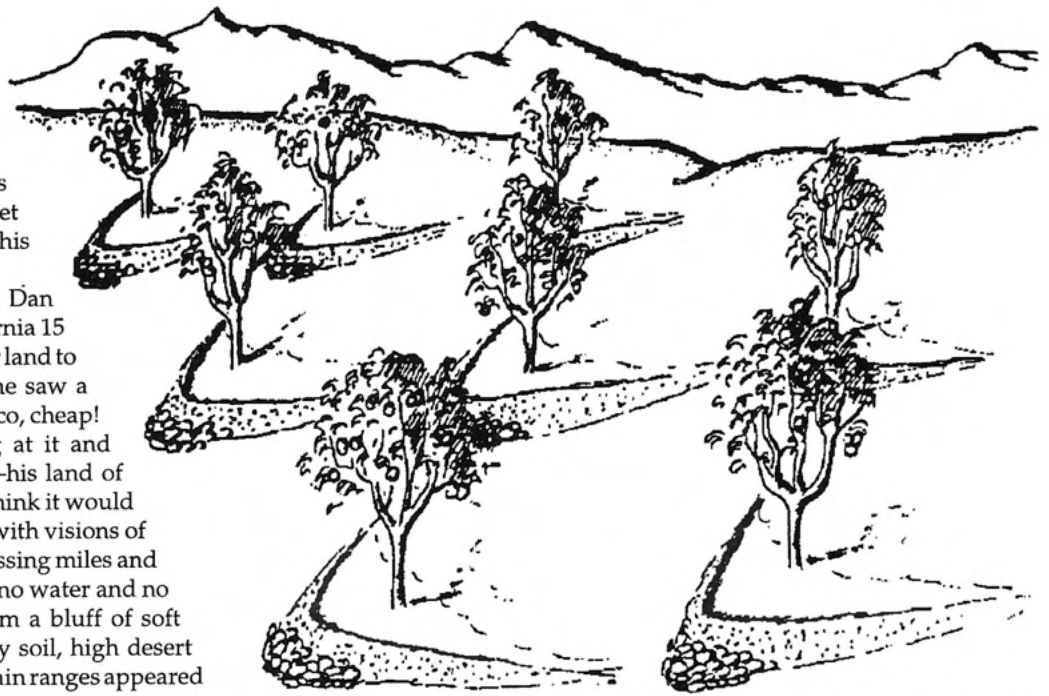
Driving back home from a conference in southern Arizona, I had the pleasure of spending the night and next morning at Dan and Karen Howell's place near Datil, New Mexico. I had heard about "Datil Dan" for many years and was quite excited to finally meet this now legendary person and see his land. I was not disappointed.

The story I had heard about Datil Dan went like this: he was living in California 15 or 20 years ago and decided to look for land to buy. On the wall of a laundromat, he saw a note about land for sale in New Mexico, cheap! He bought it without even looking at it and headed out to see his future home—his land of paradise. He was in for a surprise (I think it would have been a surprise to most people with visions of paradise). The land, reached after crossing miles and miles of dirt road, had no electricity, no water and no people in sight. There lay before him a bluff of soft sandstone, a massive valley of sandy soil, high desert vegetation, and deep arroyos. Mountain ranges appeared in the far distance.

Dan and Karen tell me they watch the rain clouds pass over their land as the clouds make their way to these distant ranges. The beauty of this place is awesome. It causes one to stop and stand still; listen and remember time. The Chaco peoples of the 1200s roamed this country, making their homes throughout this apparently barren land. Karen showed me some amazing artifacts found during her walks on the land.

I had heard rumors about Datil Dan being a human backhoe, shoveling ponds by hand and cleaning them out each year, again by hand. It's true! Not just one, but several small ponds lie in the paths of small arroyos coming off the hill on their land. These fill with water when—or if—they get a good rain storm. Then they pump the water out of the ponds into water tanks for use later when the rains have stopped. If any water escapes the ponds, it's quickly caught in a number of swales winding their way across the gentle slope of bottom land. The overflows of these swales are beautifully lined with stone.

One of the more exciting features at their homestead is the collection of small arroyo runoff gardens. Fenced in, to protect them from rabbits and their own wandering chickens, the gardens are lush islands in the otherwise harsh surroundings. When I visited, they were heavily mulched with straw, and even though it was in February, the sensation was of damp dark earth, crawling with earthworms and life. A canopy formed from a variety of green vegetables grew happily here. Karen told me they had more asparagus than they could eat!



Boomerangs support an orchard. (Illustration by Diana Hamberger.)

Having heard of a variety of permaculture techniques for water harvesting, I was glad to see so many techniques in actual use. The homesteaders were using old tires for gabions, and had constructed beautiful stone gabions as well. The boomerang technique was in use on a slight slope, with each V-shaped boomerang containing one fruit tree. The rain running off their roof collected in galvanized tanks and supplied their drinking water . . . good tasting water, too.

Besides ponds, Datil Dan hand dug a root cellar. As I walked down the wooden steps into this room under the earth, I couldn't help thinking about the lonely days the two of these inspired people spent in the humbled manner of digging, planting, waiting for those clouds to come; for the plants to grow. I thought of how *we*, who are under an illusion of plenitude here in the southwestern United States—hooked up as we are to the generators/power plants/fossil fuels that keep our water running through our showers and toilets—forget that once we were all more aware of those clouds up in the sky. The clouds would determine what tomorrow would bring. Thank you, Dan and Karen, for reminding us.

Editor's note: Roxanne has suggested we run a regular feature of people sharing their impressions of permaculture sites they have visited. We welcome your site visit essays! Send them to PDJ, PO Box 64184, Tucson, Arizona 85728.



HUMANURE HANDBOOK *A Guide to Composting Human Manure*

By Joseph C. Jenkins, Jenkins Publishing, 1994, PO Box 607, Grove City, PA 16127, USA. 198 pages, 63 tables & figures, 19 photographs and a few bad jokes. \$15.00 post paid.

"The world is divided into two categories of people: Those who shit in drinking water and those who don't." Thus Joseph Jenkins begins his first chapter, and gently encourages us, over the next 198 pages of outrageous humor and brilliant, diligent research, to understand our nutrient cycle at its most fundamental level: growing food, eating, excreting and renewing the soil for the next go-round.

For 16 years, Jenkins' family has been using a simple sawdust toilet (a 5-gallon bucket), which is emptied every few days into his hot (thermophillic) compost pile. It provides his family with free nontoxic garden fertilizer, and only uses the labor and materials necessary for good compost.

Jenkins' care for earth, people, and ethical systems is evident throughout his work; his painstaking research and historical review (he's read a lot of shit!) serves to remind us that "...feces recycling is one of the regular and necessary chores of sustainable human life on this planet," and it's clear that he's doing a much better job in his backyard than the local D.O.E. or wastewater management company.

While Jenkins provides us with useful tables and charts about bacteria pathogens, thermophillic decomposition, and results of scientific testing of his piles (no pun intended), it is ironic that a simple inexpensive, homely five-gallon bucket with a toilet seat, and a well tended compost pile nearby, can so effectively and elegantly render "waste" into a resource—and solve a horde of major pollution problems.

This is one book that could save the world! For drylands folk, some fine-tuning of the system Jenkins describes will be necessary to conserve moisture and make the most of seasonal extremes. Jenkins' homestead receives 35 inches of rain annually, with lots of humidity in the air, and raw materials. In my garden, rain water harvesting and mulching are critical to creating enough moisture for gardening and composting most of the year, as is a wind proof, moisture-retentive surrounding for the piles themselves. Seasonal monsoons and corresponding sheet flooding on overgrazed expansive clay soils in a basin-and-range landscape are worth serious consideration before locating a humanure compost system (all in a day's work for a good permaculture site design...).

This book was self published by Jenkins—can you see Price Club and Real Goods power lunching over this one? Give Joe your support: order several copies from him today. They make great gifts.

—Barbara Rose

HOW TO BUILD YOUR ELEGANT HOME WITH STRAW BALES *A Guide for the Owner-Builder.*

By Steve Kemble. Sustainable Systems Support, PO Box 318, Bisbee, Arizona 85603, 1994. 90 minute video and 60 page manual. \$64 postpaid.

Building sustainably: What do we build with? Where does it come from? How do we get it here? How long will it last? How will it recycle when it wears out? How does it heat, cool, breathe? How does it feel, look, inside and out? How does it fit the landscape?

Steve Kemble of Sustainable Systems Support addresses these concerns in a comprehensive how-to video and manual featuring the creation of a small, plastered straw dwelling, from concept through construction.

The video weaves back and forth between the hands-on step-by-step building of one structure, to the guidelines and tips which would benefit anyone considering building. It demonstrates sensible design, solar orientation, sight and climate considerations, thermal storage and ventilation, load-bearing, post-and-beam, and hybrid structures, as well as choices in lower energy-use building materials (salvaged/recycled) and designing for multiple functions.

I especially liked watching how well the neighbors and friends work together. The bales go up, steady and plumb, everybody bends their knees while lifting, safety and teamwork is demonstrated, with full participation of women and men of varied construction experience.

This educational video will empower many individuals and communities to responsibly design and build a sustainable future.

—Barbara Rose

Building With Straw Volume 1, A Straw Bale Workshop; **Volume 2, A Straw Bale Home Tour**

By Black Range Films, Box 119, Kingston, New Mexico 88042, 1994. A two-volume video set, 73 minutes and 68 minutes, respectively. \$29 each, plus postage.

This two-video set on strawbale construction nicely complements the extensive technical information covered in the video reviewed above. If you have never attended a strawbale construction workshop, you'll experience the comradery and empowerment of rank amateurs accomplishing building feats in Volume 1, A Straw Bale Workshop. A 12-foot tall greenhouse addition to Black Range Lodge is tackled by a willing crew with a mountain of bales alternating between classroom and construction. You'll know exactly what you're getting into when signing up for your first workshop.

My favorite is Volume 2, A Straw Bale Home Tour. This inspiring visit to southwestern strawbale homes starts with the pioneering couple who built their small New Mexico strawbale home for \$7.50/square foot using "found" materials. The tour winds through homes of increasing complexity, culminating in a \$100/square foot, sprawling Santa Fe-area home. In between are variations including strawbale homes clad in drywall, but the real gems are the modest, warm, earth-plastered, round-edged, friend- and family-built homes that epitomize the accessibility and comfort of strawbale construction. This tour is a delight! Also, watch for the forthcoming companion video on strawbale testing and codes, prepared by the same producer. This compendium of research on fire, compression and other code oriented data is aimed at the audience of code writers and inspectors who need a quick education on strawbale construction characteristics.

—Ann Audrey

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Women for Sustainable Technologies Announces Annual Conference

A new nonprofit organization, Women for Sustainable Technologies, has been created to educate women about sustainable technologies and encourage them to share information and new ideas about development of sustainable communities. The organization's goals are to educate women and girls in the adoption, development, support and maintenance of sustainable technologies; to meet and exchange ideas and information among women concerned about the long-term sustainability of communities; to encourage women to study technologies in school and to build careers rooted in sustainable value systems; to identify and showcase women making contributions to the field of sustainable technologies; and to encourage the development of new sustainable technologies.

The group encompasses women from technical, social sciences, and environmental education backgrounds, along with business women and community organizers. Members identify strongly with their roles as mothers, house-stewards, workers, commuters, and voters. They share a concern about sustainability on a local and global level, and a conviction that women have a significant role to play in creating a sustainable future.

Currently, the group's primary focus is setting up an annual conference as a follow-up to last year's forum on Women and Renewable Energy held at The University of Arizona in Tucson. The conference will provide an opportunity to learn about and discuss issues in the field of sustainable technology in a non-intimidating atmosphere. This year's forum will be held November 4 and 5 and will include technical workshops on building technologies, water, waste management, landscaping, transportation alternatives, and community design. Additionally there will be focus groups on relevant legislation; public relations and media; business development and financing of sustainable technologies; education, and ethics. A resource room will provide information on educational opportunities, workshops, training programs, journals, relevant organizations, funding opportunities, regulations and codes. **For more information on the conference and the organization, contact Women for Sustainable Technology at (520) 690-6356.**

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Seeking Internships in New Mexico or Arizona. Bonnie Kottiel, 34, and husband Jeff, 32, seek a farm that successfully marries ecologically sound, sustainable agriculture with prosperous marketing. They want to be involved in all aspects of the farm during an internship that lasts from 1 to 3 years. If necessary, they can provide their own housing. They bring excellent business skills having owned a furniture design business for 12 years. Their choice to leave the furniture industry is a first step towards their goal to be organic farmers and align their livelihood with their highest values. Related interests: sustainable farming, permaculture, biointensive farming, alternative energy, veganism. Because of religious beliefs, they can't consider farms emphasizing animal slaughter. Contact Bonnie or Jeff Kottiel, 5931 Monnett Rd., Julian NC 27283 (910) 697-7696.

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Regional Course Schedule

Permaculture Garden and Orchard Techniques: September 16-17. Galisteo, New Mexico. Instructors: Christopher Peck and others. Sponsored by Earth Works Institute. Intensive two-day workshop covering integration of water harvesting into gardening, keyhole beds, guilds, sheet mulching, and deep pipe planting. Call 505/982-2161. Cost \$100.

How to Build a Strawbale House: September 30. Tucson, AZ. Instructor: Dan Dorsey. Learn the basics of strawbale construction, including building a house to code. Call 520/624-8030.

9th Annual Permaculture Design Course: September 25 - October 9. Basalt, CO. Instructors: Jerome Osentowski, Sandy Cruz, John Cruickshank, Dan Howell, and Michael Moore. Sponsored by the Central Rocky Mountain Permaculture Institute. This 14-day course provides hands-on experience with many aspects of permaculture including market gardening and the forest garden. Certification upon completion of course. Call 970/927-4158. Cost: \$800.

Fundamentals of Strawbale Construction: October 6-9. Canelo, Arizona (near Sonoita in SE AZ). Instructors: Bill and Athena Steen and Paul Weiner. Call 520/455-5548. Cost \$325.

Introduction to Permaculture: October 7-9. Nambe Pueblo, New Mexico. Instructors: Richard Montoya, Thomas Mack, and Ed McMillen. Sponsored by The Native Permaculture Center. Call 505/455-7503. Register with \$30 deposit by October 1. Cost: \$60.

Magical Mystery Permaculture Tour - Advanced Traveling Design Course: October 13 - November 22, 1995. Instructors: Jerome Osentowski, Michael Moore, John Cruickshank, Susan Mullin, Dan Howell, Cuco Moyron, and Pilar Ajouda Del Real. Sponsor: Central Rocky Mountain Permaculture Institute. Journey through southwest and Baja, Mexico, visiting well-established permaculture sites. Intensive five-week traveling course covers advanced design theory. Call 970/927-4158 for info and costs (daily and weekly rates available).

Bees and Top Bar Hives: October 14-15. Galisteo, New Mexico. Instructor: Marty Hardison. Sponsored by Earth Works Institute. Top Bar Beehives are inexpensive and easily built with simple hand tools. This class will teach students how to build a hive, set up a hive, maintain it and harvest honey. Call 505/982-2161 for more information and costs.

How to Build a Strawbale House: October 21. Tucson, AZ. Instructor: Dan Dorsey. Learn the basics of strawbale construction, including how to build a house to code. Call 520/624-8030

Natural Building Colloquium and Fair: October 21-27. Black Range Lodge, Kingston, New Mexico. A week-long series of workshops and construction projects will be offered including earth-bermed structures, strawbale dome construction, large kiva construction, water harvesting. Presenters include Matts Myhrman, Bill & Athena Steen, David Bainbridge and many others. Attendance by invitation only, for information or invitation to attend, contact Catherine or Pete at 505/895-5652. Cost \$350. For associated public events, see below.

1995 Strawbale Conference: October 28-29. Black Range Lodge, Kingston, New Mexico. Join strawbale professionals from the southwest gathering to share research, techniques, and project information. Call 505/895-5652. Conference fee \$50.

Natural Building Fair: October 28. Black Range Lodge, Kingston, New Mexico. Strawbale barn raising; cob, adobe and rammed earth demonstrations. Call 505/895-5652. Cost \$5 for adults; free for children and 1995 Strawbale Conference attendees.

Strawbale Work Tours in Mexico: November 25 - December 4 and January 19 - February 1. In Cooperation with the Save the Children Foundation, the University of Arizona's Farmer-to-Farmer Program, and local sponsors in the Canelo Project. The tour will be part of an effort to improve living conditions for people using strawbale techniques. Call 520/455-5548. Cost \$1200.

6th International Permaculture Conference Perth, Western Australia Designing for a Sustainable Future Sept. 28 - Oct 7, 1996

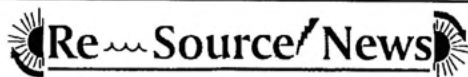
A conference to stimulate, challenge and extend our understanding of the design principles used to develop a regenerating, permanent culture on this planet. This major international event will be hosted by the Permaculture Association of Western Australia.

A program of Australian and international speakers is offered, along with forums, workshops, demonstrations, tours and a Convergence for Permaculture Certificate holders. The program will include

- A four-day conference of speakers, workshops, forums, children's programs and urban Permaculture site visits, set in a rural village atmosphere on the outskirts of Perth
- Tours of broadacre and small rural properties in the South West of the State
- A Convergence for Permaculture Design Certificate graduates
- Activities for those not eligible for the Convergence
- Pre-conference courses from September 1, 1996
- Post-conference tours.

Presenters with innovative ideas and projects are asked to contact us. If you are involved in creating change toward a sustainable future in your area, we need to hear from YOU. Participants in need of support to attend this important event are asked to contact us NOW.

For more information contact:
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