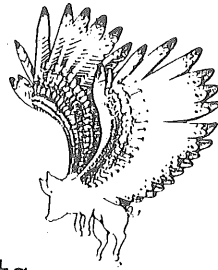




Fall 1990

THE LAND REPORT

Number 39



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Photographs: Tamara Kraus and Kris Schaefer took the photographs and made the prints for this issue, except for those on pages 25, 27 supplied by the American Minor Breeds Conservancy and page 33 by Susan Alancraig.

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On the Cover

After harvesting Illinois bundleflower all afternoon, the interns joined together and ceremoniously pulled the seeds off one last plant for the photographer. We aren't sure whose arms, legs, knees and hands are in the picture.

In This Issue

This *Land Report* contains an account of our activities during the fall session of 1990, plus three feature articles. Most of the stories are by our interns or about our interns, the nine young college graduates who spent 43 weeks here between mid-February and mid-December. Life at The Land Institute revolves around the intern program and their schedule of morning classes and afternoon physical work. They transplant in the greenhouse, hoe experimental plots, take data, and write reports of research results. Interns give tours to visitors, help with maintenance and construction, work in the garden, and they write *Land Report* articles, mostly on their own time. In this issue Doug Romig and Kathy Collmer chose to research issues in biotechnology and write feature articles. Paul Muto pursued his interest in minor breeds for another feature article. Holly Ewing wrote about prairie studies, and Tracy Noel contributed two pieces for the *Natural Connections* section. Tamara Kraus described the Visitors' Day program and helped Kris Schaefer take and print photographs of intern activities. Before scattering in mid-December, they posed for a group photo (back cover) that captures the intern spirit.

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THE LAND INSTITUTE IS A NON-PROFIT EDUCATIONAL-RESEARCH ORGANIZATION DEVOTED TO SUSTAINABLE AGRICULTURE AND GOOD STEWARDSHIP OF THE EARTH

BOARD OF DIRECTORS: George Comstock, Paula Bramel-Cox, Bruce Colman, Mari Detrikhe, Terry Evans, Charles Francis, Wes & Dana Jackson, Ivy Marsh, Rafe Pomerance, John Simpson, Alice Waters, Donald Worster

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At The Land

Mind-Mulch in the Fall Session

Jake Vail

"Is it always so windy here?" first-time visitors to The Land Institute often ask. Over the gusts we shout, "Yes!" Kansas, from the aboriginal "konza," in fact means "spirit of the south wind," and throughout the summer winds blow from the south. As the seasons change so too do the winds, and winter winds come from the north. This fall the changing winds assembled colorful visitors at The Land Institute like autumn leaves collecting in a garden bucket.

Each told a different story, which mixed unpredictably with class discussions. Add to the visitors and discussions a sprinkle of extra-curricular activities and the pile of leaves is transformed to compost, mind-mulch out of which amazing new ideas and actions grow.

While the Illinois bundleflower blossomed in August, writer/poet Lewis Hyde and his wife visited. Lewis is the author of *The Gift: Imagination and the Erotic Life of Property*, a fascinating exploration of art and gift exchange, myth, and economics. The Gift argues that nature's abundance is a consequence of our treating wealth as a gift, for the circles of gift exchange enter the cycles of nature and keep us a part of the whole. Property-based economics, in contrast, separates us from the non-human world.

"The gift must always move" explains Lewis; to break the circle and retain a gift as property destroys the intimate and dynamic relationship between giver and receiver.

A few weeks after the Hydes visited, the interns finished the summer field season and began to devote mornings to "Considerations for a Sustainable Society." Wes started fall classes with his vision of integrating ecology and economics. Reading from Herman Daly and John Cobb's important new book, *For the Common Good*, essays of historian Donald Worster, and some of his own speeches, Wes argued against the growth economy associated with industrialism and for an economic system that recognizes biological and physical limits and works creatively within them.

Ecologist Jack Ewel visited from the University of Florida and presented a slide show of his work which, like our research, uses nature as a model. One of the participants in the "Marriage of Ecology and Agriculture" symposium sponsored last October by The Land Institute (see *Land Report* #36), Jack takes a structural approach to agroecology which complements the process approach we take. He has found that agricultural systems which resemble an area's natural ecosystem (in this case a tropical forest) can produce high yields while cycling nutrients and resisting outbreaks of pests and diseases as the natural system does.

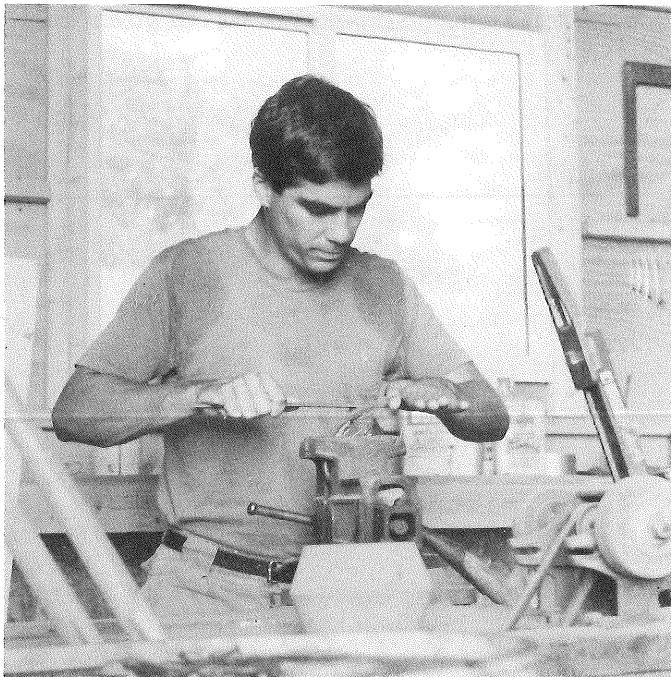
From tropical agroecosystems our attention

Class moves outside on a nice fall day. Clockwise from the left: Doug Romig, Kathy Collmer, Kris Schaefer, Holly Ewing, Peter Kulakow, Jean-Luc Jannink, Paul Muto and Tracy Noel.



turned to cities. Are cities sustainable? If not, can they be made so? Essays by Jane Jacobs, Lewis Mumford, and Paul Relis provided an infrastructure upon which we built our ideas, then Paul Relis came to personally broaden the discussion. Paul is executive director of Santa Barbara's Community Environmental Council (CEC), and a font of knowledge about local- and global-scale recycling issues. After visiting with the interns Paul addressed Salinans at a public forum on "The Future of Recycling," sponsored by The Land Institute, The Smoky Hills Audubon Society, The League of Women Voters, and Citizens for a Healthy Environment.

Integrated Waste Management is a concept pioneered by Paul and his coworkers at the CEC which considers not only material recycling, but the uses of recycled products and markets for them. Such an approach is slowly catching on as businesses and individuals realize its worth. For almost twenty years economist Herman Daly has espoused a steady state economy based on a systems approach, as Integrated Waste Management is. His ideas seem to be finally catching on, too. Plant breeder Peter Kulakow led class discussions of Daly's seminal works, plus writings of William Ophuls from his book *Ecology and the Politics of Scarcity*. Their theses are simple: we must pay attention to the consequences of our extractive economy. In the book *Economics, Ecology, Ethics*, Herman Daly declares: "Growth chestnuts have to be placed on the unyielding anvil of biophysical realities and then crushed with the hammer of moral argument."



Afternoon field work continued in September, even after classes began. Paul Muto sharpens hoe before going out to hoe the experimental plots.



Paul Relis

And if the nuts of growth-mania aren't crushed? Adam Smith's invisible hand broadcasts pollution, acid rain, ozone depletion, global warming, loss of biological diversity, festering megalopolises — the "ain't it awful" stories we hear (and tell) so often. It takes a nimble mind to bounce over the bad news and get to some concrete proposals for positive action: enter David Orr. Recently moved from The Meadowcreek Project in Fox, Arkansas, to the environmental studies department of Oberlin College, David is a long-time friend of The Land and thinker and speaker extraordinaire. Henry Thoreau recommended we "read not The Times, read The Eternities." David reads both, front to back and between the lines. After addressing a crowd of hundreds as part of Kansas State University's Lou Douglas Lecture Series, David visited The Land for an extended session with staff and interns. At KSU he posited that re-ruralization is inevitable, and presented suggestions to help make the transition a smooth one. A "discourse on methods" followed at The Land Institute, and David's political science background and familiarity with history emerged as he sparked discussion about community and the individual, language and values, new-Luddites, strategy, and praxis.

From New England came Robin Grossinger and Dick Backus. This past summer Robin worked with Ocean Arks, John and Nancy Jack Todd's solar aquatics firm that builds sewage treatment facilities using plants, animals, and sunlight as natural filters. Through "ecological engineering" Ocean Arks has expanded from its roots in the New Alchemy Institute to a successful firm in a few short years. Dick Backus

is on the board of New Alchemy and a retired scientist formerly with the Woods Hole Oceanographic Institute, and regaled us with tales of his ocean-going days studying bioluminescent fishes of the Atlantic.

Soon after Dick immersed us in the deep blue sea, author William Least Heat Moon came via blue highways to spend a morning. Many of us have an affinity for the tallgrass prairie of the Flint Hills and the human settlements there, but few have embarked on a project the scale of Bill's latest: a 76-chapter book on Chase County, Kansas. His book will take us from a time when millions of bison roamed the Great Plains to the 21st century, when perhaps only hundreds will remain.

Next on our schedule was Wendell Berry's *Home Economics*, a book of essays which attempts to describe our responsibility to a pattern that we are "wholly dependent on and only partly understand." That pattern and our responsibilities frequently enter into discussions here, and inspiration from the cycling of Wendell's ideas flows like energy from the revolutions of our wind generator propellers.

Operations manager John Craft seems to have taken William Blake's dictum that "Energy is Eternal

Delight" as his motto, and led a week of classes on energy basics with a passion that would delight the old poet. John explained electricity and solar and wind energy, and put the lessons in a context of living sustainably.

John's classes were a fitting preamble to hearing Hunter Lovins. Hunter is president and co-founder with Amory Lovins of The Rocky Mountain Institute (RMI), and followed David Orr in the Lou Douglas Lecture Series this fall. RMI is known around the world for its work in energy efficiency and national security. Hunter stopped at The Land on her way back west to Colorado, and as geese flew overhead we sat on the grass and talked about efficiency vs. sufficiency and the unpredictable behavior of complex systems — technological as well as social.

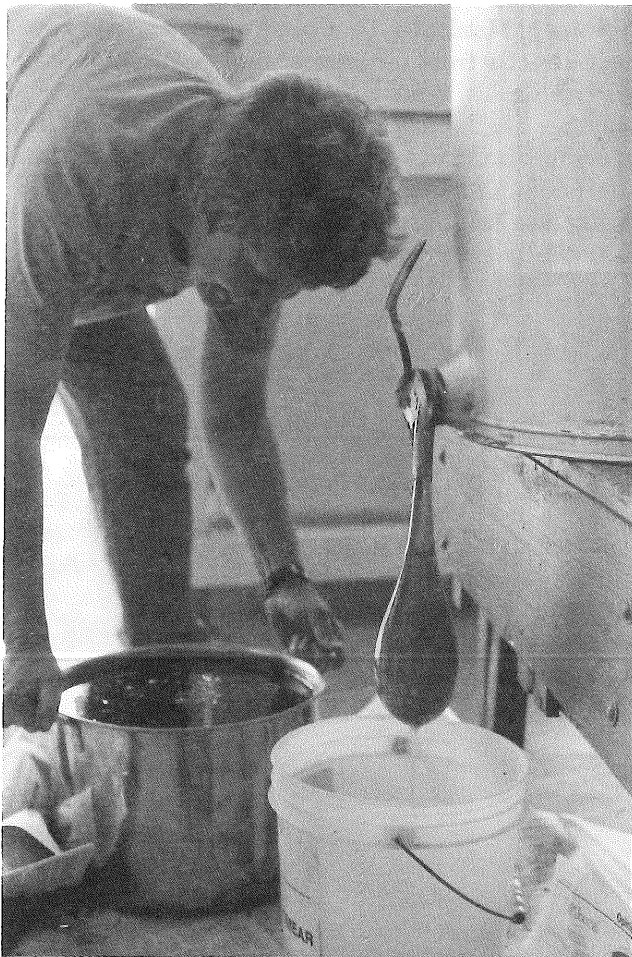
Convinced we should all do more to conserve energy, we then asked the question posed by Bryan Norton's book, *Why Preserve Natural Variety?* Part of David Ehrenfeld's *Arrogance of Humanism* enriched the discussions, which were led by Dana Jackson and staff ecologist Jon Piper.

Drive past the Konza Prairie like 1989 intern Pamela Cabbage and her folks did when they came to visit in October, and "it looks like grass." But Pamela, who studied vegetative patterns on the prairie last year, knows that a close look reveals staggering natural variety. A usually-invisible manifestation of such a diverse system can be appreciated if one keeps bees. 1990 was a great year for wildflower honey, and in early October Dana and intern Doug Romig harvested over 200 pounds of it from Dana's three hives.

Colonies of bees have long been used as metaphors for human behavior, and while not everyone agrees with E.O. Wilson's theories on sociobiology, certainly we humans have much thinking to do in areas the bees appear to have mastered, such as social learning.

Social learning and transforming society are concepts central to Lester Milbrath's comprehensive book, *Envisioning a Sustainable Society*. Transforming our dominator society to one based on partnership is the message of Riane Eisler's *Chalice and the Blade*. John McPhee's *Encounters with the Archdruid* describes David Brower's efforts to prevent human dominance over places of unique natural beauty. We spent several classes discussing selections from these books and exploring how changes in society come about. To warm Dana up for her talk at the E.F. Schumacher Society (to be published in *Land Report* # 40), we also discussed philosopher Jim Cheney's essay, "Ecofeminism and Deep Ecology."

With her new photographs from the Water and the West Project, Land Institute Arts Associate and board member Terry Evans spent a morning explor-



Dana replaces full container with empty one to catch honey filtered through nylon stocking from extractor.



Doug Romig listens intently as Tracy Noel makes a point.

ing the theme of art and the environment with the interns, wondering what the place of art and artists in a sustainable society might be.

To introduce the November 17 Kansas Sustain-

able Agriculture Conference and follow-up warm-up discussions on the 1990 farm bill, Dana led classes covering the 1980 U.S. Department of Agriculture study on organic agriculture chaired by Garth Youngberg. She related it to the 1980 study comparing organic and conventional farming done by the Council on Agriculture, Science and Technology (CAST), and a 1988 CAST study on the long-term viability of U.S. agriculture. Interns spent another day discussing the landmark report, *Alternative Agriculture*, published last year by the National Research Council of the National Academy of Science. After reading the study of Dick and Sharon Thompson's farm in Boone, Iowa, interns then had the opportunity to hear the Thompsons at the Kansas Sustainable Agriculture conference.

Classes ceased two weeks around Thanksgiving as interns concentrated on summarizing the results of their experiments and preparing oral presentations to be given at Kansas State University on December 6th and written papers to be published in The Land Institute Research Report.

Food was the topic for two of the last warm-ups of the term. 1989 intern Ray Epp visited on December 7 and told about the new bakery he helped open in Winnipeg, Manitoba, that buys organically-grown wheat directly from farmers at higher-than-market prices and mills flour right in the bakery. On December 11, the day after the board meeting, Alice Waters, proprietress of the Chez Panisse Restaurant in Berkeley, California, discussed her philosophy of cooking and emphasized the importance of using fresh, locally grown produce as much as possible.

Interns took a day off from classes to join a tour of the Vogelsberg farm near Home City, Kansas. Ed Resznicek (left) and Joe Vogelsberg (2nd from left) explain legume rotations on the Vogelsberg farm.



Board of Directors Meets

All twelve members of The Land Institute Board of Directors were present when Chairperson Mari Detrixhe convened the meeting on Sunday afternoon, December 9. The board heard program reports from staff and reviewed the financial status of The Land. Sunday evening dinner for the board was prepared in the Krehbiel House kitchen by Alice Waters, board member and proprietress of Chez Panisse Restaurant in Berkeley, California, with the assistance of Jan Wilson and Paula Fried of Salina.

On Monday the board heard a report from President Wes Jackson and then discussed proposals for new or expanded programs that could be reflected in the budget the staff will present for the board's approval at the annual meeting on June 3, 1991. Interns and staff joined the board for a potluck lunch.

Attending their first meeting were new board members Rafe Pomerance of the World Resources Institute, Washington D.C., and Chuck Francis, Extension Crops Specialist at the University of Nebraska. The board elected George Comstock to become the thirteenth member of The Land Institute Board of Directors. (See page 33.)

Energy Conservation

Rocky Mountain Institute estimates that by using systematic building modifications which are cost-effective today, we could reduce by well over three-fourths the amount of energy used for space heating. This fall we decided to make some modifications in Land Institute buildings for greater efficiency in space heating and electricity consumption.

John Jilka spent several dark days putting in fiberglass insulation in the space between the north and east walls of the first classroom building, which burned down in 1986, and the concrete walls poured outside the first ones when we rebuilt the building. He also sealed the holes and cracks around the north entrance, renovated the stairway and filled the space underneath it with dirt.

In the Krehbiel House offices John Craft installed new lighting fixtures and switched incandescent bulbs to more efficient compact fluorescents. For future improvements, John is also investigating ways of better insulating the high-ceilinged rooms of the main floor, learning about more efficient heat pumps and the effectiveness of timers on thermostats.

The propane bill for heating the greenhouse last winter was high, and we burned more wood in Igor, the wood-burning furnace, than we expected. Insulating the north hallway, which the 1990 interns did last spring, should help reduce energy consumption this winter, but John is convinced that we can do

much more than that. The research staff and the management team agreed with John that we should experiment in one of the four rooms in the greenhouse to find ways to improve heat retention. Though a fan circulates warm air from the greenhouse peak down into rock-filled benches, the automatic vents still exhaust too much warm air on sunny days. Included in the plans are solar curtains to reduce heat loss at night, relentless leak-plugging, and barrels filled with water to increase solar mass and level out temperature fluctuations. We will decide what applications to use in the other rooms based on the cost effectiveness of these changes.

New Compost Makers

"I would like to know how lands are made," wrote a young student from New Mexico. Space doesn't allow for a full explanation (even if we did know), but one way The Land Institute helps to make one component of land—soil—is by using composting toilets. For many years the only toilet for the classroom building was a cleverly-equipped 55-gallon drum, and though we've since joined the mainstream with a low-volume flush toilet, the composting toilet dubbed "World Headquarters" is still being used.

This summer the interns, with Johns Craft and Jilka, built two new composting toilets, one for the greenhouse/shop area and one to be placed near the research plots on the Ohio Street farm. In the new facilities, as in World Headquarters, human wastes are mixed with sawdust in a 55-gallon drum. When the drum is full we cap it and set it out in the sun to mature for a couple of years. Time and periodic rolling results in a barrel of friable humus, full of nutrients perfect for enriching new woodlot trees.

The new composting toilets differ somewhat from the one called World Headquarters. The greatest improvement is the relocation of the barrel to the front, which makes moving it out much easier. An elevated window keeps the interior bright.



John Craft (left) and John Jilka move new compost-maker.

Children's Programs Featured on Visitors' Day

Tamara Kraus

All too often, people who travel far across the county to visit The Land Institute are unable to get directions from Salinans on how to travel the last few miles. We do frequently joke about being "nationally known and locally unknown," and the humor is based on the blank stares Land staff and interns receive when they tell local people where they work.

Each year in October the Land Institute hosts a Fall Visitors' Day. The program of talks, workshops and tours provides another excuse for people who are familiar with the Land to visit, take a walk on the native Wauhob prairie, and learn about the progress of the research. This year Visitors' Day was held on October 6th, from 12:30 to 4:30. While we explicitly invited all Friends of the Land, we made a special effort to encourage local people to attend.

Organized by development assistant Beth Gibans, the 1990 open house was a collaborative event involving staff from the Lakewood Park Nature Center, Smoky Hill Museum, Saline County Extension Service, as well as many Salina-area individuals. People contributed by assisting in both organizing and leading the programs. For several weeks before Visitors' Day, a planning committee comprised of Land Institute staff and interns and a number of local people met to discuss ideas for the program. The insights of people less involved with The Land Institute proved to be extremely helpful. For example, John Wachholtz, a high school biology teacher in Salina, suggested that we have a panel discussion

about what interns at the Land Institute do, what brings them here and what they do once they leave.

To introduce The Land's work to the community, we offered tours of the grounds, research plots, and gardens throughout the day. Workshops included "Gardening in the Fall" led by Dana Jackson and Thom Leonard, "Xeriscaping in Kansas" by Chip Miller, and for educators and youth leaders, "Using the Prairie as a Workshop" by Linda Caselman and John Wachholz. Berni Jilka presented our slide show, recently put together by Beth Gibans, and showed the videos "Uncertain Harvest" and "The Earth is the Lord's: Ecology as a Religious Concern" which feature the vision of The Land Institute.

We put particular effort into developing an extensive children's program. Near the classroom building, tables set up for the Discovery and Crafts area offered a wide array of interesting activities. Children examined snake skins, furs, sticks, leaves, bones and insects. They made leaf-imprinted book-marks, and used casts to make prints of animal tracks. The Salina High School Raptor Education Project displayed a number of stuffed raptors with information on their habits. Behind the classroom towards the Smoky Hill River, storyteller Aunt Carol (Carol Cole) exercised the imagination of both children and adults seated on a semicircle of hay bales. Julie Fisher, Annette White, Kris Schaefer, Holly Ewing, and Tamara Kraus presented three different hour-long workshops for the children: "Explore the Prairie," "Insects of the Prairie", and "Soil, It's not Just Dirt."

In the Art Gallery visitors viewed an exclusive exhibit entitled "Where We Find Ourselves: Images from the Landscape" by area artists Terry Evans, Mary Kay and Frank Shaw. Visitors' Day ended with refreshments and music in the big barn by Ruby Tilton, Kris Schaefer, and Beth Gibans.

Over 250 people attended Fall Visitors' Day, the majority of whom had not previously visited. So, a little more knowledge of The Land Institute and, we hope, some of our vision has seeped into the community.

Special thanks for their assistance to Cynthia Abbott, Steve Burr, Lisa Calloway, Linda Caselman, Carol Cole, Terry Evans, Joyce Fent, Nick Fent, Julie Fisher, Esther Frese, Karen Graves, Mary Kay, Ivy Marsh, Evelyn Maxwell, Chip Miller, Frank Shaw, Marge Streckfus, Ruby Tilton, Chuck VanGundy, Debbie Vignatelli, John Wachholz, Annette White.



Beth Gibans welcomes Visitors' Day participants.



Above: Children make bookmrks by pounding leaves on pieces of cloth. The imprints were fixed permanently on the fabric by soaking them in an alum solution.

Right: Storyteller Carol Cole



Children make prints of animal feet from casts.



Julie Fischer, center, helps children find insects.

**Mark your calendar to attend the 13th annual Prairie Festival at
The Land Institute, June 1-2, 1991.**

Good Work Takes Good Workers

Dana Jackson

When a question comes up about the budget or any business aspect of The Land Institute, someone always says, "Ask Linda. Linda will know."

Linda Okeson, administrative assistant, has worked for The Land Institute since September, 1981, except for a nine month break when she worked as a legal secretary. She worked half time, then three-fourths time, and in 1989 succumbed to the consequences of The Land's growth and became a full time employee. She has seen The Land Institute change from a staff of four to a staff of fourteen, from an operating budget of \$70,000 to one that exceeds half a million dollars.

Linda says that the most dramatic event that affected The Land Institute was the purchase of the quarter section of land across the road. After that we planted more experimental plots, hired a research staff, and started the intern program. These activities naturally expanded the budget, and Linda's financial work became more challenging.

Linda remembers when the mailing list was kept on typed sheets and we went to Evans Grain Company to copy names onto labels to send out The Land Report. She remembers when she, Wes and Dana all shared the classroom building office, with its cold floors and no inside bathroom. Now labels for mailings are printed off our computerized list in the comfortable Krehbiel House office building. Linda's desk is the first one visible from the front door, and even when she is working on her computer with her back turned towards the entry, she can't resist turning around to give a cheerful greeting to everyone who comes in.

As The Land Institute grew, Linda felt the limitations of our electric typewriter and finally talked Wes into raising money for a computer. When the IBM PC was installed, she was the first to learn the Wordstar and Lotus programs. Now The Land has eight computers.

Linda is a graduate of Brown Mackie Business College. This past summer the management team decided to have Linda set up our own accounting system instead of sending worksheets to an accounting firm each month. Linda chose a computer pro-

This second article in a series about Land Institute staff features two women whose work, often behind the scenes, is essential to the daily business of the Institute.



Linda Okeson, Administrative Assistant

gram, installed it herself and worked her way through the manual to learn the program. It is now in operation, though she says there are still some "bells and whistles" to learn in order to enhance reporting capabilities. The management team and the president are able to get up-to-date financial information more quickly with Linda's new system.

Wes Jackson has relied on Linda since 1981 to type all his speeches, manuscripts and correspondence. She typed chapters for Meeting the Expectations of the Land, and Altars of Unhewn Stone, plus countless articles and speeches. The pressure can be intense when trying to finish up last-minute revisions of a speech in time for Wes to catch a plane, but one can hear Linda teasing Wes as he goes out the door, "When the pages are warm as you get in the car, Wes, you know you've cut it a little short!"

When asked what she considers the most interesting aspect of working at The Land, Linda replies, "The diversity. You don't know who is going to show up next or what is going to happen."

Having new interns every year with different personalities also makes the job interesting to Linda. Being the mother of a college-aged daughter herself, Linda enjoys lively banter with the interns. She can

be teased, and she can tease. But they know that when she turns around and gets to work, the humor takes a back seat to competency and The Land's affairs are in good order.

On Halloween, Sharon Thelander phoned the classroom building to invite staff and interns to partake of sweet rolls and candy she had brought to the Krehbiel House kitchen. Dressed as Pippi Longstocking, she brought smiles to the faces of all who responded to her invitation. This warmth and sense of fun isn't just holiday behavior for Sharon, however. She livens up the daily routine at The Land Institute every day.

Sharon Thelander came to work as a part time secretary/receptionist for The Land Institute on January 8, 1986. She took over the responsibility for our mailing list, answered the telephone, and paid the bills—jobs she still has. She also balances the bank statements, makes bank deposits, opens and distributes the mail, sends out packets to those requesting information, and does the payroll.

Sharon says that the most notable aspect of The Land Institute during the five years of her employment has been its growth. That started, she thinks, with the story about The Land on the front page of the *Wall Street Journal* in February 1986, and since then we've had a continuous string of publicity. Being in the public eye has increased requests for information and contributed to growth in

the number of supporters called Friends of The Land. Sharon keeps track of the 6400 Friends of The Land and prospective Friends. Since she started work we have switched to a different computer program and she now enters much more information with each name.

Keeping track of the mailing list is an important part of her work, but Sharon is glad that she has other things to do. She likes the variety that comes with working at The Land Institute.

"Sharon, where do we keep the yellow pads? Sharon, where can I find some large envelopes?" Staff members and interns count on Sharon to know what office supplies we have and where to find them. They also count on the information about Land Institute activities that Sharon helps keeps up-to-date on the large calendar in the office.

Sharon and her husband John live on a grain-livestock farm just a few miles away. On hot summer days, Sharon's first task when she goes home in the middle of the day has been to sprinkle water on the hogs to cool them down. Like other Kansas farm women with jobs away from home, Sharon takes her summer "vacation" during wheat harvest so she can drive truckloads of wheat to the grain elevator.

Pictures of her little granddaughter are always close at hand on Sharon's desk, alongside her box of cheese crackers and the Fall 1990 issue of *Country Victorian*, which featured photographs of beautiful rooms in her house decorated in Victorian style.

Sharon works from 8:00 until 1:00 P.M. each day. In talking about the positive energy she radiates in the office, one of the interns said, "I wish she were here in the afternoon too!"

Research Fellow Chosen

1990 intern Doug Romig will stay at The Land Institute as Research Fellow in 1991. Doug hails from Santa Fe, New Mexico. He has earned bachelors degrees in soil science and range management, graduating with honors from New Mexico State University. For the past ten months he's been working with Jean-Luc Janink on our Illinois bundle-flower breeding program. As Research Fellow next year, Doug will be working closely with the interns and research staff on our many experiments.



Sharon Thelander, Secretary/Receptionist

New Roots for Agriculture

Prairie Studies Continue

Holly Ewing

The fire in late March left the prairie black as it consumed the dry grass of last year's growth. As spring became summer, then fall, I watched the prairie cover change. A cover of blackened stubble slowly became a blanket of greens dotted with a dazzling array of purple, blue, yellow, and white flowers and then metamorphosed into an autumn tapestry of brown, rust, and purple grasses punctuated with small surprises of asters, sunflowers, and goldenrods. This change happens every year with a multitude of subtle variations.

The prairie is a complex, interdependent biotic community containing a multitude of plants, animals, bacteria, fungi, and viruses. Most of the plants are perennials (coming back each year from the same rootstock). These plants sprout, flower, and set seed at different times throughout the year. Some are tall; some, bushy. Others are small or thin. Some have roots in a fibrous mat close to the surface, while others have tap roots that may extend more than a meter into the soil. These plants give and take different amounts of various nutrients from the soil. Bacteria living in the roots of the legumes convert atmospheric nitrogen into a form that plants can readily assimilate. Some plant species do particularly well in dry years while others thrive in wet years.

Even when agricultural crops shrivel and farmers turn them under, leaving the soil blowing in hot, dry winds, prairie plants grow and hold the soil in place. The Land Institute is interested in the prairie's durability and regenerative nature. In 1986 we began to gather data that would give us a better understanding of how the assemblage of plants changes over time. Jon Piper, our staff ecologist, has overseen the design and development of this study (See LR # 33, pg.23). Jon selected three sites of differing productiv-

ity on the Land Institute's unplowed prairie. These sites represent a gradient in soil fertility—from thin, rocky soil on a steep slope to a relatively deep, rich soil. Jon was particularly interested in both the species composition and the total amount of plant material each site would support. This year we added another rocky slope site of even lower productivity than the existing sites. Mark Gernes (1987 research fellow), Caton Gauthier (1988 intern), Pamela Cabbage (1989 intern), and I have continued this project, writing up each year's results for the Land Institute Research Report.

Each year in May, June, and August, Jon and three to seven interns have taken twelve samples at each site along preestablished transects. Each of these samples came from a 0.5 x 0.5 m area in which we cut off all the above-ground growth and then separated it by species, a difficult task, I found, when the plants were smaller than my little finger. Back in the lab, we dried and weighed these samples. The data tell us how much growth occurs at each of the different sites, what species are where, when, and in what proportions, and how the growth and species composition changes over time under variable conditions.

We are now applying some of this information in the design of new research projects. In our agricultural model of the prairie, we have incorporated a cool season grass (*Leymus*), a warm season grass (Eastern gammagrass), and a legume (Illinois bundle flower). In one of our 1991 research plantings, we will plant different mixtures of these three species based on ratios of cool-season grasses, warm-season grasses and legumes observed at two of our prairie sampling sites.

Even as we focus on questions about a sustainable agriculture, we have patches of prairie around us to explore and appreciate. As important as our chance to study the prairie plants in the name of "science" is our opportunity to experience a remnant of the ecosystem of this place and some of the beauty and diversity it contains.





Left: Holly Ewing and Kathy Collmer examine plants within the area of a prairie sample.

Below left: Doug Romig and Peter Kulakow harvest Illinois bundleflower.

Below right: Tamara Kraus and Paul Muto harvest sorghum heads.



Right: Kris Schaefer studies disease indicators in eastern gamagrass.



Sustainable Agriculture: Avoiding the Definition Trap

Doug Romig

The final harvest of the biculture experiment was interrupted for the third time by a steady drizzle. The paper bags were deteriorating in our hands as we moved through the plots. Our clothes were soggy and our boots weighted with mud. Somebody said, "Let's blow this off and go to Lincoln." We were off!

Fortunately our adventure had purpose and was not just a frivolous expenditure of oil. Chuck Francis, and Crop Extension Specialist at the University of Nebraska, had invited the interns to attend the Sustainable Agriculture and Natural Resources (SANR) Conference in Lincoln, Nebraska. The University—along with the Soil Conservation Service (SCS), DuPont, the Nebraska Soybean Board, and twelve other groups—sponsored this forum that addressed the design of "a profitable agriculture that is environmentally sound, resource efficient, socially acceptable and thus sustainable for the future."

Participants included policy makers, researchers, public and private administrators, extension specialists, agribusiness representatives, leaders of non-profit farm groups and a smattering of farmers and ranchers. The SCS was well-represented, but Chuck had anticipated greater attendance from other governmental agencies, especially the federal Environmental Protection Agency and state agriculture departments. He was particularly surprised that no personnel from the state agriculture agencies of Kansas and Nebraska showed up.

The purpose of the four day conference was to facilitate communication within the sustainable agriculture movement. The first half of the program included guest speakers and reports about innovative ideas and successful programs in sustainable agriculture across the country. On the third day, participants formed teams and divided into regional groups to improve communication. They toured experimental stations and farms on the fourth day. The Land Institute interns attended only the first two days of the conference.

One of the first speakers we heard was Jim Moseley, an assistant secretary in the U.S. Department of Agriculture concerned with the environment and natural resources. He issued a challenge: to solidify a definition of sustainable agriculture. I have reservations about accepting this challenge. First, it may splinter the movement between those who wish to begin taking steps now to implement new farming methods, and those who wish to define a vision that has escaped language for some time. But more importantly, it gives strength and time to those who wish to snuff out the movement. The challenge

frustrated the other interns also because it restricted and redirected the focus of the conference to the search for a definition. As a consequence, much of the discussion concerning active steps to achieve a sustainable agriculture was stifled. Many speakers were so preoccupied with the challenge that they glossed over real issues that needed to be addressed at this conference. One speaker told of a collection of some 800 postulated definitions of sustainable agriculture. In light of this, it appears that waiting for a single definition could halt any progress towards sustainability in agriculture.

Many of the definitions I heard included industrial and information-age jargon. Words like "system," "management" and "producer" were being used to describe a vision that calls for more organic and biocentric terms. It could be even a greater misfortune if words such as "stewardship" and "husbandry" are adopted as the language of sustainable agriculture without their underlying meanings intact. The words may become apparitions haunting grant proposals for research that is essentially conventional.

Visionaries, on the other hand, continue to explore all the implications of sustainability and have yet to find real terms for its definition. Despite the urgency to give words to an intuitive sense, language severely limits and hinders a complete and flexible definition. This is especially true if we try to include issues of social justice and rights of nature. These are slippery concepts and can be misconstrued, but they are vital if we truly desire sustainability.

Misinterpretation begins when we judge the proverbial book by its cover. For example, Luther Tweeten, an agricultural economist at Ohio State University, said at the conference that 80% of our crops are now grown in some form of rotation. Tweeten implied that sustainable agriculture is already in place. But he is missing the point, for sustainable agriculture is much more than a type of cropping system or a political therapy for the farm. A rotation of corn and soybeans in Nebraska, fed by chemical fertilizers, protected by pesticides and irrigated by fossil water from the Ogallala Aquifer is not viable for the long-term.

It was apparent to the interns that Tweeten, like many agricultural economists, has influenced the discussion of the meaning of sustainable agriculture. The persistent focus on short-term viability and the bottom line of a farm's accounting ledger infected almost everyone's definition, and effectively prevented any quality discussion of long-term considera-

tions for agriculture. It is obvious to many sustainable agriculture proponents that a sustainable economy will depart from current economic theory. Today's economic models fail to be inclusive; air, water, topsoil, and rural culture continue to be externalized costs in the wake of progress, yet most agricultural economists debate sustainable innovations within these models. In doing so, the models dilute the merits of the innovations. Fred Kirschenmann, a farmer from North Dakota and keynote speaker of the conference, calls this "the fallacy of reductionism." Without a broader examination of how agricultural alternatives relate to ecological, social, political, and economic factors, how can sustainable agriculture really serve change?

At the Center for Rural Affairs, Chuck Hassebrook's perspective is that agricultural research policy is a form of social planning. To ensure that cultural change is positive, public policy and the research it ultimately funds must be reconsidered and directed to meet the ends we desire. If we wish to reward stewardship, then we ought to design policies to meet that end. Jim Moseley's point that agriculture based on an urban agenda will literally erode the farming base should be kept in mind. This requires that farmers be leaders in the democratic process and not solely participants. Agriculture policy without the farmer's perspective will only lead to increased regulation.

Chuck Francis spoke with the interns later this fall after the conference. He told about the excitement that grew on the second day when the program was dedicated to sharing success stories about building networks and transferring information to farmers. Representative from Practical Farmers of Iowa, Appropriate Technology Transfer for Rural Areas (ATTRA), the National Agriculture Library, and dozens of other organizations, both conventional and alternative, presented their ideas and exciting results of innovative strategies to exchange information. Three concurrent sessions illuminated new informational sources, transitional processes, and on-farm demonstrations. The alternative agriculture movement has improved the means by which farmers can tap educational resources. By employing new methods of education and extension, a change has occurred in the direction that information flows. Vertical dissemination is being replaced by cyclical transfers of information and technology. On-farm demonstrations and cooperative experiments between researchers and farmers attest to dialectic movements of information, showing how improvements of farming methods no longer need to move from researcher through extension to the farmer. Cooperative efforts such as on-farm research begin a conversation in which all parties participate.

Perhaps increasing opportunities for farmers to

speaking with researchers will lead to the creation of technologies to fit the farm and not force the farm to fit the technology. As Fred Kirschenmann succinctly puts it: "A farm is not a factory and a cow is not a production unit." What has led us to this perception, he holds, is that our abstractions concerning reality are flawed. When we attempt to conform reality (the farm) to our abstractions (farm models), we fail, because we rely on our incomplete models too heavily.

The interns left Lincoln after the second day to complete the biculture harvest, but the SANR conference continued. Chuck informed me that team building during the third day greatly improved communication among supporting members of sustainable agriculture. Teams were formed by geographical region, and members included people involved in all levels of sustainable agriculture: non-profit organizations, SCS, extension, researchers and farmers. Better communication may begin to inspire new directions and a possible agenda for change.

I went to the SANR conference wearing two different shoes, one of a Land Institute intern, the other that of a land grant aggie alumnus. From my first perspective, I agreed with Ron Kroese, executive director of the Land Stewardship Project, who pointed out at the conference that rural and farm advocacy groups must take the lead in critiquing conventional agriculture as the institutions that benefit from the system and perpetuate it will not work for change. From my other perspective, I am encouraged that a slow evolution is happening in the land grants even though the sustainable agricultural movement did not begin there. Seventeen land grant universities now have some sort of sustainable agriculture program. But public discussion about the role of the land grants in sustainable agriculture must continue.

The effort to transform agriculture and translate fundamental values into a guiding policy are vital. Ron Kroese suggests that non-government organizations can take on the work of imagining and inspiring "positive cultural change." For example, the LSP works with religious groups to foster change and empower farmers.

On an individual level, we can be inspired by Harlyn Meyers, a vegetable grower from California, who spoke at the conference in Lincoln. She feels that an affirmation of feminine values and the cultivation of healthy relationships between earth, agriculture, and society will move agriculture to sustainability. The Land Institute would add to this the importance of learning from natural ecosystems.

The interns returned to Salina—where a biculture of eastern gamagrass and Illinois bundleflower awaited harvesting hands—without a solid definition of sustainable agriculture. But the conference proved, nevertheless, that enough of a common understanding exists for the work to go forward.

New Routes in Conventional Agriculture

The Promises and Pitfalls of Herbicide-Resistant Crops

Doug Romig

In January of 1989, Monsanto Company of St. Louis reported that their researchers had genetically engineered a new variety of cotton with the ability to withstand application of the company's non-selective herbicide glyphosate, better known as Round-Up. Currently six other companies, both agrichemical and biotechnical, are working to develop crops that are resistant to Round-Up. Those crops include alfalfa, canola, cereals, corn, forest trees, soybeans, sugar beets, tobacco, and tomatoes.

The recently-published report, *Biotechnology's Bitter Harvest: Herbicide-Tolerant Crops and the Threat to Sustainable Agriculture*, lists 27 corporations that are developing crops resistant to many of the major weed killers used in today's agriculture. Among those corporations are the top eight chemical pesticide companies, as well as many of the large seed corporations. Researchers are considering almost all cereal and vegetable crops, oilseeds (rape, canola), timber and pulp trees and even horticulture plants as recipients of the herbicide-resistant genes. They are attempting to make crops resistant to many chemical herbicides, including Atrazine, which is reported to be the herbicide used in the largest quantities on America's cropland. Atrazine is also a groundwater contaminant in thirteen states.¹

Many questions arise as we contemplate the consequences of developing herbicide-resistant crops. Who gains? Who loses? How will this technology affect farmers and their communities? What impact could this research have on the sustainable agriculture movement? Crop breeding methods based on technical breakthroughs that have come with the biological revolution are a great concern to a broad spectrum of citizen activist groups, academics, state agricultural agencies and public interest organizations. The Biotechnology Working Group draws its membership from these disquieted people. Its purpose is to foster the public's interest in biotechnology issues by disseminating information and planning action strategies. The group published *Bitter Harvest* to cultivate a better understanding of the subject.

Herbicide-resistance (HR) is the first viable product developed by the biotechnology industry for crop producers. Initially numerous possibilities for agriculture (as well as medicine, industry and pharmaceuticals) spurred ecstatic interest and financial

investment into genetic research. Promises of increased yields and photosynthetic efficiency, improved pest and disease resistance, drought and cold tolerance, the ability for grain crops to fix nitrogen (a property that only legumes have) and allelopathic characteristics to inhibit weed germination were touted as vehicles to advance crop production into the age of "high-tech" agriculture. It seems ironic that the initial intent of biotechnical pursuits for agriculture was to wean the farmer off chemicals. The direction the industry takes now only perpetuates the pesticide habit.

Marc Lappe's book *The Broken Code* (1984, Sierra Club Books) explains the reductionist view held by many geneticists that led to the assumptions and excitement. Initially they believed that many of the commercially desirable traits of our food plants such as yield, plant size and drought tolerance, were controlled by one gene (monogenic). As the complexities of the cell's nucleus and its mechanisms were further understood, it became apparent that most of the genes for crop improvement were polygenic. They are traits determined by numerous biochemical pathways; multiple genes govern their expression. Researchers' visions soon darkened as insurmountable technical difficulties arose, threatening to dash all hopes of miracle crops in the field. Companies having invested millions of research dollars (\$120 million by DuPont alone) looked for alternatives. They examined traits that would not only be financially rewarding, but technically easy to transfer in the lab from one organism to another. It had been observed that many weeds tolerated the application of herbicide, and the ability to survive the toxin was governed by one gene. Herbicide resistance was the industry's choice.

Herbicides, other than a few sparingly applied sulfur compounds, were not used in agriculture before World War II. Research in chemical warfare and malaria control helped conjure ideas of agricultural pesticides, and the post-war synthetic chemical industry grew rapidly. The discovery in 1944 that the phenoxy group of chemicals critically damaged plants spurred research into herbicides. Soon these new toxic chemicals were commonly applied on all major crops.

Herbicide use has grown consistently for decades. In 1966, approximately 110 million pounds of herbicides were applied to field crops, a fifth of what is used today.² An Environmental Protection Agency report says that herbicides account for 62% of total pesticide use on the farm.³

The U.S. Department of Agriculture Economic

Research Service estimates that 80% of the half billion pounds of agricultural herbicides are used on corn and soybean crops alone.⁴ Corn crops are normally rotated with soybeans all across the Midwest. Farmers use Atrazine in cornfields to control grass seedlings and many broadleaf weeds, but the subsequent crop of soybeans is adversely affected by residual Atrazine and thereby dictates the level at which it can be applied. Clearly, if a variety of soybeans were engineered to tolerate high soil concentrations of Atrazine, the herbicide could be used at higher levels than those currently employed. James Kent, a seed industry consultant, told *The Farm Journal* that such a development would increase the use of Atrazine by a factor of three.⁵ A paper entitled "The Influence of Biotechnology on the Agrichemical Business" bluntly states that it is more likely that "the farmer will be able to use more herbicide, more often, on more crops."⁶

Most researchers and industry representatives continue to circumvent the issue by adhering to the point that HR crops will reduce herbicide use. They suggest that farmers will use the newer, more expensive but "environmentally benign" herbicides. Yet there is some question as to whether or not these chemicals are less toxic, or if they do have a shorter residual life in the soil. Ironically, most research in herbicide-resistance is on older, proven herbicides like Atrazine and 2,4-D.⁷ These herbicides are highly toxic, used in large quantities, persist long in the soil and contaminate surface and groundwater. Atrazine has been declared a restricted-use herbicide in Iowa because of its presence in groundwater. More brazen industrial researchers tell it like it is: the introduction of HR into crop plants may promise "new and patentable products and significantly extend the useful life of our more valuable herbicides."⁸

As transnational corporations take over small biotech companies and their patents, buy out seed companies and make multi-million dollar research contracts with major universities, a large proportion of inputs for agriculture are consolidated into the hands of a few multinational conglomerates. As reported in *Dollars and Sense*, of the top fifteen biotech companies, five are multi-nationals; DuPont (U.S.), Monsanto (US), Imperial Chemical Industries (U.K.), Ciba-Geigy (Switzerland) and Sandoz (Switzerland). The remaining ten either have research contracts or financial agreements with or are independent subsidiaries of the transnationals. The total annual biotech research and development budget of these fifteen corporations amounts to \$172.2 million.⁹ Jack Doyle, in his book *Altered Harvest*, illuminates the political clout gained by companies like Monsanto, Ciba-Geigy and Sandoz. The political and monetary strength that envelopes the conglomerates may result in their ability to resist many regulatory

measures.

The profit motive of an herbicide-resistant carrot is clearly steering the agrichemical donkey. A projected increase in sales of Atrazine if a soybean were constructed to be tolerant starts at \$120 million a year.¹⁰ Plant Genetic Systems is attempting to develop crops resistant to the herbicide Basta. Hoechst, the producer of the herbicide, could realize another \$200 million in annual global sales if Plant Genetic Systems is successful.¹¹ The current value herbicides have in the domestic agrichemical market is about \$2.5 billion.¹² The availability of a patented seed with herbicide resistance would boost this figure. Howard Schniederma of Monsanto said: "I don't know if we could offer a (seed-herbicide) package, but if we could, we would."¹³

Though the seed/herbicide package would likely be a lucrative product for the agrichemical companies, it would not be an economic benefit to farmers. The authors of the Center for Rural Affairs publication, *Choices for the Heartland*, predict that "Herbicide resistance will provide seed companies (which are often chemical companies) with more influence over the decisions farmers make about pesticide use, especially if the industry is highly concentrated." And concentration is expected. Biotech analysts report that ten to twenty multinationals will dominate the profitable portions of global agriculture by the year 2000.¹⁴ These profitable portions are obviously not on the family farm, but involve input and processing factions of food production.

The farmers' well-being is being usurped not only by the concentrated power of the input producers, but by the public sector as well. On November 29, 1989, the Biotechnology Working Group conducted a search into the USDA's Current Research Information System. They discovered 409 research projects in plant breeding related to herbicide resistance. Many are being conducted at the federal level, as well as at land grant universities and state agricultural agencies. An estimated total of \$10.5 million of taxpayer money over the past few years has funded this research.¹⁵ The money was directed into the research budgets of Cornell, North Carolina State University, University of Illinois, University of Minnesota, and Oklahoma State University. As a rough comparison, \$12.8 million has been spent by the USDA over the past three years on all low-input sustainable agriculture research.¹⁶ The LISA program is the only publicly funded research that could help farmers decrease herbicide dependence.

But the farmer's voice is drowned out more thoroughly by private funding at the public institutions that were created for American agriculture. Land grant universities have made multi-million dollar deals with agrichemical giants in basic plant

genetics and physiology, including HR. Agrigenetics, now owned by the chemical company Lubizol, has \$20 million in research contracts with eleven universities including Oregon State University, University of California, University of Colorado and Cornell.¹⁷ *Choices for the Heartland* describes two HR projects at the University of Wisconsin and Michigan State University. Ciba-Geigy gave Michigan State University a grant to work on Atrazine resistant varieties because MSU had discovered the chloroplast gene responsible for Atrazine resistance in the early eighties.

The principal objective of many such contracts is to identify germplasm with herbicide tolerance for the development of commercial varieties by private industry.¹⁸ This shift in the clientele of land grant colleges should be considered as a conflict of interest. Farmers' questions are being replaced by those of agriculture input companies. Agricultural colleges collect knowledge and technologies to assist industry in the development of salable products.¹⁹ The university fails to focus on options which would reduce the farmer's input costs, a major initiative of the sustainable position. Instead, by assisting the corporate world, they help increase costs for farmers. There is also the opportunity for the college to gain financially from royalties and patents.

Herbicide resistance courts environmental disaster as well. Many crops have weedy relatives that they are able to pollinate, generating concern that HR genes could move into these weed populations. Wild and cultivated potatoes in South America, corn and teosinte throughout Central America as well as sorghum and johnsongrass here in the U.S., all hybridize. Hybridization with wild species can instill vigor into a crop's gene pool, but can also transfer crop genes into wild populations. Secondly, if a crop's gene pool acquired, either naturally or in the lab, many different genes that gave it resistance to several herbicides, it is possible for the crop itself to become a pest. For example, soybeans are candidates for six HR genes that could give them tolerance to six different herbicides.²⁰ Finally, the adaptive nature of weeds to herbicides is phenomenal. Over fifty species of weeds have been documented to withstand several herbicides; ten years ago that number was twelve. If HR crops lead to an increased use of weed killers, weeds will experience stress and adapt accordingly. This could further the development of new resistant weed species that could require more lethal chemicals for their removal from the field.

In 1982, fifteen representatives of universities, corporations and the USDA met and critiqued the government's role in agricultural science. The resulting Winrock Report and the action that followed elevated USDA research to the "cutting edge" of science. It also allocated research funds competi-

tively rather than distributing them to states equally. The outcome: biotechnology research programs in more prominent universities, doing work judged to be adventurous in plant molecular biology, are receiving more competitive monies from the government.²¹

The charade now presented by many land grant leaders and their industrial supporting actors portrays biotechnology as sustainable agriculture.²² Not only is biotechnology siphoning off the few dollars available for agricultural research and hindering the opportunity to pursue sustainable alternatives, but it perpetuates the social and economic decline of rural communities. While land grant colleges come under increasing pressure "to serve private interest (of industry) at the expense of the public interest,"²³ they abet and accelerate a "trend toward economic concentration in agriculture, decrease the number of farms and the deterioration of rural communities."²⁴ These problems are rooted in the industrial agriculture of today. Technological fixes such as herbicide resistance will only continue to aggravate the problems.

The agenda of the sustainable agriculture movement is to seek solutions that promote the conservation of all resources to insure the long-term health of agriculture and society as a whole. Herbicide resistance in our crops obstructs any such movement, prolongs the farm's chemical dependence and continues environmental impoverishment.

Marty Strange of the Center for Rural Affairs has written:

Many of the new technologies not only made it possible to farm more land, but made it necessary to farm more land to pay for the technology.²⁵

All of the revolutions in agriculture—mechanical, chemical and biological—have burdened the land with a heavy debt. With herbicide resistance, we exact a greater demand of the land and expect continued high levels of productivity despite its eroding soil collateral. How the land will pay is unknown, but it may pay dearly for our shortsightedness.

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Brave New Pigs: Part Human, Part Machine

Kathy Collmer

The simple act of biting into a ham sandwich may soon qualify as cannibalism. If genetic engineers at the U.S. Department of Agriculture, Ohio University, Dow and Monsanto have their way, pigs whose chromosomes have been spliced with human genes may be on the market in less than ten years.¹ A herd of forty such pigs—all of which carry human genes that code for the production of human growth hormone—is under study at the USDA's Agricultural Research Center in Beltsville, MD.²

Of course, since nature never intended for pig and human genes to intermix, there are side effects. The price of genetic tinkering is paid by the pigs themselves, which suffer from arthritis, anestrus, lack of libido, pneumonia, ulcers, lack of rear-leg coordination, and increased susceptibility to stress.³

These creatures interest agricultural researchers because they are leaner than other pigs and have greater feed conversion efficiency, that is, they require less feed to attain a particular weight. The human gene insertion even offers the possibility of cutting seven weeks off the time it takes before a pig is ready for slaughter.⁴ For pork producers looking at the bottom line, less feed and shorter finishing time mean lower costs and thus, greater profits. Evidently, making profits overrides such moral problems as what Wes Jackson calls "creeping cannibalism." Today, we insert two or three human genes; tomorrow, twenty, thirty, a hundred? At what point is a pig no longer a pig?

The pigs at Beltsville are but one exhibit in the brave new world of genetically engineered animals, creatures whose very existence represents a radical break from evolutionary history. Down through the centuries, almost every culture in the world has had strict taboos against bestiality, or sex between humans and animals, which was seen as a violation of natural law. Nature's wisdom in setting boundaries between species was assumed and respected. When people did engage in liaisons with animals, nature at least provided a control: Offspring were not biologically possible.

Now molecular biologists have gone beyond the obscene. Making an end run around nature's restrictions, genetic engineers are mixing genes from many distantly related species of organisms to produce progeny that nature would never allow. Gene splicing—or recombinant DNA technology—allows biologists to insert mouse genes into sheep, bacterial genes into cows, human genes into pigs. The resulting offspring are known as transgenic animals.

Whereas mules—the product of conventionally crossing horses and donkeys—are sterile, transgenic animals are capable of reproducing and thus passing on their altered genetic endowment into perpetuity. And unlike conventional breeding, genetic engineering gives biotechnologists the potential to splice genes from any species into any other, no matter how far apart evolutionarily those species may be.

It has been suggested that such drastic interventions in the animal kingdom may have unforeseen environmental repercussions.⁵ Despite the concerns of some scientists, however, a tightly knit alliance of universities, government agencies, corporations and venture capital firms has jumped on the biotechnology bandwagon, sinking millions of dollars into research on transgenic animals.

President Reagan's 1986 signing of the Federal Technology Transfer Act made it possible for federal laboratories and private companies to engage in cooperative research projects. Even the trade publication, *Genetic Engineering News*, admitted that "the idea of government, industry and university collaboration, given their traditional penchant for 'separatism,' is quite alien to American enterprise."⁶

Nevertheless, promises of regional "economic development," especially in areas hard hit by the loss of U.S. jobs in manufacturing and heavy industry, have given impetus to the formation of biotech consortiums involving the private, public, and academic sectors. In its "Directory of Biotech Centers 1989," *Genetic Engineering News* listed 57 such centers in the United States.⁷

The Edison Animal Biotechnology Center

(EABC) at Ohio University in Athens, Ohio, provides an enlightening example of the relationship between government, universities and corporations that is nurtured at these centers. Begun in 1983 as an effort "to spark Ohio's economy," the \$250 million program has fostered cooperation between some 600 private companies and several public Ohio research centers.

One research company called Embryogen, Inc., was formed at EABC in 1984 as a collaboration between Ohio University scientists and private investors. Typical of joint biotech enterprises, Embryogen makes profits from government contracts as well as from research agreements with such pharmaceutical companies as the Upjohn Co. and Merck & Co. (Merck, interestingly enough, owns a poultry breeding company called Hubbard Farms.) Embryogen has invested more than \$2 million in swine research, and anticipates commercial transgenic pig production by the end of the decade.⁸

Transgenic animals have become increasingly attractive for both medical and agricultural research. Mice whose chromosomes have been spliced with genes known to be associated with cancers are being tested to see if they are more sensitive to carcinogens than normal mice and could therefore be used to speed up toxicity testing.⁹ Other animals might have genes spliced in that could make them useful models for the study of diseases such as AIDS.¹⁰

The pharmaceutical industry has taken a keen interest in transgenic animals as "bioreactors"—living machines that can be genetically programmed to produce substances more cheaply than they can be produced through chemical synthesis or tissue culture. Theoretically, any human protein could be manufactured in large quantities if the gene that codes for that protein could be inserted into a bacterium and then "turned on" or triggered into actively coding for the production of that protein. In practice, however, human proteins produced by bacteria or yeast cells are not rendered in a form directly usable by the human body and must be processed further.

This fact has spurred current research efforts to insert human genes into mammals rather than into bacteria. In the case of transgenic mammals such as pigs, the human gene is usually injected into a fertilized egg at the one- or two-cell stage. A recent article in *Science* explains how the trend toward transgenic mammals evolved:

The attraction of using another mammal to manufacture human proteins was that it would probably process the proteins properly after making them, something other genetic engineers were having trouble persuading bacteria and yeast cells to do. And if they could attach the human gene to a gene for a protein

produced in milk, they could reasonably hope that the product—whatever it was—would be secreted in the milk and have no effect at all on the host.¹¹

Now considerable amounts of private and government money are going into the development of farm animals as bioreactors. "Cows are nothing but 'cells on the hoof,' according to EABC director Thomas E. Wagner, and he sees them as future living factories of pharmaceuticals, industrial enzymes, and other substances. Wagner envisions the dawn of a 'high-tech agrarian age' where farmers grow soybeans not for food but for industrial use and raise cows that yield plasma or pharmaceutical products instead of milk.¹²

This vision of the farm as a high-tech production line is perhaps a logical extension of the farm-as-factory mentality that has accompanied the industrialization of agriculture. The assembly-line model of farming, in turn, necessarily entails treating animals as machines. Agricultural researchers are splicing genes from other animals, including humans, into farm animals in efforts to increase milk production in cows, meat production in pigs, and wool production in sheep.

Animal-welfare advocates raise questions about the ethics and inhumaneness of pushing animals beyond their natural limitations. Dr. Michael W. Fox, vice president of the Humane Society of the United States, says that the rising technocracy is "turning the natural world into an industrialized wasteland and the cow into a biomachine."¹³

In some ways, the transgenic pig—unique as it is in being the first pig to contain human genes—is merely the culmination of longstanding trends in hogbreeding. Even prior to the genetic engineers and their creation of the arthritic, transgenic pig, "deformation" of pigs had been going on for decades. Pig morphology has been radically altered, from the short, round-backed little "piggies" pictured in children's storybooks to the huge, elongated, flat-backed porkers that are now standard—the result of animal breeders' successful attempts to develop an animal with a longer side of bacon. This evolution has not come without cost. "The resulting products of contemporary porkbreeding are so top-heavy that their bones and joints are literally crumbling beneath them," says author John Robbins.¹⁴

In addition to genetic changes, pigs also suffer deformities inflicted after birth, such as foot injuries and skeletal malformations resulting from the slatted metal floors and concrete slabs on which they are often confined. Among meat producers, the pork industry is probably second only to the chicken industry in its use of inhumane and unsanitary practices.¹⁵

The irony seems particularly cruel considering that pigs are perhaps the most intelligent farm animal. Of all livestock, pigs are the most similar to humans in personality, intelligence, digestive system, even skin characteristics (that's why pigskin grafts are used to treat third-degree burn victims). Yet many pigs spend their entire lives in what are called "confinement operations." While smaller hog farmers generally confine their animals for limited periods, seven of ten Iowa hogs are now raised in total confinement, never seeing the light of day.¹⁶ In some confinement operations, pigs are stacked in cages three deep, so that excrement from pigs above falls on those below. In these arrangements pigs may have less than seven square feet of living space each.¹⁷

Given this scenario of cruelty, the willingness of researchers to genetically engineer pigs destined to be afflicted with arthritis and other ills can be seen as part of a continuum of inhumane treatment that has characterized the pork industry for years.

Aside from the welfare of the animals themselves, many people have concerns about the possible effects on human health of consumption of milk or meat from genetically engineered animals. With the marketing of genetically engineered pork perhaps only a few years away, an instructive example of the forces that may come into play is found in the current controversy over the genetically engineered hormone BST (bovine somatotropin, the genetically engineered analogue of the naturally occurring BGH, or bovine growth hormone). BST is injected into dairy cows to increase their milk production. The manufacturers of BST—Monsanto, American Cyanamid, Upjohn, Eli Lilly and Dow Chemical—who anticipate \$500-million annual worldwide sales of the hormone, claim that

there are no harmful effects from drinking BST-treated milk.¹⁸

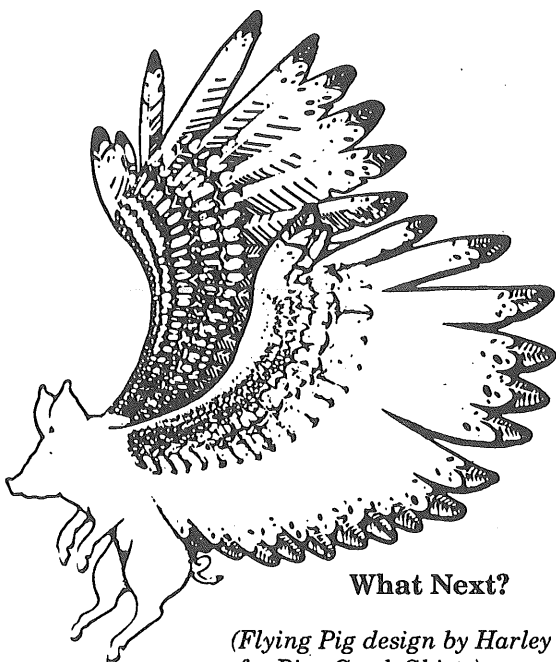
However, Dr. Samuel S. Epstein of the University of Illinois Medical Center, Chicago, has documented faulty experimental procedures as well as outright cover-ups in research conducted by corporations and in university research programs funded by these chemical companies. Epstein cites independent studies that point to such dangers as increased concentrations in BST-treated milk of antibiotics, viruses, fat-soluble carcinogens and growth factors, all of which are, if consumed at high levels, harmful to humans.¹⁹

So heated is the debate over BST that it became a major issue in the Wisconsin governor's race. In that state, however, the possible dangers to human health are mostly overshadowed by the concern that commercial use of BST could put small dairy farmers out of business.²⁰ Only the largest operators would be able to afford the expensive BST injections, and since BST-treated cows produce 10-25% more milk than other cows, operators who use them could undercut their competition.²¹

Similarly, transgenic pigs would be affordable only for the largest pork producers. Thus, the entry of these pigs onto the market could accelerate an already disturbing trend—the concentration of the pork industry into fewer and fewer hands. Up to the 1960s, hogs served a valuable function for small farmers struggling to get established. In a 1981 study, *Take Hogs, for Example: The Transformation of Hog Farming in America*, Chuck Hassebrook and Marty Strange describe the former role of pigs on the family farm:

Most of the money from selling hogs is available to meet the farmer's cash flow requirements on a regular basis. Unlike a great many farm enterprises, hog production is a labor-intensive enterprise which requires relatively little investment in facilities and equipment.... In fact, because hogs provide a low-investment means of earning the cash income from which to pay other bills—including the farm mortgage—they have been viewed for decades as a key commodity for the beginning farmer with little equity. So successful were hogs in this respect that they became known in the popular lingo as "mortgage burners."²²

Those were the days. Now the majority of hogs in this country are raised in huge, mechanized complexes, some of which can house over 100,000 pigs at a time.²³ One factory operation produces half a million hogs a year and farrows 30,000 sows.²⁴ Be-



What Next?

(Flying Pig design by Harley Elliott for Pipe Creek Shirts)

cause of tax concessions afforded to such operations from the early 1970s, many small farmers who once depended on the income from their hogs have gone out of business.

The potential of genetically engineered livestock to squeeze still more small farmers out of the market has motivated many farm-advocacy organizations—among them the National Farmers Organization, the American Agriculture Movement, the Center for Rural Affairs, the Land Stewardship Project and the National Farmers Union—to join with various environmental and religious groups in calling for a halt to the patenting of animals such as the transgenic pig.²⁵

Sen. Mark Hatfield (R-OR) and Rep. Charles Rose (D-NC) introduced bills in the Senate and House that would have put a moratorium on the patenting of genetically engineered animals, but both bills died in committee. The commercialization of genetic engineering has been accelerating since 1980, when the U.S. Supreme Court, in the landmark *Diamond v. Chakrabarty* case, upheld the right to patent a recombinant-DNA bacterium.

In April 1987, the U.S. Patent and Trademark Office ruled that it considers not only bacteria, but all nonhuman, multicellular organisms, including animals, to be patentable subject matter. The ruling caused alarm among many religious groups and civil liberties advocates, as expressed by Thomas Murray, a bioethicist at the University of Texas Institute for Medical Humanities in Galveston: "The decision draws us dangerously close to the concept of ownership of human forms."²⁶

The partly-human Beltsville pigs may be just the tip of the iceberg. Only after a public outcry several years ago was a halt put to research that sought to develop a human/primate "anthropoid" which could be used as slave labor to perform menial tasks such as street cleaning.²⁷ Frighteningly, not until two years after the 1987 animal patent ruling did Congress legislate, almost as an afterthought, an amendment to the patent code that specifically exempts human beings from being patented.^{28, 29}

Unless citizens educate themselves and take action, greed rather than concern for the common good will dictate the course of molecular biology just as it has that of nuclear physics. Unfortunately, the very complexity and expense of genetic engineering, like nuclear technology, militate against democratic participation. Since a thorough knowledge of gene-splicing technology is limited to a small elite of experts, the general public is ill-equipped to participate in decisions regarding the use of that technology. Decisions are made by the corporations and venture capital firms that alone can come up with the huge amounts of capital the technology requires and that will profit from its development.

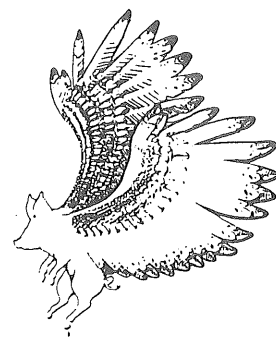
The food industry is already shrouded in mounting layers of secrecy. Few Americans are aware of the conditions in pig confinement operations described earlier, although animal-welfare organizations have educated many citizens about factory-farming conditions through circulation of photographs and statistics obtained in their investigations of such operations.³⁰

Unfortunately, such information is getting harder and harder to come by. A law passed in Kansas in May of this year makes it illegal to photograph facilities where animals are kept, bred, exhibited or offered for sale without permission of the owner.³¹ A similar federal law would make unauthorized entries into animal research or agricultural facilities "a federal offense, subject to \$10,000 fines and three-year prison terms. It also would require the FBI to go after perpetrators."³²

Nevertheless, some of the pork industry's most macabre aspects are revealed in the pages of the trade magazine, *Hog Farm Management*. There we find articles and advertisements about pig confinement operations where pigs are kept on slatted or perforated floors over large pits in which wastes collect until drained away into outside storage tanks. Concentrations of methane, ammonia, hydrogen sulfide and carbon monoxide from these pits can reach toxic levels, killing hogs in a matter of minutes through respiratory paralysis. Hog asphyxiation is a continuing problem in confinement operations.³³ Humans occasionally suffer the same fate: From 1979 to 1986, at least nineteen people died from exposure to toxic gases from hog manure pits.³⁴

In addition to toxic gases, bacterial contamination is a major problem where hogs are confined in large numbers. Researchers from the University of Illinois found up to 700,000 bacterial cells per cubic meter in commercial hog houses. The result is that "over half of the hogs marketed in the United States have evidence of rhinitis or chronic pneumonia."³⁵ Odds are, the average American has no idea of these facts when s/he bites into a bacon cheeseburger.

Only an informed, vocal populace can insist on humane and healthy alternatives in pork production. Luckily, there are many examples of hog-raising methods that are not only profitable but humane, and healthier for both pigs and people. Dick and Sharon Thompson of Boone, IA, for instance, manage 80 sows with "virtually no drugs or antibiotics" in open-air farrowing, nursery and finishing units.³⁶ Other farmers such as Richard Bennett of Napoleon, OH, have found success with rotational grazing on pasture.³⁷ Even more radical is a system that returns



pigs to their natural, pre-domesticated role as forest-dwelling foragers. In the "improved natural agriculture" system, pigs forage among fruit and nut trees for their food, which results not only in healthier pigs but in lower costs and management requirements for farmers.

As healthy as these systems may be, consumers can "vote with their pocketbooks" only if humanely raised pork is labeled as such. Sadly, labeling requirements that would help consumers make informed choices are poor to non-existent in most states. Although the 1990 Farm Bill contains provisions for federal organic certification standards, consumers must demand strict enforcement in order to guarantee a viable market for organically produced meats.

In the event that transgenic pigs do end up being marketed—a real possibility in the next decade—at the very least, legislation should be passed that would require pork from transgenic animals to be labeled as such. The fact that currently no federal legislation exists that requires labeling of BST-treated milk should give consumers some idea of what they're up against.

Groups such as the Foundation on Economic Trends³⁸ and the Council for Responsible Genetics³⁹ are working to promote independent (i.e., non-corporate-funded) studies and greater public disclosure of the possible hazards of genetic engineering. These groups deserve support. Concerned citizens should educate themselves and mobilize politically, for as fossil fuels become scarcer, it is likely that we will see a huge, multibillion-dollar push for genetically-engineered life forms as substitutes for the products of fossil-fuel technology.⁴⁰ For example, proponents of transgenic pigs cite the evidence that such pigs consume less feed—an increasingly attractive trait in an age of accelerating resource shortages.

Biotechnologists claim some of the same goals that we at the Land Institute espouse—a society with less pollution and lower energy and resource requirements—but the biotechnological method of moving toward those goals is diametrically opposed to ours. Genetic engineers believe they can improve the human lot by dominating and distorting the rest of nature to suit short-term demands. We believe history shows that such a strategy sooner or later exacts a huge toll. A truly sustainable society can be achieved only by respecting natural limits.

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Traditional Roots in Agriculture

Genetic Diversity Available in Minor Breeds

Paul Muto

Modern agribusiness rests on a narrow foundation. Years of intensive breeding and the demand for increased productivity and profitability have reduced the spectrum of genetic variability in crops and livestock to a frightfully limited base. Our livestock today produce more milk and meat and short term profits than older breeds, but the tradeoffs have been a higher cost of production, overspecialization and great strain on the physical limits of the animal.

If we are to envision a sustainable agriculture in harmony with nature, then we must look to those breeds of livestock that evolved in a natural environment. This implies a shift away from the single motive of profit in agriculture to one of diversification and acceptance of physical limits inherent in any animal. Because these animals are low in overall numbers and are currently of minor economic importance, they are known as rare or minor breeds.

What do minor breeds have to offer, and why is it important that they be saved? First of all, these breeds have generally been around for centuries, sometimes millennia, and have been able to thrive without high-energy feeds, specialized housing, or reproductive assistance. With limited human interference, breeds of livestock have been shaped primarily by their immediate environment. Those which could not adapt to the available forage, parasite populations, or the local weather system would perish, while animals better suited to the ecosystem would survive. Many of these breeds represent the direct descendants of the earliest domesticated animals and are not only important in helping to discover more about early agriculture, but have a right to exist for their own sake. Just because they may no longer be the most profitable animal, we do not have the right to allow their extinction. Like any other wild organism, they represent a long period of evolution and add greatly to the diversity of our current livestock gene pool. Their adaptability may once again find them an important niche in a solar-powered agricultural system.

Although hardiness is a common characteristic among minor breeds, there are examples of breeds under domestication for a long period and are not adapted to all of the climatic conditions of their natural ecosystem. In cases where winters are very severe, livestock may have a difficult time surviving

without the benefit of winter housing. Since breeding for winter hardiness is no longer a necessity, other characteristics, such as extreme fecundity, have been selected. This represents an early example of breeding in a human environment. The Finnish Landrace sheep is an example of such a breed. One would expect this breed from Scandinavia, to be very hardy, but winters are so severe there that sheep have traditionally been housed. The result is a highly prolific breed known for giving birth to "litters" of lambs. Other problems, however, have developed. Their wool has lost its ability to shed water, and the animal is prone to foot and jaw problems.¹ Despite these problems, they are still useful for crossbreeding in order to increase a flock's fertility. This example of breeding under artificial conditions, although quite rare in minor breeds, is a prevalent practice in modern agribusiness. For farmers, this has resulted in increased productivity, but also a higher cost for housing and livestock health. For a more sustainable system in a natural environment, the source for livestock adapted to rougher conditions would still come from minor breeds. For the most part, minor breeds exhibit characteristics such as hardiness, disease and parasite resistance, and good mothering abilities that are necessary to thrive in a low input, diversified system.

The main emphasis in livestock breeding today is on increased productivity and profitability. This is accomplished not only through standard breeding programs, but through the more recent technological innovations of hormone treatments and gene splicing. The animal, once part of the natural system, has now been turned into a production machine, one that is increasingly pushed to its physical limits.

Modern day confinement pigs are an example of an animal bred for maximum production under the most controlled environment. "Scientifically formulated diets are delivered at regular intervals in housing which exerts full artificial control of temperature and humidity, but provides the smallest permissible amount of space." The Landrace pigs of Scandinavia, "their bodies as long as the algebraic formulae that were used to computerize their breeding," have shown signs that their hind legs no longer function properly, and meat quality has shown a marked decline.² This type of overbreeding is present in many types of livestock, but is particularly bad in swine and poultry production units. The animal's ability to survive outside the confinement building is almost totally absent.

The concept of the animal as a production machine is relatively new, dating to the shift towards

the industrial economy in the nineteenth century. Unfortunately, modern farm animals are products of this industrial mind. We are left with breeds more suited to a human-created environment and increasingly dependent on human "solutions" to physical problems such as parasites, birthing problems, and high nutritional requirements. While these needs are easily met under an energy-intensive system, increasing costs are making farming highly prohibitive to the beginning or limited-capital farmer. What is needed in order to make the transition to a low-capital, diversified system are crops and livestock able to withstand the vicissitudes of nature with minimal human intervention.

The ability to give birth without assistance should be a primary consideration when choosing a breed of livestock. However, the modern emphasis on rapid growth and high growth rates have made birthing assistance necessary for many breeds of cattle and sheep. Charolais cattle, a breed from the lush pastures surrounding Vichy in France, have become increasingly popular because of the extremely high growth rates in calves. The muscular development at birth is so advanced that calving difficulties are common. One Charolais bull imported into Great Britain sired calves of which 9.4 percent underwent a difficult birth and 7.1 percent died within 12 hours.³ Although this may be an extreme example, it does illustrate that the goal of maximum production can be counterproductive to the welfare of the animal, and that other breeds, particularly those that reproduce with little or no human interference, are perhaps what are needed for an agriculture based on nature's model.

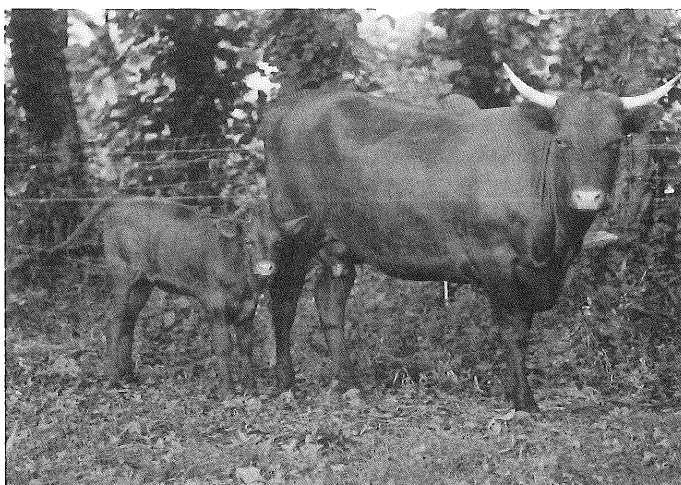
Specialization, which is the rule today, was seldom a top priority in the past, since multifunctional abilities were more important. For example, an older breed such as the Milking Devon not only produced high quality milk from a strictly grass diet, but also served as a beef animal and excelled other breeds for draft purposes. It was able to do this while foraging on poor land and surviving an adverse climate. A modern dairy breed such as the Holstein can certainly produce more milk, but high energy feed and protection from bad weather is necessary. In fact, some modern Holsteins produce so much milk that they require three milkings in a twenty-four hour period.⁴ In addition, the emphasis on the extreme dairy conformation in Holsteins has resulted in animals with very little flesh, reducing the value of the carcass when the animal has reached the end of its useful milking life.⁵

While dual and triple purpose animals are not conducive to the high profits of agribusiness, they are ideal for a sustainable system. Unfortunately, the Milking Devon has been reduced to between 300 and 400 animals, and if lost would be the end of that

genetic line of cattle.⁶ The future breeding stock of cattle would rest on a much narrower genetic base. With environmental changes such as global warming and ozone degradation, preserving a wide genetic base in livestock is important to aid in the development of new breeds. To allow genetic truncation of livestock is a risk not worth taking. Another shortcoming of many breeds is their dependence on high-energy agriculture for their survival. With the rising cost of intensive livestock maintenance, it is important to preserve breeds better suited to low input systems.

The original stock for most of the minor breeds in the United States comes from Europe. Some breeds, such as the Texas Longhorn, evolved for a significant time in the U.S. as a feral population, but the foundation stock is Spanish in origin. These cattle, known for their huge, widespread horns, are becoming commercially useful again due to the market trend towards leaner meat. Because of the recent increase in numbers, Texas longhorn cattle are no longer considered a minor breed.

Many breeds of livestock are still prevalent in their country of origin, but are at risk of disappearing rapidly due to increased industrialization of agriculture. A country as small as Great Britain is the home to at least 112 native breeds of cattle, sheep, goats, pigs, and horses.⁷ Many of these are now very rare. In the U.S. the number of native and non-native breeds is smaller than that of Europe, but some breeds in the U.S., such as the Dutch Belted cattle, are no longer present in their country of origin. This distinct breed, jet black except for a white belt encircling the body between the shoulder and hips, can achieve milk yields comparable to that of the Holstein but of higher butterfat content.⁸ The U.S. is an important source for some rare breeds, and through continuing importations is providing much protection



Milking Devon cow and first calf resulting from the AMBC rare breeds semen bank. Photo by Robert Amberg, courtesy of AMBC.

for many other minor breeds.

Most breeds arrived in the U.S. during the colonial period, and importations have continued since then. The Milking Devon again is an interesting case to consider. This breed was quite common in New England during the colonial period due to its versatility as a draft, milk, and beef animal. However, in its country of origin it was decided that the Devon should be bred for greater beef production, and the milking and draft qualities were ignored. This resulted in the formation of the Beef Devon breed. The original triple-purpose Devon became known as the Milking Devon, and its numbers declined rapidly in Great Britain. By this century, the U.S. contained the larger number of Milking Devon stock closest to the original animal, and thus has become an important source for future breeding.⁹

Many other breeds face similar futures unless more people become aware of the importance of maintaining genetic diversity. These breeds, once common but now rare, represent irreplaceable genetic adaptation to farming systems closer to our sustainable ideal than anything agribusiness can provide for us today. As we aim for sustainable agriculture, it is important that we incorporate sustainable breeds and maintain genetic diversity. How do we go about saving these minor breeds?

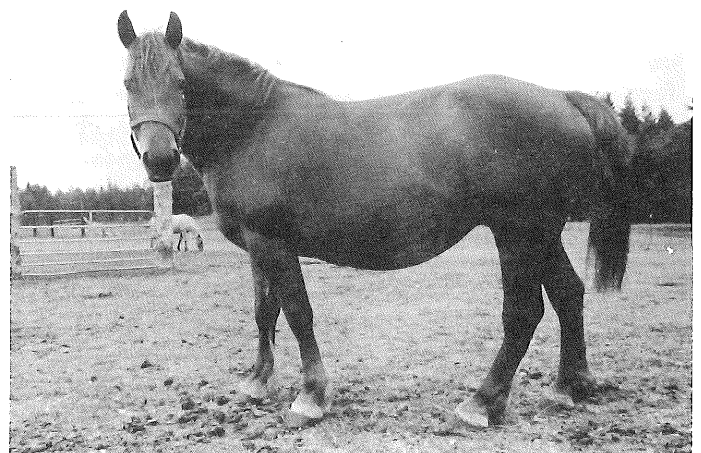
The American Minor Breeds Conservancy is a non-profit organization dedicated to the preservation of these breeds. Founded in 1977, membership now stands near 2700 and includes more than 700 breeders who raise rare breeds. Public education about the importance of minor breeds and the genetic diversity they represent is one of the functions of the AMBC. The AMBC provides information about minor breeds and their breeders and gives technical support to breed associations. A semen bank for rare breeds is also part of AMBC's operation.

The AMBC categorizes breeds according to population size and numbers of individual registrations per year. They label cattle and horse breeds "rare" if there are fewer than 200 registrations per year, and sheep, goats, and pigs if there are fewer than 500 registrations per year. A "minor" category is given to those breeds with fewer than 1000 registrations per year, 2000 in the case of pigs. A "watch" category is given to breeds whose registration over a 25 year period have shown a steady decline or where registrations are fewer than 5000 per year. The AMBC also monitors feral populations, which are escaped domestics known to have been running wild for at least 100 years with no known introductions of outside blood. Breeds may also be included or placed in a more critical category if they have large numbers but a limited number of blood lines or geographical distribution.¹⁰

With more emphasis on sustainable agriculture, the outlook for minor breeds should be positive. An increased understanding of the importance of genetic diversity is a positive step for the preservation of these breeds. Although many are maintained by peoples' interest in the breed rather than their economic importance, their suitability to certain types of agricultural systems should boost their numbers. As people become more concerned about the inhumane treatment of confinement operation pigs, the shift to outdoor pork production will demand breeds suited to that purpose. Many pig breeds such as the Tamworth or Gloucester Old Spot were developed under an outdoor foraging system and should become increasingly important in the development of forage-raised pork. The Tamworth, a distinctive ginger-red breed from England, is particularly suited to outdoor operations since it is not susceptible to sunburn like many all white breeds and produces high quality meat as well.¹¹

Dual purpose cattle, such as the Irish Dexter, providing both meat and milk have proven to be the ideal family cow in situations where small size and efficient forage utilization are important. The Dexter is the smallest breed of cattle; cows commonly weigh 650 pounds, and bulls weigh around 800 pounds. Their numbers have been increasing in recent years.¹² As with the Tamworth pigs, those cattle breeds more suited to foraging should increase in numbers as emphasis shifts to low-input systems. Rising fossil fuel costs and pressure by animal rights groups could make it increasingly difficult to maintain highly developed breeds dependent on high nutrient feeds and expensive confinement housing.

As fuel costs increase, draft animals may again be economical to use. Many of the minor breeds today are draft horses which were very prevalent earlier this century. The shift to mechanized farming was so rapid that it caused the population of draft



Suffolk Punch. Photo provided by AMBC.

horses in this country to plunge. In the 1920s, the horse and mule population stood at about 25 million. Today, the horse population stands at about eight 8 million, and most are for recreational purposes.¹³

Many draft horse breeds have become very rare. The Belgian, which is the heaviest of the draft breeds weighing 1,900-2,200 pounds, was once the most numerous draft horse breed with 3,200 registrations in 1937. During the 1950s, due primarily to the mechanization of agriculture, Belgian registrations fell to fewer than 200 per year. However, the breed has proven to be an inexpensive alternative source of power and the number of new registrations in 1980 surpassed the record of 1937. The numbers continue to increase with 4200 registrations in 1985.¹⁴ The Belgian is now no longer considered a minor breed. Other draft horse breeds however, are still critically low. The Suffolk Punch, the only draft horse developed exclusively for farm work and highly efficient to keep because of its excellent food conversion ratio, has a total population of approximately 400 in North America. Horses of this breed are even rarer in their country of origin, Great Britain.¹⁵ It would have been disastrous if these animals had been allowed to become extinct.

Many people are well aware of the importance of saving wild animals and their ecosystems, whether it be for economic reasons or just because they exist. Breeds of livestock are equally prone to extinction and should be preserved for the genetic diversity they represent. They have served us well in the past and may again be important to agriculture in the years to come.

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Remembering Robert Rodale

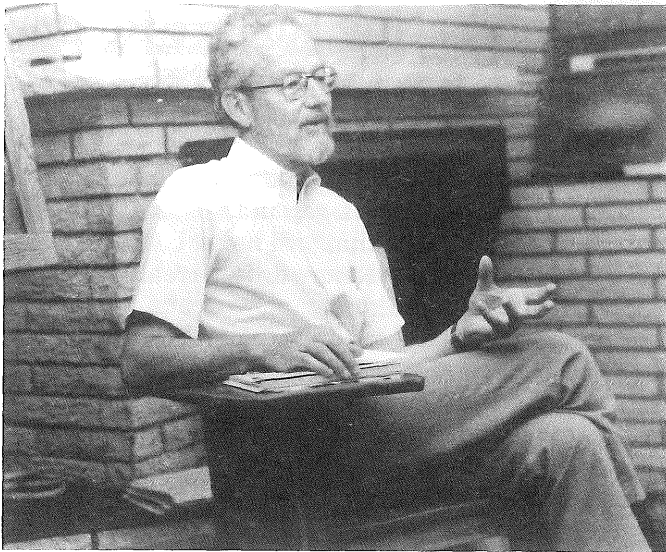
Wes Jackson

Robert Rodale's instant death in a motor vehicle accident on the way to the Moscow airport on September 20, 1990, left a gap in the sustainable agriculture movement that will never be filled. This is true because Bob had more or less created the niche that only he could fill.

Robert Rodale was one of those friends with whom I had countless disagreements. The last time I saw him, he and I had been roommates for nearly a week at a conference in California. Whether it was during the conference or in our room, our disagreements were always polite, largely due to his spirit and the manner in which he argued. At some level, we both knew we were ultimately on the same side. In spite of our clear differences, in the early 80s The Rodale Institute provided financial support to The Land Institute for our fledgling research program. Three summers ago, Bob generously gave himself for four days as a visiting scholar at The Land.

There have been, and there will be, many deservedly glowing eulogies about Bob's life and work, all of them more or less accurate, I suspect, but there is a side of Bob that will either not be mentioned or if it is, not given the standing it deserves.

As Chairman and CEO of Rodale Press, Robert Rodale became an entrepreneur with a style all his own. Rodale Press is for-profit, and yet Bob was surrounded by people from non-profits and government. He founded the non-profit Rodale Research Institute which publishes *The New Farm*. There is a plethora of entrepreneurs these days, but Bob was one of the very few entrepreneurial eccentrics left in this country. He inherited the company from his father, J. I. Rodale, an organic zealot, who was an entrepreneur with a social conscience and likely set a good pattern for young Bob. If we imagine for a little bit what his upbringing must have been like, it is not surprising that when Bob inherited the Rodale enterprise from his father, he would lead it to financial success. Rodale Press accurately judged the physical fitness market when they began the specialized sports journals: *Bicycling*, *Runners' World* and *Backpacker*. And under Bob's leadership, their flagship publications, *Prevention* and *Organic Gardening*, maintained a devoted readership. While profits climbed (Bob said at least once that he could not help but make money), Robert Rodale also led the organization in what some would consider a loopy direction by starting special projects in the non-profit sector. Most notable was the Cornucopia Project which promoted and financially supported studies of the food systems in several states with the goal of discovering how states could lessen importation of food from



Robert Rodale at The Land, summer 1987.

other states by diversifying their agricultural production. In this era of admiration for the CEO and MBA, few businessmen are what Bob was, an entrepreneur who applied his imagination in the realm of social improvement.

Not everything Bob tried worked. Even his most favorite term, "regenerative" which with body, soul and money he promoted as superior to "sustainable," failed. Regenerative didn't roll around the mouth quite right and besides, sustainable was firmly in the culture when Bob trotted out regenerative. He called once and lobbied me hard to start using the term, feeling that it captured more of the totality of what we were all striving for than sustainable, but in the end, I noticed, even Bob quit using the term. He seemed undaunted, nevertheless, and kept on generating new ideas.

Though I was shocked and profoundly saddened to learn he had been killed, I was not shocked to learn where. He was trying to get a magazine, *Novii Farmer (The New Farmer)* launched in the Soviet Union. Had someone told me his days on earth had ended while inspecting washtub-sized cabbages being grown by a paraplegic 200 miles northeast of Anchorage reachable only by snowmobile or dog sled, I would not have been surprised. That was the nature of his loopyness.

Bob was forever telling me and others that I was too negative. I would tell him that he courted the rich and powerful too much and that he abandoned too many good research projects at the Rodale Research Farm, projects that needed to be carried out ten years and more. I argued that you don't begin with either the government or the bastards or the bullies. He thought we should sit down with the power brokers. In fact, the last argument had Bob and Amory Lovins on the same side making the case

for what I considered then, and still do, an absolutely absurd proposal. They thought that several of us should sit down with the major agrichemical company heads in order to work out some kind of compromise for the 1990 Farm Bill. As I remember the argument, I said that the agrichemical companies had capital assets that they wanted to amortize and could do so only by selling chemicals. They would just co-opt us, I felt. Amory and Bob insisted that the companies' material capital would depreciate and that their main assets were people with information that could help farmers. It was a stand-off.

But let's look at what that spirit, that attitude, has accomplished. Bob put his company's money where his mouth was and spent a considerable amount, I am told, to lobby for LISA (low input sustainable agriculture). LISA passed, and 4.5 million dollars per year has united scientists and farmers in a research effort that I could not have imagined would ever be likely. That tiny percentage of the USDA budget has altered consciousness.

Finally, this leads me to what, in my view, is Robert Rodale's real legacy. He stood more or less alone while most of the rest of us carped about "failure of culture," "power structures," and "capitalism," all the while wringing our hands and developing elegant language against the likes of the Reagan and Bush administrations. Our current major deficiency, in my view, is that most of us in the sustainability camp don't really see ourselves putting our ideas into practice or influencing the political and economic machinery. Bob did! And because he did, change has come. In fact, if through some sort of magic the government and the economic system should ever be turned over to our side, we would not know what to do, and near chaos would result. Were that magic to happen, and if Bob were still around, he would be the first one I would call; and soon thereafter, I suppose, the first one I would argue with and ultimately oppose on major issues. Meanwhile, he would quietly and cheerfully get a little something done.

Harry Caudill 1922-1990

"I urge all who will listen to do as my wife and I have done. Find some jaded land and buy it...Plant it in trees and thin the stands as they grow or, if circumstances allow, turn it into a clover-rich meadow. Then watch the wild things discover it and make it their nesting and burrowing ground. In transforming itself from aridity to abundance it will provide a strong new bond between an American family and the vast rich continent their ancestors so precipitously cleared."

from "The Land as Therapy," reprinted with Harry Caudill's permission in *Land Report* # 37.



Natural Connections

At Home in a Word

You call this blanket of grass
Prairie, because you were born
A member of a tribe who took to
The lean feast in that name.
Your lips hold the word in
To give thanks just so: Prairie
You say, and hear the grass
Speaking through the thorny wind
Season after season. You sit
Wrapped in that word.

That Trick of Silence

This slab of land, never
So much anything in the public
Mind as a place to get behind you
From Kansas City to Denver,
Was just out there, out where
So little stood upright past
The hundredth meridian
That every tree was remarkable,
Every stream new chance
You could not have predicted.
You could drink and wash
Your face and look around
Where the vast nothing held open
Its face to teach you that
Trick of silence.

Reprinted from *That Trick of Silence*, Washburn University Center for Kansas Studies, 1990, by permission of the poet. Steven Hind is a native of the Kansas Flint Hills. He lives and teaches in Hutchinson, Kansas.

Poems by Steven Hind

Last Night Before Cold Weather

"To begin with, there were fewer
People and more grass."
the storyteller

This grass goes bronze with weather,
Goes black with darkness
And the sky goes far, fixed
With cold lights, as one owl
Says a thing he likes so well
He says nothing else.

Wood to last the night and
Breath pushing into the night
When I turn from the fire,
Squatting, convinced: if there
Is a life after this one, I will
Come back here to stay
As long as the grass stays.

Afternoon of the First Day

People lived here with names
Like Sitting Bear (Satank),
Powder Face and Bird Chief.
I walk along the Hills, looking
Up now and then, watching
The hawk stretched across
The wind's hand, running out
My hand over the long blue stems,
Wanting my new name.

The Practice of the Wild

by Gary Snyder

North Point Press, Berkeley, CA., 1990

224 pages, \$10.95 paper

Reviewed by *Jake Vail*

This August, riding back from visiting John and Joe Vogelsberg's farm, I read to my car-mates an essay from Gary Snyder's new book, *The Practice of the Wild*. I had read the book earlier, and so knew which essays delighted me most. The experience reminded me of two things: reading aloud among friends is always enriching beyond any expectation, and Gary Snyder's writings should never be read only once.

Go read your Gary Snyder books again, then get to *The Practice of the Wild*. Its nine chapters roam off the trail over lands good, wild, and sacred, past ancient forests and blue mountains, quietly but enthusiastically telling stories and teaching of survival and sacrament.

"Old men ought to be explorers," said T.S. Eliot, but Gary Snyder has been exploring since before he slept in secret camps in the woods at age nine. He grew up on a dairy farm on the edge of logging country in northwest Washington. By eighteen he was working aboard ships out of New York; by twenty had published poetry as a student at Reed College in Oregon, and in following years worked on an archaeological dig for the Park Service, as a fire lookout on Sourdough Mountain, as a logger in the northwest, on a trail crew in Yosemite, and as a wiper in the engine room of a Pacific freighter. During the same period he earned a degree in anthropology-literature, studied Oriental languages as a graduate student at the University of California at Berkeley, wrote book reviews and more poetry, shared a cabin with Jack Kerouac, and studied Zen and Japanese language at a monastery in Japan.

California governor Jerry Brown once accused Mr. Snyder of always going against the grain. "It's only a temporary turbulence I'm setting myself against," replied the poet. "I'm in line with the big flow." Believing our present experiences stand so far out of the historical mainstream that we can't act wisely from generalizations based on them, Gary Snyder suggests we instead study the old ways—human and non-human—and learn the practice of the wild.

We must try to live without causing harm, not just to fellow humans, but to all beings. We must try not to be stingy, or to exploit others... Such are the lessons of the wild.

Think of the ancient forests of the Pacific northwest, where battles are raging between loggers and environmental advocates. But think like a redwood, one which has been dead for 200 years yet still stands, an active member of its community providing shelter and nourishing its neighbors. Muses Mr. Snyder:

How curious it would be to die and then remain standing for another century or two. To enjoy "dead verticality." If humans could do it we would hear news like "Henry Thoreau finally toppled over."

From his first published poetry Mr. Snyder has been trying to view our place in the world from Raven's eyes or contrast it with the world of a Chinese hermit of 1,400 years ago. In his writing one always finds an intriguing blend of poet, anthropologist, ecologist, and craftsman. And, as though he were an Inupiaq elder teaching tradition to a granddaughter growing up in a schizoid world of trapping and television, he shares his thoughts with humor, humility, and spirituality.

"Books are our grandparents!" he exclaims, reflecting both his "excited and deep study of antiquity" and the decline of the old ways of family/tribe. The introductory essay of *The Practice of the Wild*, "The Etiquette of Freedom," is nature's contribution to what Mr. Snyder calls "grandmother wisdom," which he takes to include most of the Ten Commandments and the first five of the Ten Great Buddhist Precepts.

The etiquette of the wild world requires not only generosity but a good-humored toughness that cheerfully tolerates discomfort, an appreciation of everyone's fragility, and a certain modesty.

Etiquette is honoring the other, and understanding that responsibility is a part of freedom. The etiquette of freedom requires that "we learn the terrain, nod to all the plants and animals and birds, ford the streams and cross the ridges, and tell a good story when we get back home."

Home? But what of the "tens of millions of people in North America who were physically born here but who are not actually living here intellectually, imaginatively, or morally"?... "The Place, the Region, and the Commons" points us toward home. Mr. Snyder here contributes an important addition to Garrett Hardin's theory of the tragedy of the commons, by redefining the commons as a level of organization of human society that includes the non-human. If we look back a few hundred years we see a good example of this: "The culture areas of the major

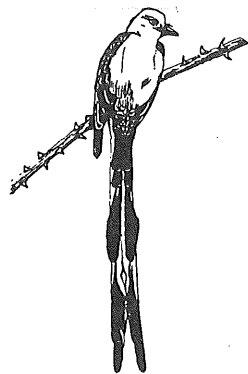
native groups of North America overlapped... almost exactly with broadly defined major bioregions." Native Americans thus knew a tragedy of the commons centuries before Mr. Hardin coined the phrase, as they lost their homes and cultures to colonizing Europeans. Mr. Snyder warns that we colonizers are now inflicting a similar fate upon ourselves:

There will be no "tragedy of the commons" greater than this: if we do not recover the common—regain personal, local, community, and peoples' direct involvement in sharing (in being) the web of the wild world—that world will keep slipping away.

And how can we even think without such a web? "Artificial intelligence" will take on new meaning as ways of thought follow artifice. "Tawny Grammar" stresses that we are not rootless intelligences, but think with "grandparents, place, grammar, pets, friends, lovers, children, tools, and the poems and songs we remember."

Friends of The Land Institute should remember "Good, Wild, Sacred" from the book *Meeting the Expectations of the Land*. Reprinted in slightly different form in *The Practice of the Wild*, it connects the discussion of how our surroundings shape our thought with observations of a culture which has known its surroundings for centuries. In "Blue Mountains Constantly Walking" the poet-anthropologist-ecologist observes the Chinese interpretation of Mountains and Waters as a dyad symbolizing wisdom and compassion, then wonders about what they "say." In the terminology of conservation biologists, the Great Plains "say" bison, ancient forests of the northwest "say" spotted owl. Mountains and waters, wisdom and compassion, Mr. Snyder concludes, must "say" all beings.

The concluding essays provide additional examples of the practice of the wild and how we might learn of it and from it. "On the Path, Off the Trail" is notable for its gentle weaving of Zen, art, and ecology. We see that a forager, a person hungry for nourishment, does not walk along the path for long. Off the trail is where sustenance is found — and where we do our best work. "But you must first be on the path before you can turn and walk into the wild," warns Mr. Snyder. We can put ourselves on the path by learning the creative processes of nature, then, using those processes as a model for our own actions, gracefully saunter off the trail.



The Season Circle

Tracy Noel

Early in the fall during a "warm-up" session, we had a discussion about ritual. From as far back as pagan moonlight dances, traveling the great cultural distance to our modern day graduations, rituals have been important in our culture. Sometimes it is difficult, though, to figure out exactly what role some of the modern rituals play.

Long ago, and still for some cultural groups, many rituals centered around natural events. The changing seasons, rains, ripening of plants for harvest, and the migration of animals for hunting were of primary importance and widely celebrated. Today's society has lost touch with many of these natural connections. Now we celebrate the football season with homecomings and Superbowls, and imitate the cannons and gunfire of years of bloodshed with fireworks on the fourth of July. Some people believe it is important to recognize and celebrate the natural world, both individually and communally. This requires a good bit of creativity, since much must be created anew or redesigned from the remnants of a largely forgotten past.

The idea of creating an "earth circle" or "season circle" at The Land Institute had been floating around among the interns for a month or two before our warm-up discussion. As the fall equinox approached, we realized that it was the right time to carry out plans for the circle.

We needed an open space with a clear view of the horizon on the east and west. A small, sparsely vegetated section of rocky soil east of the parking lot near the Wauhob Prairie proved ideal. On the afternoon of September 21 we dug a hole and set a native osage orange pole to prepare for the equinox. At sunrise two days later, we placed the first of several limestone slabs embossed with ancient fossils from eastern Kansas to mark the due east rising sun. This point marked the radius for drawing the rest of the circle. We used a strip of nylon webbing to make a compass by tying one end to the top of the pole and stretching the other to where we placed the stones. Following this end around the pole we scraped a circle in the ground and later covered the scrape with wood chips. Just before sunset we collected stones from the Smoky Hill River, which borders the west edge of The Land. As the sun was setting we set the largest stone on the circle directly in line with the pole and the sun. We stacked the other stones on top and watched the last summer sun disappear. Autumn had begun, and our season circle was completed—for now.

We invite future interns to set stones in the season circle during the solstices and other occasions

they might deem important, and to fill in with objects from nature. It is not our intention to try to bring back or create a ceremonial event, but rather to recognize what a unique experience it is to be an intern at The Land Institute. The circle is a gift to The Land and to all interns past and future. We would like to think that each intern who has been or

will be a part of these surroundings will find some personal significance in the season circle. For all, it can be a celebration of the cycles of interesting and eager people who come to The Land as interns each year. Just like the cycles of the seasons, each is constant, yet unpredictable, and no less significant than the last.



The Sunflower Puzzle

Tracy Noel

Anyone who walked near the greenhouse or classroom building this last summer likely would have noticed a sunflower that wasn't familiar.

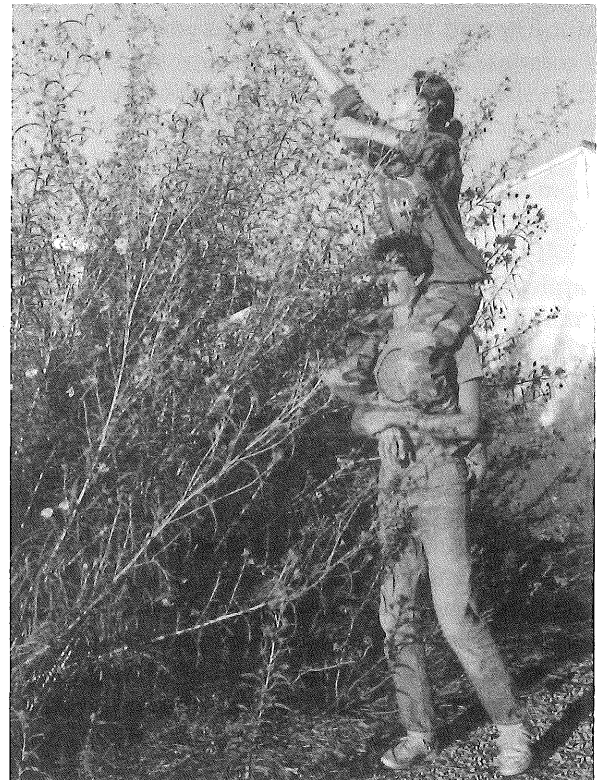
The plants were nearly twice as tall as a person, but the surprisingly narrow semi-woody stems, that seemed to be just stuck into the ground, managed to remain vertical in even an average Kansas wind. An aspiring botanist might have guessed by the long slender leaves and light colored flower disks that this was Maximilian sunflower (*Helianthus maximiliani*) with an extra dose of tall genes. Knowledge that The Land Institute has studied Maximilian sunflower might have helped in making this assumption. Closer examination would have revealed a few flowers with darker disks and leaves that were smooth and not hairy like those of Maximilian sunflower. One might then conclude that more than one species had been planted; and the other species, given the long smooth leaves and the dark flower centers, was probably willowleaf sunflower (*H. salicifolius*) which, like Maximilian sunflower, is a native perennial.

Though this wouldn't be exactly correct, I would applaud the botanist for getting much farther than I did without a handy wildflower guide. The truth is that the seeds from which these plants grew were collected from only one species. In 1989 staff ecologist Jon Piper collected *H. salicifolius* seeds from the herbarium, which was established in 1978 to evaluate about 300 different perennial species for research as potential crops. Jon planted these seeds in the greenhouse, and they were transplanted into the flower bed west of the greenhouse and also in the garden east of the classroom. So why was there variation in the flowers?

Maximilian sunflower is a native species which

readily hybridizes with other members of the sunflower family, and it too had been evaluated in the herbarium. Since flowering times of the two species overlap—*H. maximiliani* flowers from late July to mid-October and *H. salicifolius* flowers in September and October—pollen from Maximilian no doubt reached ovules of the willowleaf plants from which Jon collected his seeds. Plants which grew from these seeds took on many traits of Maximilian sunflower, and plants which grew from seeds pollinated by other willowleaf flowers naturally took on willowleaf traits. Now we can conclude that several of Maximilian's traits are dominant when crossed with willowleaf.

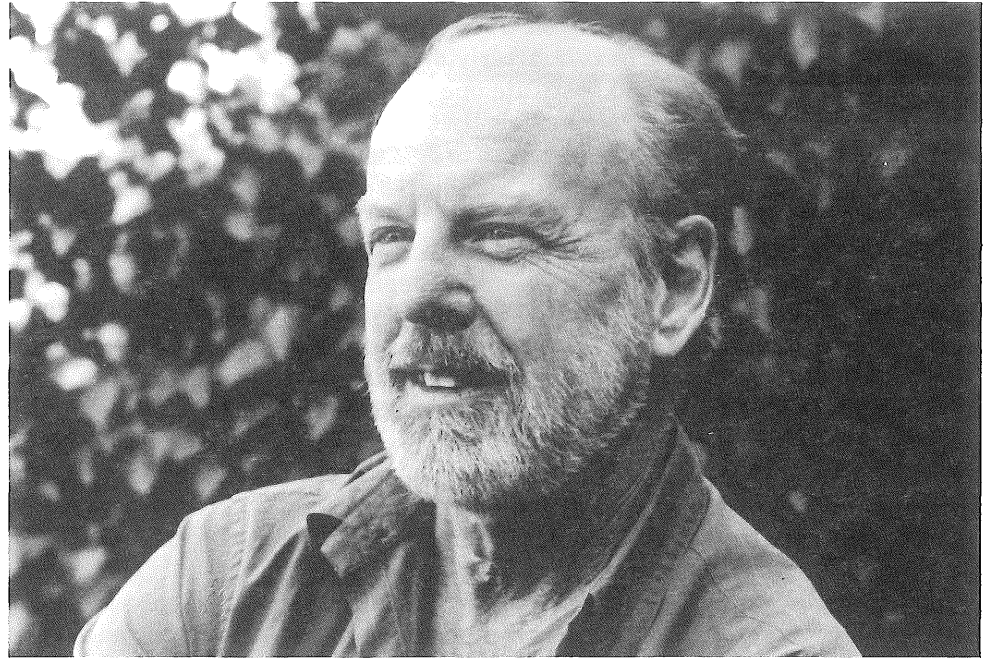
As for the height, both Maximilian and willowleaf are among the tallest of perennial sunflowers, Maximilian commonly reaching about ten feet and willowleaf eight to nine feet. Our eleven feet tall plants could be a result of vigor common in second and third year perennials. They could also be evidence of the idea that "two bigs make a bigger." Or maybe they're simply the products of a little love.



Tracy, on Jake's shoulders, checks sunflower height.

A Good Friend of The Land

Tom Mulhern



George Comstock

The Land Institute is a long way from California's Silicon Valley, both in miles and in mind-set. However, The Land has a special friend who is working to build connections between the researchers and students of perennial polyculture and the developers and marketers of computer technology.

George Comstock is a warm and easygoing man, whose thoughtful manner suggests a college professor more than a high-tech entrepreneur. However, George is a successful entrepreneur who has spent his professional life developing high technology products and companies. Since January 1, 1990, he has also devoted one day per week as a volunteer for The Land Institute.

He first learned about The Land Institute in 1987 when he saw a review of Wes Jackson's book *Altars Of Unhewn Stone*, ordered the book, and read it during the Christmas holidays. In his words, "It struck a resonant chord, and I decided that I would find out more about Wes Jackson and The Land Institute at some point in the future." That point came in the fall of 1988, when George stopped by The Land Institute on a cross-country trip and took in the Fall Visitors' Day. He was impressed with what he saw and with the people he met at The Land, particularly the student interns. William Irwin Thompson, founder of the Lindisfarne Association and author of wide-ranging works of cultural history, was a special guest at that Visitors' Day, and George remembers that he and Thompson continued to discuss the issues when they sat next to each other on the flight from Salina to San Francisco.

Sometime during the following months George told Wes that he was thinking about "trying out" retirement one day per week, and that he might like to

use some of his extra free time to do volunteer work for The Land Institute. Wes encouraged him, and they continued to discuss the possibility. By the end of 1989 George was ready to begin. Since January, he has spent nearly every Friday making connections and building support for The Land Institute.

His work has already paid off in some very tangible ways. George negotiated with Tandem Computer Corporation and arranged for the donation of two personal computers to The Land. These computers have more file storage space and greater speed and power than anything else at The Land Institute, and are being used by Peter Kulakow, plant breeder, and Jon Piper, ecologist. This gift has greatly enhanced the ability of The Land Institute to analyze and compile research data into useful results and reports.

In another venture, George mailed out more than 1,200 letters to other high-tech entrepreneurs and fellow Cal Tech alumni, to introduce them to the work of The Land Institute and to invite them to become supporters. He also has made numerous personal calls on friends and associates to talk about The Land, and has arranged for some of them to meet with Wes Jackson when Wes visits the West Coast.

George makes a generous personal contribution to The Land each year, and he has influenced the company he works for, Network General, to make an annual corporate grant to The Land Institute.

"I am personally finding a lot of satisfaction in devoting energy, time, and money to the long term question of how humans will feed themselves when our present exploitive approach to agriculture runs out of steam," George says. "All my professional life I've been involved with science and engineering and

the computer industry, focusing on what the next product will look like, the next quarterly and annual report, and so on. 'The Land Institute opens up a whole new vista for me.' George feels that the long term perspective of The Land Institute provides a satisfying balance to the short term emphasis that has characterized much of his work.

George grew up in Worcester, Massachusetts, where he obtained his B.A. in Mechanical Engineering and B.S. in Electrical Engineering from Worcester Polytechnic Institute. He went on to get a Masters in Physics from Cal Tech. His professional career has spanned four decades and has included a series of positions with engineering, electronic and computer companies.

In 1969 George and a partner started Diablo Systems, where they developed interchangeable cartridge disk drives for computers (a precursor to the floppy disk), and they also developed the daisy wheel for high-speed letter quality computer printing. They sold Diablo to Xerox in 1972, and over the next fourteen years he worked for Xerox, started Durango Systems with three partners to develop personal com-

puters for business, and worked as a private consultant.

In 1986 George joined three others who were starting Network General Corporation, in the business of making and selling computer systems used to analyze and troubleshoot computer networks. George is currently Vice President for Business Development at Network General, where sales have more than doubled each year of operation and are currently running at \$40 million per year.

George is a licensed pilot, following a love that started with building model airplanes as a kid. He's a capable handyman as well: earlier in his career, he built one home himself, and he completed all the plumbing, heating and wiring work in a later home. George and his wife Anne Hillman now make their home in Portola Valley, California.

The Land Institute is fortunate to have a friend and advocate like George Comstock. His volunteer commitment of time, energy, and resources shows that you don't have to be a researcher in Kansas in order to make a significant contribution to the work of sustainable agriculture.

Back Issues of *The Land Report* Available

Back issues contain essays by Wes Jackson, Dana Jackson, Wendell Berry, David Orr, Donald Worster, Gary Nabhan, Harry Caudill, Paul Gruchow, Conn Nugent, Nina Leopold Bradley, and many others, as well as staff and most of the 151 Land Institute students and interns. **Plus— book reviews** in almost every issue, photographs by Terry Evans, poetry, Prairie Festival speeches, and lots of illustrations.

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#11 Fall 1980

Perspectives of the Food Cooperative Movement; American Politics and the Populist Movement; The Kansas Cherry; Seeds of Strife (plant patenting); Living Nets in a New Prairie Sea; Man is Just a Little Bigger Pest; The Windcraft 2500; Consumer Information Board.

#13 Summer 1981

In the Classroom; Prairie Festival 1981: Diversity; Investigations in Sustainable Agriculture; Experiments in Aquaculture; A Celebration of Prairie Diversity; Beginning Beekeeping; The Great Plains in Transition; Out of Conviction (nuclear power).

#14 Fall 1981

Laying the Groundwork for an Ecological Agriculture; The Salina

Energy Fair; The Renewable Challenge: The Reagan Administration vs. Solar Energy; A Tour of the Wolf Creek Nuclear Power Plant; PCBs in the Environment: Everyone's Problem; The Limits of Cost-Benefit Analysis; Democracy at Work.

#15 Winter 1982

Agricultural Research at The Land; A New Threshold; Optimism on a Finite Earth; Prairie Images; A Passive Solar Facelift; Installing a 500-Watt Windcharger; Photovoltaics: Sunlight to Electricity in One Step; Completing the Solar Hot Water Heater; County Energy Planning: An Update.

#16 Summer 1982

Prairie Festival 1982: Resettling America; Two Worlds of Water; Getting Along with Nature; Breeding Perennial Grain Crops; Heating and Cooling the Classroom; Kansas Energy: A Resource Guide for Community Action; Asking the Right Questions (irrigation); Great Plains Desertification: It Could Happen.

#17 Fall 1982

Peace: The Kansas Dream; Time to Live Lightly on the Earth; Essays on Sustainable Agriculture; Asking Questions - Seeking Answers (perennial polyculture breeding); Biological Pest Control in Livestock; What Happens if an Electrical Utility Goes Bankrupt; Solar Ponds.

#19 Summer 1983

Prairie Peace Pilgrimage; Prairie Festival 1983: Food and Peace; Alternatives; An Uncertain Road (water issues in western KS); Hydroponic Corn: Insanity in the Sandhills; Words of the Prairie; Breeding Sustainable Domestic Plant Populations; A Living Museum (the Herbarium); Weed Ecology; On the Economics of Small Farms; Soil Conservation on a Family Farm; Solar-Powered Amish Farms.

#21 Summer 1984

Seminars Enrich Programs; Prairie Festival 1984: Ecology and Economics; Walking Across the Tallgrass Prairie; Nature's Wisdom or the

Scientists' Cleverness?; More Wind Energy Experiences; Wars of the 20th Century; Third World Desperation - A Threat to World Security.

#23 Spring 1985

Mission Impossible? (The Land Institute); 1985 Research Season Begins; Soil Surveyed in Experimental Plots; The Making of Mollisols; Farm Debt; Alternatives in Energy; The Pipe Creek Shirt Company; Agriculture in Nicaragua; Going Fission.

#25 Fall 1985

Illinois Bundleflower - A Perennial Food or Feed Crop?; Successful Farming - Organically; Agriculture Pulls the Plug on the Central Flyway; Making Connections (feminism and sustainable agriculture); The Role of Women in Changing Agriculture; Agricultural Development - or Intrusion?; Roots of African Famine; Pesticides are Poison for Workers in Mexico.

#26 Spring 1986

Sustainable Agriculture: A Concept Catching On; 1986 Research Season Underway; Allelopathy: Natural Phenomenon or Unproven Concept?; The Environmental Problems of Irrigation Agriculture; Scientific Assumptions and the Problem of Agriculture; On Herons, Human Senses, and Healing; The Wild Thread; Celebrations of Nature; Speak Often and Carry a Big Check: A Guide to Political Effectiveness; On the Road Again (in Nepal).

#27 Summer 1986

Land Institute to Celebrate 10th Anniversary; Prairie Festival 1986: Soil and Seeds, the Sources of Culture; Soil, Seeds, and Settlers; Midsummer Research Report; Land Folk Visit Small Farms Resources Project; Soil and Nuclear Power Plants; Reflections on the Organic Garden at The Land; Were the First Farmers Gardeners?; Trees on the Plains: They're for the Birds; Raptors on the Rebound; Tallgrass Prairie Preserve on the Horizon; County Poor Farms - Good Riddance?; Student Directory 1976-1986.

#28 Fall 1986

New Property Purchased; Wauhob Prairie Dedicated; Speech of Dedication; Leymus: A Plant with a History of Human Use; Sorghum: A Perennial Future; A Reading List; Prairie Meditation; Evil and Change; Women in Agriculture; Lasso - Winner or Loser?; The Fertilization of Industrial Agriculture; Farmers and the Folly of the Free Market.

#29 Spring 1987

Spring Report; Design Process for the Greenhouse Nearly Complete; 1987 Research Season Begins; The Re-Search of Thoreau; America's Rarest Gamebird; The Grain Exchange; Rediscovering Traditional Agriculture; The Failure of Successful Agriculture in Mexico; Our Role in the Evolution of a Land Ethic; Farm Policy for the Long Term; The Land Needs People; Will the Cornbelt be Relocated?

#30 Summer 1987

Talk about the Weather; The 1987 Prairie Festival: Citizenship and the Land Ethic; Americans and the Land; Why Does Kansas Need a State Soil?; U.S. Winter Vegetables and Pesticide Poisoning; The Future of Pesticide Reform; Mid-summer Research Report; Diversity: Corn, Convolvulus, and Coons; Concepts of Time; The Role of Women has Changed, and my Husband Doesn't Want Pie.

#32 Spring 1988

New Greenhouse is Dedicated; The Farmer, Speaking of Greenhouses; Kansans Talk to Annie (the play "Planting in the Dust"); 1988 Research Season Underway; Prairie Images; Grain Exchange Board of Advisors Meets; Kansas Organic Producers Meet; Sustainability and Strong Democracy; Society as a Maturing Ecosystem; Resourceful Farming: A Primer for Family Farmers; Reshaping the Bottom Line.

#33 Summer 1988

10th Annual Prairie Festival: Health, Beauty, and Permanence; Land and People - An Ecological Perspective; Seeking Permanence (Conn Nugent and David Orr); A Flint Hills Visit; Listening to Silence; Music

to Evoke the Prairie; Prairie Patterns and their Relevance to Sustainable Agriculture; In the Greenhouse; The Land's Harvest; Grain Patches in the Garden; An Introduction to Biodynamic Agriculture; Energy Choices.

#34 Fall 1988

Prairie Music with a Human Voice; Prairieland Food Cooperative Thriving; At The Land; Paula Bramel-Cox - Sorghum Breeder; Plant/Soil Interactions Studied; A Nitrogen Cycle Primer; Marketing the Land's Harvest; Albert Howard - His Ecological View of Agriculture; Rumania's Socialist Utopia; Conservation and Society.

#35 Summer 1989

Prairie Festival 1989: The Global Environment, a Prairie Perspective; Changes (at The Land Institute); The 1989 Experiments; Drought and the Prairie; Biological Controls Provide Help off the Pesticide Treadmill; Large-scale Organic Farmer Expresses Optimism (Fred Kirschenmann); The Platte River and the Prairies of Nebraska - Saving What's Left; Loam, Loam on the Plains; Rishi Kheti - The Agriculture of the Sages; Questioning the Sustainability of Westernization; What on Earth Can We Do?

#37 Spring 1990

Using Nature as a Model; LISA-funded Legume Research; Foliar Diseases on Eastern Gamagrass; The Asilomar Declaration for Sustainable Agriculture; The Land as Therapy; The Mad Farmer's Letter to Some Relatives in Town; What Did You Do for Recreation?; The Greening of Religion; Creating a New Picture of the Earth; Green Thumbs Gather; Solarize Soil to Control Wilt; Squash Bug Woes; Reading about Gardening; The Greening of Agricultural Policy - Can it Happen in Kansas?

Results of the 1989 experiments are available in *The Land Institute Research Report, Number 6.* Copies are \$3.00 postpaid.

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1990 Interns. *Back row (l. to r.): Berni Jilka (2nd year -- intern coordinator), Paul Muto, Tamara Kraus, Doug Romig, Tracy Noel, Jean-Luc Janninck. Front row: Kris Schaefer, Holly Ewing, Kathy Collmer*

1991 Interns

Nine new interns will be selected in January from applications received this fall. The new term starts February 18 and ends December 13, 1991. The Land Institute admits students of any race, color, national or ethnic origin.

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