The Land Report

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Regulars

Cover: The Snake Fence*, by H. Eric Bergman. Wood engraving, 8 by 6.2 inches, 1936. Gift of Bud and Ruby Jennings to Spencer Museum of Art, University of Kansas.*

The Land Institute Mission Statement

When people, land and community are as one, all three members prosper; when they relate not as members but as competing interests, all three are exploited. By consulting nature as the source and measure of that membership, The Land Institute seeks to develop an agriculture that will save soil from being lost or poisoned, while promoting a community life at once prosperous and enduring.

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The Land Report is published three times a year.
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At the Land

Not every nonprofit organization that began with a $10,000 budget in 1976 is still going. This one started with a dropped-out professor and teacher who came "back to the land." They began The Land Institute with the help of two neighbors—those families are still represented on our board—and "The Land" has been growing ever since.

So, please help us celebrate our 30th anniversary. Our sights are on a $1.7 million budget and more, to carry on the big job of making possible a new agriculture, one with perennial crop plants grown in mixtures to mimic natural ecosystems and conserve soil while still providing our food.

Prairie Festival
The annual gathering for conversation, food and art will mark our 30th anniversary. For more about what will happen and how to register, see page 10.

Research focus: perennial sorghum
In spring, a perennial sorghum breeder looks for sprouts. How many plants in the breeding program will emerge from the soil, unscathed by winter? These aren't native plants that have grown on the Plains for millennia. These are genetically mixed-up plants with a lineage of both hardy wild species and tender subtropical annual crops.

There are many ways for a plant to fail during winter: not enough food stored up in the underground stems called rhizomes; rhizomes not burrowed deep enough to escape the worst of the cold; susceptibility to molds that thrive in cool, damp soil; failure to read the signals of spring. The proteins encoded by many genes must do their job correctly to avoid these failures. Hybrids with more than one annual ancestor are most likely to express the ineffective "annual" copy of at least one of these critical genes rather than the "perennial" copy.

Thankfully, genetic theory predicts that with large enough populations, plants with rare combinations of the necessary genes will be found. Now the going is easier. Using only the rare plants as parents makes the rare genes more common with succeeding cycles.

The theory appears to be correct: persistent crossing and the growing out large numbers of plants is paying off.

This spring Land Institute sorghum breeder Stan Cox found 300 sorghum plants vigorously emerge from their winter dormancy, far more than in any previous year. All had hybrid ancestry. In our early work with sorghum, many hybrids between annuals and perennials survived winter. But later generations, with a higher percentage of genes from the annual crop, suffered almost complete winter-kill. These included plants with the most promising grain characteristics. This year is different. Many plants have towering stalks and narrow leaves, and so won't be confused with commercial grain sorghum. But the population has the full range of height, head and seed characteristics that we saw in the larger populations. Cox has good reason to be optimistic that this population includes genes for improved grain yields: the data from last fall shows that, on average, the families with winter-hardy plants yielded 20 percent more grain than the families with no surviving plants.

Research request
Land Institute scientist David Van Tassel would appreciate receiving seeds from Lewis blue flax (*Linum lewisii*) plants growing in the wild. This perennial species is indigenous to much of North America, but seed from locally collected populations is hard to find. Van Tassel seeks seed adapted to a particular ecosystem, not from a flower garden or the city park, which likely are products of a big seed farm. Lewis blue flax growing at The Land Institute appears to be well adapted to the farm environment. We would like to study its genetic diversity for potential grain production.

Leland's shack
In the spring *Land Report*, Land Institute President Wes Jackson told of his friendship with Leland Lorenzen. Thoreau's *Walden* catalyzed critical thoughts about industrial life for Lorenzen, who went on to live 29 years in a 6-by-16-foot shack. Lorenzen died in 2005. With the blessing of his family, we moved his building to The Land Institute. In woods behind our office it will stand as a memorial to following a different drummer—toward means more modest, ends more durable.

Exposure
The *Proceedings of the National Academy of Sciences* published March 21 a study whose authors include Land Institute soil scientist Jerry Glover and former institute graduate research fellow Sasha Kramer. They found that compared with organic farming, synthetic fertilizer use cut populations of microbes that help make healthy soil, and increased loss of nitrogen to water. Nitrogen is vital to build plants but can pollute water for wildlife and humans. In natural settings, soil microbes manage the nutrient more efficiently, so plants get what they need of it with no human help. The Land Institute's goals include largely weaning agriculture from the synthetic fertilizer use, with crop plants and their arrangement more like those that dominate nature.

Land Institute plant breeder Lee DeHaan tosses from our research combine packets of intermediate wheatgrass seed. Wheatgrass is a wild perennial that we are both breeding with wheat and domesticating directly. The combine, driven by Steven Lancaster, let DeHaan harvest seed separately from more than 600 short rows of plants with different parentage. Comparing seed yields will help us evaluate our breeding method. Scott Bontz photo.

Land Institute staff members spoke individually in Santiago, Chile, for a conference on sustainable forestry; in Armonk, New York, for a meeting about the environment and the effects of global warming on how we live; in New York City for a meeting of Humans, Nature and Democracy; in St. Louis; at The College of Wooster in Ohio and at the University of Minnesota; at a conference of Humans and Nature in Libertyville, Illinois; and in Traverse City, Michigan, about land use.

Land Institute President Wes Jackson was one of three orators for a performance of *Grasslands: Prairie Voices* by the Paul Winter Consort and the Kansas City Symphony and Chorus, with 100 singers. The Symphony in the Flint Hills hosted 6,000 people outdoors at Tallgrass Prairie National Preserve near Cottonwood Falls, Kansas. Eugene Friesen composed the symphony after Jackson's suggestion in the mid-1990s. For Jackson's text, see page 25.

Prairie Writers Circle

We send op-ed essays to newspapers around the country. Recent topics: the folly of biofuels (see page 26), the environmental cost of air conditioning and lawns, living within natural limits, farm policy reform, the promise of hydrogen fuel. All of the essays are at www.landinstitute.org under Publications. They are free for use with credit to the Prairie Writers Circle and The Land Institute.

Presentations scheduled

October 12, Prairie Village, Kansas.
October 25, Ames, Iowa

For details, call 785-823-5376 or see www.landinstitute.com.

Tours

We would enjoy meeting you, telling our story and hearing yours. Please call ahead. We give guided tours only with advance arrangement, from 8 a.m. to 5 p.m. weekdays. See Visit at www.landinstitute.org or call 785-823-5376.

Back Home on the Range

Wes Jackson

In mid-July The Land Institute welcomed back 22 bison to its 160-acre prairie. Their kind had been gone for some 130 years, and now that they've returned, it's not with freedom to roam, but as an artifact. Such accouterments as fences, corrals and block mineral salt make it that way.

Our neighbor to the north, Paul Mai, has raised these former Monarchs of the Plains for 15 years or so. After we struck a deal with him, we did some fence tightening, and Paul had one of his steel companies build a gate on our common boundary.

I opened the gate. But getting the bison on our side wasn't as simple as I'd imagined. From my pickup, I finally spotted them at the northwest corner of Paul's pasture. At a safe distance I got out and shook a five-gallon bucket of range cubes. They heard, they saw, and they began to move toward me. I drove a ways. They stopped and I shook the bucket again. I crossed Paul's dam. The entire herd lingered, splashing in the pond, but with more bucket shaking the big bull came out of the water, and the cows, calves and yearlings followed.

I was making good progress when Paul arrived riding in the back of *his* pickup, with *his* bucket of cubes. A friend driving that pickup shot ahead of me toward the gate. Paul motioned for me to get out of the way, but my old truck wouldn't start—vapor lock. Paul, not knowing my situation, motioned to me wildly.

The bison surrounded the truck, hunting range cubes. All Methodist molecules left my body and I became a Buddhist. I waited quietly. Finally they heard and saw Paul's bucket as he stood in the back of the truck—or he tried to. The driver, who must have been more comfortable with automatic transmissions, jerked forward, sending Paul to his knees. At the fence opening, the pickup stalled, the engine raced, the pickup leaped, stopped, leaped, died. Paul staggered, cussed. The truck finally moved through the opening, through this would-be Prairie Arc de Triomphe. But not the bison.

They must've wondered, like Methodists of old, if they should succumb to temptation or avoid going to where the grass is greener. Finally the wiles of the devil overtook them, and they passed through to explore and graze the hillside.

It was a beautiful prairie evening. One of my dreams had come true. I got Joan to come out, and from the other end of the pasture, from a half a mile off, we watched them graze on our prairie grasses. On my cell phone I called Don Worster, chairman of our board for 10 years. I gave him the chance to share in the excitement. He didn't disappoint me.

Early next morning I went out early to our prairie, expecting to see the bison peacefully grazing. They weren't there. They had forsaken prairie growth tickling their bellies, as Aldo Leopold put it, and headed for home, where the grass was chewed down and the ground dusty. Ingrates!

An apt poem came to mind. The one about Little Bo Peep. Remember, she "lost her sheep, and doesn't know where to find them. Leave them alone and they'll come home, wagging their tails behind them." (If Little Bo Peep has lost her sheep, why say that she doesn't know where to find them? If they are lost, they are lost. And "leave them alone"—what choice does she have? The poem goes from bad to worse. "They will come home, wagging their tails behind them." Where else would a sheep wag its tail?) These allegedly wild creatures were like Little Bo Peep's sheep. They went home.

As far as I could tell, they stayed home all day. But on the third day they arose from their home pasture and went to our grass heaven.

They left their calling cards. That is, we saw their pies. Pie seems a little word for such a nice, great big, radically symmetrical pile. With the hot, dry days, they were on their way to becoming chips. I began to have fantasies of using buffalo chips at the Prairie Festival, to cook our organic meal just like the early settlers did, and to have a pie throwing contest.

You can see that the Greek ideal is very much alive around here. We have the wild. We have the domestic. We have poetry. We have cooking fuel more sustainable than propane. And we have our own Discobolos, epitome of athletic form, this time with organic disci.

I write this so that we don't take ourselves too seriously, since none of this would be possible without the tree of knowledge-sponsored accouterments of civilization, like a vapor-locking '83 Chevrolet Silverado four-wheel-drive pickup and range cubes.

Enlisting and Infecting Higher Education

For help in reforming agriculture, The Land Institute reaches into the seminal ground of higher education. Our graduate fellowship program funds master's degree and doctoral students in research to pattern agriculture after natural ecosystems. Students can take advantage of major universities' resources. This work at schools otherwise might not happen—it's perceived as too risky, too lengthy or unnecessary for today's agriculture.

The program also plants the seeds of our ideas at the schools, both during the research and afterward, when these bright young people move on to their life's work.

We aim for a worldwide interdisciplinary network of research groups interested in natural systems agriculture.

Fellows receive up to $9,000 annually. We have awarded 68 fellowships since the program began in 1998. For more see www.landinstitute.org.

Following are sketches of work by this year's new fellows.

Becky Chaplin-Kramer
University of California, Berkeley

Does natural habitat help control pests?
Many studies have shown that the natural enemies of agricultural pests benefit from natural habitat near farms, but it is unclear if this provides better pest control, since it might help pests as well as their enemies. My work will address this for application to better land management.

Maggie Mangan
University of Minnesota

Nitrogen flow in prairie
My objective is to estimate biological nitrogen fixation, the conversion of atmospheric nitrogen into a form that plants can use. I will measure nitrogen concentration and plant production, in grass monocultures and in mixtures of grass and legumes, to see how much of the nitrogen is available for plants. Knowing better how nitrogen moves through prairies will help us in farming to mimic natural systems' efficiency and community stability.

E. J. Blitzer
University of California, Berkeley

Plant diversity's effects on pests and their parasites
I will study how plant diversity affects insect pest regulation by natural enemies in sunflowers and cocklebur. The gauges will be two species of leafminer and their shared parasites. This work will help with food web models for farm pest management that mimics natural systems.

Mary Damm
Indiana University

Mycorrhizal fungi in prairie and farm
Mycorrhizal fungi form a symbiotic relationship with plants, providing them with more soil nutrients, particularly phosphorous and nitrogen, in exchange for carbon. Without the luxury of externally applied chemical fertilizers, farmers might one day need to rely on the soil for plant nutrition. Mixed perennial grains that The Land Institute seeks might depend on a diverse mycorrhizal fungi community. To determine the influence of mycorrhizal fungi, I will compare the mycorrhizal species composition among native tallgrass prairie, annual cropland and a potential perennial grain mix.

Muhammet Sakiroglu
Iowa State University

What genes shape perennial plants?
To develop effective breeding strategies for perennial grain crops, it is crucial to know how genetics control things such as seed and biomass production. I am interested in mapping these genes for alfalfa.

John Mai and Mary Damm identify species and measure how much each covers in prairie northwest of The Land Institute. The institute funds Damm's work at Indiana University. Mai works at the institute. Scott Bontz photo.

Tianna DuPont
University of California at Davis

How do natural systems manage disease and fertility?

Natural systems of mixed perennial plants often cycle nutrients more efficiently and suffer less disease than do farms' annual monocultures. Soil organisms such as insects, bacteria, fungi and microscopic round worms called nematodes decompose organic matter into nutrients available for plants and regulate organisms that attack plants. I hypothesize that the identities and abundance of these soil organisms may increase or decrease a system's ability to manage disease and fertility. Using nematodes as an indicator, I will compare the composition of soil organism communities in mixed perennial grasslands, mixed annual cover crops and annual monocultures.

Brook Wilke
Michigan State University

Balancing water availability and fertility

Planting perennials and cover cropping with annuals are two ways to recover organic matter and enhance soil quality in low-input farming, but only with tradeoffs. Winter cover crops in annual systems add needed nitrogen, but often leave little residual winter moisture for later crops. Water benefits of perennial systems may be offset after several years by reduced nitrogen. I will study how plant species composition in annual and three perennial ecosystems—undisturbed, burned and lightly tilled—affect soil moisture and nitrogen availability.

Can We See with Fresh Eyes?

Beyond a culture of abstraction

Craig Holdrege

The problem with biases is that we often don't know we have them and aren't aware of how strongly they inform the way we view and act in the world. I want to address one fundamental bias that infects modern Western culture: the strong propensity to take abstract conceptual frameworks more seriously than full-blooded experience. The more we place abstractions between ourselves and what we encounter in the world, the less firmly rooted we become in the world. Is it any wonder that a culture caught in a web of abstraction becomes a culture disconnected and alienated from nature? I want to show some ways to move beyond a culture of abstraction.

The capacity to abstract is what allows us to pull back from our perceptions and look at the world from a distance. We can form clear and distinct conceptions about things, form judgments and then act. The ability to abstract is a central feature of being human. But like all gifts and strengths, our capacity to form abstract concepts is a double-edged sword when it becomes too dominant and habitual. If we do not consciously attend to how we form abstractions and then remain aware of their relation to experience, they tend to take on a life of their own. As a result, we run the danger of attending more to the abstractions themselves than to the world they are meant to illuminate.

Captured by abstractions

Since the first step in overcoming a firm habit of mind is to acknowledge its existence, let me present some examples of abstraction gaining the upper hand. I'll begin with Charles Dickens in *Hard Times*:

> "In this life we want nothing but Facts, sir; nothing but Facts!" ...
>
> "Bitzer," said Thomas Gradgrind, "your definition of a horse?"
>
> "Quadruped. Graminivorous. Forty teeth, namely 24 grinders, four eye-teeth, and 12 incisive. Sheds coat in the spring; in marshy countries, sheds hoofs, too. Hoofs hard, but requiring to be shod with iron. Age known by marks in mouth." Thus (and much more) Bitzer.
>
> "Now girl number 20," said Mr. Gradgrind, "you know what a horse is."

You can see Dickens' wry smile. You can have as long a list of "hard facts" about the horse as you like, but you do not understand the horse unless you begin to see how the features are connected to make the whole animal. Many of us have spent hours learning such fragmented facts in science classes. Did any teacher or professor ever tell us that a fact is an abstraction? Or that when we look at the world in terms of "facts," we are portraying it as if it consisted in neatly separable entities?

The science educator Martin Wagenschein tells of a ninth-grader introduced to chemistry as a world of quantitative relations. Evidently there was little hands-on lab work where he could also have met substances and chemical transformations as bubbling, colorful and smelly. In this course he learned that water is H_2O. This made a deep impression on him:

> From my childhood on I have had a passionate, almost magical connection to water, both to flowing and to standing water. When I learned H_2O I was, for a few weeks, deeply saddened. As if my beautiful old water was gone and from now on I would have to think: "It's only H_2O." Childish maybe, but I was very sad and deeply estranged. After a time these feelings left all by themselves and the old magic returned. *How* this inner healing occurred I do not know. I do know that in any case my teachers had nothing to do with it.

The boy's teacher could have done an impressive, qualitatively rich demonstration: Start with two colorless and odorless gases, oxygen and hydrogen. Combine them in a sturdy tube, two parts hydrogen to one part oxygen, and light the mixture. With a squeaking explosion, water droplets will form on the tube. On the basis of the observed phenomena, the formula H_2O can meaningfully be viewed as an abbreviation indicating the volumes of these gases that are needed to produce water. This way it remains in experience—and an awe-inspiring one.

The problem is that we do not learn to pay attention to how concepts are formed. Rather, since we usually learn them as abstractions already separated from their genesis—from their actual scientific and human context—we have little choice but to take these abstractions as if they were object-like facts of the world.

Instead of letting children explore—with all their senses and sense of wonder—the realm of substances, you teach them indigestible abstractions. To make them palatable, a poor teacher—carrying the yoke of curriculum standards and standardized tests—might resort to

cute anthropomorphisms like cartoon-figure atoms joining hands to make molecules. You might as well show them a Mickey Mouse film; at least it makes no pretensions about being real.

This essentially unconscious process of reification is what the philosopher Albert North Whitehead called the fallacy of misplaced concreteness. We treat our abstractions as concrete things of the world. I simply call it object-thinking—thinking of the world in terms of objects.

The conundrum of knowledge

Recognizing the power of abstractions to catch us in their web, the philosopher Edmund Husserl, already nearly 100 years ago, made an impassioned cry for a "return to the things themselves." But this return—or perhaps better said, forging ahead—to the things themselves is no easy task, as Husserl describes in *Ideas: General Introduction to Pure Phenomenology*:

> "That we should set aside all previous habits of thought, see through and break down the mental barriers which these habits have set along the horizons of our thinking … these are hard demands. Yet nothing less is required. What makes … phenomenology … so difficult, is that in addition to all other adjustments a new way of looking at things is necessary, one that contrasts at every point with the natural attitude of experience and thought. To move freely along this new way without ever reverting to the old viewpoints, to learn to see what stands before our eyes, to distinguish, to describe, calls … for exacting and laborious studies."

So how can we learn to see with new eyes, to re-ground our knowing in the world of lived experience rather than in enticing but tenuous abstractions? We can begin by realizing the virtues of ignorance. Henry David Thoreau describes beautifully in his *Journals* the role of ignorance in knowing:

> "It is only when we forget all our learning that we begin to know. I do not get nearer by a hair's breadth to any natural object so long as I presume that I have an introduction to it from some learned man. To conceive of it with a total apprehension I must for the thousandth time approach it as something totally strange. If you would make acquaintance with the ferns you must forget your botany. … Your greatest success will be simply to perceive that such things are, and you will have no communication to make to the Royal Society." (October 4, 1859)

> "I must walk more with free senses—It is as bad to study stars & clouds as flowers & stones—I must let my senses wander as my thoughts—my eyes see without looking. ... Be not preoccupied with looking. Go not to the object; let it come to you. ... What I need is not to look at all—but a true sauntering of the eye. (September 13, 1852)

To help us learn this "sauntering of the eye," Thoreau, who was no reticent person, might well have taken us on walks and prodded us with his walking stick to just look, just smell, just hear—and rid ourselves of all our confounded knowledge. But, he was also not simpleminded; he knew there was more involved in knowing:

> "It requires a different intention of the eye in the same locality to see different plants, as, for example, Juncaceae [rush] or Gramineae [grass] even; i.e., I find that when I am looking for the former, I do not see the latter in their midst. … A man sees only what concerns him. A botanist absorbed in the pursuit of grasses does not distinguish the grandest pasture oaks. He as it were tramples down oaks unwittingly in his walk." (September 8, 1858)

Thoreau realized that we don't see anything unless we have concepts, unless we have an intention that we bring to the world; otherwise we would just have confusion. I was once walking and saw something black moving across the path in front of me. I couldn't "get it." I saw something but had no idea what it was. That was disturbing. I tried the concept snake, but it didn't take, and then suddenly I saw it: a blowing black plastic bag. The perceptual world, for a moment in disarray, had come together again. Only if I bring concepts to experience do I see coherently.

We have a problem: the openness and freshness—the ignorance—that allows us to perceive things that don't fit into our preformed ideas and thereby to see the unexpected, on the one hand, and on the other that to see, to see richly, we need to bring the fruits of previous experience. We need openness to take in something new, but only through applying concepts formed from previous experience—which are in this sense biases—can we make sense of the world at all.

So there is a real tension between pre-formed concepts and openness. I would say that we need to live *actively* and *consciously* within this tension. It's a matter of transforming our concepts from biases that color phenomena to tools that can help illuminate the not-yet-seen. Can we be just as interested in what does not fit into our scheme of things, as in what does? Can we continually stretch and remold our view of the world? Or to put it another way: Can we bring new life into our way of knowing?

Over a number of years I studied a particular plant, the skunk cabbage. I was intrigued by its strangeness and wanted to get know it better. So I went out regularly and

Prairie Festival

October 6-8, 2006
The Land Institute
Salina, Kansas

At a place working to make farms more like natural ecosystems, hundreds of people —artists, scholars, critics, farmers, poets, historians, environmentalists, writers, business people, scientists and, we hope, you—will gather to celebrate and discuss the country's livelihood.

WENDELL BERRY, writer of poetry, fiction and essays, including *The Unsettling of America.* **RAY ANDERSON,** environmentally progressive leader of the interior furnishings company Interface. **DAVID ORR,** Oberlin College environmental studies director, author of books including *Ecological Literacy.* **FRANCES BEINECKE,** Natural Resources Defense Council president. **WES JACKSON,** Land Institute founder, author of books including *New Roots for Agriculture*. **LAURA JACKSON,** University of Northern Iowa teacher in ecology, conservation biology and environmental studies. **DOUG TOMPKINS,** conservationist, founder of Foundation for Deep Ecology. **JAKOB VON UEXKULL,** from Sweden, founder of The Right Livelihood Award, and *Time*'s 2005 European man of the year. Singing by **ANN ZIMMERMAN.** Gallery and talk by *National Geographic* photographer **JIM RICHARDSON.** Plus: food, barn dance, bonfire and visiting. Free camping.

The weekend costs institute supporters $18, others $24. One-day attendance is less. Students: $10. Saturday night supper: $12.50 extra. For more, including a schedule, see www.landinstitute.org or call 785-823-5376.

◄ A model to remake and save farmland: prairie plants longer—and longer lived—than we are. By Jim Richardson.

observed its habitat, life cycle and how it adapted to its environment. I'd often go out with a particular question and focus.

But I also made it a rule to occasionally go out with no fixed focus and try to perceive with Thoreau's sauntering eye. Sometimes it didn't work, because my attention would wander inward and I'd start thinking about all sorts of other things. Although I was out in the woods, I was in my head and hardly seeing anything. But sometimes it worked, and I could tell that repeated practice makes it possible to cultivate a kind of open, receptive awareness infused with an animated expectation of what might come.

One March afternoon I went down to the wetland where skunk cabbage grows. In upstate New York where I live it often is still wintry at this time of year. On this day the sun was shining through the leafless shrubs and it warmed my face. My eyes were wandering over skunk cabbage flowers just emerging from the cool muck. Then I saw a few bees. I watched those bees fly into the flowers and fly out again into other blossoms. In a flash I realized, I hadn't seen any bees yet that year. The first bees of the year were visiting this plant—this strange plant that warms up to over 60 degrees when it comes out of the ground, even though the air temperature is often at or below freezing. Skunk cabbage warms up, and on a first somewhat warm and sunny afternoon, the bees come.

I'm pretty sure I would have overlooked this wonderful meeting of bee and skunk cabbage had I not been practicing a "sauntering of the eye." I know myself well as a not-so-open observer and that I usually must focus intently to see. But that very focus can prevent me from seeing the unexpected. So, by going out purposefully with the broad focus of open expectation, I overcome my limitations, and, as the philosopher Hans-Georg Gadamer puts it, invite the world in.

Another exercise to heighten openness is to think back on the day in the evening and ask myself: "What did I experience today that I wasn't expecting?" It can be disheartening to realize how much of what I experienced was actually expected. Biases were supported: The colleague who is usually a jerk was once again a jerk, and so on. To cherish those few moments when something new and unexpected appeared, and then to vividly and concretely re-picture those experiences to myself can lead me to cultivate an interest in and sensitivity to the unexpected. So I can reflect back on my troublesome colleague's actions and words that *did not* fit my expectations. I try to create a field of openness. It actually does bear fruit. I can begin to see another person, a landscape, or a social problem—whatever it may be—with fresh eyes.

Beyond abstraction to living concepts

I have been focusing on how we can open up our perceptual field by trying to put the conceptual element in the background. But, since we need concepts, we also can work to change them. And I mean not only their content, but their style.

Most people think giraffes have long necks. As many biology teachers do, I taught this as a straightforward illustration of Darwinian evolution via variation and natural selection.

Later I studied the giraffe and its neck in more detail. The first step in overcoming the abstraction of the "long neck" was to view the neck both within the context of the whole animal and in comparison with other mammals. I discovered that the neck is not the only thing long in the giraffe. Its foot and leg bones are long, and since they are arranged more vertically than in other hoofed mammals, the overall leg length is increased significantly. It is the only hoofed mammal with longer front legs than hind legs. It has a long head, a very long tongue and long eyelashes too. And at the other end, in its tail, are the longest hairs you'll find on any animal. I realized the giraffe's neck is part of an overall tendency in the animal toward vertical lengthening.

But this all has consequences. A giraffe is not only concerned with the world from six to 16 feet up, where it browses. It sometimes lowers its head to drink and graze. Then it must spread its forelegs awkwardly far apart, making it more vulnerable to predators, to reach earth or water. The giraffe has a manifestly short neck! What other hoofed mammal has a neck so short that it cannot reach the ground without spreading its legs?

Again, if a fact is to be more than an isolated abstraction, we need to view it within a context. And in the case of the giraffe's neck, the context is the organism itself.

The trouble is we usually don't make the effort to view things within their dynamic, changing contexts. There are lots of stories about how characteristics of organisms evolved, but these stories work only as long as you treat the beak, the fin, the feather or the stomach in isolation from the whole animal. So becoming sensitive to how our concepts inform what we see is important. Otherwise we end up explaining schemas and not the things themselves.

What we can do is become more playful with our concepts. When I see the giraffe both in terms of its "long neck" and its "short neck," I overcome a predilection to look at it in just one way and don't get stuck within a too-narrow conceptual framework. And at the same time I begin to appreciate more deeply the organism's complexity. To do justice to this complexity I need to take multiple perspectives. I might not end up with a neat, unified explanation of the animal, but at least I have met the richness of the creature rather than having created an abstract phantom.

As the German poet and scientist Goethe said, "If we want to achieve a living understanding of nature, we must follow her example and become as mobile and flexible as nature herself."

I have come to realize how organisms can teach us about a living, dynamic way of thinking. If I'm willing to pay attention, I can learn from life how to think in a living way. For me the study of the growth and development of plants has become an especially vivid and rich model for what I could call living thinking.

A plant sends roots spreading intimately through the soil, in exchange with the earth. We do this when we explore and meet the world with fresh eyes. Always growing, always probing, and meeting things anew. We become rooted in the perceptible experiential world.

As a flowering plant grows, it unfolds leaf after leaf, which you can see most vividly in annual wildflowers. When the plant grows up toward flowering, the lower leaves die. So a plant lives by unfolding something very important at that moment, then moves on to make new structures while past forms fall away. What a wonderful guiding image of how we can work with our concepts: Instead of falling in love with a particular idea and holding on to it at all costs—object-thinking—we could learn to form a concept, use it, and then let it die away as our experience evolves. A plant shows us what it means to be undogmatic. Or to put it positively: how to stay dynamic and adaptable.

By studying a plant's form you can also read the environment. A plant develops differently in drier or richer soil, in shade or sun. A plant is always in context.

If we were to think plantlike, our concepts would stay closely connected to the context they arose from, and if that context changed, we would drop or metamorphose our ideas to stay within the stream of life. Then we can experience ourselves as both active and receptive conversationalists with nature. We are no longer distant onlookers gazing coolly at a world of objectified things.

This re-rootedness in the world is exhilarating, but is not necessarily comfortable. One of the comfortable things about object-thinking is a sense of license to manipulate. Science becomes a kind of value-free zone. But the moment we become aware of the participatory, interactive nature of knowing, everything changes. Entangled in the world at every moment, we know that we bear responsibility for our way of knowing and its externalization in our technologies and actions. A living thinking is a thinking that knows itself as embedded in the world.

If we are interested in a new kind of culture, then it won't do to simply tweak the old forms. We need a revolution. So imagine if, for the next 400 years, instead of striving toward ever greater abstraction in our thoughts—the goal of goals being a unified theory of everything—we cultivate a thinking modeled after concrete living phenomena. This shift from abstraction and object-thinking to a plantlike dynamic thinking would help us develop the capacities we need to truly ground our understanding and interactions with nature in nature.

Based on a talk at The Land Institute's 2005 Prairie Festival. *For audio tapes, see page 15.*

Raccoon track. Scott Bontz photo.

Breeding Resistance to Special Interests

Stephen Jones

Farmers have certain fundamental rights, and one of them is to plant back what they harvest. I think it takes incredible arrogance in our generation to do away with a right that's been around since the beginning of organized agriculture, which is about 10,000 years. That's what's happening right now, and it's happening with the help of most tax-funded, land grant universities. Of course it's happening with corporations, but if you're a land grant with a breeding program, odds are you're working with one corporation or another on herbicide-resistant crops. Every land grant that has a breeding program is working on types of plants that take away farmers' rights to plant back what they grow. To me, that's hard to understand. The usual excuse is that the money is needed to keep the land grants going. But why keep them going if they are no different from the corporations?

Our number one strategy in the Washington State University wheat breeding program is to involve the growers. Our program has worked with them every year, for 110 years.

One way that we work with growers is through evolutionary participatory breeding. "Evolutionary breeding" was a term coined at the University of California at Davis in the 1940s. It's basically getting populations that are highly variable into different parts of a field. We then let nature act on the variation in the field and in the population to select for the best plant types in that environment. Growers then join in and help the natural selection to develop their own varieties. We like to call this "genetic anarchy," although that term gets misunderstood. It is actually a very natural and predictable process. We are just letting nature and the farmers have more power on what type of plants emerge as superior.

It's very simple. In wheat you take an acre-size field. Farmers can go out with a weed eater and take out plants they don't like. If they don't like tall ones, they take them out. It's very easy to walk an acre of wheat after supper and in a few nights go through the selection. Then the grower harvests that acre and plants the seed back next year.

We view our service at the university as creating variation. We can make crosses in the greenhouse and put them in our field to increase. This works like Mendel made his crosses, taking pollen from a plant with one set of characteristics and fertilizing a different plant. Over a few generations of increasing this population, all the variation present in the genes can be observed and selected from. We harvest with our little combines enough for a grower to plant 60 or 100 pounds of seed.

We haven't done participatory breeding on a wide scale so far. There are about 2,500 wheat growers in Washington, and I talk to at least 800 a year, directly, in groups of two or 200. But I haven't said, "Hey, let's all go and breed your own varieties." While some would be interested, it won't appeal to everyone. We're growing our traditional wheats in 25 areas throughout the state. These 25 growers are the ones we work most closely with, and it's within this group that we're doing participatory breeding.

I envision it getting larger and even going out of state. It would be very simple for a grower from Kansas or California to call us and say, "These are the varieties that we grow in this area, can you make the cross, blow up 50 or 60 pounds for us and send it back?" We want to get into that type of service.

One of our favorite locations is our first one. He's a grower that came to us and said, "We want to get the granddaughters interested in farming; they're going to inherit the farm." So we told him, "Why don't you have them breed a variety and name it after you?" And he liked that. So, the oldest granddaughter took it on as a Future Farmers of America project. She has the plants in the field right now, and this fall will be the first fall that she goes out with her grandfather after supper and selects the plants. She is a sophomore, and this is a project that will go on 10 or 15 years. It's working very well. She has a little notebook, she takes pictures, she really enjoys it. She came to the greenhouses and made the crosses herself. We do a lot of that in our program, bring a lot of school kids into the greenhouse.

Basically it's straight farmer participatory breeding except that we're adding a strong natural selection element to it. You need strong selection. You need the forces of nature out there working for you: disease, so you can find the plants that best resist it, cold for the most winter hardy plants, drought for the drought-tolerant. Otherwise you're wasting your time out there.

One thing we want to do is give growers varieties adapted to certified organic situations. Modern varieties aren't as tough as needed for the demands of organic conditions such as low soil fertility, weed pressures and diseases. They have been bred with synthetic fertilizer and pesticides. So, we certified 11 acres on our 230-acre research farm in Pullman. We did that to go through the same hassles that the growers do, and to show the growers when they come out to the farm what organic can look like. We did it so that we'd have to deal with upset neighbors, too, just like farmers do. Some of our upset

neighbors were the farm manager and other researchers in the department who thought we were just crazy.

We are very proud that we have that 11 acres certified. We also have a goal in Washington that every university research farm put some acreage or an acre into certified organic. The school has nine research farms in the state, and we want all of them to have certified organic acreage to show what's possible.

We set up a breeding program specifically for organic. A lot of breeders say, "It's all the same, the best variety is the best variety." We don't know that, because the best varieties have not been selected under certified organic systems. Since about 1950, the selection in other wheat breeding programs has been under high-input, chemical-intensive systems. Are genes lost if not selected for in breeding? Yes, they are lost just by chance. We feel strongly that if we have not selected under low-input systems, we've lost genes favorable to that system.

We have great diversity in our program—wild wheats, old wheats, new wheats. What we're looking for are qualities that were in lines adapted to the area before the 1950s. We have found all 162 heritage varieties that were originally grown here, and all have been crossed to the modern varieties hundreds of times. These old wheats are beautiful, but a lot of them get very diseased and have traits that are not desirable. We can improve them.

Something else we look at is the end-use qualities of these old varieties. There's a lot of folklore that they were all great—that they all made great bread and cookies and noodles and pizza crust. But that's not true. We have a quality lab on campus run by the U. S. Agriculture Department's research service, and they make cookies and bread out of these old lines. Some loaves of bread made from these old wheats turn out like a brick. So we're trying to dissect the folklore as well.

Every year we have traditional farmers that come to the university for a farm tour. They are very surprised when they see a certified organic wheat field that looks like ours. It's as clean as theirs, it looks as good as theirs. We have beautiful looking wheat. They see our raptor poles and kestrel nesting boxes that work really well for gopher control, and they get interested in that. That's some of the value of having certified acreage on a university farm. Some of the older growers come up to me and say, "Hey, I can do organic, that's all we did when I was a kid."

A lot of times, during more political discussions about breeding at public institutions, people ask, "What can we do?" The things that I think should be discussed are very simple. Biotechnology is about ownership. The argument doesn't go there enough. It stays on the environment and on food safety. But it's about ownership and ownership only. It's about having a gene, and putting it in a vessel, and selling that vessel to the grower, and making them buy it every year.

So here is what I think—you can say that these things will be impossible to achieve, but I don't believe so:

■ No patents on life. That would solve the problem, the story would be over.

■ Get corporations off of our college campuses. They came on very quickly and they're having undue influence.

■ Repeal the Bayh-Dole Act of 1980. This allows public researchers to obtain patents and to get royalties from them.

For example, if I were to put herbicide resistance into a wheat, it could go on 1 million acres the first year. Under the act, I would be the inventor of that wheat variety and get 40 percent of royalties. Let's say the royalty was a dollar an acre back to the university, from Monsanto or BASF or whoever is at the other end of it. I would get $400,000 a year on a million acres of production.

This goes on at every public university and they're very proud of it. If you're interested in the Bayh-Dole Act, do a Google search for five minutes and you'll find that big-name schools' intellectual property offices love to brag about it. You'll find some good discussions about it, too.

So if we don't work with corporations and take royalties, what sort of funding do we have? I hear a lot that we have to work for these corporations, because there's no other money, and that everyone's doing it. The university administration pushes that we need to work with corporations, that we can't survive as public scientists.

But I have a list of funders for my program with over a million and a half dollars represented, and you don't see Monsanto and BASF among them. We're funded by the Washington Wheat Farmers, Fund for Rural America, Sustainable Agriculture Research and Education, and Organic Farming Research Foundation. We have a special grant on perennial wheat from the Agriculture Department, the Washington Department of Ecology, for buffers and borders, and The Land Institute.

And we have a woman in Idaho that we've never met who sends us $25 a year. So we make raptor poles with it and send her pictures of them.

In 2003 some 100 growers, researchers, political folks and activists gathered to talk about corporate influence, and the plant breeders decided we would form a sort of oath—something public breeders can sign that says we won't receive extra money for what we do, and we won't take away farmers' rights. Not much has happened since, because it's a touchy issue. But all of us agreed we would sign something like that. The venue to get it out is what we're working on. The group met again in 2005, and we are working on a 2007 meeting.

The position is delicate. I've given many talks where

by the time I get home I have a phone call or letter from someone who didn't like what I said. I've received letters from other land grant administrators to my land grant administrators.

The safety net that we have is the program itself. I have tenure. But mostly we just do a good job at breeding traditional wheat. There is pressure continually from within the system to do herbicide wheat, no doubt about that. But our best strategy has always been the same, and that is to be successful: Get grants, write papers, release varieties, have students, teach and do the things we're supposed to do. That's my strategy, and it's working so far.

The growers we work with are very excited. They like the idea of developing their own varieties, and they like it because for now, the United States is probably the most wide-open country in terms of wheat seed. In Canada, for example, you have to grow registered varieties of wheat, you can't just choose what you want to grow. It's like the cotton districts here, where you can only grow one kind of cotton. That's not true with wheat, and wheat growers really like that—your variety doesn't even have to have a name.

The people who won't like it are seed dealers, the university and the corporations. Think about it: the farmer developing their own seed? Their own variety? That's not good, right? That's dangerous stuff.

Adapted from a talk and interview in Organic Farming Research Foundation's Information Bulletin *No. 14.*

Prairie Festival Tapes

September 23-25, 2005, The Land Institute

☐ S1 *Healthy Land, Healthy People: Why Local Food is Better* — David Kline

☐ S2 *Cheap, Fast and Easy: You Wouldn't Want it in Your Daughter, so Why is it Good for Your Economy?* — Bill McKibben

☐ S3 *What Do We Tell the Children?* — Sue Halpern

☐ S4 *Natural Systems Living* — Carl McDaniel

☐ SU1 *Water Wildness* — Strachan Donnelley

☐ SU2 *Can We See with Fresh Eyes? Wonder, Bias and the Conundrum of Knowledge* — Craig Holdrege

☐ SU3 *Conceptual Revolutions: Who Needs Them? Why?* — Wes Jackson

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The Embedded Values of Earth

Aubrey Streit

Ceramist Ron Michael was first captivated by the earth on his grandparents' farm, seven miles east of Mankato in north-central Kansas. Athough Michael was born and raised in Denver, he spent nearly every summer working, playing and learning on that farm.

He soon shared his grandfather's attachment to the land. "I remember going for a drive with my grandpa after he had been diagnosed with cancer. As we drove he talked about the land he had worked most of his life. I could feel the love he felt for it."

Michael's own attachment isn't simply sentimental. It's also physical.

"Every farmer will grab a handful of soil, run it through their fingers," he said. "They're able to do a quick assessment of the soil's health just by touching it."

Texture is just as important for Michael's work with clay: "You need to grab it, hold it, experience it."

And it's hard to ignore, he said. "A few days after a rain, when most everything has dried out, there are always a few areas where you can still get stuck. That's because those areas are holding moisture longer—they're deposits of clay."

During graduate school, Michael remembered when his grandmother, an artist, shared some clay with his father. Michael then began his own exploration of native clays by checking out a geological survey book at the library. The book indicated that Jewell County had few large clay deposits. The quality of what clay could be found was "worthless," at least for industrial purposes.

Unconvinced, Michael decided to experiment by firing a chunk. Not only did it work, but it produced a distinctive orange color. He named it "Osage orange," in homage to its similarity to a local species of tree.

Lacking strength, this native clay can only be used in small quantities and must be combined with other clays. That doesn't bother Michael, who relishes the time he spends gathering it.

Michael's work starts on dry days, when he searches for exposed deposits on the ground he owns in Jewell County, Kansas. These are often where roads have been cut into the land. He digs the clay and places it in buckets.

Back in his Lindsborg, Kansas, studio, he allows the clay to fully dry before adding water to create a slurry. This slurry is strained through screens to remove organic matter before mixing. Michael's recipe combines small parts of native clay and "grog"—clay that is already fired and crushed—with a large amount of bagged powder clay. Ingredients are proportioned to create the desired consistency and durability.

The mixture is then placed in plastic bags and left at least a month for bacteria that increase its plasticity.

No deposit of native clay is the same, so slight variations of color and texture exist in each batch. Each piece, then, has its own identity, its clay linking it to a particular place.

That natural world doesn't feature straight lines, and neither do any of Michael's pieces. "Even if you can build it straight the [kiln] fire will often warp it," he said. In ceramics, "A straight line is a weakness."

Many of Michael's shapes mimic the curves, dimples and protrusions of the Kansas landscape. This is due not only to what the particular clay mix brings, but also to hours of observation and technique.

One of the best ways to craft sturdy large pieces—in Michael's case, up to 7 feet tall—is to build layers. Layering supports and stabilizes the piece as it is built. Because each layer must firm before the next can be added, bands form. The effect resembles the accumulation of sedimentary layers in the land.

When Michael recognized this, he started to explore the technique more, often choosing to build by hand rather than throw on a wheel. By layering different types and colors of clay, and by applying different textures to each layer, he can call attention to the bands.

Many large pieces distort during firing. This causes subtle curves, similar to the tilt and tumble of the land in hills and valleys.

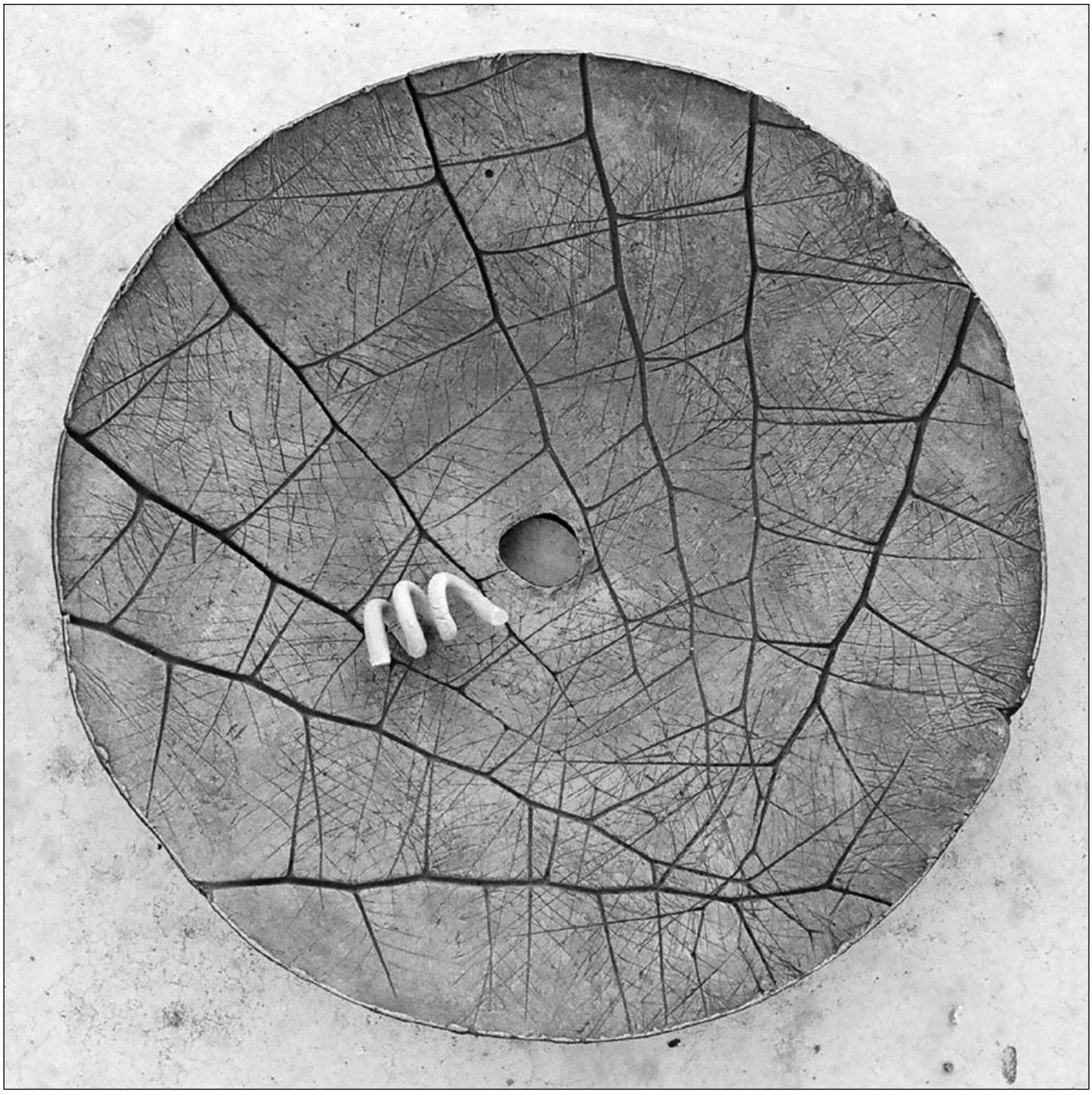
Other imperfections include bits of limestone in the native clay. Michael tries to remove as much as possible because they hold water. When this water is rapidly heated in the kiln, it quickly evaporates. The limestone bits expand in miniature explosions and can leave holes or chips in the finished piece.

But what another artist might discard as a mistake, Michael accepts. "I rely on surprises," he said. "Insights are about going below the surface."

The soil, rock and clay that lie below us are a "sublime mystery," he said. "Soil is just as deep and mysterious as the stars and the ocean."

Michael hopes that viewers can intuitively relate to the values embedded in his work—that "soil is not just there for us to utilize until all the nutrients are gone."

"We can dig up the ground, scientifically examine it, create art with it, but we can't conquer it."



Ron Michael imprinted this ceramic plate with a tree seedling.

Renewing Husbandry

After mechanization, can modern agriculture reclaim its soul?

Wendell Berry

I remember well a summer morning in about 1950 when my father sent a hired man with a McCormick High Gear No. 9 mowing machine and a team of mules to the field I was mowing with our nearly new Farmall A. That memory is a landmark in my mind and my history. I had been born into the way of farming represented by the mule team, and I loved it. I knew irresistibly that the mules were good ones. They were stepping along beautifully at a speed in fact only a little slower than mine. But now I saw them suddenly from the vantage point of the tractor, and I remember how fiercely I resented their slowness. I saw them as "in my way."

For those who have had no similar experience, I was feeling exactly the outrage and the low-grade superiority of a hot-rodder caught behind an aged dawdler in urban traffic.

This is not an exceptional or a remarkably dramatic bit of history. I recite it to confirm that the industrialization of agriculture is a part of my familiar experience. I don't have the privilege of looking at it as an outsider.

We were mowing that morning, the teamster with his mules and I with the tractor, in the field behind the barn on my father's home place, where he and before him his father had been born, and where his father had died in February of 1946. The old way of farming was intact in my grandfather's mind until the day he died at 82. He had worked mules all his life, understood them thoroughly, and loved the good ones passionately. He knew tractors only from a distance, he had seen only a few of them, and he rejected them out of hand because he thought, correctly, that they compacted the soil.

Even so, four years after his death his grandson's sudden resentment of the "slow" mule team foretold what history would bear out: the tractor would stay and the mules would go. Year after year, agriculture would be adapted more and more to the technology and the processes of industry and to the rule of industrial economics. This transformation occurred with astonishing speed because, by the measures it set for itself, it was wonderfully successful. It "saved labor," it conferred the prestige of modernity, and it was highly productive.

Though I never entirely departed from farming or at least from thoughts of farming, and my affection for my homeland remained strong, during the 14 years after 1950 I was much away from home.

In 1964 my family and I returned to Kentucky and in a year were settled on a hillside farm in my native community, where we have continued to live. Perhaps because I was a returned traveler intending to stay, I now saw the place more clearly than before. I saw it critically, too, for it was evident at once that the human life of the place, the life of the farms and the farming community, was in decline. The old self-sufficient way of farming was passing away. The economic prosperity that had visited the farmers briefly during World War II and for a few years afterward had ended. The little towns that once had been social and economic centers, thronged with country people on Saturdays and Saturday nights, were losing out to the bigger towns and the cities. The rural neighborhoods, once held together by common memories, common work and the sharing of help, had begun to dissolve. There were no longer local markets for chickens or eggs or cream. The spring lamb industry, once a staple of the region, was gone. The tractors and other mechanical devices certainly were saving the labor of the farmers and farmhands who had moved away, but those who had stayed were working harder and longer than ever.

Because I remembered with affection and respect my grandparents and other country people of their generation, and because I had admirable friends and neighbors with whom I was again farming, I began to ask what was happening, and why. I began to ask what would be the effects on the land, on the community, on the natural world and on the art of farming. And these questions have occupied me steadily ever since.

The effects of this process of industrialization have become so apparent, so numerous, so favorable to the agribusiness corporations and so unfavorable to everything else, that by now the questions troubling me and a few others in the '60s and '70s are being asked everywhere. It has become increasingly clear that the way we farm affects the local community, and that the economy of the local community affects the way we farm; that the way we farm affects the health and integrity of the local ecosystem, and that the farm is intricately dependent, even economically, upon the health of the local ecosystem. We can no longer pretend that agriculture is a sort of economic machine with interchangeable parts, the same everywhere, determined by "market forces" and independent of everything else. We are not farming in a specialist capsule or a professionalist department; we are farming in the world, in a webwork of dependences and influences probably more intricate than we will ever un-

derstand. It has become clear, in short, that we have been running our fundamental economic enterprise by the wrong rules. We were wrong to assume that agriculture could be adequately defined by reductionist science and determinist economics.

It is no longer possible to deny that context exists and is an issue. If you can keep the context narrow enough (and the accounting period short enough), then the industrial criteria of labor saving and high productivity seem to work well. But the old rules of ecological coherence and of community life have remained in effect. The costs of ignoring them have accumulated, until now the boundaries of our reductive and mechanical explanations have collapsed. Their collapse reveals, plainly enough for all to see, the ecological and social damages they were meant to conceal. It will seem paradoxical to some that the national and global corporate economies have narrowed the context for thinking about agriculture, but it is merely the truth. Those large economies, in their understanding and in their accounting, have excluded any concern for the land and the people. Now, in the midst of so much unnecessary human and ecological destruction, we are facing the necessity of a new start in agriculture.

And so it is not possible to look back at the tableau of team and tractor on that morning in 1950 and see it as I saw it then. That is not because I have changed, though obviously I have; it is because, in the 55 years since then, history and the law of consequence have widened the context of the scene as circles widen on water around a thrown stone.

My impatience at the slowness of the mules, I think, was a fairly representative emotion. I thought I was witnessing a contest of machine against organism, which the machine was bound to win. I did not see that the team arrived at the field that morning from the history of farming and from the farm itself, whereas the tractor arrived from almost an opposite history, and by means of a process reaching a long way beyond that farm or any farm. It took me a long time to understand that the team belonged to the farm and was directly supportable by it, whereas the tractor belonged to an economy that would remain alien to agriculture, functioning entirely by means of distant supplies and long supply lines. The tractor's arrival had signaled, among other things, agriculture's shift from an almost exclusive dependence on free solar energy to a total dependence on costly fossil fuel. But in 1950, like most people at that time, I was years away from the first inkling of the limits of the supply of cheap fuel.

We had entered an era of limitlessness, or the illusion thereof, and this in itself is a sort of wonder. My grandfather lived a life of limits, both suffered and strictly observed, in a world of limits. I learned much of that world from him and others, and then I changed; I entered the world of labor-saving machines and of limitless cheap fossil fuel. It would take me years of reading, thought and experience to learn again that in this world limits are not only inescapable but indispensable.

My purpose here is not to disturb the question of the use of draft animals in agriculture—though I doubt that it will sleep indefinitely. I want instead to talk about the tractor as an influence. The means we use to do our work almost certainly affect the way we look at the world. Brought up as a teamster but now driving a tractor, a boy almost suddenly, almost perforce, sees the farm in a different way: as ground to be got over by a means entirely different, at an entirely different cost. The team, like the boy, would grow weary, but that weariness has all at once been subtracted, and the boy is now divided from the ground by the absence of a living connection that enforces sympathy as a practical good. The tractor can work at maximum speed hour after hour without tiring. There is no longer a reason to remember the shady spots where it was good to stop and rest. Tirelessness and speed enforce a second, more perilous change in the way the boy sees the farm: Seeing it as ground to be got over as fast as possible and, ideally, without stopping, he has taken on the psychology of a traveler by interstate highway or by air. The focus of attention has shifted from the place to the technology.

Mechanical farming makes it easy to think mechanically about the land and its creatures. It makes it easy to think mechanically even about oneself, and the tirelessness of tractors brought a new depth of weariness into human experience, at a cost to health and family life that has not been fully accounted.

Once one's farm and one's thoughts have been sufficiently mechanized, industrial agriculture's focus on production, as opposed to maintenance or stewardship, becomes merely logical. And here the trouble completes itself. The almost exclusive emphasis on production permits the way of working to be determined, not by the nature and character of the farm in its ecosystem and in its human community, but rather by the national or the global economy and the available or affordable technology. The farm and all concerns not immediately associated with production have in effect disappeared from sight. The farmer too in effect has vanished. He is no longer working as an independent and loyal agent of his place, his family and his community, but instead as the agent of an economy that is fundamentally adverse to him and to all that he ought to stand for.

After mechanization it is certainly possible for a farmer to maintain a proper creaturely and stewardly awareness of the lives in her keeping. If you look, you can still find farmers who are farming well on mechanized farms. After mechanization, however, to maintain

Machines on their way to replacing horses and men, and reducing the intimacy that farmers have with the land. J. C. Allen & Son photo.

this kind of awareness requires a distinct effort of will. And if we ask what are the cultural resources that can inform and sustain such an effort, I believe that we will find them gathered under the heading of husbandry.

The word "husbandry" is the name of a connection. In its original sense, it is the name of the work of a domestic man, a man who has accepted a bondage to the household. Husbandry connects the farm to the household. It is an art wedded to the art of housewifery. To husband is to use with care, to keep, to save, to make last, to conserve. Old usage tells us that there is a husbandry also of the land, of the soil, of the domestic plants and animals—obviously because of the importance of these things to the household. And there have been times, one of which is now, when some people have tried to practice a proper

human husbandry of the nondomestic creatures, in recognition of the dependence of our households and domestic life upon the wild world. Husbandry is the name of all the practices that sustain life by connecting us conservingly to our places and our world; it is the art of keeping tied all the strands in the living network that sustains us.

Most and perhaps all of industrial agriculture's manifest failures appear to be the result of an attempt to make the land produce without husbandry. The attempt to remake agriculture as a science and an industry has excluded from it the age-old husbandry which was central and essential to it.

This effort had its initial and probably its most radical success in separating farming from the economy of subsistence. Through World War II, farm life in my region (and, I think, nearly everywhere) rested solidly upon the garden, dairy, poultry flock, and meat animals that fed the farm's family. Especially in hard times farm families, and their farms too, survived by means of their subsistence economy. This was the husbandry and the housewifery by which the farm lived. The industrial program, on the contrary, suggested that it was "uneconomic" for a farm family to produce its own food; the effort and the land would be better applied to commercial production. The result is utterly strange in human experience: farm families that buy everything they eat at the store.

An intention to replace husbandry with science was made explicit in the renaming of disciplines in the colleges of agriculture. "Soil husbandry" became "soil science," and "animal husbandry" became "animal science." This change is worth lingering over because of what it tells us about our susceptibility to poppycock. Purporting to increase the sophistication of the humble art of farming, this change in fact brutally oversimplifies it.

"Soil science," as practiced by soil scientists, and even more as it has been handed down to farmers, has tended to treat the soil as a lifeless matrix in which "soil chemistry" takes place and "nutrients" are "made available." And this, in turn, has made farming increasingly shallow—literally so—in its understanding of the soil. The modern farm is understood as a surface on which various mechanical operations are performed, and to which various chemicals are applied. The undersurface reality of organisms and roots is mostly ignored.

"Soil husbandry" is a different kind of study, involving a different kind of mind. Soil husbandry leads, in the words of Albert Howard, to understanding "health in soil, plant, animal, and man as one great subject." We apply the word "health" only to living creatures, and to soil husbandry a healthy soil is a wilderness, mostly unstudied and unknown, but teemingly alive. The soil is at once a living community of creatures and their habitat. The farm's husband, its family, its crops and animals, all are members of the soil community; all belong to the character and identity of the place. To rate the farm family merely as "labor" and its domestic plants and animals merely as "production" is thus an oversimplification, both radical and destructive.

"Science" is too simple a word to name the complex of relationships and connections that compose a healthy farm—a farm that is a full membership of the soil community. If we propose not the reductive science we generally have, but a science of complexity, that too will be inadequate, for any complexity that science can comprehend is going to be necessarily a human construct, and therefore too simple.

The husbandry of mere humans, of course, cannot be complex enough either. But husbandry always has understood that what is husbanded is ultimately a mystery. A farmer, as one of his farmer correspondents once wrote to Liberty Hyde Bailey, is "a dispenser of the 'Mysteries of God.'" The mothering instinct of animals, for example, is a mystery that husbandry must use and trust mostly without understanding. The husband, unlike the "manager" or the would-be objective scientist, belongs inherently to the complexity and the mystery that is to be husbanded, and so the husbanding mind is both careful and humble. Husbandry originates precautionary sayings like "Don't put all your eggs into one basket" and "Don't count your chickens before they hatch." It does not boast of technological feats that will "feed the world."

Husbandry, which is not replaceable by science, nevertheless uses science, and corrects it too. It is the more comprehensive discipline. To reduce husbandry to science, in practice, is to transform agricultural "wastes" into pollutants, and to subtract perennials and grazing animals from the rotation of crops. Without husbandry, the agriculture of science and industry has served too well the purpose of the industrial economy in reducing the number of landowners and the self-employed. It has transformed the United States from a country of many owners to a country of many employees.

Without husbandry, "soil science" too easily ignores the community of creatures that live in and from, that make and are made by, the soil. Similarly, "animal science" without husbandry forgets, almost as a requirement, the sympathy by which we recognize ourselves as fellow creatures of the animals. It forgets that animals are so called because we once believed them to be endowed with souls. Animal science has led us away from that belief or any such belief in the sanctity of animals. It has led us instead to the animal factory which, like the concentration camp, is a vision of Hell. Animal husbandry, on the contrary, comes from and again leads to the psalmist's vision of good grass, good water and the husbandry of God.

Agriculture must mediate between nature and the human community, with ties and obligations in both directions. To farm well requires an elaborate courtesy toward all creatures, animate and inanimate. It is sympathy that most appropriately enlarges the context of human work. Contexts become wrong by being too small—too small, that is, to contain the scientist or the farmer or the farm family or the local ecosystem or the local community—and this is crucial. "Out of context," as Wes Jackson has said, "the best minds do the worst damage."

Looking for a way to give an exact sense of this necessary sympathy, the feeling of husbandry at work, I found it in a book entitled *Feed My Sheep* by Terry Cummins. Mr. Cummins is a man of about my age, who grew up farming with his grandfather in Pendleton County, Kentucky, in the 1940s and early '50s. In the following sentences he is remembering himself at the age of 13, in about 1947:

> When you see that you're making the other things feel good, it gives you a good feeling, too.
>
> The feeling inside sort of just happens, and you can't say this did it or that did it. It's the many little things. It doesn't seem that taking sweat-soaked harnesses off tired, hot horses would be something that would make you notice. Opening a barn door for the sheep standing out in a cold rain, or throwing a few grains of corn to the chickens are small things, but these little things begin to add up in you, and you can begin to understand that you're important. ... I do think about myself a lot when I'm alone way back on the place bringing in the cows or sitting on a mowing machine all day. But when I start thinking about how our animals and crops and fields and woods and gardens sort of all fit together, then I get that good feeling inside and don't worry much about what will happen to me.

This passage goes to the heart of farming as I have known it. Mr. Cummins describes an experience regrettably and perhaps dangerously missing now from the childhood of most children. He also describes the communion between the farmer as husband and the well-husbanded farm. This communion is a cultural force that can exist only by becoming personal. To see it so described is to understand at once how necessary and how threatened it now is.

Two paramount accomplishments of husbandry to which I think we will have to pay more deliberate attention, in our present circumstances, are local adaptation and local coherence of form. It is strange that a science of agriculture founded on evolutionary biology, with its practical emphasis on survival, would exempt the human species from these concerns.

True husbandry, as its first strategy of survival, has always striven to fit the farming to the farm and to the field, to the needs and abilities of the farm's family, and to the local economy. Every wild creature is the product of such an adaptive process. The same process once was a dominant influence on agriculture, for the cost of ignoring it was hunger. One striking and well-known example of local adaptation in agriculture is the number and diversity of British sheep breeds, most of which are named for the localities in which they were developed. But local adaptation must be even more refined than this example suggests, for it involves consideration of the individuality of every farm and every field.

Our recent focus upon productivity, genetic and technological uniformity, and global trade—all supported by supposedly limitless supplies of fuel, water and soil—has obscured the necessity for local adaptation. But our circumstances are changing rapidly now, and this requirement will be forced upon us again by terrorism and other kinds of political violence, by chemical pollution, by increasing energy costs, by depleted soils, aquifers and streams, and by the spread of exotic weeds, pests and diseases. We are going to have to return to the old questions about local nature, local carrying capacities and local needs. And we are going to have to resume the breeding of plants and animals to fit the region and the farm.

The same obsessions and extravagances that have caused us to ignore the issue of local adaptation have caused us to ignore the issue of form. These two issues are so closely related that it is difficult to talk about one without talking about the other. During the half century and more of our neglect of local adaptation, we have subjected our farms to a radical oversimplification of form. The diversified and reasonably self-sufficient farms of my region and of many other regions have been conglomerated into larger farms with larger fields, increasingly specialized, and subjected increasingly to the strict, unnatural linearity of the production line.

But the first requirement of a form is that it must be comprehensive; it must not leave out something that essentially belongs within it. The farm that Terry Cummins remembers was remarkably comprehensive, and it was not any one of its several enterprises alone that made him feel good, but rather "how our animals and crops and fields and woods and gardens sort of all fit together."

The form of the farm must answer to the farmer's feeling for the place, its creatures, and its work. It is a never-ending effort of fitting together many diverse things. It must incorporate the lifecycle and the fertility cycles of animals. It must bring crops and livestock into balance and mutual support. It must be a pattern on the ground and in the mind. It must be at once ecological, agricultural, economic, familial and neighborly. It must be inclusive enough, complex enough, coherent, intelli-

gible and durable. It must have within its limits the completeness of an organism or an ecosystem.

The making of a form begins in the recognition and acceptance of limits. The farm is limited by its topography, its climate, its ecosystem, its human neighborhood and local economy, and of course by the larger economies, and by the preferences and abilities of the farmer. The true husbandman shapes the farm within an assured sense of what it cannot be and what it should not be. And thus the problem of form returns us to that of local adaptation.

Soon the majority of the world's people will be living in cities. We are now obliged to think of so many people demanding the means of life from the land, to which they will no longer have a practical connection, and of which they will have little knowledge. We are obliged also to think of the consequences of any attempt to meet this demand by large-scale, expensive, petroleum-dependent technological schemes that will ignore local conditions and local needs. The problem of renewing husbandry, and the need to promote a general awareness of everybody's agricultural responsibilities, thus becomes urgent.

How are we to do this? How can we restore a competent husbandry to the minds of the world's producers and consumers?

For a start we can recognize that this effort is already in progress on many farms and in many urban consumer groups scattered across our country and the world. But we must recognize too that this effort needs an authorizing focus and force that would grant it a new legitimacy, intellectual rigor, scientific respectability and responsible teaching. There are many reasons to hope that this might be supplied by our colleges of agriculture.

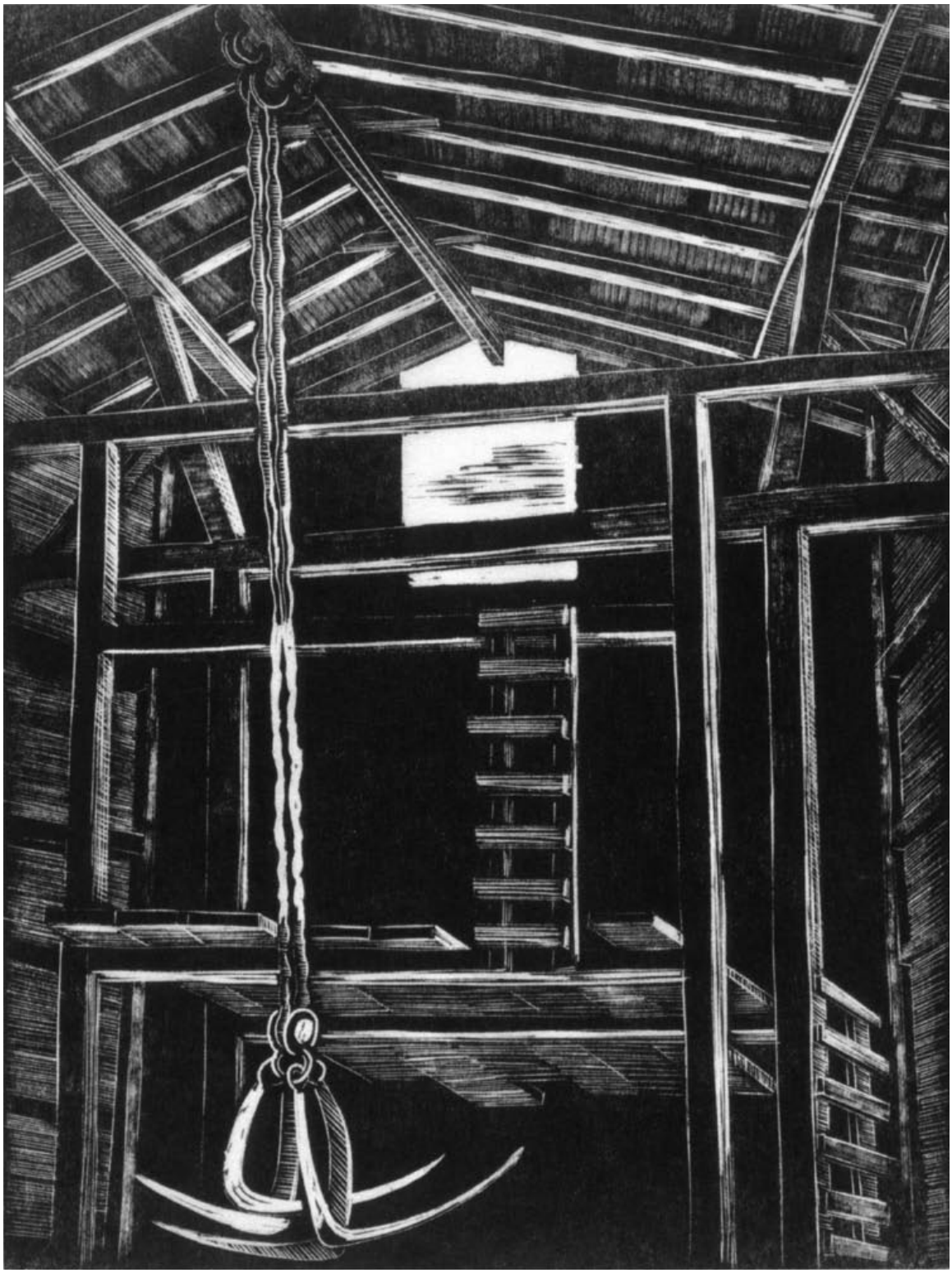
With that hope in mind, I want to return to the precaution that I mentioned earlier. The effort of husbandry is partly scientific but it is entirely cultural, and a cultural initiative can exist only by becoming personal. It will become increasingly clear, I believe, that agricultural scientists will need to work as indwelling members of agricultural communities or of consumer communities. Their scientific work will need to accept the limits and the influence of that membership. It is not irrational to propose that a significant number of these scientists should be farmers, and so subject their scientific work, and that of their colleagues, to the influence of a farmer's practical circumstances. Along with the rest of us, they will need to accept all the imperatives of husbandry as the context of their work. We cannot keep things from falling apart in our society if they do not cohere in our minds and in our lives.

Appeared in the September/October 2005 issue of Orion.

The Mower Against Gardens

Andrew Marvell

Luxurious man, to bring his vice in use,
Did after him the world seduce,
And from the fields the flowers and plants allure,
Where Nature was most plain and pure.
He first enclosed within the gardens square
A dead and standing pool of air,
And a more luscious earth for them did knead,
Which stupefied them while it fed.
The pink grew then as double as his mind;
The nutriment did change the kind.
With strange perfumes he did the roses taint,
And flowers themselves were taught to paint.
The tulip white did for complexion seek,
And learned to interline its cheek;
Its onion root they then so high did hold,
That one was for a meadow sold.
Another world was searched through oceans new,
To find the marvel of Peru.
And yet these rarities might be allowed
To man, that sovereign thing and proud,
Had he not dealt between the bark and tree,
Forbidden mixtures there to see.
No plant now knew the stock from which it came;
He grafts upon the wild the tame,
That the uncertain and adulterate fruit
Might put the palate in dispute.
His green seraglio has its eunuchs too,
Lest any tyrant him outdo.
And in the cherry he does Nature vex,
To procreate without a sex.
'Tis all enforced, the fountain and the grot,
While the sweet fields do lie forgot,
Where willing Nature does to all dispense
A wild and fragrant innocence;
And fauns and fairies do the meadows till,
More by their presence than their skill.
Their statues polished by some ancient hand,
May to adorn the gardens stand;
But, howsoe'er the figures do excel,
The Gods themselves with us do dwell.



The Loft*, by David E. Bernard. Wood engraving, 6 by 8 inches. A gift of Charles L. Marshall to Spencer Museum of Art, University of Kansas.*

Living Nets in a New Prairie Sea

Wes Jackson

Originally written in 1981, this became a spoken part in Eugene Friesen's symphony called Grasslands: Prairie Voices. *For more about the performance, see page 4.*

Eighteen eighty-three. A spring day in North Dakota. John Christiansen, a Scandinavian immigrant farmer, looked up while plowing a field to discover an old Sioux silently watching him turn the prairie grass under. The farmer stopped the team, leaned against the plow handles, and rolled a cigarette. He watched amusedly as the Sioux knelt, thrust his fingers into the furrow, measured its depth, fingered the soil and the buried grass. Eventually the Sioux straightened up and looked at the immigrant. "Wrong side up," said the Sioux and went away.

A writer in the 1930s described how his grandfather "broke prairie sod, driving five yoke of straining oxen, stopping every hour or so to hammer the iron ploughshare to a sharper edge. Some of the grass roots immemorial were as thick as his arm. His grandfather said it was like plowing through a heavy woven doormat."

To many of us today it seems tragic that our ancestors should have so totally blasphemed the grasslands with their moldboards. But in their time, who among us would have done otherwise? Nevertheless, it was one of the two or three worst atrocities committed by the new Americans. With the cutting of the roots—as one 20th century pioneer recalled, it was a sound that reminded him of a zipper being opened or closed—a new way of life ended a long line of nature's elegant designs.

Before the coming of the Europeans, the prairie was a wilderness, both beautiful and stern, a wilderness that supported migrating water birds, bobolinks, prairie chickens, black-footed ferrets and Native Americans. Never mind that the Europeans' crops would far outyield the old prairie for human purposes, at least in the short run. What is important is that the Sioux knew it was wrong, and that his words became regionally famous for the wrong reason. The story was often repeated because farmer Christiansen and others thought it amusing. To their minds those words betrayed the ignorance of the poor Sioux. For the immigrant, breaking the prairie was life's purpose.

Agriculture has changed the face of the land the world over. A piece of land that once featured a diverse ecosystem we call prairie is now covered with single-species populations such as wheat, corn, sorghum or soybeans. The prairie features perennials whose lives can span decades or centuries, while agriculture features annuals. For the prairie, at least, the key is the roots. Though the aboveground parts of the prairie's perennials may die each year, the roots live on.

Before the fossil fuel era even, traditional agriculture coasted on the accumulated principal and interest, in the form of soil, hard-earned by wild nature over millions of years. Modern agriculture coasts on fossil fuels—sunlight trapped by floras long extinct. We pump it, process it, transport it over the countryside as chemicals, and inject it into our wasting fields as chemotherapy. Our fields respond with an unsurpassed vigor, and we feel well informed on the subject of agriculture. That we can feed billions is less a sign of nature's renewable bounty and our knowledge than a sign of our discounting of the future. For how opposite could a monoculture of annuals be from what nature prefers?

Is there any possible return to a system that is self-renewing like the prairie? Yes there is, and research is under way to make major crops perennial.

We have the opportunity now to develop a more sustainable agriculture, based on a mixture of perennials. This would be an agriculture in which soil erosion can go to near zero, an agriculture that is chemical-free or nearly so, and certainly an agriculture that scarcely demands fossil fuel.

Conventional agriculture, which features a single crop that dies each year, is nearly opposite to the original prairie. If we could build domestic prairies, we should one day be able to enjoy high-yielding fields that are planted only once every decade or so. After the fields have been established, we would need only to harvest the crop, relying on species diversity to manage insects, pathogens and fertility, as does the prairie on which we stand.

Aldo Leopold lamented that "no living man will see the long-grass prairie, where a sea of prairie flowers lapped at the stirrups of the pioneer." Many share his lament, for what are left are prairie islands, far too small to be counted as a "sea."

As Wendell Berry has said, "When we came across this continent cutting the forests and plowing these prairies, we have never known what we are doing because we have never known what we were undoing."

But now the grandchildren of the pioneers have the opportunity to establish a new sea of perennial flowers that yield grains—the product of accumulated scientific knowledge, their own cleverness and the wisdom of the prairie.

The Biofuel Illusion

Julia Olmstead

There's been a lot of talk lately about the promise of biofuels—liquid fuels like ethanol and biodiesel made from plants—to reduce our dependence on oil. Even President Bush beat the biofuel drum in his last State of the Union speech.

Fuel from plants? Sounds pretty good. But before you rush out to buy an E-85 pickup, consider:

■ The United States annually consumes more fossil and nuclear energy than all the energy produced in a year by the country's plant life, including forests and that used for food and fiber, according to figures from the U. S. Department of Energy and David Pimentel, a Cornell University researcher.

■ To produce enough corn-based ethanol to meet current U. S. demand for automotive gasoline, we would need to nearly double the amount of land used for harvested crops, plant all of it in corn, year after year, and not eat any of it. Even a greener fuel source like the switchgrass President Bush mentioned, which requires fewer petroleum-based inputs than corn and reduces topsoil losses by growing back each year, could provide only a small fraction of the energy we demand.

■ The corn and soybeans that make ethanol and biodiesel take huge quantities of fossil fuel for farm machinery, pesticides and fertilizer. Much of it comes from foreign sources, including some that may not be dependable, such as Russia and countries in the Middle East.

■ Corn and soybean production as practiced in the Midwest is ecologically unsustainable. Its effects include massive topsoil erosion, pollution of surface and groundwater with pesticides, and fertilizer runoff that travels down the Mississippi River to deplete oxygen and life from a New Jersey-size portion of the Gulf of Mexico.

■ Improving fuel efficiency in cars by just 1 mile per gallon—a gain possible with proper tire inflation—would cut fuel consumption equal to the total amount of ethanol federally mandated for production in 2012.

Rather than chase phantom substitutes for fossil fuels, we should focus on what can immediately both slow our contribution to global climate change and reduce our dependence on oil and other fossil fuels: cutting energy use.

Let's be bold. Let's raise the tax on gasoline to encourage consumers to buy fuel-efficient cars and trucks. We can use the proceeds to fund research and subsidies for truly sustainable energy.

Let's raise energy efficiency standards for vehicles, appliances, industries and new buildings.

Let's employ new land-use rules and tax incentives to discourage suburban sprawl and encourage dense, mixed-use development that puts workplaces, retail stores and homes within walking distance of each other. Let's better fund mass transit.

Let's switch the billions we now spend on ethanol subsidies to development of truly sustainable energy technologies.

And why not spend money to make on-the-shelf technology like hybrid cars more affordable? Fuel-efficient hybrids aren't the final solution, but they can be a bridge to more sustainable solutions.

The focus on biofuels as a silver bullet to solve our energy and climate change crises is at best misguided. At worst, it is a scheme that could have potentially disastrous environmental consequences. It will have little effect on our fossil fuel dependence.

We must reduce energy use now if we hope to kick our oil addiction and slow climate change. Pushing biofuels at the expense of energy conservation today will only make our problems more severe, and their solutions more painful, tomorrow.

With the Prairie Writers Circle, The Land Institute invites and distributes essays to about 500 newspapers and a dozen Web services. All essays are at www.landinstitute.org, and free to use.

A Question 50 Years Ago

"Will we eventually raise crops that are sold to be processed into fuel, to be repurchased by us to burn in our tractors, where we now have available a hay-burner of our own?" —Horse breeder Lloyd Wescott, writing for *Suffolk Bulletin* in 1946

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The Writers and Artists

H. Eric Bergman (1893-1958) was a German-born printmaker in Manitoba. He made wood engravings and etchings.

Wes Jackson is president of The Land Institute. He'll speak at the Prairie Festival on Oct. 8. For more about that, see page 10.

Craig Holdrege is founder and director of The Nature Institute, in Ghent, New York, and author of books including *Genetics and the Manipulation of Life: The Forgotten Factor of Context* and *The Giraffe's Long Neck: From Evolutionary Fable to Whole Organism.* As advocate for a holistic approach to science, he gives talks and workshops in the United States and Europe. He taught high school biology for 21 years.

Stephen Jones leads wheat breeding at Washington State University, including work on development of perennial wheat. Some of his students have been Land Institute graduate research fellows. For more on that program, see page 6.

Aubrey Streit was a Land Institute intern last year. She graduated this spring with an English and communications degree from Bethany College in Lindsborg, Kan. She'll teach English at a high school in Bratislava, Slovakia.

Wendell Berry has written more than 30 books of essays, novels and poetry. Two of his latest are *Given: Poems* and an essay collection called *The Way of Ignorance*. He will speak at The Land Institute's Prairie Festival on Oct. 7. For more about that, see page 10.

Andrew Marvell (1621-78) was a poet and parliament member from England's Yorkshire.

David E. Bernard organized the printmaking program at Wichita State University, for which he is a professor emeritus. He now lives in St. Cloud, Florida.

Julia Olmstead is a Land Institute graduate school fellow in plant breeding and sustainable agriculture at Iowa State University.

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