The Land Report

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Contents

Cover: Richard Bergen. Silo and Sheds.

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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Conceptual Revolutions: Who Needs Them? Why?

Wes Jackson

Eliot has shown us what the world is very apt to forget, that the statement of a terrible truth has a kind of healing power. In his stern vision of the hell that lies about us… there is a quality of grave consolation. In his statement of the worst, Eliot always implied the whole extent of the reality of which that worst is only one part.
—Kathleen Raine, on T.S. Eliot's *The Waste Land*

A conceptual revolution comes when one system of concepts and rules replaces another. The Copernican explanation replaced the Ptolemaic, and we had a new place under the sun, rethinking our centrality in the universe. A conceptual revolution often changes the way we think about the world. Sometimes it is not complete. We still say the sun comes up.

After Copernicus and Galileo came Newtonian mechanics. Newton was born the same year Galileo died, 1642, so this change in consciousness wasn't far behind. Newton's insights built on the Copernican understanding to unite celestial with earth-bound physics, and forced out the cosmological views of Descartes. In 1783, Lavoisier's theory of oxygen replaced the phlogiston theory. In 1859, Darwin's theory of evolution replaced the idea of divine creation. And in the 20th century, Einstein's theory of relativity partially replaced Newton's physics. In geology, plate tectonics theory explained continental drift. What's on the horizon? In the 1990s it was increasingly acknowledged that information does not flow in one direction from DNA/RNA to the rest of the cell but depends on context, and that information can flow back and forth.

Those are conceptual revolutions. Now, "Who needs them?" That's not easily answered, because by "need" we often mean whim, fashion, desire or simple want. As school kids we were taught that our basic needs are food, clothing and shelter. Beyond these, other needs have evolved in societies. In modern industrial societies, one needs some form of transportation to get to work.

But we did not *need* the Copernican revolution at the time it happened. Our species had made it until then without knowing the "truth" about the earth-sun relationship. Same for Newtonian mechanics, Lavoisier's oxygen theory, Einstein's theory and quantum theory and plate tectonics: None of them was needed when they arrived.

In some cases, insights from them rearranged society, and that rearrangement created need. To do without Newton's insights and his calculus would seriously cripple us now.

How about Darwin's idea of evolution? Though I count myself as an evolutionary biologist, it is fair to ask how important it has been to *know* Darwin's theory of evolution through natural selection rather than accept the idea of divine creation of species. What difference will it make about our behavior on Earth?

Well, it is important *now* to understand Darwin's insight, because it is totally intermingled with ecology, and it is around this knowledge base that a conceptual revolution is brewing. And this time a conceptual revolution is needed. This time, unlike the others, there is moral necessity for change.

This invites consideration of the basis of morality. It ultimately gets back to some sort of social conduct to meet a perceived need. The need now is to stop the dismemberment of the ecosphere, its ecosystems, their biota, their collective processes and the processes of what we call the physical world. I am talking about what makes the planet not just livable. More is on the line here than biodiversity. We are the only species that represents matter and energy's way of having gained self-recognition, the only species that has an inkling of where we come from and what kind of thing we are.

But back to why the need *now* for the conceptual change. It should be clear to everyone that the biodiversity of our planet is under siege and the ecological processes that have evolved over millennia are being undone. Moreover, there is evidence all around us that we are at the teetering point of the industrial age. We are nearing when the supply of oil and natural gas, so crucial to meeting needs of the society we have built, cannot match demand. Alternative energies don't measure up. And I may as well say it as directly as necessary: It is the oil supply now. Food supply will be next.

Some of us have chosen to study the efficiencies of nature for meeting this most basic of all needs, food. My friend Chuck Washburn once put it, "If we don't get sustainability in agriculture first, it is not going to happen." Agriculture alone has the disciplines of ecology and evolutionary biology to stand behind it. The materials sector, the industrial sector, lacks such time-tested principles.

This look to nature is not just for how to be more efficient with energy and the cycling of materials. William Stanley Jevons argued in *The Coal Question* that technological efficiency increased the consumption of resources, especially coal and iron, rather than saved them. This was in 1865, and I think we have enough evidence since then that to rely on efficiency alone can have devastating consequences.

Richard Bergen. Deserted Farm.

Moon shots and Manhattan skyscrapers are pipsqueak creativity compared with nature's

Some of the most meaningful insights come from the late ecologist J. Stan Rowe, who saw Earth as a supraorganismic system. Embedded within this ecosphere he considered three-dimensional ecosystems as real objects. Rowe said that this acknowledgment marks a critical change in concept, and, so, in thinking. By starting with ecosystem as a physical space to which we belong, we no longer center on environment. To do that is to center on ourselves and place environment "into the circle of our belongings."

Why is this change not the dominant view even among biologists? The common-sense view for all of us is to look from the inside, from where we are, out. It is a bit like the common-sense view that Earth is at the center and all else revolves around it. An outside-in view would begin with the ecosphere and go inward to ecosystems, to how living and nonliving things interact. Here is an analogy from Stan Rowe. Imagine that we make ourselves small enough to go in a cell, so small that we need binoculars to look around. We would see some objects, such as crystals, as dead or not-alive, and moving things as living. Now we go outside the cell and scale up. Here we see that all is alive and interdependent. Our bio-bias is because we have evolved within the ecosphere. It is common sense and has informed our scientists throughout the history of biology. That view now limits us.

But let's put the outside-in view to a test. As Rowe said, "The ecosphere is beyond people, larger than life as judged by precedence in time, inclusiveness, complexity in organization, evolutionary creativity and diversity."

This is important, so let's go through it again. We'll take the easy one first—time. The ecosphere was here before humans. Inclusiveness? That's easy too. The ecosphere is larger than people and other life in; it includes the nonliving part of the world on which life depends. The ecosphere is far more complex than any human.

Finally, there is evolutionary creativity responsible for the diversity. I contend we have never matched this creativity with our art or with our science.

All of our efforts at changing the genetic profiles of plants and animals, from their domestication onward, leave us way behind nature's ecosystems, even in our age, with fossil energy giving us cultural slack to accommodate what we call the creative impulse of scientist and artist. Natural ecosystems can be sustained on contemporary sunlight without a measurable draw down of the planet's capital stock. The skyscrapers of Manhattan and the trips to the moon required huge investments of nonrenewable energy and a goodly amount of toxicity added to the ecosphere. They are the products of an economics bound for burnout, the opposite of steady-state economics, and if we insist on calling that creativity, it is pipsqueak creativity by ecosystem standards.

The word "creativity" of course presents problems, because creativity and destruction are intertwined. Dust to dust, the Bible says. The asteroid that ended the Cretaceous has been estimated to be six miles high at the point of impact, as high as Mount Everest. It is further estimated as having released as much energy as 3,000 years of our current oil consumption planet-wide. Too bad for the dinosaurs. But this vast destruction opened up new options for creativity: Mammals and birds diversified in a big way. And without that asteroid we would not be here—another improbable event.

Earth will abide, but not as we have known it. The human-sponsored asteroidlike impact is unlikely to stop the creative processes of ecosystems for *other* life forms to evolve. The larger point is there is no guarantee that a comparable species will evolve again, one capable of producing Copernicus, Galileo, Newton, Darwin, Einstein and more.

I hope to have convinced you that ecology's task is not peripheral but central, that nothing can be more important than efforts to comprehend this supraorganismic reality called nature or the ecosphere. Nested immediately below are ecosystems, which become the subject for our attention now.

Staring at native prairie ecosystem with the mind of an artist, we may contemplate how this piece of the world, this prairie, *is*. But once our mind moves to a utilitarian framework, which it must if we are to follow the prairie as model for a sustainable agriculture, we ask a different question: "How does it work?" Now we are looking at an economic system—nature's economy. Because it features material recycling and runs on contemporary sunlight, it is a real economy. There is nothing phony about it, no matter that it has no currency, no metrical device called money, no abstraction.

How do these ecosystems work? What's needed to make them run? We may think about the molecular structure of both the living and nonliving parts—molecules and nature's building blocks, atoms. There are more than 100 elements on that periodic chart hanging in our chemistry classrooms. Less than one-third, about 30, make up life's various forms. Four flowing in the life stream—carbon, hydrogen, oxygen and nitrogen—also circulate in Earth's atmosphere. They move about the global commons mostly in molecular form, as di-nitrogen, di-oxygen and water. They make up 95 to 99 percent of the human body. The other 1 to 5 percent are soil-based elements, and all of them are hydrophilic, at home in water.

So how do these atoms make it into our bodies? If we begin with those 20-some elements that are not in the atmospheric commons, deal with those in the upper soil level of Earth's crust, we appreciate right away why a variety of plant root architectures are so important in life's drama. In aggregate they are "designed" to manage these nutrients and water. It is no wonder that native growth almost everywhere features mixtures of roots, present year round, anchored there year after year—perennials, a primary feature of most natural eco-systems.

There is the word *system*, often used but seldom defined. An old friend of mine, Dan Luten, defined a system as "an object of interest together with its significant environment." Deciding what is a "significant environment" forces us to become students of boundaries. The coming conceptual revolution forces us to place the boundary around landscapes. When we establish such a boundary, necessary for rigorous accounting, we must be very cautious and mindful of what we have excluded. We have to be careful to state our assumptions. If it is food we have in mind, boundaries will be agricultural landscapes and the adjacent wild spaces. In this new mindset we will do a better job of keeping track of what goes through the boundaries.

Why is this necessary, why such a fuss over the ecosystem as the conceptual tool and attendant accounting? Well, we're coming to the end of a 10,000-year era. The last major carbon pools beyond soil and forests—coal, oil and natural gas—are approaching their peaks. We can see over them and soon will be headed down. In my lifetime of 69 years, about 97 percent of all the oil ever burned has been burned. A person of 48, less than half a century old, has lived through 90 percent of that burning, and a 23-year-old, almost fresh out of college with less than a quarter century behind, has lived through half the burning. Col. Drake's oil well in western Pennsylvania was in 1859—two lifetimes ago. In one lifetime, the past 75 years, we seem to have forgotten the relatively low level of food production from our landscapes without fossil fuel for fertility and traction. During this blip in the industrialization process, the number of people who possess the cultural information necessary to run agriculture on contemporary sunlight across our great agricultural mosaic has been greatly reduced.

But here is the good news for the sort of agriculture we are promoting. Chris Field, writing in *Science* in 2001, had this to say: "We do not generally manage [ecosystems] in a way that augments natural potential. In most parts of the world, human activities, and agriculture in particular, have resulted in decreases in NPP (net primary productivity) from the levels that likely existed prior to human management." In other words, generally nature's land ecosystems fix more carbon, produce more plant growth, than agricultural systems. So by bringing the processes of the wild to the farm we have a "source" of carbon for food formerly unavailable. If we can combine that with the realization that it is here in such natural systems—ecosystems—that we find what I have called the sole source of creativity on Earth, we have a way of thinking about possibilities that is a source of hope.

So, to build an agriculture based on what we can learn from nature's ecosystems becomes the first order of business, and this has to mean a diversity of root architectures below the soil surface to finely manage the nutrients and water for life to occur. That is why we are perennializing major crops and domesticating wild perennials to grow in mixtures.

In the midst of all of our efforts we don't want to forget that the conceptual revolution of which I speak would require us to not constrain our view of Earth as containing the living and the nonliving, but to think of the entire planet as alive, including the heat within it, which helps those tectonic plates move, mountains form and volcanoes erupt. And it is not just the heat within Earth changing its face. The ice age and recent glaciers pulverize rocks. All of these physical forces release minerals essential to plant growth, essential to essentially all of life. Furthermore, evidence supports the hypothesis that the nonliving world gave rise to life, not the other way around. At this level, it is easier to see that the only truly creative force at work in the world today is between what we call the living and what we call the nonliving.

Stan Rowe reminded us that to not see the nonliving world as precious too is to regard it as material we can play fast and loose with. Evidence of this regard is what we have done to the atmosphere, our waters and what most people regard as dirt—which in fact is soil filled with life.

There has been considerable success in "marketing" the idea that organisms as part of intact natural ecosystems are far more important to our well-being than we have given them credit. A comparable move is necessary to save our air, water and Earth's crust, especially the soil component, from industrial chemicals. The spent carbon sent to the "nonliving" atmosphere from fossil fuels contributing to climate change represents what might be our most serious assault on the ecosphere.

But we are struggling to come to terms with this reality. Terms is the right word, since action inevitably lags behind the abstraction. Currently the abstraction is slowly being adopted. For example, the U.N. World Charter for Nature, written in 1982, acknowledged that life depends on natural systems functioning without interruption. The language was human-centered and utilitarian. Eighteen years later in 2000, The Earth Charter presented "respect and care for the community of life" and "ecological integrity" ahead of strictly humanistic goals. Biodiversity is valued. Endangered species are to be protected. So are ecosystems. The evolution will never be finished. But there is movement. It is worth remembering what Aldo Leopold told us long ago: "Nothing so important as an ethic is ever written. Rather, it evolves in the mind of a thinking community." Moses didn't write the Decalogue, Leopold said, he summarized an already existing ethic for a seminar. The thoughts in the thinking community are evolving.

From our actions, it is clear that we take for granted this beautiful planet in which we are enfolded. When we think of our cosmic origins, or, more closely, our stellar origins, our sun itself, we see this place is rare. Our sun has 25 percent more heavy elements than other typical stars of the neighborhood. Cycled through a super nova at least twice, we earthlings sit on a continental crust 45 percent oxygen by weight and 85 percent oxygen by volume. There is enough to fully oxidize most of the silicon and magnesium and part of the iron. Carbon, cooked in the remote past of a dying star, yielding those rich chemical properties key to life, is a mere trace element on Earth. It rode through space here with hydrogen, another trace element, and whose gifts, one author said, "include the oceans and all water, the essential fluid of terrestrial life." The low probabilities don't stop there. Radioactive trace elements such as uranium, potassium and thorium decay contribute the heat for volcanoes and the drifting, uplifting continents on which we ride.

So here we are at a rare place at a rare moment, embedded within ecosystems within the ecosphere, the only home we have known, and we're screwing it up. Why do we do it? Is it dumbness? Yes. Is it arrogance? Yes. Is it greed? Yes. It is all of the above and more if we could think of enough negative terms. Is it inevitable? Finally, a hopeful No! But a conceptual revolution is necessary, and this time a moral one, because it's perceived by us as necessary. And essentially all moral imperatives in civilized life require codification beyond the mental abstraction. We will need the morality and the code to help stop our dumbness, arrest our arrogance, shelve our greed and set ourselves on a journey measured by how independent we become of the extractive economy.

I realize that this might be asking more of us than it is reasonable to expect. The way we are behaving is little different from essentially any life form rising and falling during that 3.5 billion-year journey. Except for relatively trivial examples, energy-rich carbon pursuit is what it has been all about. Restraint wasn't called for. Now we are the only species required to ask ourselves to exercise it.

Whether we are talking about population, resource depletion, soil loss or disruption of the ecosphere in general, it is important to keep in mind the Kathleen Raine quote at the beginning, that "the statement of a terrible truth has a kind of healing power."

No matter that it took the discovery and exploitation of energy-rich carbon pools to create civilization from soils and forests, and for coal, oil and natural gas to create the industrial revolution. Those soil and forest carbon pools sponsored the slack and the critical mass of discussants who gave us Copernicus, Galileo and Newton. After coal was added, Darwin and Einstein entered the stage. The Hubble telescope was a product of all, plus oil and natural gas. On this course two of the old religious questions were answered: 1) Where did we come from? and 2) What kind of thing are we?

And now to the third old religious question: What is to become of us? The answer depends on whether we acknowledge and act on the reality that the worst we see around us is the consequence of having failed to learn and live within the limits of the ecosphere and its embedded systems. If we remain ignorant or choose poorly, we seem certain to get where we are headed, and the terrible truth's promised healing power that Kathleen Raine refers to in T.S. Eliot's *The Wasteland* will have to wait.

Richard Bergen. Tree and Shed.

Plant Breeding: A Step Forward and a Walkthrough

This year we finished one round in turning a wild perennial grass into a grain crop. Here we not only report progress, but explain some of how plant breeding works. In this case the plant is a perennial called intermediate wheatgrass, *Thinopyrum intermedium*. We are both crossing it with wheat to make a hybrid, and domesticating it through direct selection. Other plants we are working to make perennial grain crops are sunflower, sorghum and protein-rich Illinois bundleflower.

In October 2003 we dug up and took 1,000 wheatgrass plants to the greenhouse. As gardeners can do with mums and rhubarb, we split each plant into thirds and put them in separate pots with the same label. Each division of a plant would go in separate thirds of a field. Repetition would let us gauge if differences among identical

Scott Bontz. **After two years of measuring growth by 3,000 wheatgrass plants, we ready to cut them and study seed production. Wheatgrass is a wild perennial that we're working with to make a grain crop.**

Scott Bontz. The "disassembly line." At the back table, various measurements of the plants are made. In the foreground, from right: Seeds are threshed loose, cleaned of chaff and packaged in labeled envelopes for later measurement.

plants and their neighbors were because of genetic makeup or growing conditions. The field was mapped with a 3-foot square for each plant. In mid-November the wheatgrass went in the ground.

The next summer we controlled weeds and cut the wheatgrass heads to keep them from going to seed and sending up new plants that would disrupt measurements. The first year is not the best indicator of seed production for a perennial. But we did take other measurements on each of the 3,000 plants: when it matured, how it spread, how high it grew.

This summer we measured again, then harvested seed. We tied stems from each plant in a bundle and stapled to it an identifying envelope. A machine lopped the bundles in what for more than a year and a half had otherwise been largely hand labor.

The bundles made high piles in a barn. There, in a six-person operation called the disassembly line, we combed through each bundle. One person measured and recorded the width of five stems. One counted the number of spikelets on five seed heads—each spikelet may produce several seeds. One measured the length of five heads. Then a machine threshed loose the seeds, which were cleaned of chaff in another machine and poured into the marked envelopes. This job took three weeks.

We didn't select the best plants based on any of the gauging through this point. These measurements in the barn and those in the field were to look for connection with what mattered most, yield—the mass of seeds collected from a plant or area—and individual seed size. Example: Would more spikelets signal higher yield? Not necessarily—the spikelets might have shattered early and dropped their seed before harvest, a trait of the wild, and one selected against for crop plants.

So after taking apart bundles in the barn, seed went to the lab. There we measured yield by weighing seed that had been threshed from 20 stems. The remaining seeds went to a machine that counted out 500, which then were weighed. From this we calculated average seed size. This took another three weeks.

Selection was based on both yield and seed size. We didn't pick by yield alone because larger seed is easier to harvest, and better for human food, with more digestible endosperm—the white of flour—compared with the fibrous bran coating. It's hard to get good flour out of the currently small wheatgrass seed.

We took 50 out of the 1,000 original plants. Five percent makes a good portion for selective breeding, big enough for the strength of genetic diversity, but not so big that weaker plants diminish the traits we want. A smaller selection could be even more intense for good traits, but it might reduce the strength of diversity and bring inbreeding.

Unlike wheat, which pollinates itself and so can be bred for genetic uniformity to get desirable traits, inter-

Scott Bontz. Alfredo Paine counts wheatgrass spikelets, each of which can hold several seeds.

How Annuals Got Here, Why Perennials Should

Wheat used to be a scrawny thing. Tough, maybe, but by today's standards without much seed to make our food. The same was true for all grain plants, source of most modern human calories.

These plants produce more now not just or even necessarily because they are annuals, keyed to making seed and without the need to save energy for winter like a perennial. They yield more because humans picked and babied them for it. Our ancestors weeded out the competition for sun, water and soil nutrients. And in a yearly cycle they saved the plumpest seed from the most prolific plants. Over millennia this added up.

With the past few decades' advance in knowledge and method, the same increase in seed production appears possible with perennials. The Land Institute is working to make that happen because perennials, with roots deeper, thicker and alive all year, trounce annuals at saving soil, on which all land life depends, and at using those building materials of sun, water and soil nutrients. Because perennials are so far ahead, we think more of that mass can become seed without losing those long-lived roots. It will take picking the right plants and putting them on a farm.

Scott Bontz. Kathleen League sorts packets of seed for counting and weighing to calculate seed size.

mediate wheatgrass, like rye, can mate only with other plants. So inbreeding is out, and genetic diversity necessarily maintained.

And many alleles, the forms of genes, combine to affect yield. It's not a simply determined trait like eye color or the ability to roll your tongue. We want to keep that array of genetic diversity needed for the recipe to work, and be careful not to lose alleles that could be needed to increase yield in the long run.

A good thing learned from this effort is that we can select for yield and seed size without compromising traits we want to keep. In intermediate wheatgrass no strong tradeoff appeared between high productivity and rhizomes, the underground, winter-hardy stems that a perennial can spread with. Production also wasn't tied to plants going to seed late, a bad trait for crops.

With the complexity of genetics, addressing all desired traits at once usually slows progress. So concurrent to selection for yield and seed size we are working on a separate population of wheatgrass in hopes of selecting for alleles that make for shorter stems. This would help prevent flattening in storms and wasting energy on competition. Later we would combine this group with the high-yielding population.

Another good thing learned from this two years of work is that yield and seed size in wheatgrass depend largely on inherited genetics, less on growing conditions. This showed in how similarly each divided plant grew in different parts of the field relative to the other 999 plants. From now we can make good progress without the extra year required to compare clones.

Next to manufacturing, plant breeding is slow work. There's only so much we can do to speed a biological process. To breed a new variety of an annual crop takes about 15 years. To achieve the first workable mix of perennial grains for the farm we expect to take 25-50.

The findings this year with wheatgrass encourage us. Several of our most productive plants yielded about twice the experiment's average, and the highest was 10 times the lowest. The largest seeds were about a quarter again the average size and more than double the smallest. This range of heritable traits means that through selection we have considerable room for improvement. The numbers show that we might double yield in as little as 10 years.

This would be only halfway to the yield of wheat. But without the annual demands of field preparation and planting, wheatgrass—and all perennial grains—should cost the farmer far less to produce. A study in western North Dakota found that if sold for as much as wheat, wheatgrass at current yield would come out ahead after eight years.

At the Land

Perennial Grain Breeding
We harvested thousands of sorghum plants for our first replicated yield comparison of breeding lines. The aim is to learn more about the relationship—or lack of one—between seed yield and ability to survive winter. Grain sorghum until now has been an annual plant. We also are looking for perennial sorghum families that yield well. To learn more about this kind of work, see page 8 for the story on intermediate wheatgrass, a perennial we are domesticating.

In a study similar to the one with wheatgrass, we harvested from second-year growth of hundreds of perennial maximilian sunflower clones. As with the sorghum, harvest of these warm-season plants has just finished, and we are taking and analyzing data.

Agroecology
Steve Culman, a Land Institute graduate research fellow from Cornell University, visited in October to help scientist Jerry Glover collect soil samples from research plots. Cullman will analyze them for how vegetation changes affect soil microbe community. In particular, he wants to see how conversion from perennial plants to annuals affects microbes associated with nitrogen cycling.

Presentations
Institute agroecologist Jerry Glover visited southeastern Australia for 18 days. He gave a keynote talk at the International Federation of Organic Agricultural Movement's international meeting in Adelaide, then traveled to research stations, farms and universities in Rutherglenn, Wagga Wagga, Canberra and Hobart. Glover gave presentations at Charles Sturt University, University of Tasmania and a federal research station at Rutherglenn.

Scott Bontz. At the Prairie Festival in late September, Land Institute scientist David Van Tassel explains our work.

Managing Director Ken Warren explained our work to the Kansas Geological Society in Wichita.

Presentations Scheduled
February 17, American Association for the Advancement of Science annual meeting, St. Louis.

April 21, Lawrence, Kansas.

For details, call us or see Calendar at www.landinstitute.org.

Visitors
Len Wade is chair of crop agronomy at The University of Western Australia and leader of a plan to develop perennial wheat for Australia. He came to meet our scientists and learn what they are doing with perennial grains in general, and to explore the exchange of seed between our breeding programs. His effort would be funded by a consortium of government organizations and growers levies. Wade also visited Washington State University's perennial-wheat breeding program. Western Australia's problem with saline soils result from cropping with annuals, whose shallow, seasonal roots don't prevent salty groundwater from rising and damaging land. Perennials' deeper and more efficient roots help prevent this.

Prairie Festival
Our Prairie Festival, held Sept. 23-26, drew 442 paying attendees, enough to overflow seating in the big barn where talks are given. Eighty-six festivalgoers were paying college students, about the same percentage as in the previous two years. We are especially pleased to get our ideas to young people.

An adaptation of Wes Jackson's festival talk begins on page 3, Strachan Donnelley's on page 20. To order audiotapes of the talks, see page 19.

Prairie Writers Circle
We send op-ed essays to newspapers around the country. Recent topics: the decline of oil, talking to strangers, climate change and what to take from New Orleans.

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.

Leland Lorenzen

December 28, 1926-September 6, 2005

For more than a quarter-century Leland Lorenzen chose to live on less than $500 a year in a tiny shack in rural McPherson County, Kansas. This good friend was the most bottom-line person I have ever known. When his end was near, Lorenzen turned to his son, Jule, and said, "It's time to open a hole." That statement is characteristic of the fabric of Leland's life. A neighbor with a backhoe dug the grave on Lorenzen's one acre. Lorenzen asked to be buried not in a coffin, but in his sleeping bag. The burial did not cost his family one cent. Lorenzen is survived by his wife, Bernice; children, Lelain, Jule and April; and grandchildren, Sosie Grace and Graham Wheeler. In a later *Land Report* I will say more about Leland's life and his influence on my thinking.
—*Wes Jackson*

Terry Evans. Leland, October 1990.

Hunger for Natural Gas

By Stan Cox

Two Gulf hurricanes and the approaching winter in the Northern Hemisphere have kept natural gas futures hovering near all-time highs. But with the accelerating depletion of reserves in North America, the intermittent gas crises we've been seeing since 2001 will start coming thicker and faster, finally merging into an era of permanent scarcity.

A chronic gap between supply and demand would mean plenty of hardship in the United States and Europe, which have come to rely on natural gas not only for heat, but increasingly for electricity generation and manufacturing. But the future looks even grimmer in the global South, where the maintenance of human life itself has come to depend on the steady and reliable supply of natural gas that's needed to synthesize nitrogen fertilizer for food production. Turn off the gas, and a lot of American families would have a hard time cooking dinner—but a lot of families in places like Nepal and Guatemala would have nothing to cook.

Crop plants assemble carbon, hydrogen, oxygen and nitrogen into proteins that are essential both to plant growth and to the diets of humans and other animals. Of those four elements, nitrogen is the one that's too often in short supply. If you see yellowish, stunted crops, whether they're in an Indiana cornfield or an Indonesian rice paddy, it's likely that you can blame it on a lack of nitrogen.

A world of 6.4 billion people, on the way to 9 billion or more, needs more protein than the planet's croplands can generate from biologically provided nitrogen. Our species has become as physically dependent on industrially produced nitrogen fertilizer as it is on soil, sunshine and water. And that means we're hooked on natural gas.

Vaclav Smil, professor at the University of Manitoba and author of the 2004 book *Enriching the Earth: Fritz Haber, Carl Bosch and the Transformation of World Food Production*, has demonstrated the global food system's startling degree of dependence on nitrogen fertilization. Using simple math—the kind you can do in your head if there's no calculator handy—Smil showed that 40 percent of the protein in human bodies planetwide would not exist without the application of synthetic nitrogen to crops. That means that without the use of industrially produced nitrogen fertilizer, about 2.5 billion people out of today's world population of 6.2 billion simply could never have existed.

If farming depended solely on naturally occurring and recycled nitrogen fertility, the planet's cropped acreage could feed only about 50 percent of the human population at today's improved nutrition levels, according to Smil. But absolute dependence on synthetic nitrogen is geographically lopsided—it's largely in countries with a high human-cropland ratio. This includes India, Indonesia and China, where 4 in 10 human beings on Earth live. In contrast, those countries lucky enough to have ample cropland and relatively low population density could survive on far less synthetic nitrogen than they currently use.

The nation that ranks as the world's third biggest nitrogen fertilizer consumer could, conceivably, get by without the stuff. If that country, the United States, were to moderate its meat consumption, raise all livestock on pasture and rangeland instead of nitrogen-wasting grains, rely more on legume crops—plants like beans and alfalfa that obtain nitrogen from the air with the help of bacteria—curb waste and cut food exports, it could maintain its food supply without using any synthetic nitrogen, according to Smil's calculations.

The momentum of past population growth is expected to add 2 billion to 4 billion people to the world's population by 2050, even with concerted efforts to rein in growth. Almost all of the increase will occur in Africa, Asia, Latin America and the Middle East. That will double the demand for nitrogen fertilizer in those regions, and by that time, says Smil, 60 percent of their inhabitants will depend existentially—in the literal sense, not the philosophical one—on natural gas-derived nitrogen fertilizer.

Ironically, in that vast volume between the earth's surface and the atmosphere's upper limits, nitrogen is the most abundant element. We're continuously bathed in nitrogen gas, which makes up 78 percent of the air we breathe. But in the air, nitrogen atoms are paired up, each atom linked to another by an extremely tight molecular bond. Those molecules can't be used by living organisms unless that bond is broken, and only a small number of single-celled species have developed a means to do that biologically.

To pry nitrogen atoms apart chemically requires intense energy; it happens, for example, around a bolt of lightning. So it was not until 1909 that humans developed an industrial-scale method, called the Haber-Bosch process after its German inventors, to reassemble nitrogen atoms into another molecule, ammonia, that is usable by crop plants.

The two essential inputs to the Haber-Bosch process are air, which is free, and natural gas, which is expensive and becoming more so. To extend Vaclav Smil's reasoning, soon 60 percent of Earth's inhabitants will

Richard Bergen. Kansas Farm.

owe their survival to natural gas, a nonrenewable fossil fuel. And if Julian Darley is right, a species that can't survive without natural gas is a species in big trouble.

Darley is author of the 2004 book *High Noon for Natural Gas*, in which he argues that the era of cheap and plentiful gas, like that of cheap oil, is coming to a close. Humans began tapping Earth's deposits of oil and natural gas a little over a century ago. We've been exhausting the planet's oil reserves more quickly than gas reserves, because oil is easier to pump, transport and use. The planet's gas endowment will last longer, but the world is now using more each year than is being discovered—an ominous sign.

Accelerated consumption across the globe, says Darley, will continue to drive up natural gas prices, deplete reserves and trigger chronic shortages. In a world where growing energy demand has begun to run up against environmental limits, gas is almost too good

Natural gas is the methadone in humanity's vain attempt to ease withdrawal from coal and oil to be true, and, it seems, too good to leave in the ground. For instance:

- Countries trying to meet the greenhouse emissions limits set by the Kyoto Protocol are rapidly building natural gas-fired power plants, which emit much less carbon dioxide than do coal plants. Even in the United States, the world's No. 1 Kyoto deadbeat, most newly built power plants are gas-fueled, even as domestic gas reserves dwindle.
- In response to criticism of its heavy coal burning, China intends to triple or quadruple its use of natural gas for power generation in the coming decade.
- The petroleum industry is pushing hard to build large numbers of liquefied natural gas tankers, along with the requisite high-tech port facilities in the major producing and consuming nations. That will make it easier for a big energy user like the United States to suck not only from gas pipelines on its own continent but from wells almost anywhere on the planet, as we currently do to feed our oil habit.
- Building and operating a global liquefied natural gas system will require vast amounts of energy—much of it supplied by gas, of course. To produce the power required to haul liquefied gas across oceans while keeping it cooled to about 260 degrees below zero, LNG tankers draw on their own cargo. And an explosion at a LNG terminal could produce a fireball a mile wide—qualifying LNG as a potential WMD.
- The process of extracting oil from sands in the Canadian province of Alberta—often looked to as a key new resource in a "safe" part of the world—requires natural gas, and a lot of it. Darley predicts that if the oil sands are to satisfy even one-eighth of North America's demand, they will have to absorb a quarter to a half of Canada's natural gas production.
- Hydrogen is often hailed as a fuel of the future, but today most hydrogen is manufactured from—what else?—natural gas. Hydrogen could be generated by, say, using solar energy to split water molecules, but don't count that happening on a large scale as long as gas is available. President Bush's 2003 FreedomCar initiative relied mostly on gas-derived hydrogen.

Not everyone is as pessimistic about natural gas as is Darley. The Department of Energy, as usual, paints a much rosier picture of potential gas reserves. Vaclav Smil appears to expect future gas availability to end up somewhere between what Darley and the Energy Department predict. But on one point there seems to be universal agreement: Consumption of the world's natural gas will continue to accelerate, and in the rush, gas could prove even more volatile than oil, politically and economically as well as chemically.

The timetable for peak gas or plateauing natural gas production and an eventual decline is much harder to forecast than it is for oil. But a perfect storm of long-term forces appears to be blowing demand in only one direction—up—and the greatest access to such a hard-to-transport, hard-to-store resource will likely go to those players with the most money and the strongest armies.

Why armies? Because the world's remaining natural gas reserves lie mostly in the Mideast, Central Asia and Russia, almost guaranteeing that a century of conflict and chaos lies ahead.

The slice of the pie labeled "Rest of World" includes a number of small countries, many of them in Africa. Their gas reserves could sponsor decades of domestic fertilizer production. But, as people from Kirkuk to Caracas to the Niger Delta can tell you, fossil fuel reserves also can attract a lot of unwelcome attention from more powerful, energy-hungry nations. As natural gas becomes both more portable and more essential to food production in much of the world, impoverished farmers in Bangladesh and Egypt will find themselves bidding for it against Kansas farmers, homeowners from sweltering Phoenix or frigid Buffalo, and appliance-makers from Shanghai. Ask someone whose children's lives depend on getting nitrogen out of the air and into food crops, and she'll probably tell you there's no higher use for natural gas. But in affluent societies that take food for granted, gas—"one of the cleanest, safest and most useful of all energy sources"—can provide a lot of options that, after a while, start looking like necessities: keeping the house cool in August, cooking a corn-fed pot roast, driving to the store when you're out of organic milk, or relaxing in a hot tub.

Fertilizer production currently uses only about 5 percent of the world's natural gas production, and nonagricultural uses are already asserting greater dominance over tightening gas supplies on this continent. The escalation of gas prices in recent years has made fertilizer production far less profitable; as a result, the United States has lost 30 percent of its nitrogen fertilizer production capacity. American farmers now obtain more than half of their nitrogen fertilizer from abroad, making them the world's biggest importers of the product.

Mainstream economists, as always, predict an easy resolution: As the price of natural gas goes up, they say, people and nations will get more serious about conservation. But natural gas, latched onto increasingly as a somewhat more benign substitute for other fossil fuels, is playing the role of methadone in humanity's vain attempt to ease its withdrawal from coal and oil. And market forces tend to go haywire when dealing with addictive substances.

Without a right to food, people have no rights at all. So when there's a worldwide rush on a mineral resource essential to the production of adequate food—when the market is the problem, not the solution—nonmarket measures are needed to ensure that farmers are free to raise essential food crops.

The Food and Agriculture Organization of the United Nations has nonbinding "Right to Food" guidelines stating in part that, "States should consider specific national policies, legal instruments, and supporting mechanisms to protect ecological stability and the carrying capacity of ecosystems, to insure the possibility for sustained, increased food production in present and future generations, prevent water pollution, protect the fertility of the soil, and promote the sustainable management of fisheries and forestry."

A firm legal basis for ensuring that all people have access to the means of food production is the United Nation's 1976 International Covenant on Economic, Social and Cultural Rights, which recognizes "the right of everyone to be free from hunger." The treaty has been ratified by more than 150 nations. The United States is not among them.

Americans cannot expect to support a universal right to food by the roundabout and inadequate practice of importing natural gas and fertilizer, using them to produce surplus grain, and then exporting the grain to countries with food deficits. Every nation must have the means to grow its own food sustainably, with efficient recycling of crop, livestock and human wastes. And when those nutrients aren't sufficient, farmers need guaranteed access to fossil fuels and fertilizers as well.

Nitrogen fertilizer made it possible for us to overpopulate the Earth, and now we're hooked. Someday, as reserves of fossil fuels dwindle, our descendents will come to inhabit a less crowded planet, on crops fed entirely by sunlight and natural fertility. Whether that future population decline happens humanely through planning and restraint or cruelly through catastrophe depends largely on how we manage nonrenewable resources, especially natural gas.

This essay originally appeared on the Web site AlterNet.

Water Wildness

Strachan Donnelley

Aldo Leopold's Land Ethic, the fundamental moral imperative of American conservation, enjoins us to uphold the integrity, stability and beauty of biotic community, of which we ourselves are an integral part. True to his Midwestern, Iowa Hawkeye roots, Leopold exhorts us to become plain citizens of the land. Among the values that we are to recognize and protect is wildness.

Some people can live without wild things and some cannot—so said Leopold. He could not and I cannot. And why particularly am I so captivated by water wildness?

Following the wise example of Leopold's *A Sand County Almanac*, I begin with stories.

Each June, I fish during a mayfly hatch on a remote pond in northern Wisconsin. Other actors in this annual event—a natural-high holiday—include my daughters Inanna and Tegan, redwinged blackbirds and swallows, brown trout and the mayflies. Typically the pond is still, or there is a slight breeze. It is dusk with a red-orange sun setting behind a blackening forest of evergreens. The air is cool, and there are sounds only of birds and mosquitoes. A swallow leaves its perch on a dead stump in the middle of the pond and dives through the air. Other birds join it. We quickly row over to the birds. From the water emerge a host of dun mayflies. A swirl breaks the surface, and a mayfly disappears.

The dusk deepens, with only faint horizon light. Inanna, Tegan and I hear slurps of feeding trout all around us. We cast our flies to the sounds. Occasionally there is a decent cast, and we dimly see the dry fly riding high on the water. With a swirl comes a pull on the rod. We fight the fish in the dark, trying to keep it away from submerged logs. The fish is lost, or we land it—a cool, smooth, fat-bellied brown trout. We throw it back, or we put it in the boat's live-box.

Then, along with the blackbirds and swallows, we go home, leaving the pond's other trout to continue their feast well into the night, and hoping that enough mayflies make it to the trees and mate to ensure next year's hatch. We drive the sandy roads back to the cabin in silence, mesmerized by the moths and mayflies that the headlights draw.

There are several things to note about this human involvement in a mayfly hatch. First, it is the natural, animal world that importantly sets the terms of the human experience and determines reflections on its meanings and values. The concerns and preoccupations of the human city are left far behind. Second, a human being enters the realm of action as only one among several actors, and the actors are in a fundamental sense on equal terms. All interlock in a single dynamic realm of living, whether seeking prey, avoiding predators or preparing to mate.

Being a participant actor within, rather than a spectator-observer without, decisively transforms the human experience. We experience the animals in a way complex and compelling. The swallow in this context is an animal subject active in its world. It attentively awaits the mayflies, an unwitting lookout for the human fishermen. The brown trout are wily animate others lurking in the depths, strangely beautiful, intricately patterned and colored. It takes the mayflies for the trout to shed their natural caution and surface. The mayflies are delicate emissaries from the mysterious insect kingdom, the focus of this complex drama, having their one day in the sun after a year as nymphs in the muddy pond bottom.

These animals are not mere objects of scientific inquiry or disinterested curiosity. They are living, individual and interconnected wild presences. By their wild otherness and our encountering them firsthand, they vividly confront us with our own existence as living organisms and shock us back from the provinces of the human city to our place within the wider natural scheme of things. By their own animate being, they force us to probe radically the nature of our own organic being and to question thoughtfully the natural world and its ultimate meaning, values and goodness—why we, animals and nature matter, and matter together.

Here are more fish stories. They are about Atlantic salmon, endangered and perhaps threatened with extinction, thanks to our blundering and lack of foresight.

I had been fishing for salmon in a Nova Scotia river, the St. Mary's, for four days without luck. In the bright noon sunshine, I absentmindedly watched my dry fly float over a riffle. A gray-silver salmon appeared, circled quickly around the fly, batted it with its tail and disappeared. The fly went bobbing down the river. After making four or five casts in another direction, I came back to the riffle. This time the salmon struck, and minutes later I was on my knees on the hot stones of the river's edge taking the fly from the mouth of a silvery grilse, a small salmon, fresh from the ocean, still covered with sea lice.

Another time I hooked a salmon in a broad, swift Icelandic river. The salmon made a long run across and up the river, returned closer to where I was standing on the bank, and then hunkered down on the bottom. I could neither see the fish nor move it. Some 20 minutes later, the salmon rolled up to the surface, showed its silvery side and swam straight for a narrows 200 yards downstream. It had come through the narrows on its way up to spawn. I couldn't stop its run. I ran along the bank, tripped, fell to my knees and scrambled up, all along keeping my line taut. When I got to the narrows, the salmon had stopped. I held tight. After several minutes of no movement, I dipped the tip of my rod into the water and came up with my fly, moss hanging from the hook. The salmon had rubbed the fly off on a rock and was gone.

A few years ago I traveled to Newfoundland to fish Portland Creek and the River of Ponds, both storied North Atlantic salmon rivers. My guide was Gideon House, who had a brogue that seemed to echo down Dublin streets: "Yes, Strachan, me boy, the River of Ponds is the river for salmon. For salmon, it's the River of Ponds." There followed a tuneless, "La de da de da," which over the week we came to tolerate, if not love. One evening on the River of Ponds, following a frustrating day of rising salmon toying with my fly, Gideon reached into his vest and took out a black salmon fly with a yellow butt. "Yes, Strachan, me boy, the Lemon Tip is the fly for the River of Ponds. For the River of Ponds, it is the Lemon Tip."

Gideon tied the Lemon Tip onto my leader, and at the end of the pool, just before dark, sure enough a salmon broke the water's surface and took the fly. This was no ordinary salmon, but a Smokin' Joe Frasier. It raced to the far side of the pool, leapt high into the air, and swam straight back toward me, leaving a wide loop of slack line—a great opportunity for losing a salmon. It charged upstream, back down to the bottom of the pool. And then let me reel it in close by. It slowly rose to the surface, gave me the eye, and returned to the bottom. Soon after, it leapt backward 6 feet into the air and snapped the line. Wonderful. I had hooked up with a wild one in its native home river.

A few days later, our fishing over, we visited Humber River to watch salmon jumping its Big Falls on their way upstream to spawn. It had been raining heavily all week, and Big Falls had turned mini-Niagara. We saw countless salmon trying to leap up, through and over the falls. None made it. They would have to wait for the flow to drop. This was an awesome scene, in the old and genuine sense of the term. I was humbled, overwhelmed with respect. Compared with Atlantic salmon and their rigorous lives, traveling from natal rivers to Greenland and back, we humans—at least many of us—

Richard Bergen. Winter Tree.

are couch potatoes, leading cushy lives in cultural enclaves. We usually miss life's stark, challenging reality and the natural world that spawns and fosters it.

I want to tell one more story, this time not about wild trout and salmon, but about wild ducks.

In South Carolina there is a coastal island, Fenwick Island, with five duck ponds—all poetically named: Long, Back, North, Middle and South. Middle Pond has not been hunted for five years or more, to provide winter sanctuary. Wild ducks are smarter than we might think. Each fall, after running the hunter's gauntlet from Canada down the Atlantic seaboard, the ducks pour into Middle Pond. By best SWAG calculations—Scientific Wild-Ass Guesses—there are 15,000 to 25,000 birds. Each evening, joined by ducks from nearby ponds, they fly to roost elsewhere for the night. Their flight starts 10 to 15 minutes before dusk. Raft after raft, species by species, they take to sky and make Middle Pond a smokestack, dark, billowing clouds of wild ducks rising from the water and trailing off into the northern horizon. The show is over in 10 minutes. At dawn the birds return—widgeons, teals, gadwalls, mallards and more, especially pintails. From 2,000 to 3,000 feet up, with uncharacteristic boldness pintails set their wings and carve their way down into the pond. These evening and morning events are one of Mother Nature's great wild *sonne et luminere*—sound and light—shows. It stirs the depths of spectator birds, me and human others.

These stories vividly tell the story of wildness, and they speak for themselves. Yet I cannot resist scratching philosophic itches.

Wildness is nature's wildness, a character or value that does not fly in from somewhere else. Wildness is of this earth, if not also of the natural universe as a whole. It is ingredient in the earth's beauty and goodness, which themselves are generated in and by evolutionary, ecological, and geological processes. In wild nature we meet innumerable organic capacities and forms of order, and innumerable lives joined in the rigors of earthly existence—births, matings and deaths, predator-prey relations, competition and symbiosis, extinctions and explosions of new ecological niches, and much more.

Such natural wildness, beauty and goodness might be ultimate values, not to be finally defined in words, only encountered, experienced and wordlessly enjoyed. Yet the values are ingredient in the concrete facts of our world, and about the concreteness of the world many things can be said.

A few things particularly strike me. In a certain sense, the wildness, beauty and goodness of our earthly home come from a protean nature that transcends the human realm and is beyond human comprehension. Yet we dwell in this nature and can appreciate its wildness, beauty and goodness. How can this incredible fact of our human existence be? For me, the only plausible speculative answer is that we are also wild ones, organisms living within a nature that has aboriginally developed the capacities of feeling, emotion, thought and action to capture, however imperfectly, its own self-engendered wildness, beauty and goodness, which by now we emphatically must realize to include ourselves. If we breathe, metabolize, move about, feel—do what natural organisms have evolved to do—we too are wild ones, whether we live in the wilds, on farms, in rivers or in cities.

Oddly, this most basic of worldly facts comes as a stunning revelation to many of us, who have been taught to live in denial of our natural and evolutionary origins. I live in a city of 8 million wild ones, and few seem to realize it.

What a shame this denial is. What natural riches are missed. What a grand, historical, worldly drama that includes us is hidden from view. This was Darwin's unspoken judgment, and this regret very much underlies Leopold's indictment of modern culture and of those who can live without wild things and wildness, including their own deepest recesses.

This cultural eclipse of our and the earth's wildness is not merely sad or to be regretted. It is dangerous and pernicious. Those well acquainted with the wildness, goodness and beauty of earthly nature are also actively aware of its finitude, mortality and vulnerability to harm. This is natural fact. But it is equally an ethical issue that inescapably confronts us humans and our native, if circumscribed, freedom of choice and action. Responsibility to act well within the natural world is given with our very being as wild ones, who are born into a world laced with value—wildness, goodness, beauty and others. We can either face our responsibilities for upholding and promoting the earth's values and goodness, including our own, or we can choose to be irresponsible. Over this, there is no other choice.

Leopold's Land Ethic explicitly recognizes our moral situation and responsibilities to the wider natural world. Leopold knew that we were wild ones living in a wild and wonderful home. He also knew that moral responsibility was more than pragmatic, practical expedience. For example, we and other creatures need good water not only to survive as bodily, metabolizing organisms. We need good and abundant water so Earth's wildness, goodness and beauty may continue to be. We have ultimate issues on our hands, like it or not.

Could it be that vivid recognition of our own wildness, the wildness of our earthly home, and the wildness of our waters and all creatures that dwelleth therein is the key to saving ourselves and our world, which will stand or fall together? If so, it is time to listen again, appreciatively and critically, to the prophetic voice of Leopold and, more importantly, to the wild world that he champions.

Outside the Big Box

Jeff Walker

I have never been to Home Depot. For a homeowner and small-time farmer these days, this is quite an admission. But then again, I have never been to Wal-Mart, or Sam's Club, or Lowe's. My kids haven't seen the inside of a McDonald's since our 16-year-old daughter went to a birthday party at one 12 years ago. Chain book stores, chain pharmacies, chain department stores, chain pizza parlors, chain convenience stores and chain grocery stores abound, but we try to avoid them whenever possible, preferring instead to buy from locally owned businesses.

Supporting a local business means literally supporting your neighbors—with the reciprocal hope, of course, that they will support you. Our butcher lives right down the street. Two of the family members that own the hardware store live within a mile of us. Before we moved to our farm, we lived almost next door to the family that owns the bookstore. We know the waitresses at the diner, the workers at the Chinese restaurant, the pizza man, the pharmacist and the cashiers at the drug store, the owners of the department and the feed stores. We know that the money we pay to them goes into their own pockets and supports them and their families. The money stays in the community a little longer, and in doing so contributes to everyone's economic well-being.

Supporting local businesses is an important part of a thriving local economy, which is one important key to building sustainable communities. The longer money can circulate throughout a community, the more it can support local people and local activities.

At a chain store, the money that you work so hard to bring into the community is whisked instantly away to be distributed among stockholders of a parent company that has little reason to care about your town. An analogy would be the comparison between water used in cooking and water used to flush a toilet: The former cooks food and ultimately nourishes your body; the latter just goes down the drain.

It is often said that buying from local business is more expensive. If indeed that is the case, the consumer is making a conscious decision to spend that extra money to support local business and the local economy. Sometimes, the consumer may even get a pleasant surprise like the time I bought a new extension ladder.

The owner of the local hardware store thought I was crazy when I asked to order a ladder we both thought I could find in stock, and for less money, at one of the "big box" stores. He placed the order anyway, and several days after the ladder arrived, my junk mail informed me that the exact same ladder could be had at one of the big stores for $10 less. After figuring in the 10 percent discount I get for maintaining an account in good standing at the hardware store, turns out the ladder actually was cheaper there.

This example begs us to consider how the price of an item is related to its true cost. "Price" is the dollars and cents we pay to purchase an item. "Cost" is much more complex—it includes things measured in monetary terms along with things measured in nonmonetary, and sometimes even nonquantifiable, terms. For instance, whereas cost includes the money necessary to produce the item and transport it to the point at which it is sold, there are environmental costs associated with obtaining and refining the raw materials used to produce the item and its packaging, with transporting raw materials to the factory and delivering finished products to the market, with disposing of the item and its packaging when we no longer want them, with building and maintaining large stores, and with abandoning those stores when the

Richard Bergen. Sunflowers.

economic wind blows ever so slightly from a different direction. Most of these costs are externalized by businesses because many feel little responsibility to worry about them.

There are also the social costs of production, such as the cost of livelihoods displaced by building a large factory in a rural landscape simply because land and the labor market are cheap. Social costs also include the working conditions in the maquiladora like this, whether it is in Mexico or Asia, and the problems thrust upon the local community when, once the people have adapted to life with the factory, the company pulls out for an even cheaper location.

Granted, many items sold by local businesses are produced by globalized networks that externalize these environmental and social costs for everyone to bear. But some social costs work at the local level, and it is here that the chain versus local business question begins to become clear. The predatory attitude of many chain stores means that one of their goals is to bankrupt or absorb all other similar businesses within a certain distance. Those thus unemployed, particularly the owners of once-thriving but now-defunct businesses, reflect a cost to the society that must support them. And I'll bet that, for most of them, working at the chain is a poor substitute.

So, while local businesses seem inevitably to sell items that are not locally produced, my feeling is that, on the whole, local businesses will work to minimize the local costs of their commerce. In fact, since local businesses are strongly rooted in the neighborhood, the wishes of the neighborhood can help to shape their business decisions. One could imagine an ideal system in which local goods are produced in local factories or farms from local raw materials and sold by local businesses.

Such a system, however, must grow from the bottom up. The pressures of globalization work against local production and local markets, and our governments are so clearly enamored with globalization that they can be counted on to do little to really encourage local business. We need to do it ourselves. We need to create the local market to encourage the local business to buy or produce locally. Without a local market, which is ultimately our direct entry point into the economic system, we will never get anywhere. Our choices can make a difference: that pound of bacon we buy today will allow our neighbor to go on making a living, and so help to create the nucleus of a thriving community in the coming years.

Once we submit to the feeling that globalization is inevitable, that Internet marketing is inevitable, that chain stores must replace local businesses because of some immutable law of economic determinism, sustainable communities will not be possible.

From *The Longhorns*

An excerpt from J. Frank Dobie's book of folklore and history about a breed of cattle and ranchers.

When he was something over 80 years old, Don Victoriano became too stiff in the legs to mount a horse at all, and [his son] was at the same time becoming too old to run in the brush. They could no longer handle the wild cattle in the only way they knew, and the vaqueros working for them had absolutely no sense of management.

When Don Victoriano was 89 years old, his son persuaded him to sell out the stock, lease the land and agree to move from the old ranch at the tank to a little corner of ground two or three miles away. The cattle were to be caught by the purchaser.

As the time approached for delivering the ranch, Don Victoriano became very morose. "When we are gone," he kept saying, "and everything in our brand has been cleaned out of the pasture, I can no longer sit and listen to the brindle bull *hablando*—talking — as he comes to water. I can no longer hear the bell on the dun mare telling me that the remuda is coming down the trail. God will never again bless me as I stand in the shelter of the *ramada* when it rains and watch the water come up in the tank inch by inch. When next spring comes, I will not see the quail pecking up berries with worms in them fallen from the agrito bushes growing under my oaks.

"Why have we been talked into this evil trade? We belong here. My roots go deeper than those of any mesquite growing up and down this long arroyo. We do not need money. When a man belongs to a place and lives there, all the money in all the world cannot buy him anything else so good. *Valgame Dios,* why, why, why?"

Bent far over on his two walking sticks of Spanish dagger stalks, Don Victoriano would disappear, muttering, into the brush under the motte of oaks. Two days before the date of delivery, on June 14, 1901, he hobbled out into a little barn with a dirt floor, got up on a box, tied a strangle knot around his neck, and fastened the rope over a rafter. Then he kicked the box out from under his feet. When he was found, his toes were not six inches from the ground and his legs were doubled up, showing that his will to die could not be thwarted by a step on to the earth he would be buried in rather than be dragged from.

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The Writers and Artists

Wes Jackson is president of The Land Institute, and author of books including *Becoming Native to This Place.*

Richard Bergen, who made the linoleum block prints in this issue, is known primarily as a sculptor. He and son Rich work at a Salina studio in bronze, steel and aluminum sculptures for private buyers and public art, including the Native American statue *Ad Astra* atop the Kansas Capitol dome. Their Web site is www.bergen-sculpture.com.

Scott Bontz is editor of *The Land Report.*

Terry Evans, a Land Institute board member, has several books of photographs, primarily about the nature of prairie from native state to human use. Her latest work is *Revealing Chicago: An Aerial Portrait.*

Stan Cox leads The Land Institute's plant breeding team.

Strachan Donnelley is a Land Institute board member and president of the Center for Humans and Nature.

Jeff Walker is associate professor of geology at Vassar College in Poughkeepsie, New Work, and has a 15-acre, horse-powered farm.

J. Frank Dobie, 1888-1964, was a folklorist, newspaper columnist and writer of many books about rural Texas and Southwestern culture. He also helped save the Texas longhorn breed of cattle.

David Kline farms in Ohio, edits *Farming Magazine*, and has written books including *Great Possession's: An Amish Farmer's Journal.*

From an Amish Farmer

Ohio dairyman David Kline was the opening speaker at our Prairie Festival this year. Here are a few of the things he said.

- "The best health insurance that anyone can have is to eat the best food that can be grown on healthy soil."
- "One thing about the Amish community: We have kept the brightest within the community … they haven't been siphoned off."
- "[Tourists] asked the question: 'Now where are we and you different?' And the Amish speaker said, 'How many of you have television?' They all raised their hands. He said, 'How many of you, if you had children, would think it would be better not to have it?' They all raised their hands. He said, 'How many of you are going home and get rid of it?' Nobody raised their hands. He said, 'That's the difference between us and you.'"

Richard Bergen. Kansas Moon.

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