

LAND REPORT

THE LAND INSTITUTE • FALL 2011



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.

OUR WORK

Thousands of new perennial grain plants live year-round at The Land Institute, prototypes we developed in pursuit of a new agriculture that mimics natural ecosystems. Grown in polycultures, perennial crops require less fertilizer, herbicide and pesticide. Their root systems are massive. They manage water better, exchange nutrients more efficiently and hold soil against the erosion of water and wind. This strengthens the plants' resilience to weather extremes, and restores the soil's capacity to hold carbon. Our aim is to make conservation a consequence, not a casualty, of agricultural production.

LAND REPORT

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ELECTRONIC MEDIA

To receive Scoop, e-mail news about The Land Institute, write to Joan Jackson at olsen@landinstitute.org, or call. Our Web site is landinstitute.org.

SUPPORT

To help The Land Institute, see the contribution form on the back cover, or contribute online at landinstitute.org. Funders receive the Land Report.

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*Cover: Intermediate Wheatgrass in a Mason Jar.
Duane Schrag photo.*

*Contents photo: An offspring combining traits of
annual grain sorghum with a wild relative, to make a
crop that won't need replanting every year, will better
conserve water and nutrients, and can take the heat.
For the story, see page 6. Scott Bontz photo.*

At the Land

NATIVE PRAIRIE PURCHASE

With money from a donor who didn't want to be identified, in October The Land Institute bought 37 acres of rare floodplain still in native prairie. Several years ago the owner, farmer Jim Duggan, had let institute researchers begin study of soil and nutrient flow in the rich, unplowed ground, and compare it with a neighboring wheat field. Duggan died last year, and his family wanted to sell the land near Niles. It is 15 miles away, but a valuable study benchmark for an organization aiming to pattern agriculture after natural ecosystems. The earlier survey found that the hay of perennial plants continued to yield about as much protein-building nitrogen as the field of annual wheat, but without the wheat's fertilizer. This bolstered evidence for the value of developing perennial grain crops. For more about the study, see the summer 2010 Land Report.

MINNESOTA WHEATGRASS WORK BEGINS

Beginning August 1, Land Institute researcher Lee DeHaan spent six weeks enlisting the University of Minnesota to help him develop intermediate wheatgrass as a perennial grain crop. He designed experiments, organized and executed planting, and planned research with food scientists. "It was a lot more hands-on than I had anticipated, but turned out to be a great opportunity to get



The Land Institute bought 37 acres of rare native bottomland prairie near

experiments started and strengthen working relationships with important collaborators," he said. He and a team of university researchers recently won a \$695,000, three-year grant to fund this work. For getting this kind of help around the world, see a plan described by Wes Jackson on page 27.

NEW FUND-RAISING DIRECTOR

The Land Institute hired a successor to its director of institutional advancement, Joan Jackson, who will retire. The new leader of fund-raising staff will be Jayne Norlin.



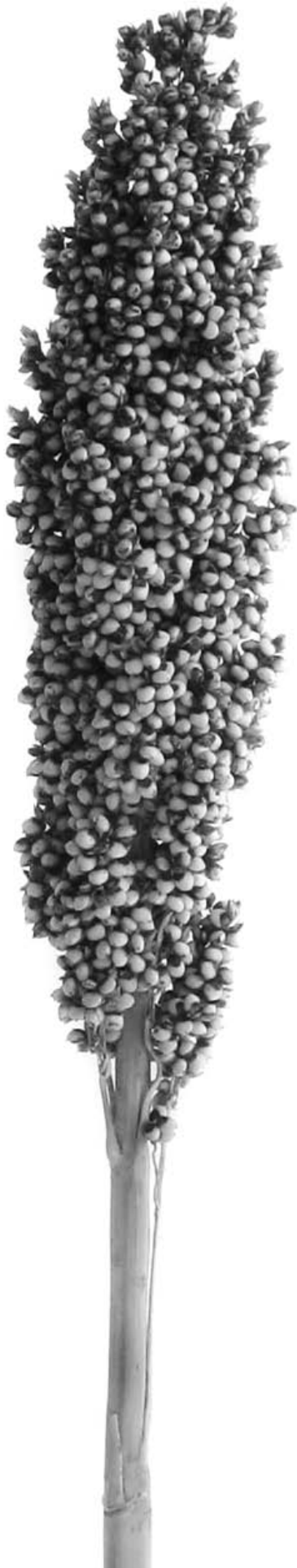
Niles, Kansas. It's a natural benchmark for modeling agriculture. Pictured, in 2006, are Land Institute researchers. Scott Bontz photo, from 2006.

She comes from fund raising as an associate vice president at Bethany College in nearby Lindsborg. Norlin plans to start December 1. Jackson, who joined staff in 1998, will stay on as long as needed to train Norlin.

PRESENTATIONS

Land Institute scientist Stan Cox argued for perennial grains in the English online edition of the Arab news service Aljazeera. The PBS television show "This American Land" included in episode 108 a version of The Land Institute profile by Kansas

City Public Television. Land Institute staff members spoke in Michigan, Minnesota, Wyoming, Oregon, California, Connecticut, and Maryland. Upcoming events: November 17, Charleston, South Carolina. November 30, Urbana, Illinois. December 4, Austin, Texas. January 23-24, Chestnut Ridge, New York. March 6, Wichita, Kansas. March 29, Indianapolis. April 6-7, Stanford, California. April 25, Sioux City, Iowa. May 5, Overland Park, Kansas. May 19, Deerfield, Illinois. For more, call us at 785-823-5376 or see Calendar at www.landinstitute.org.



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OVERCOMING NEGATIVE RELATIONSHIPS

SCOTT BONTZ

Y oung sorghum is hard to tell from corn. Later, instead of growing covered ears at midstalk like corn, it raises above the rest of the plant a tight, heavy plume of bare seed. Another difference is waxy leaves, which cut sorghum's water losses in heat. Genes in corn say never mind the weather: produce or bust. Sorghum will try to wait out a drought. Its average seed yield is less than corn's. But in the semiarid world, from subsistence plots in Africa, sorghum's birthplace, to vast High Plains spreads, farmers bet on sorghum's dependability. Among US grains, it trails only corn and wheat. Most goes to livestock and export. But there is a growing food market for sorghum, including people who can't tolerate gluten.

There's something that soil can't productively tolerate, at least not without transfusions by fertilizer, and even then, in most places not for the long run. That is annual cropping. Here sorghum has even greater potential. It's from the tropical savannah, and after harvest at low latitude, it can grow again. Perennials relieve farmers from planting each year, as they must with annuals. Perennial establishment thwarts weeds. Perennials are vastly better than annuals at conserving soil and nutrients. This counts for more as population climbs and fossil energy noses down. Perennial sorghum breeder Stan Cox said losing large

cuts of grain calories to the middlemen that are livestock will come to make even less sense than now. People will eat more grains directly, and for good nutrition will demand from these staples more diversity. Sorghum's regrowth doesn't yet pay off enough for tropical farmers, who treat it as an annual. And on the Plains, that regrowth dies with the first autumn freeze. But sorghum is genetically nearer to perenniality than are other grains. It also can breed with a closely related *Sorghum* genus plant that overwinters all the way to Montana. And cold actually could help make it profitable.

Cox works to see that livelong grain sorghum. His cohorts at The Land Institute have a like aim for sunflower, a prairie legume called Illinois bundleflower, wheat, and wheat's perennial cousin, intermediate wheatgrass. Chinese colleagues are developing perennial rice. Corn appears in the offspring elsewhere. (See this spring's Land Report.) But that likely will require injecting genes, and Cox said, "We're going to have perennial sorghum before perennial corn, I'm pretty sure."

Still, he faces difficult genetic puzzles. "I can select plenty of good-looking, relatively large-seeded plants in the fall and save their seed," he said, "but the winter-hardy plants that emerge the next spring in that nursery will be other plants, ones that will not be close to as good. And when I sow

Cross annual grain sorghum, far left, with perennial johnsongrass, then over generations breed out weediness for a perennial crop. For developments so far, see page 12. Scott Bontz photos.



Stan Cox checks seed of hybrid sorghum. The bag at left covered the head so flowers took only that plant's pollen. Over generations this makes traits more consistent, and helps the breeder secure the traits most desired.

seed from the good-looking selected plants, their offspring are rarely if ever winter-hardy.” But knowledge gained patiently through years of examination and selection can make a plant right for farm and food. Cox said, “The history of plant breeding is the history of overcoming such negative relationships between traits.”

For millions in semi-arid areas, sorghum remains the principle food grain. Recently it has lost ground to imported and subsidized commodities such as rice. Without commercial milling, sorghum takes more time than rice to prepare for the plate. In Africa and Asia’s ballooning cities, it suffers the reputation of “village” food. But its drought hardiness holds favor among farmers whose lives hang on their crops. The US Grains Council, a promoter of sorghum, barley, and corn exports, says sorghum also better tolerates wet soils and flooding than most grain crops. If climate change brings more drought and more erratic rainfall, sorghum will advance on corn, Cox said. Regardless, it will gain advantage as the Ogallala Aquifer is sucked out from under the Plains and irrigation costs rise.

Jane Lingenfelter, coordinator of crop performance tests for Kansas State University, said sorghum’s reproductive development differs from corn. It’s planted later. It doesn’t devote as much to vegetative growth – its portion of seed is higher. It’s shorter. Corn silks on time regardless of weather. In enough heat, Lingenfelter said, “Pollen fries, kernels abort.” Sorghum can delay maturing if the weather’s not right. “Sorghum will usually go ahead and make something, regardless of heat or drought,” she said. This hot, dry summer in Kansas, some corn in her test plots didn’t set ears. In sorghum plots, the heads were smaller, and some didn’t fill completely. But she said every sorghum test made some grain.

“When a biotech person tells you he’s going to transfer the waxy-leaf gene from sorghum into corn and make corn drought-tolerant, don’t believe it,” Cox said. He was careful about saying sorghum will become more valuable as Earth warms. “Everyone likes to claim that their crop of interest is the secret to preventing or adapting to climate change,” he said. “But a case could be made that because sorghum loves heat and can produce a very large quantity of food on a minimum of water, in places – like maybe the central US – that are expected to become hotter and drier, sorghum could displace other summer crops. Especially if it’s perennial sorghum.”

Kansas State researchers photographed a sorghum field over a season to show the plant’s growth habit. The year, 2002, saw a long dry spell, and the story shows, with some of the suspense that farmers must endure, how sorghum tried to hang tight while corn withered. It also shows how no-till farming controls erosion. The same can come with perennials, and they can do it without no-till’s herbicides. See <http://www.ksre.ksu.edu/sorghumseason/welcome.htm>.

Americans lack a subsistence village culture with staples to disdain, and they don’t have to pound their grain for flour. Still, sorghum comes to them mostly through livestock, where half to 90 percent of the grain calories are lost. “It just hasn’t been part of food culture,” Cox said. Lloyd W. Rooney teaches at Texas A&M University and for decades has studied the food and feed qualities of sorghum, corn, wheat, and pearl millet. Only recently has sorghum become available for food in the US, he said. When he introduces it to people, they become interested and ask where to get it. But building links to market has been hard. Gerald Simonsen, who grows about 1,000 acres of food sorghum at Ruskin, Nebraska,

said it's a chicken-and-egg problem: lack of market puts off growers, and lack of growers puts off the market. And because much of the early market for food sorghum is with people who have food allergies, growers and processors face the trouble of keeping their product uncontaminated by other grains. Simonsen, who turns a bit of his crop to flour as Twin Valley Mills, said, "Flour is a little hard to contain."

But he now has 15 buyers, including in Asia, and said demand has been making a slow but steady rise. Earl Roemer estimated that in two years his numbers are up 15 to 20 percent. Roemer farms 1,000 to 1,500 acres of food sorghum at Scott City, Kansas. He has helped US Agriculture Department scientists to breed light colored sorghums without the astringency associated with feed sorghum. After 12 years of research and development, he plans to start up next year a 35,000-square-foot facility for milling and turning his sorghum into products including flour, pearled grain for pilaf, and bran high in antioxidants. Nu Life Market also will make a sunflower spread for people allergic to peanuts.

Promoters say manufacturers and cooks value sorghum flour for its light color, neutral flavor, good texture for cakes, cookies, bread, and pizza, and in whole grain form for a texture that is hearty and chewy. Sorghum substitutes for couscous, bulgur, and barley in soups and side dishes. Rooney said sorghum is good for breads where other flours are mixed with wheat to reduce cost. Corn adds too much corn flavor, he said. Roemer said sorghum far outyields and so isn't as costly as quinoa or amaranth, two other wheat substitutes. People who can't tolerate gluten, unavoidable in wheat and barley, increasingly turn to sorghum, Rooney said. Cox thinks sorghum has more flavor than cornmeal or white wheat flour. He

called it, uncritically, "rustic." More on sorghum's plus side for Cox: high fiber. Higher protein than rice or corn. In yellow sorghum, beta carotene, precursor to vitamin A. On the minus side: high fiber. A somewhat coarser flour texture.

Sorghum pops like corn, but smaller, more tender, and with less teeth-clogging hull. It also goes to making beer. This is a major use in South Africa. Anheuser-Busch produces Redbridge, a sorghum beer for the gluten-free market. So do smaller US brewers. Intrigued home brewers note: sorghum sprouts produce cyanide, and take special attention for malting.

The seed of some sorghum varieties has tannin, which Rooney said slows carbohydrate digestion. Though not proven, this might moderate blood sugar to benefit diabetics. Tannin flavor, or at least its reputation, puts off some people. Rooney said it can make good rye-flavored bread. The bitterness is valued for making beer. Through breeding, tannin is gone from US sorghums because it reduces digestion by livestock, Rooney said. It also deters birds – though not holding off hungry ones.

Grain sorghum's scientific name is *Sorghum bicolor*. In the *Sorghum* genus are at least 28 other species. One of these is weedy johnsongrass. *Bicolor* has 20 chromosomes in one pairing – a diploid, as are humans. Johnsongrass, *Sorghum halepense*, has double the chromosomes and pairings. Cox said the cell language of DNA shows that 20 of johnsongrass's 40 chromosomes are very similar to those of grain sorghum, and the rest are similar to those of another diploid, tropical, perennial species, *Sorghum propinquum*. It is thought that an annual species and *propinquum* were descended from a common perennial ancestor, that much later those two species made a hybrid which doubled chromosomes and became johnsongrass, and

then that the annual species evolved further to become the wild ancestor of *bicolor*. *Propinquum* isn't perennial outside of the tropics. Johnsongrass, which the USDA says was introduced as forage in 1830, rapidly evolved to survive North American winters. It's now on every continent but Antarctica, and one of the world's worst weeds. It's also what will make grain sorghum robustly perennial.

In the 1980's, The Land Institute's Walter Pickett, and later Peter Kulakow, Jon Piper, and interns, crossed johnsongrass with grain sorghum. Kansas State University supplied sorghum with its chromosomes doubled. This matched johnsongrass to assure fertile offspring. Doubling sometimes occurs naturally. Breeders can induce it chemically. Working with these hybrids and backcrossing to the cultivated sorghum parent, Kulakow and Piper reported that a plant can be bred to devote more energy to reproduction – yield more seed – without sacrificing its perenniality. This was an early counter to arguments against perennial grain crops. The paper, and more along this line from current Land Institute scientists, is on the Web site www.landinstitute.org.

Piper and Kulakow left seed from the crosses in storage. When Cox picked up the sorghum breeding in 2000 and planted those seeds, he got plants similar in appearance to johnsongrass, but with bigger seed and shorter stature. They had fewer rhizomes, the underground stems that enable winter survival and early spring starts for perennials. And they had little shattering, the dropping of seed, which is common in wild plants but ruinous for harvesting a grain crop. In other words, the hybrids were less weedy. "Today, our perennial lines are much more tame than that," Cox said. As he put it September 24 at The Land Institute's Prairie Festival, "We've ruined

johnsongrass as a weed." If crossed lines did escape from cultivation, they might evolve as have weedy oats, grain sorghum, and other annual crop plants, and perhaps hybridize to become weedier. But Cox said, "I can't conceive of their producing anything worse than johnsongrass, which, by the way, is constantly absorbing genes from grain sorghum through natural cross-pollination and doubtlessly rejecting most of them through natural selection." He selects perennials with short rhizomes, no more than 9 inches, usually less, and he most values rhizomes that angle downward instead of spreading. "That improves their chance for winter survival," he said.

And could the perennial sorghum taint neighboring fields of annual sorghum? "There have been many studies on the genetics of gene flow in *Sorghum*, and it is a one-way flow from grain sorghum into johnsongrass," Cox said. Because of how seeds form, hybrids between plants of differing ploidies – the number of chromosome sets – almost always occur with the higher ploidy as the female. So johnsongrass picks up genes from grain sorghum, but not vice versa. Also, US grain sorghum fields are sown with newly purchased hybrid seed. These aren't hybrids of different species, but of inbred lines that when joined make for one vigorous generation of offspring. That generation's seed would make plants of unprofitable variety, and not worth sowing.

Cox isn't working for that kind of hybrid. Farmers would be able to save its seed for planting – though perennials won't need planting often. Cox breeds sorghum with sorghum-johnsongrass crosses. He now wants just one trait from johnsongrass, its perenniality. From the crop plant he wants lots of big seeds that don't shatter onto the ground, plus short stature and other tame behaviors to replace the wasteful competi-



Annual grain sorghum crossed with the perennial johnsongrass makes a hybrid.

Over generations the



Plants that came from crossing those select hybrids and proved perennial.

Solidly perennial hybrids



hybrids self-pollinate, and the breeder picks plants that show the best results.



are backcrossed to grain sorghum. Spring will show which plants have kept perenniality along with good seed heads.

tion seen among wild plants. This way, more energy goes to making seed.

In general, Cox said, it's not hard to increase grain yield at a steady, fairly rapid rate. Seeds from his good plants run two to four times the size of johnsongrass seeds, and half to one-third the size of commercial grain sorghum seeds. He also can achieve plants about 3 feet tall, rather than the 10-foot towers of johnsongrass and sorghum bred for fodder. But this is not easy. Dwarfing in the sorghum with doubled chromosomes is governed by recessive genes in eight different locations. For supershort plants he would need all of 16 parent genes to be recessive. Having 12, however, might make the plant short enough. Recessive genes also make the seed whiteness favored for food sorghum. Cox said white seed probably was achieved early in sorghum selection, but in trying to combine that trait with others in the endeavor for perenniality, he still has few white-seeded lines.

He can get rhizomatous, winter-hardy plants with all those traits. "But the hardest thing is what you might call 'plant form,'" he said. All of his winter-hardy plants produce too many tillers, as extra stalks are called. Tillers sprout not only from the plant's base, but from up the central stalk, and over the whole season. At harvest some seed heads are mature but others are green. "This is not surprising," he said, "because tillers and rhizomes come from the same clump of tissue at the crown. So a plant with vigorous rhizome growth tends to waste a lot of energy on unproductive tillers." His current plants are much better about this than were the original perennials. They make fewer tillers, and their heads mature more in sync. "But it remains a struggle," he said. "Getting all of these positive traits expressed in a rhizomatous plant that can be perennial in the tropics or even in warm

temperate climates is no problem, but to get them in a Great Plains winter-hardy plant is more difficult."

The Plains does have advantage over the tropics. The winter will kill all of the plant above ground. Come spring there will be no tillers from old stalks. Cox said regrowth from rhizomes rather than the crown makes a markedly more productive new crop plant. Unfortunately, some of the desirable genes for winter survival probably are on the same johnsongrass chromosomes as the genes for undesirable traits such as smaller seed. If so, those linkages must be broken. University of Georgia scientist Andrew Paterson can use DNA markers to do this, and has begun work with Cox.

"I learned quickly – and Piper and Kulakow showed – that if you just get a hybrid and backcross it to *bicolor*, even once, you get hardly any perennial offspring," Cox said. He must let the hybrid and its progeny self-pollinate for at least three generations. Through this time he selects those that retain perenniality. He then backcrosses only winter-hardy plants to crop sorghum. "Every year, I also cross perennial – or at least rhizomatous – plants with one another," Cox said. "Some of the better perennial plants have come from doing that." But the perennial gene pool still lacks enough variation for him to select plants with large, light-colored seeds. "For that and other traits, more backcrossing is needed," he said. "But every cross must have at least one parent that is a 'hard-core' perennial. If that's not the case, the cross will never produce a perennial plant. All of the above is to be expected when dealing with a trait governed by a complex genetic system."

This year his results were encouraging. Spring 2006 was the first time he found many winter survivors among his hybrids. Come fall, 17 percent of those were worth

harvesting seed from for sowing the next year. Until 2011 that measure didn't improve, and dropped as low as 4 percent. Cox was saving almost every plant that regrew, because he needed hardy plants to make crosses. Last fall he could be more selective, and marked to check for spring survivors only those rows of plants with shorter stature, more compact seed heads, superior seed production, more synchronous maturity. Now 38 percent proved worthy for harvest, testing, and further crossing. And this was by a higher standard of what he considered a keeper. By today's criteria he probably would've kept no more than a quarter of those he'd saved five years ago.

For three years Cox grew hybrids in Alabama. Perennials there looked more like crop plants and were better seed producers than the best perennial lines in Kansas. Most of the Alabama versions, however, couldn't weather Kansas winters. The company with which Cox had the Alabama arrangement closed the site this year. He dug up and brought home established plants, and said that their growth now looks more promising for survival. But Cox wants to find another place with mild winters. Perenniality gains for sorghum likely will be gradual – success will take longer farther north. The sooner farmers replace their annual crops with perennials, anywhere, the better.

THE RIVAL

SYLVIA TOWNSEND WARNER

The farmer's wife looked out of the dairy:
She saw her husband in the yard;
She said: "A woman's life is hard,
The chimney smokes, the churn's contrary."

She said:

"I of all women am the most ill-starred.

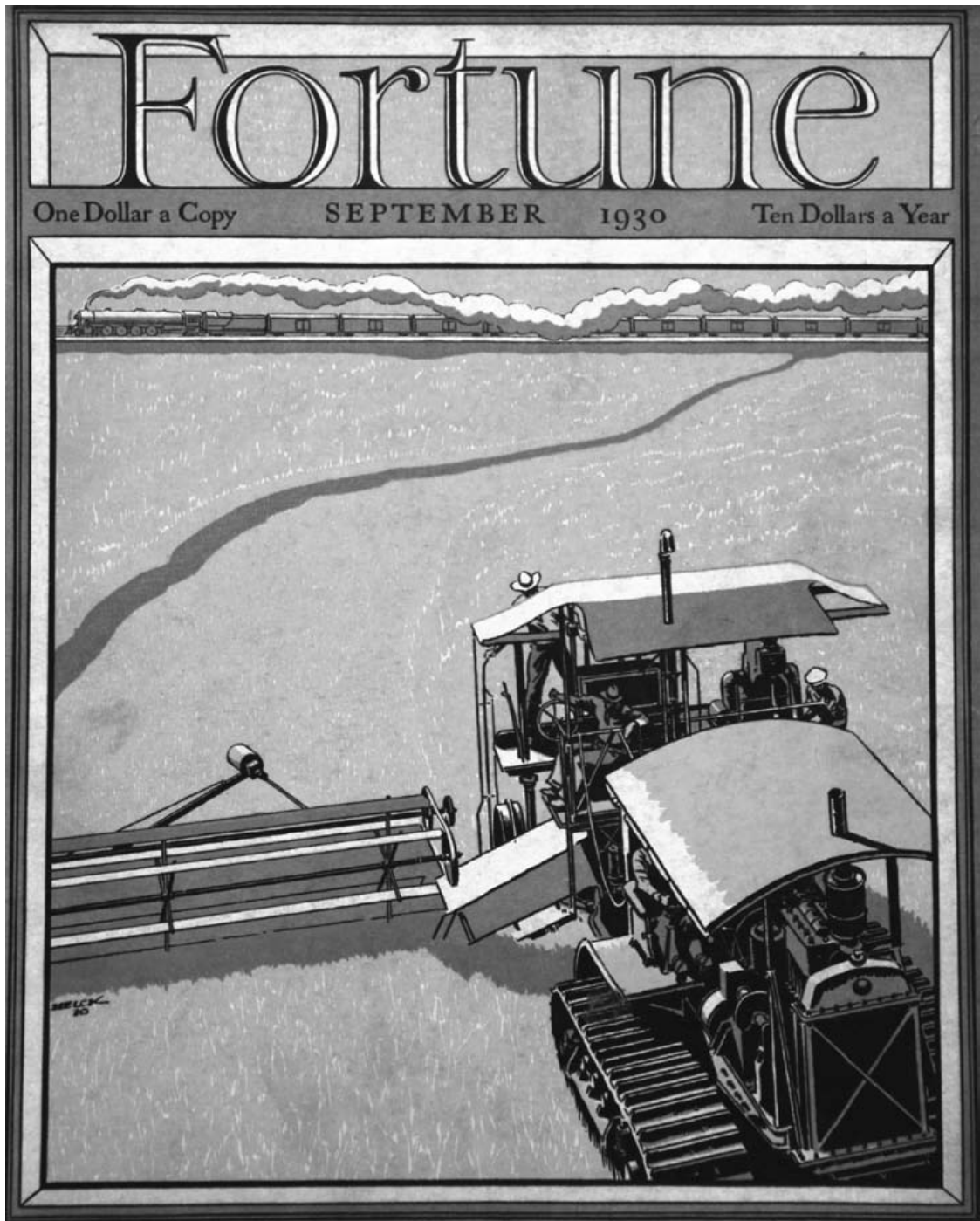
"Five sons I've borne and seven daughters,
And the last of them is on my knee.
Finer children you could not see.
Twelve times I've put my neck in the halter:
You'd think
So much might knit my husband's love to me.

"But no! Though I should serve him double
He keeps another love outdoors,
Who thieves his strength, who drains his stores,
Who haunts his mind with fret and trouble;
I pray
God's curse may light on such expensive whores.

"I am grown old before my season,
Weather and care have worn me down;
Each year delves deeper in my frown,
I've lost my shape and for good reason:
But she
Yearly puts on young looks like an Easter gown.

"And year by year she has betrayed him
With blight and mildew, rain and drought,
Smut, scab, and murrain, all the rout;
But he forgets the tricks she's played him
When first
The fields give a good smell and the leaves put out.

"Aye, come the Spring, and the gulls keening,
Over her strumpet lap he'll ride,
Watching those wasteful fields and wide,
Where the darkened tilth will soon be greening,
With looks
Fond and severe, as looks the groom on bride."



Henry Luce founded *Fortune* magazine thinking the business slump triggered in 1929 might last a year. Capitalism's revival took a decade. But the ascent was profound. Now its fuels and their effects grow more costly, investors continue to waver, and protests mount. Speakers at The Land Institute's Prairie Festival tell a new fortune, if we'll have it. This *Fortune* illustration is by Peter Helck, and is used courtesy of Bone Creek Museum of Agrarian Art, 2008.6.1.

“WE NEED A MERGER”

SCOTT BONTZ

In her best seller “The Shock Doctrine,” Naomi Klein argues that free market standard bearers seize on and even multiply crises for profit. If so, they have a “metadisaster” of opportunity with climate change. But so do those who see laissez-faire as I don’t care. At The Land Institute’s Prairie Festival, Klein blamed the same “hyperindividualist, hierarchical” system for rending both the natural environment and the social body, and said climate change could supercharge progressives – if united – to turn economics around.

She draws this hope from the very market apologists who deny that humans have brought climate change on themselves. Denialists understand how completely the development challenges what they stand for. “If the science is true, the game is over,” Klein said. Down comes what she calls state corporatism. “I don’t think they are paranoid, I think they’re paying attention to the implications of what this quite revolutionary science is telling us.” If denialists admit that climate change is real, she said, they lose the central ideological battle of our time. “I think we have a moment here,” she said. “It looks to them like the end of the world. But it’s not. It’s the end of their world.”

Klein said a better world depends on splintered camps of the environmentally embattled and economically distraught – conservationists, the foreclosed upon,

family farms, the waning middle class, feedlot critics, trade pact disenfranchisees, the unemployed, and everyone beholden to and battered by fossil fuels corporations – recognizing that all are part of one crisis in so-called creative destruction by an economic system. She said it will take radical, collective action, possibly nationalization, to make fossil fuel companies pay for pollution of unprecedented effect. She said the question is whether we gather, plan, and manage our societies to reflect our goals and values, or simply leave them to the market.

At the festival September 23-25, thoughts that the economic world as we’ve known it faces radical change, chosen or not, also ran through talks by Richard Heinberg, whose books include “The End of Growth,” and David R. Montgomery, author of “Dirt: The Erosion of Civilizations.” Speaker Kamyar Enshayan told how local government can make a difference in all this, and urged his listeners to influence it. Brian Donahue detailed work to pool preservation of forests, farms, and grassland across an entire region, in this case New England, to sustain prosperity both economic and cultural. And Wes Jackson proposed a \$1.64 billion, 30-year international coordination to develop perennial grains that work like natural ecosystems.

Klein attended the 2010 Prairie Festival to observe. Driving back to the

Kansas City airport, the Toronto journalist saw a billboard with the headline “Slap Mother Nature in the Face.” It struck her as emblematic of the industrial economy’s attitude. But when that system delivers a slap like the 2010 Gulf Coast oil spill, she said, the pitch twists to lauding nature’s resilience. Klein sees a Madonna/whore relationship. Put another way, “We can’t decide whether we are gods or fleas.”

For “Shock Doctrine,” Klein studied crises including coups in Latin America, the breakdown of the Soviet bloc, the war in Iraq, and Hurricane Katrina. With each disruption, she said, proponents of University of Chicago economist Milton Friedman’s “wild west” economic policies – including that their imposition be sudden – won what in more stable moments the shaken societies would reject. After seizing power, Chile’s Augusto Pinochet and other dictators influenced by the Chicago school sold for cheap their nations’ valuable industries, enriching cronies and foreign buyers. Russia, which under the Soviets had no millionaires, followed suit, though keeping the selloffs to select Russians, who became billionaires. The United States turned over much of its military’s work to contractors who took no-bid deals in Iraq and continue making millions from taxpayers. Two weeks after Katrina, Heritage Foundation thinkers and members of Congress made a list of 32 free market wishes, including rollback of labor standards, conversion of public education to private by use of vouchers, and Arctic oil drilling. Klein said they got action on most. There was no interest in solving why lack of preparedness and swift help left New Orleans devastated, she said. The plan was entirely opportunist. Klein said this strategy of boldly imposing unpopular policy when people are desperate for relief from disaster or upheaval can include quelling opposition

with the further shock of torture and killing. Then industry under private corporate control with state backing draws investors who may infuse the economy, but widens the gap between rich and poor.

Now, Klein said, “We’re going to see climate change itself be used for shock doctrine.” For a new book, she’s hanging out with those who deny climate change. She listens to their talks, and reads their books. The common theme: climate change is a conspiracy to replace capitalism with eco-socialism. Klein said that greenhouse gas emissions went down with collapse of the Soviets, and that the political right is wrong about an agenda to bring back state socialism. She said it is correct about an agenda that seeks return to long-term planning.

Her strategy: Urgently break every rule in the free market playbook. Reverse privatization and rebuild the public sphere. Make large parts of the economy more local. De-industrialize agriculture. Lessen consumption. Heavily regulate and tax corporations, and if they stand in the way, nationalize. Cut military spending. Recognize debts to the global south. Climate change is not cause for a world government, Klein said, but handling it does need international agreement.

All of this depends on stripping corporations of their status as people, she said. The essence of protest against global trade pacts has been that they sacrifice democratic control to a bill of rights for corporations. “It made it illegal for us to protect our communities,” she said. “We need to regulate the hell out of corporations.” For projects like digging tar sands from Canada and piping them to Texas – and generating three times the greenhouse gas emissions as from conventional oil – she said, “We need that kind of old regulation, the kind that says, No.”

The deeper we get into the ecological crisis of climate change, Klein said, the more we see need to think about fundamental economic change. She said so-called green capitalism only reinforces the hyperindividualism of capitalism and unsustainable growth – growth she calls justice deferred. Embrace instead the established idea in Western law that the polluter pays, Klein said: as with taxes on tobacco, take a much greater share of profits to cover the human and environmental health costs of fossil fuels. She said the top five oil companies made \$900 billion in the last decade, and ExxonMobile's profit in the last quarter was \$20 billion. There's no other way to respond to a crisis of this magnitude than by going to that money and redistributing it, Klein said. That's why the climate change denialists are scared, she said: wealth redistribution. Carbon tax. End of fossil fuel subsidies.

She said that as the current model of an economy fumbles, interest in fundamental reformation gains. This is not because of climate change, she said, it's because of failed mortgages and lost jobs. They're all of a piece, though now shoved to separate corners. "We need a merger," she said. "Because actually these are the same crisis." The Koch brothers, financiers of Tea Party assault on government and attempts to discredit climate science, understand that it's a single, coherent project. Klein said opponents of this force are splintered and lack unified strategy. They don't talk enough about the power they're up against.

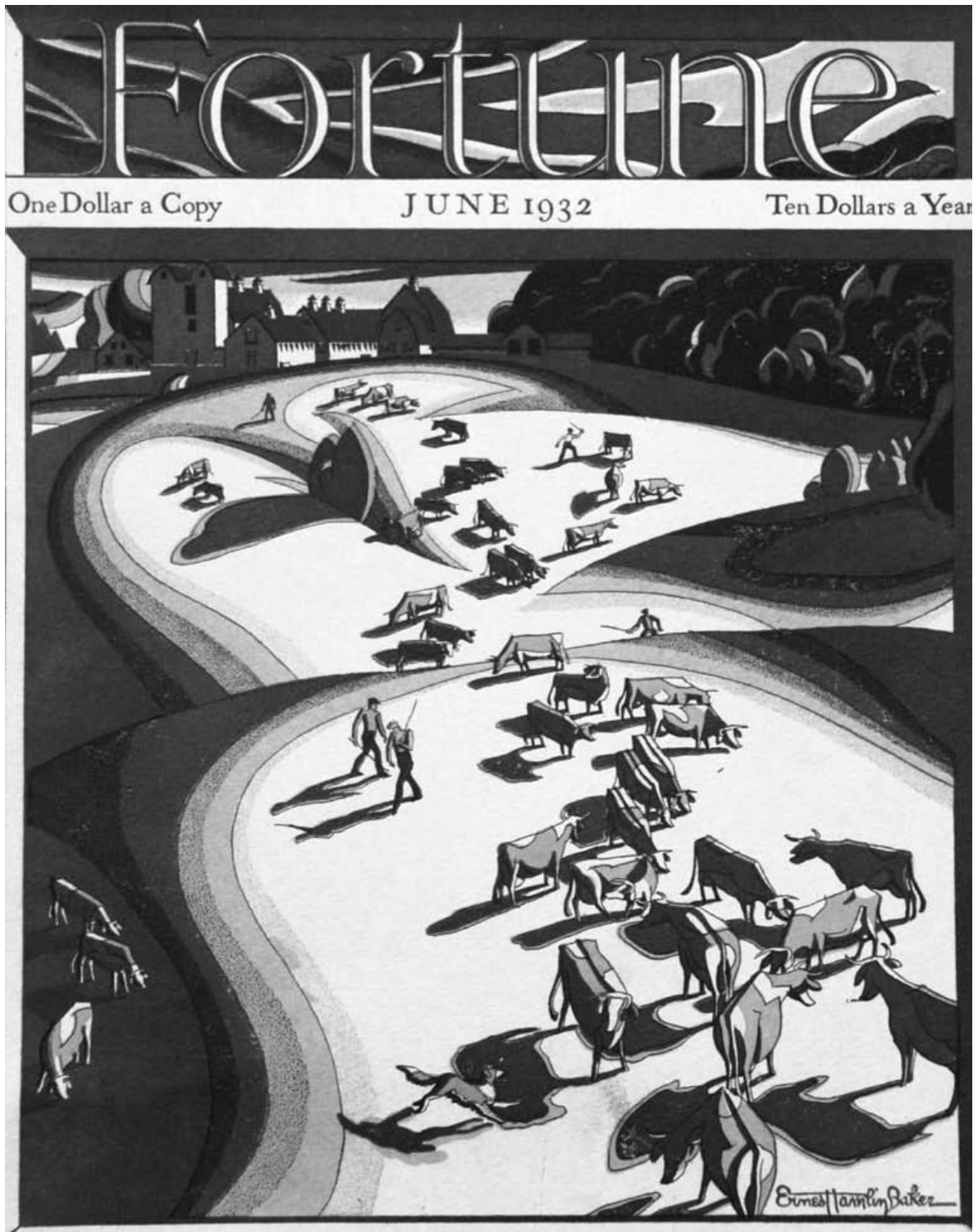
Here's what Klein said she's worried about. Ideas will shape how we respond to climate change. The US Chamber of Commerce says we can adapt. But how will we treat those most affected? In our hearts we know the answer, because we see how we treat them already. If we don't get at the mentality that says, "Let them die," we'll

see it go from reference to one person to millions. "We know that societies can turn nasty quickly," Klein said. "We have to believe that they can turn kind."

Powering down, growing up

Richard Heinberg's latest book, published this year, is called "The End of Growth," and he treats it less as forecast than announcement. The oil plateau, the popped financial balloon that won't take to patching, vanishing ores, the debt that threatens homes and nations: all go together, Heinberg says, and though hopeful economic spurts might continue here and there, as a whole the party's over – this another of his titles. Humanity finally has arrived at the formidable challenge of keeping what it can of a civilization, but with less of the tremendous energy that built it and helped sextuple world population, he said. At moments of "The End" and his Prairie Festival talk, Heinberg hedged and noted that he can't say with certainty that we've peaked, that in aggregate the natural resources which make for real wealth have started downhill. But with the low-hanging fruit gone, he said, "What we're seeing is capitalism trying to profit from its own collapse. Economic growth as we know it is coming to an end."

Heinberg is a fellow at the Post Carbon Institute in Santa Rosa, California, where he also lives. He said the institute has studied alternatives to fossil fuels, and finds nothing to match what oil, gas, and coal deliver. Hunter-gatherers enjoyed about 10 units of energy for each unit of energy spent getting them. Oil initially had energy returns of 100:1 or better. "That enabled us to change society



Fortune magazine illustration by Ernest Hamlin Baker, courtesy of Bone Creek Museum of Agrarian Art, 2008.6.5.

in profound ways,” Heinberg said. Before, societies could afford to support about 10 percent of the population in pursuits other than harvesting photosynthesized energy as farmers. With tapped fossil fuels, Heinberg said, “We could afford to take people off the land. In fact, we forced them off the land.” Only 2 percent of Americans live on farms. But now those enabling fuels are harder to reach and refine. New oil discoveries are delivering at about 10:1. In 1970 US oil production peaked, and since then, he said, it has topped out in most other oil countries, including Indonesia, once a member of the Organization Petroleum Exporting Countries but now an importer.

Also in 1970, US economic growth moved more into the business of debt while manufacturing emigrated. Consumption increased with credit. Heinberg said the measurement called gross domestic product is only about exchange of money. “Real wealth is based on energy, raw materials, and labor,” he said. But economists attribute growth to the magic of the market exchange, not to cheap energy and material. With that belief, “We built the biggest credit bubble in history, by far.” We can afford the interest on debt while the economy grows. Without growth, we can’t pay. “Suddenly the bill comes due, and there’s a crisis,” he said. Oil hit a record \$145 a barrel before tumbling with the economy in 2008. Heinberg thinks the economy can’t bear for long oil at more than about \$100 per barrel. We face not just declining supplies of and rising prices for oil, Heinberg said, but also for clean water, minerals, and metals. He covered this in “Peak Everything.” In “Blackout,” he said that useable supplies of coal are much smaller than has been claimed.

Finance and desire for economic growth has immediate attention. Heinberg said that in the long range climate change is

more important. It will affect the world for thousands of years. His program: feed a population forecast to grow by another quarter, to 9 billion. Take environmental thinking seriously. Learn to live on less energy, and find new energy. Make finance a much smaller part of the economy. Help farmers and small manufacturers. Recognize the economy as a subset of the environment, not the reverse. Cut consumption of nonrenewable resources below replacement rate.

Heinberg noted that surveys show people with less material wealth than Westerners are just as happy. We must find ways to make culture flourish while the economy declines, he said. We must return to living within limits. “That’s not a bad thing,” he said. “We become, if you will, adults.”

Peak soil

“The system of agriculture, (if the epithet of system can be applied to it) which is in use in this part of the United States, is as unproductive to the practitioners as it is ruinous to the landholders.” Something from Wes Jackson? Wendell Berry? No, it was George Washington, who predicted that farmers in the Atlantic states would exhaust their soil and move west for more. Two centuries later, the West is filled and agriculture still loses soil. Instead of quitting run-down acreage, farming covers with synthetic fertilizer. But agriculture and its civilizations continue to bite the hand that made and feeds them. Observers as early as Plato reported this behavior.

David R. Montgomery, who as a geologist can see as a minute the two millennia since the Greeks lost their soil and great-

ness, told festival-goers that treatment of the land is not just physical, it is societal, ethical, cultural. It's an attitude. And attitude is malleable. Our most malleable feature is our culture, Montgomery said. If we can change culture, we can change soil's treatment. See soil not like in the past, as exploited mystery, chemical reservoir, or just another industrial commodity, he said. Recognize it as an ecosystem, the mother of terrestrial life, and "the only thing we absolutely need to support our civilization in the long run." Montgomery said that the rate of soil loss far exceeds the rate of soil formation. A conservative estimate for average farmland soil loss is 1 millimeter per year, or 1 meter per 1,000 years. Most places in the world don't have a meter of soil, he said. He called soil "our most strategic and undervalued resource."

He wrote a book called "Dirt: The Erosion of Civilizations." His publisher didn't think the word soil would attract readers. Dirt would. Montgomery said dirt is soil out of place. Something out of place implies dynamics, and, as Montgomery said after his festival talk, dynamics are what people find interesting. But for most, 1 millimeter per year doesn't register. "Slow emergencies seem most difficult to address," he said. To a geologist, a century is a "round-off error," and Montgomery sees humans remodeling the world at a phenomenal pace. But to a politician or a farmer, a few centuries is forever. So, though almost imperceptibly, he said, "We manage to turn places like Iowa and Kansas to erode like Nepal."

Nature's drive is to rebuild soil, Montgomery said. He saw this in watching over time a sidewalk break up in Seattle, where he teaches at the University of Washington. To the cracks came worms. "Nature was essentially turning the side-

walk back into soil," he said. Likewise plants ventured onto the mineral-rich but lifeless land of Earth half a billion years ago. A positive loop developed, plants breaking rock to make soil to feed more plants. Vegetation came to cover the land. Most of the plants came to be perennials. They enriched the land with carbon drawn from the atmosphere, and fed the rise of terrestrial animals. "Life makes soil, and soil makes life," Montgomery said. At the Prairie Festival a key word was peak, meaning when production of a finite resource such as oil tops out before a long, irrevocable fall. "Life and soil were partners until agriculture changed the rules of the game," Montgomery said. "Peak soil is when humanity invented the plow."

We can undo much of the damage, he said, and with dedication can work faster than nature at restoration. His house was put on land bulldozed to death. Through years of adding organic matter and labor, his wife built topsoil that now stands, alive, higher than the patio.

Restored soil fertility will be vital after fossil fuels peak and take down with them synthetic fertilizers, he said. People will increasingly need to rely on soil's natural capital.

The first challenge is for their culture to recognize this living bank. Montgomery said only individuals and governments will fund long-term research required to save it. They must, he said, because how society treats land determines how land will treat society, and for how long. "The state of the land is the central variable." Wars and natural disasters might be the trigger, but he said, "It's the way we treat the land that loads the gun."

Forests for wood, in forest for good

Poet Robert Frost wrote in “The Road Not Taken” of being sorry he could not travel both of two paths diverging in the woods, and “doubted I should ever come back.” But later New Englanders get to choose again. Pioneers cleared much of the region’s vast forest until more fertile Midwest soils began feeding the East in the middle of the 19th century. From then trees reclaimed ground as fast as it had been lost, with Maine and New Hampshire nearing pre-European cover, and 80 percent forest cover overall. But once more forest faces breakup, this time to urban and suburban development. An effort called Wildlands and Woodlands Partnership aims to limit this, and to keep a turnabout that is rich and historically rare.

The network of more than 60 groups isn’t trying to stop development in its tracks. Nor is it against logging – far from it. But it is for keeping 70 percent of New England in forested cover, a level that members see necessary for wildlife, and beneficial all around. With large forests, Brian Donahue told the Prairie Festival audience, “Everyone can have a piece of the pie.”

Donahue teaches at Brandeis University, in the Boston suburb Waltham, neighbor of Weston, a town that achieved on a smaller scale what Donahue’s group seeks across New England. He tells the Weston story in “Reclaiming the Commons.”

Today, New England has 33 million acres of trees, waters, and wetlands. Wildlands and Woodlands wants to keep 30 million of that permanently free from development. This would leave 18 percent of the region available for development, twice the current built-up space. The group

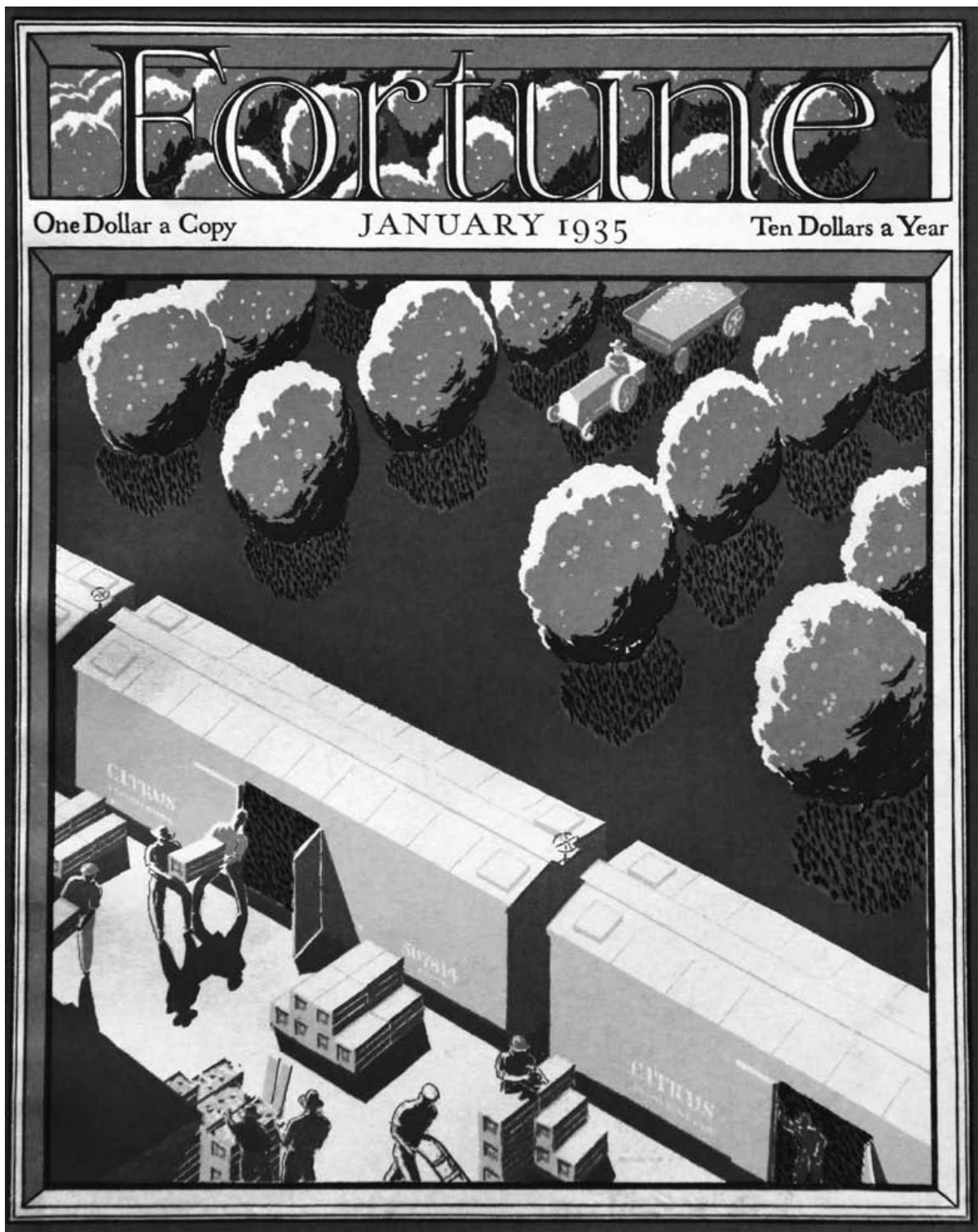
doesn’t advocate a doubling, but says in a booklet, “New England has always been a peopled and working land; the region, and this vision, needs viable communities and strong citizen engagement to succeed.” In Massachusetts land preservation now outpaces development, Donahue said.

The Wildlands and Woodlands goal is for 70 percent of New England to be protected forest within the next half-century. About 63 percent of the region would be worked for timber and other wood use, largely in private ownership but protected by conservation easements from division and development. Seven percent of New England would be wild reserves. Much of this already is public land, but private holders could join. The numbers another way: of the protected forest, 90 percent would be woodland, 10 percent wild land.

Donahue said woodland and wild preserves go hand in hand. Trying to protect wild species in wild lands alone, a small bit of the pie in disconnected bits, is a waste of time. He said there isn’t a species known that can’t survive in well managed New England woodland. Preserves would be kept because old growth allows some species to do particularly well, and provides a standard for comparison for woodland management. It sequesters more carbon than young forest, a selling point. And Donahue said, “Maybe we’re romantics. We have a kind of cultural need for wilderness.”

Important is contiguity. Part of this is for wildlife movement. “If you aim at protecting a lot of forests, there’s room for everything, including wild reserves,” Donahue said. If half of the land is protected, he said, you get contiguity. “The goal is acreage. Lots and lots of acreage.”

Donahue likes looking at wood, cutting wood, working wood. He likes seeing well managed woodland. “It feels different than



Fortune magazine illustration by Norman Reeves, courtesy of Bone Creek Museum of Agrarian Art, 2008.6.7.

a wild forest,” he said. “It’s beautiful in its own way.” Wildlands and Woodlands says the protected woodlands of its plan could do these things: bolster New England’s economy with a dependable source for wood products. (Donahue said Massachusetts now produces only about 2 percent of the wood that it uses.) Ensure clean water and air, flood and erosion control, and carbon sequestration to slow climate change. Offer landscape for tourism and recreation. Make large, connected wildlife habitat. Expand tree cover in and around development.

Just 5 percent of New England is farmed. Wildlands and Woodlands allows for that to triple, a level last seen in the early 20th century. In the 19th century about 75 percent was farmed. Donahue called that unsustainable. He also said New England has imported food since about 1790. But he figured the region could grow almost all of its vegetables, and about half of its fruit. Most of the farmland would be better as pasture than tilled, he said. In grass, the land could make almost all of the region’s milk, and, if consumption were halved, most of its beef. But only a little grain could grow. “There just is not room for that in New England,” Donahue said. Grain is dry, keeps well, and is easily hauled. “Bring in the grain,” he said. “You’re buying fertilizer.” Pressed, New England might produce 80 percent of its food, Donahue said. He doesn’t advocate this, and figures the region will long depend on farming elsewhere.

Donahue, former education director of The Land Institute, said the Wildlands and Woodlands idea of mating protection and production applies elsewhere, including at the institute’s home county, where half of the land is farmed and half is in range that could be a well-managed prairie.

Wildlands and Woodlands depends on building a vast network. “Northeastern

forests are comprised of hundreds of thousands of private ownerships ranging from ten to many thousands of acres in size,” the group’s booklet says. “In many areas, conserving large, continuous forest blocks will require work with dozens of landowners to weave the parcels together.” And: “This cannot be accomplished by sweeping public acquisition or regulatory fiat.” The means will be aggregate land trusts for easements. Easements will be hard to monitor. Trusts will need money. Wildlands and Woodlands can’t say where all that will come from. There might be arrangements with developers to cluster buildings and protect forest and farm land at the same time. Or a carbon tax. Only something on this scale will serve a project of this size, Donahue said. But the group’s membership has doubled in two years, and it connects 23 conservation partnerships in all six New England states. For a road not taken, they could make all the difference.

For more about the effort, go to <http://www.wildlandsandwoodlands.org/> or <http://www.hup.harvard.edu>, or write to Harvard Forest, 342 North Main Street, Petersham, MA 01366.

The little government that could

Kamyar Enshayan would never say, “You can’t fight city hall.” Enshayan, who grew up in Iran, thinks we can make a big difference for our home places through the underappreciated power of local government. Unlike government at the state and federal level, he said at the festival, city hall is quite accountable and nonpartisan. There’s less money involved. Voters can regularly see their lo-

cal representatives and government staff. “City hall makes lots of decisions about our daily lives,” he said. “In absence of state leadership, city hall is where we can weigh in. Let’s engage our local governments. It’s more than sewage and water.”

Enshayan is in his second four-year term on the city council in Cedar Falls, Iowa. In 2008 the Cedar River flooded the city. Unlike with tornadoes and fires, Enshayan said, we know where floods are going to be. Flooding of homes and businesses in floodplains is not an act of God, he said, but of city councils. They regularly allow development on floodplains, requiring only that the land be filled to raise buildings a foot higher than the river level that planners expect once in 100 years. This not only leaves the development vulnerable to big floods like that in 2008 – and which with climate change vagaries might come more than once in a century. It also pushes the water to bury areas that were not on the floodplain before. Waterways are like busy roadways, Enshayan said: along them there should be no parking.

Two weeks after the flood, for a project already in the pipeline, the council voted 4-3 to allow one home in a floodplain. But council members went on to develop and pass a floodplain ordinance. This requires building elevation to be above the 500-year flood level. No filling in on the floodplain – no parking. Enshayan touched on another watershed idea for local governments to consider. He said study shows that if 10 percent of a watershed is in prairie rather than tilled ground, water flow to make flooding drops 70 percent.

He moved on to address how a city can affect our sense of life. Step outside your home, and you enter the public realm. This is very much part of your world, he said. You affect it, and it affects you. To

honor that public realm is a “civic art.”

“Engineers in the basement,” said Enshayan, himself an engineer, are concerned only with code, and often can’t see this. He advocates a fuller, richer view, like that of James Howard Kunstler, who in “The Geography of Nowhere” and “Home from Nowhere” says failure to address esthetic details makes the public realm inhospitable and hurts civic life. Civic art is about things like welcoming architecture, sheltering trees, and how building height and distance from the street affect downtown appeal. Enshayan said it’s about avoiding abandonment of good community districts for malls at town’s edge on lots designed for 500-year parking events.

Enshayan held up for example Fayetteville, Arkansas, which mapped a plan not just for neighborhoods of mixed use, which can halve driving, but of mixed housing types, including enough homes for those of moderate means. The plan puts invigorating new construction in waning spots of the city rather than letting sprawl further their decay. It embraces traditional town form, putting communities before traffic flow. It plants a “continuum of green” through tree-lined streets, parks, and trails. The goals and means of making Fayetteville a more pleasantly livable came not only from a planning firm, Enshayan said, but with “huge public participation” in local government.

Later he won great applause in alluding to anti-government feeling in the US: “You never hear that corporations should be small, and their influence on government limited.” But you can influence your representatives in local government. “They can’t walk away from it,” he said. And: “Democracy is not what we have, it’s what we make every day.” When asked after the talk why more don’t go to city hall, Enshayan said people are busy and things don’t seem bad enough yet. People don’t

realize that their neighborhoods could be more pleasant. He said, “It’s a matter of awareness ... knowing what we’re missing.”

Economic truth and justice

No longer missing in the scientific media, both peer-reviewed and popular, is the significance and likelihood of perennial grain crops. Land Institute President Wes Jackson rolled off names: *Science* magazine and the Royal Society, among others. He also noted that players among universities and other institutions now number 13. But for Jackson perennial grains are only half of the story. He emphasized to the Prairie Festival audience how perennials in nature work in an economy more complex, efficient, and productive than a farm field reduced to one annual species. He said the growing of perennial grains must follow natural ecosystems. He also offered a global plan for how to get them there.

Starting with that: foundations and the United Nations would commit to a 30-year research agenda eventually funding 110 PhDs, 110 technicians, and 110 support staff at 11 sites in North America, South America, Asia, Africa, and Australia. The scientists would include plant breeders, molecular geneticists, ecologists, modelers, soil scientists, pathologists, and entomologists. The effort would total \$1.64 billion, less than \$55 million a year. Its 30-year price equals one-third the annual cost of ethanol subsidies.

Jackson opened talking about the Green Revolution. Like the revolution he proposes, this one could not come from a market fixated on quarterly profits. Politics aiming to calm turbulent Mexico drove the early development of crops that made more grain. Jackson said that money for the

researchers and their work came with assumptions, as appraised by Angus Wright: low production is the problem. We need higher yields. Traditional farming technique is more obstacle than resource. Technology is neutral. Agriculture is a means for the advancement of industry. Agriculture is not vitally linked to wild nature.

The program’s high-yielding crops took more water and fertilizer. But the crops were still annuals, and so lost more of those additions than would perennials. And they remained grown in monocultures, prime ground for epidemics. What has since become conventional agriculture continues to ignore the brittleness and vulnerability that come with a system so far from the more complex and resilient natural ecosystems. Until we recognize this, Jackson said, we’ll be blinded by the worst kind of fundamentalism: technological.

A sustainable green revolution must stand on natural economies, he said. We need to study ecology to reform agriculture – the number one threat to biodiversity – because we’ve run out of space, and because we face the back side of energy peaks that subsidized fertility for the first revolution. We’ve been like bacteria in a Petri dish. They multiply and eat their way to the wall, and then they die. “Capitalism is nothing more than Petri dish economics,” he said.

Looking to natural ecosystems to inform agriculture had to “wait until our time,” for our thoughts and knowledge to rise to the task, Jackson said. He referred to three accumulating syntheses: Charles Darwin united biology with evolution, Theodosius Dobzhansky united the origin of species with genetics, and James Watson and Francis Crick added the molecular dimension. After each, knowledge flowered and accumulated. Now ecology – shorthand for the three advances – and computing

power for both molecular genetics and modeling species mixtures can unify with agriculture – a fourth synthesis.

Especially important in our time is to see the vulnerability of a whole system over any single cause of failure. “The cause of the collapse is in the entire structure,” he said, and understanding that the structure of a diverse ecosystem comes

only through the science of ecology. The ecosystem concept will allow people to be in landscapes in a way not just better informed, he said, but more meaningful. Jackson said that in this way, “Economic justice is embedded.”

These are short summaries of hour-long talks. Full recordings can be ordered from the form below.

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THE WRITERS AND ARTISTS

Duane Schrag works in The Land Institute's development office. Sylvia Townsend Warner (1893-1978) was an English novelist and poet. Peter Helck (1893-1988) was a magazine illustrator, advertising artist, and painter from New York City. Ernest Hamlin

Baker (1889-1975) was a self-taught illustrator who made 11 covers for Fortune and more than 300 for Time. The Rhode Island native also painted for the Works Progress Administration. Norman Reeves was an artist active in New York.



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