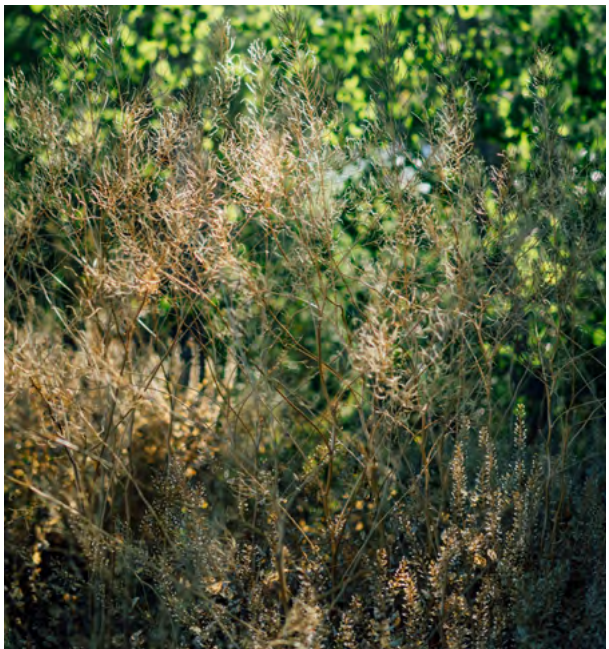
MAD AGRICULTURE READER



2021

A collection of books, essays, poems & wisdom keepers that have inspired the work and philosophy of Mad Agriculture.

This Reader is for educational purposes only.

FOREWARD

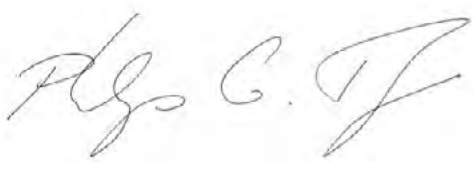
Dear Reader,

We need a cultural revolution at the global scale that liberates us into a more vibrant and collective belonging on Earth, where humanity and the Earth system live in a deeper reciprocity and equity. This revolution must be founded on the virtues of good and true economy that discovers a new harmony between human and ecological wellbeing.

I am often asked, 'why mad?'. Mad is inspired by the Mad Farmer poems of Wendell Berry, which call us to rework society and agriculture with love, community and lots of radicalism. In Wendell's words, 'I am done with apologies. If contrariness is my inheritance and destiny, so be it. If it is my mission to go in at exits and come out at entrances, so be it.' The world that I'm striving to create is so vastly different than the world that is, that nearly everything that I do bears certain madness.

The wisdom of our elders and ancestors, the progress of science and technology, the support of community, and the songs of our places will guide the way. Mad Agriculture doesn't have all the answers, nor do we try to have all the answers. Our work is in pursuit of a collective liberation into something greater.

Philip Taylor
Co-Founder & Executive Director



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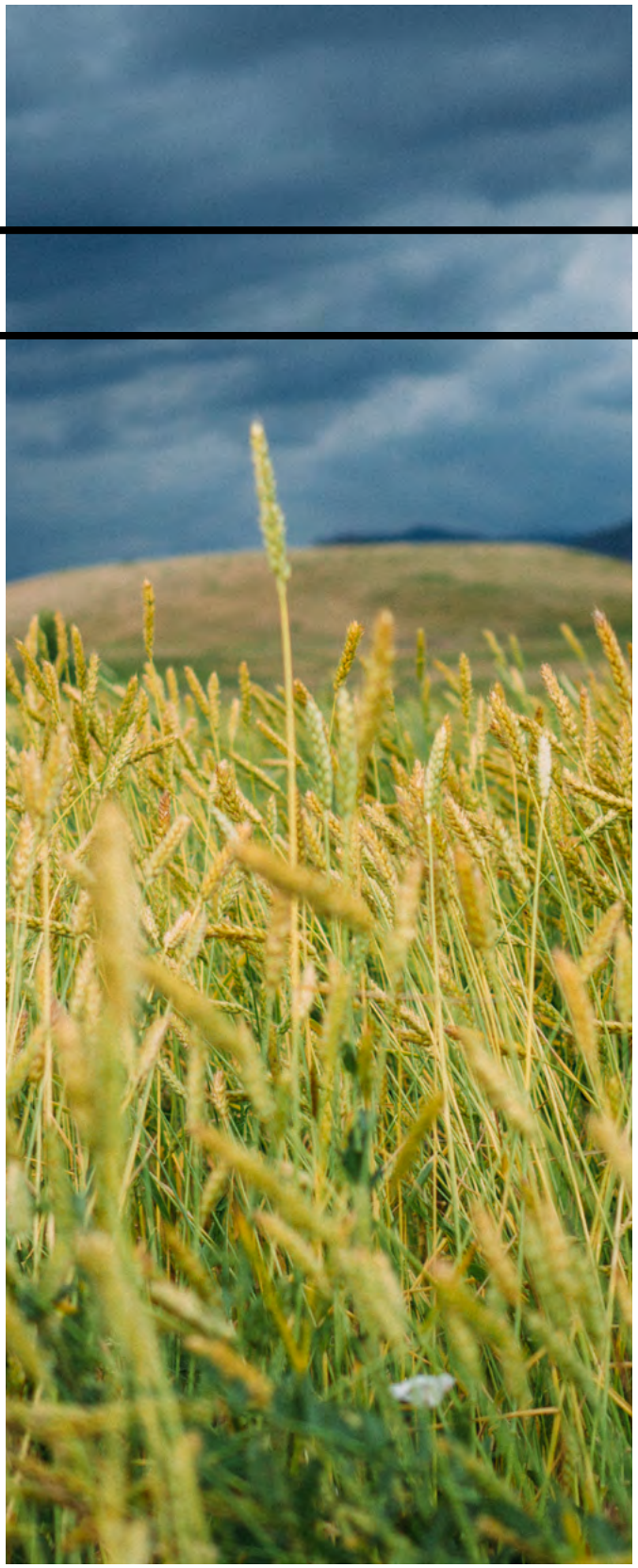


ELDERS & WISDOM KEEPERS

Adrienne Maree Brown
Alan Savory
David Abram
Daren Doherty
Carol Sanford
Charles Eisenstein
Clarissa Pinkola Estés
EF Schumacher
Eric Schlosser
Gary Nabhan
Gary Snyder
Herman Daly
Jane Goodall
Joanna Macy
Konda Mason
Leah Penniman
Yvon Chouinard
Michael J. Meade
Martín Prechtel
Marion Nestle
Martin Shaw
Naomi Klein
Octavia Butler
P.A. Yeoman
Rowen White
Stuart Chapin
Terry Tempest Williams
Vandana Shiva
Wendell Berry
Wes Jackson

PLACE:

Place-based thinking is a central tenant in our farm planning work.

BOOKS

Unsettling of America: Culture and Agriculture - Wendell Berry
Sand County Almanac - Aldo Leopold
An Unspoken Hunger: Stories from the Field - Terry Tempest Williams
Refuge: An Unnatural History of Family and Place - Terry Tempest Williams
Wisdom Sits in Places - Keith H. Basso

ESSAYS & ARTICLES

Consulting the Genius of the Place: An Ecological Approach to a New Agriculture - Wes Jackson

POETRY & NOVELS

"Mad Farmer Liberation Front" - Wendell Berry
Turtle Island - Gary Snyder
"Wild Geese" - Mary Oliver

Manifesto: The Mad Farmer Liberation Front

by Wendell Berry

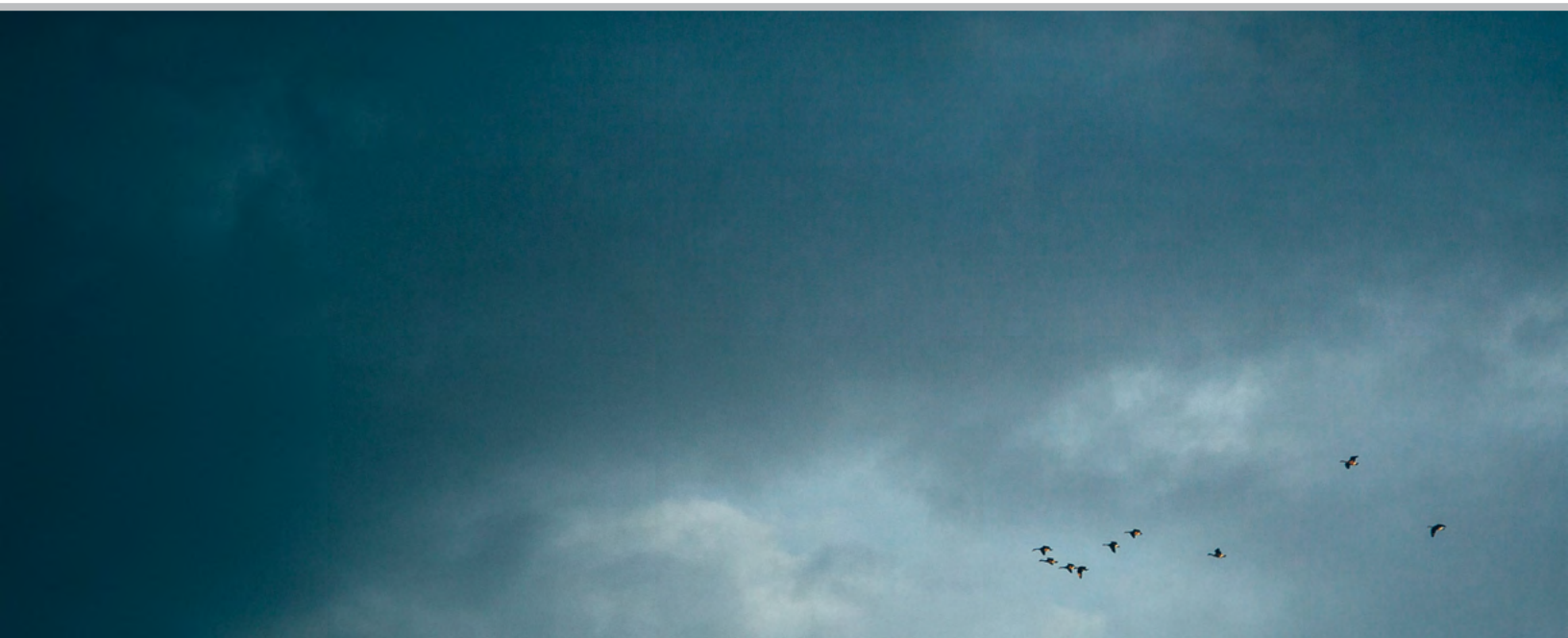
Love the quick profit, the annual raise,
vacation with pay. Want more
of everything ready-made. Be afraid
to know your neighbors and to die.
And you will have a window in your head.
Not even your future will be a mystery
any more. Your mind will be punched in a card
and shut away in a little drawer.
When they want you to buy something
they will call you. When they want you
to die for profit they will let you know.
So, friends, every day do something
that won't compute. Love the Lord.
Love the world. Work for nothing.
Take all that you have and be poor.
Love someone who does not deserve it.
Denounce the government and embrace
the flag. Hope to live in that free
republic for which it stands.
Give your approval to all you cannot
understand. Praise ignorance, for what man
has not encountered he has not destroyed.
Ask the questions that have no answers.
Invest in the millennium. Plant sequoias.
Say that your main crop is the forest
that you did not plant,
that you will not live to harvest.
Say that the leaves are harvested
when they have rotted into the mold.
Call that profit. Prophesy such returns.
Put your faith in the two inches of humus

that will build under the trees
every thousand years.
Listen to carrion — put your ear
close, and hear the faint chattering
of the songs that are to come.
Expect the end of the world. Laugh.
Laughter is immeasurable. Be joyful
though you have considered all the facts.
So long as women do not go cheap
for power, please women more than men.
Ask yourself: Will this satisfy
a woman satisfied to bear a child?
Will this disturb the sleep
of a woman near to giving birth?
Go with your love to the fields.
Lie easy in the shade. Rest your head
in her lap. Swear allegiance
to what is nighest your thoughts.
As soon as the generals and the politicos
can predict the motions of your mind,
lose it. Leave it as a sign
to mark the false trail, the way
you didn't go. Be like the fox
who makes more tracks than necessary,
some in the wrong direction.
Practice resurrection.

Wild Geese

You do not have to be good.
You do not have to walk on your knees
for a hundred miles through the desert repenting.
You only have to let the soft animal of your body
love what it loves.
Tell me about despair, yours, and I will tell you mine.
Meanwhile the world goes on.
Meanwhile the sun and the clear pebbles of the rain
are moving across the landscapes,
over the prairies and the deep trees,
the mountains and the rivers.
Meanwhile the wild geese, high in the clean blue air,
are heading home again.
Whoever you are, no matter how lonely,
the world offers itself to your imagination,
calls to you like the wild geese, harsh and exciting -
over and over announcing your place
in the family of things.

——— *Mary Oliver*



Sand County Almanac by Aldo Leopold

There are two spiritual dangers of not owning a farm. One is the danger of supposing that breakfast comes from the grocery, and the other that heat comes from the furnace.

To avoid the first danger, one should plant a garden, preferably where there is no grocer to confuse the issue.

To avoid the second, he should lay a split of good oak on the andirons, preferably where there is no furnace, and let it warm his shins while a February blizzard tosses the trees outside. If one has cut, split, hauled, and piled his own good oak, and let his mind work the while, he will remember much about where the heat comes from, and with a wealth of detail denied to those who spend the weekend in town astride a radiator.

* * *

The particular oak now aglow on my andirons grew on the bank of the old emigrant road where it climbs the sandhill. The stump, which I measured upon felling the tree, has a diameter of 30 inches. It shows 80 growth rings, hence the seedling from which it originated must have laid its first ring of wood in 1865, at the end of the Civil War. But I know from the history of present seedlings that no oak grows above the reach of rabbits without a decade or more of getting girdled each winter, and re-sprouting during the following summer. Indeed, it is all too clear that every surviving oak is the product of either rabbit negligence or of rabbit scarcity. Some day some patient botanist will draw a frequency curve of oak birth-years, and show that the curve humps every ten years, each hump originating from a low in the ten-year rabbit cycle. (A fauna and flora, by this very process of perpetual battle within and among species, achieve collective immortality.)

It is likely, then, that a low in rabbits occurred in the mid 'sixties', when my oak began to lay on animal rings, but the acorn that produced it fell during the preceding decade, when covered wagons were still passing over my road into the great Northwest. It may have been the wash and wear of the emigrant traffic that bared this roadbank, and thus enabled this particular acorn to spread its first leaves to the sun. Only one acorn in a thousand ever grew large enough to fight rabbits; the rest were drowned at birth in the prairie sea.

It is a warming thought that this one wasn't, and thus lived to garner eighty years of June sun. It is this sunlight that is now being released, through the intervention of my axe and saw, to warm my shack and my spirit through eighty gusts of blizzard. And with each gust a wisp of smoke from my chimney bears witness, to whomsoever it may concern, that the sun did not shine in vain.

My dog does not care where the heat comes from, but he cares ardently that it come, and soon. Indeed he considers my ability to make it come as something magical, for when I rise in the cold black pre-dawn and kneel shivering by the hearth making a fire, he pushes himself blandly between me and the kindling splits I have laid on the ashes, and i must touch a match to them by poking it between his legs. Such faith, I suppose, is the kind that moves mountains.

It was a bolt of lightning that put an end to wood-making by this particular oak. We were all awakened, one night in July, by the thunderous crash; we realized that the bolt must have hit near by, but, since it had

not hit us, we all went back to sleep. Man brings all things to the test of himself, and this is notably true of lightning.

Next morning, as we strolled over the sandhill rejoicing with the coneflowers and the prairie clovers over their fresh accession of rain, we came upon a great slab of bark freshly torn from the trunk of the roadside oak. The trunk showed a long spiral scar of barkless sapwood, a foot wide and not yet yellowed by the sun. By the next day the leaves had wilted, and we knew that the lightning had bequeathed to us three cords of prospective fuel wood.

We mourned the loss of the old tree, but knew that a dozen of its progeny standing straight and stalwart on the sands had already over its job of wood-making.

We let the dead veteran season for a year in the sun it could no longer use, and then on a crisp winter's day we laid a newly filed saw to its bastioned base. Fragrant little chips of history spewed from the saw cut, and accumulated on the snow before each kneeling sawyer. We sensed that these two piles of sawdust were something more than wood: that they were the integrated transect of a century; that our saw was biting its way, stroke by stroke, decade by decade, into the chronology of a lifetime, written in concentric annual rings of good oak.

* * *

It took only a dozen pulls of the saw to transect the few years of our ownership, during which we had learned to love and cherish this farm. Abruptly we began to cut the years of our predecessor the bootlegger, who hated this farm, skinned it of residual fertility, burned its farmhouse, threw it back into the lap of the County (with delinquent taxes to boot), and then disappeared among the landless anonymities of the Great Depression, Yet the oak had laid down good wood for him; his sawdust was fragrant, as sound, and as pink as our own. An oak is no respecter of persons.

The reign of this bootlegger ended sometime during the dust-bowl drouths of 1936, 1934, 1933, and 1930. Oak smoke from his still and peat from burning marshlands must have clouded the sun in those years, and alphabetical conservation was abroad in the land, but the sawdust shows no change.

Rest! cries the chief sawyer, and we pause for breath.

* * *

Now our saw bites into the 1920's, the Babbittian decade when everything grew bigger and better in heedlessness and arrogance – until 1929, when stock markets crumpled. If the oak had heard them fell, it wood gives no sign. Nor did it heed the Legislature's several prostestations of love for trees: a National Forest and a forest-crop law in 1927, a great refuge on the Upper Mississippi bottomlands in 1924, and a new forest policy in 1921. Neither did it notice the demise of the state's last marten in 1925, nor the arrival of its first Starling in 1923.

In March 1922, the 'Big Sleet' tore the neighboring elms limb by limb, but there is no sign of damage to our

tree. What is a ton of ice, more or less, to a good oak?

Rest cries the chief sawyer, and we pause for breath.

* * *

Now the saw bites into 1910-20, the decade of the drainage dream, when steam shovels sucked dry the marshes of central Wisconsin to make farms, and made ash-heaps instead. Our marsh escaped, not because of any caution or forbearance among engineers, but because the river floods it each April, and it did so with a vengeance – perhaps a defensive vengeance – in the years 1913-16. The oak laid wood just the same, even in 1915, when the Supreme Court abolished the state forests and Governor Phillip pontificated that 'state forestry is not a good business proposition.' (It did not occur to the Governor that there might more than definition of what is good, and even of what is business. It did not occur to him that while the courts were writing one definition of goodness in the law books, fires were writing quite another one on the face of the land. Perhaps, to be a governor, one must be free from doubt on such matters.)

While forestry receded during this decade, game conservation advanced. In 1916 pheasants became successfully established in Waukesha County; in 1915 a federal law prohibited spring shooting; in 1913 a state game farm was started; in 1912 a 'buck law' protected female deer; in 1911 an epidemic of refuges spread over the state. 'Refuge' became the holy word, but the oak took no heed.

Rest! cries the chief sawyer, and we pause for breath.

* * *

Now we cut 1910, when a great university president published a book on conservation, a great sawfly epidemic killed millions of tamaracks, a great drouth burned the pineries, and a great dredge drained Horicon Marsh.

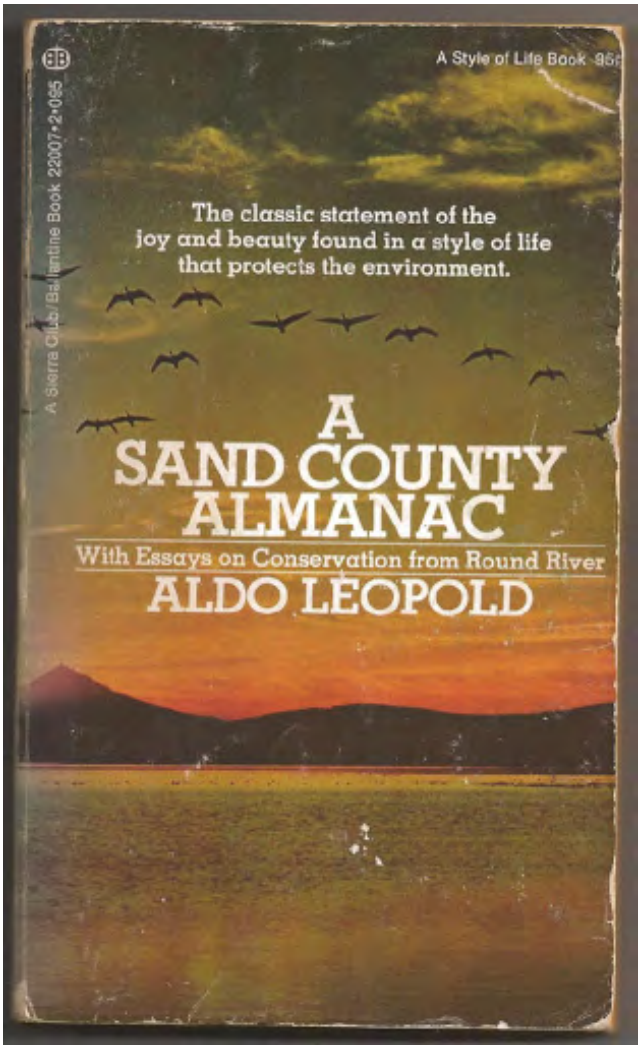
We cut 1909, when smelt were first planted in the Great Lakes, and when a wet summer induced the Legislature to cut the forest-fire appropriations.

We cut 1908, a dry year when the forests burned fiercely. and Wisconsin parted with its last cougar.

We cut 1907, when a wandering lynx, looking in the wrong direction for the promised land, ended his career among the farms of Dane County.

We cut 1906, when the first state forester took office, and fires burned 17,000 acres in these sand counties; we cut 1905 when a great flight of goshawks came out of the North and ate up the local grouse (they no doubt perched in this tree to eat some of mine). We cut 1902-03, a winter of bitter cold; which brought the most intense drouth of rainfall only 17 inches; 1900, a centennial year of hope, of prayer, and the usual ring of oak.

Rest! cries the chief sawyer, and we pause for breath.



* * *

Now our saw bites into the 1890'2, called gay by those whose eyes turn cityward rather than landward. We cut 1899, when the last passenger pigeon collided with a charge of shot near Babcock, two counties to the north; we cut 1898 when a dry fall, followed by a snowless winter, froze soil seven feet deep and killed apple trees; 1897, another drouth year, when another forestry commission came into being; 1896, when 25,000 prairie chickens were shipped to market from the village of Spooner alone; 1895, another year of fires; 1894, another year of drouth, and 1893, the year of 'The Bluebird Storm', when a March blizzard reduced the migrating bluebirds to near-zero. (The first bluebirds always alighted in this oak, but in the middle 'nineties it must have gone without.) We cut 1892, another year of fires; 1891, a low in the grouse cycle; and 1890, the year of the Babcock Milk Tester, which enabled Governor Heil to boast, half a century later, that Wisconsin is America's Dairyland. The motor licenses which now parade that boast were then not foreseen, even by Professor Babcock...

CLIMATE:

Agriculture has been a piece of the challenge and will be critical to climate solutions.

BOOKS

Break Through: From the Death of Environmentalism to the Politics of Possibility - Ted Nordhaus and Michael Shellenberger
Climate: A New Story - Charles Eistenstein
Confessions of a Recovering Environmentalist - Paul Kingsnorth
The Uninhabitable Earth: Life After Warming - David Wallace Wells

ESSAYS & ARTICLES

"Why I am Afraid of Global Cooling" - Charles Eisenstein
Regenerative Annual Cropping - Project Drawdown
"The Three Most Important Graphs in Climate Change" - Jonathan Foley
"Farming Our Way Out of the Climate Crisis" - Jonathan Foley
"Global Warming of 1.5°" - Intergovernmental Panel on Climate Change
"Can Dirt Save the Earth?" - Moises Velasquez-Manoff

Charles Eisenstein

Why I am Afraid of Global Cooling

July 2018

There is a French translation of this essay. You can also read this article en Francais.

In the run-up to the publication of my **next book**, I've been monitoring sources across the spectrum of opinion on climate change. The other day I happened upon **this piece,** which describes recent measurements of ice mass and ice extent gains in the Arctic, Antarctic, and Greenland, along with cool surface and tropospheric temperatures. My heart sank. This is what I've been worried about for several years now as I've seen cracks spread in the global warming consensus.

Before I explain why I am worried about cooling, let me offer **an opposing article**, from *Nature*, stating that Antarctica is losing ice mass faster than ever, and **another** article predicting 10 degrees (Celsius) warming by 2021. For more dissonance, read **this** and **this**. Partisans of each side will no doubt hasten to explain to me how I've been duped by the other, but my purpose here is not to establish the correctness of one viewpoint over

another. Instead, I intend to illuminate something that gets lost in what has become a highly polarized and politicized debate.

Why on earth would I be concerned about global cooling? Given the dangers of global warming, one would think that signs of a cooling trend would be welcome news. Phew! Ecological catastrophe averted! Now we can go back to business as normal.

This is precisely my concern. Business as normal is ruining the planet – regardless of whether the climate is warming or cooling. Here are some of the changes that have happened just in my lifetime: Fish biomass has decreased by more than half. The number of monarch butterflies has dropped by 90 percent. Deserts have expanded on every continent. Coral reef extent has declined by half. Mangroves in Asia have declined 80 percent. The Borneo rainforest is nearly gone, and rainforests globally cover less than half their former area. And all over the world, flying insect biomass has plummeted, by as much as 80% in some places. Have you noticed that there is less bug splatter on the windshield than when you were a child? It isn't your imagination. This should be alarming whatever the trend in global temperatures – insects are crucial to every terrestrial food web. The insect die-off means the planet is becoming less alive.

None of the above can be directly attributed to climate change. Most are caused by "land use changes" and resource extraction. Forests have been clearcut. Mangrove swamps have been drained for development. Coral reefs have been blasted, bottom-trawled, and suffocated by sediment released by soil erosion and deforestation. Climate change may be an exacerbating factor, but it is not the primary cause (the reefs, for example, suffered catastrophic losses before bleaching was widespread). In the case of the insect holocaust, we also must consider the ongoing 90-year experiment we have performed by regularly dousing vast areas of land with insecticide.

It would be nice to attribute all ecological problems to a single, quantifiable cause – greenhouse gases. Then to be "green" all you

have to do is use solar power and offset your emissions. Then, collectively, all we need to do to "save the planet" is to switch to carbon-neutral energy sources. Certainly, that would be technically challenging, but in principle, it wouldn't require a fundamental shift in the course of development or humanity's relationship to the planet.

Over the last twenty years practically every environmental issue has either been hitched to the climate change wagon, or relegated to secondary status. Issues like offshore oil drilling or forest conservation used to be about preserving the forests we love and preventing oil spills. Now it is: "We have to stop drilling and clearcutting because… climate change!" Meanwhile, causes like **plastic in the oceans** or elephant conservation (which have little obvious relevance to climate change) become boutique issues, since after all what do they matter compared to the momentous goal of saving the world?

For at least twenty years we have been saying, "Stop the pipeline because it will contribute to global warming," "Stop the tar sands excavation because it will contribute to global warming," "Stop fracking because it will contribute to global warming," "Implement soil conservation measures because exposed soil organic matter oxidizes into CO_2 and contributes to global warming," and so on. If it becomes apparent that global warming isn't happening – or even if one can plausibly argue it isn't happening – then these issues lose their grounding. Environmentalists might come to regret tethering so many issues to climate change. They might regret building the equation "green = low carbon."

The skeptic websites I scan do not hesitate to use any sign of global cooling to discredit environmentalism generally. Their skepticism about global warming accompanies skepticism about biodiversity, toxic waste, plastic in the oceans, and virtually every other environmental issue. With a few notable exceptions, their message is basically, "Everything is fine! Those enviros and greenies hate progress and are concocting issues like global

warming as a way to implement their agenda of totalitarian socialist world government."

In most polarized debates, evolutionary truths are revealed by questioning the tacit agreements that both sides share. In this case, both sides agree to stage the fight on the matters of greenhouse gases and temperature. This agreement sucks the oxygen out of the room for any other issue. It also usurps the other, non-climate reasons for opposing things like fracking or pipelines – reasons that do not require adherence to a highly politicized and hard-to-prove scientific theory.

At one point I realized that every practice that one might oppose on climate grounds, I oppose for other reasons too. Pipelines leak oil and gas, tar sands excavation destroys entire landscapes, fracking contaminates groundwater, coal burning emits harmful pollutants, offshore oil drilling creates horrible oil spills. Even if global warming were a hoax, I would want to curtail them all. In a way the skeptics are right about me – I do have "an ulterior agenda." It isn't to implement a totalitarian one world government (sorry), it is to change fundamentally the human relationship to the rest of life. It is to consider, in conducting any human activity, how we affect the beings and places where we act. In testing navy sonar, it asks, "How will this affect the whales?" In building a pipeline, it asks, "How will this endanger the river?" In mining for gold in the Amazon, it asks, "How will this affect the forest and the people indigenous to it?" In developing new pesticides, it asks, "How will this affect the soil, the earthworms, the birds, the insects, the river, the estuary, the bay, and the ocean?"

Another article I read today describes efforts to save seabirds on the remote Lord Howe Island in the South Pacific. Marine biologists are there performing lavage on the chicks to wash plastic from their stomachs, often hundreds of pieces of it, that is preventing them from absorbing nutrition. The chicks are starving. I can think of no convincing argument that these painstaking efforts will mitigate climate change or bring any

quantifiable benefit to humanity. But looking at the video of the tender rescue effort, I couldn't help but feel grateful to the biologists. It seemed obvious to me that they are rendering Earth and humanity an important service. Who can say through what mysterious causal pathways their work will bear its impact? Who can say how the morphic field of care they stand in will propagate?

The skeptics accuse environmentalists of caring more about seabirds, whales, and spotted owls than about people. It may sound here that I too care more about the seabirds than about the economic benefits of cheap plastic, that I care more about "the soil, the earthworms, the birds, the insects, the river, the estuary, the bay, and the ocean " than I do about human beings; that I would sacrifice jobs, sacrifice the "benefits of modernity," and even sacrifice human lives for the sake of "the environment." Voicing this critique, the Japanese skeptic Kunihiko Takeda says global warming is a hoax by those who want to "keep developing nations walking barefoot." What he means is that if we stop expanding the use of fossil fuels, "development" will halt, and the benefits of modernity will be lost to the world.

In the end, this objection can only stand in a mindset of separation that sees human wellbeing as separable from that of all beings. The Story of Separation says: What happens to nature need not affect ourselves. I subscribe to a story which says the contrary: that self and other, human and nature, inner and outer, are not really separate. That everything that happens to the world happens, in some manner, to ourselves as well. That with every extinction, something dies in us. That with loss of biodiversity comes cultural and spiritual poverty. That environmental pollution inevitably coincides with the spread of moral, mental, physical, social, and spiritual poisons.

Besides, are we really benefiting from all that plastic? Are we happier than our grandparents for having plastic bags rather than cloth, plastic bottles rather than refillable glass, plastic drinking straws rather than paper? For that matter, is it so bad to

walk barefoot? Is it so bad to be without cars, cheap air travel, broadband, air conditioning, abundant consumer goods, convenience foods, and cheap throwaway stuff? In the context of the current society built around these things, it is hard to be without them. If we take cars for granted, it is progress to have a nicer one. If we take roads for granted, it is progress to have a wider one. If we rely on digital communication devices, it is progress to have a faster one. The houses are built for air conditioning. The towns are built for cars. The pressures of life demand conveniences and time-saving technology. Exercising different choices as an individual consumer is not the whole answer. We need to explore forms of development and economy in which humans thrive without extracting more and more from the world.

The specter of global warming asks us to rethink the direction of civilization and the human relationship to Earth. No wonder many people want to deny it is happening. My point here – actually, my plea – is that whether or not it is happening, still, let us rethink the direction of civilization. Let us change our relationship to Earth. Let us explore a different conception of wealth, measured in relationships, not products, participation and not extraction. My fear is that a cooling trend will abort that inquiry. My fear is that it will quell what the idea of climate change has awakened: the disturbing realization of the mutual dependency of human and natural wellbeing. My fear is that it will sabotage our awareness that the welfare of the soil, the insects, the trees, and the whales, is our wealth too. It may not be the kind of wealth visible in GDP statistics. It may not register as an increase in kilowatt-hours of power consumed per capita, or miles driven or megabytes downloaded, or any of the other things we normally measure and count.

I think we already have enough of the quantifiable (although it is poorly distributed, a separate though deeply related issue). What we need more of are the things that are hard to quantify. The rising tide of suicide and depression in the developed world is not caused by shrinking residential floor space or lack of access

to 4G cell service. It probably has something to do with the disintegration of community, the withering of connection, loss of purpose and meaning, chronic pain and unresolved trauma, unprocessed grief, ambient anxiety, and the other *accoutrements* of Separation. This point seems obvious here at my brother's farm where I write this, because my life is rich here; rich in relationship to the natural world through my hands, my senses, my labor, and yes, my bare feet, and rich in relationship to the human world as well through shared labor, common purpose, and mutual reliance. And the point seems equally *unobvious* when I'm separated from all these things. In the busy world of cars and clocks and screens, faster and more of them seems like progress.

The richness of life around me enriches my own experience of life. That is the realization of non-separation. It is also the fundamental realization of ecology. In my book research, I confirmed again and again that climate science has, over the years, consistently underestimated the effect of biology on climate. While appreciation of carbon sequestration by forests and other ecosystems has grown, a covert geomechanical bias holds sway, seeing life as a hostage to random or manmade fluctuations in atmospheric components. A rival view, which I call the living planet view, holds that fundamentally it is life itself that maintains the conditions for life. Accordingly, the depletion of life is the biggest threat to the climate and the biosphere generally. Unless we stop degrading ecosystems, clearcutting forests, draining wetlands, decimating fish and land vertebrates, and dousing the land with insecticides, then even if we cut carbon emissions to zero, the planet will still die a death of a million cuts. There is indeed a horrifying crisis underway – and cooling will not signify that it has abated.

In the last ten years, science has gained a new appreciation of the ways living beings and systems affect temperature, weather, and climate. Whales **transport nutrients** from the depths to the surface, and from nutrient-rich feeding grounds to nutrient-poor birthing areas, allowing life to thrive there and ultimately

affecting carbon sequestration. Ice-nucleating bacteria stimulate the **formation of clouds** that reflect sunlight and bring rain, where otherwise there would be heat-trapping haze and so-called "humid drought." Forests generate a **biotic pump** that draws moisture-laden air from the oceans to the interiors; their destruction causes many of the droughts blamed on climate change. Healthy soils, grasslands, and wetlands **absorb water** that would otherwise run off, buffering against flooding (also blamed on climate change) and recharging aquifers that feed springs that nourish life through the dry season. A healthy climate comes from a healthy biosphere. Gauging health by temperature alone obscures this truth.

In the living planet view, no longer can we cut down a virgin forest here and offset the carbon with a tree farm there. No longer can we dam the Niger, thereby destroying vast wetlands, while assuring ourselves that the planet will benefit from the "climate-friendly electricity." No longer can we convert the Carolina forests to woodchipping plantations (again for "climate-friendly electricity"). No longer can we blithely assume that some ecosystems or species are expendable. Why? Because they are the organs and tissues of a living Earth.

Will the planet warm or cool? I have no idea. Over my years of book research, I became less confident, not more, of the inevitability of greenhouse-gas-induced warming. Slowly, cracks are spreading in the dominant narrative. We could very well see cooling, or warming, or even both – worsening gyrations like a top spinning out, like an animal with organ failure that can no longer regulate its body temperature. Wild fluctuations in temperature and precipitation are inevitable as the living systems that maintain homeostasis lose their vitality.

Regardless of whether the planet warms or cools, the things we need to do to maintain ecological health are the same. The key words are conservation, protection, regeneration, and repair. Conserving forests, stopping pipelines, repairing ecosystems, regenerating agricultural soils, and so on will, as a side effect,

reduce greenhouse emissions and increase biotic carbon uptake. But they do not rely on that result for their motivation. The motivation is to serve the flourishing of life – biological and human. This commitment should not depend on the trend in global temperature.

The New York Times Magazine | https://nyti.ms/2vnSYOC

FEATURE

Can Dirt Save the Earth?

Agriculture could pull carbon out of the air and into the soil — but it would mean a whole new way of thinking about how to tend the land.

By Moises Velasquez-Manoff

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When John Wick and his wife, Peggy Rathmann, bought their ranch in Marin County, Calif., in 1998, it was mostly because they needed more space. Rathmann is an acclaimed children's book author — "Officer Buckle and Gloria" won a Caldecott Medal in 1996 — and their apartment in San Francisco had become cluttered with her illustrations. They picked out the 540-acre ranch in Nicasio mostly for its large barn, which they planned to remake into a spacious studio. Wick, a former construction foreman — they met when he oversaw a renovation of her bathroom — was eager to tackle the project. He knew the area well, having grown up one town away, in Woodacre, where he had what he describes as a "free-range" childhood: little supervision and lots of biking, rope-swinging and playing in the area's fields and glens.

The couple quickly settled into their bucolic new surroundings. Wick began fixing leaks in the barn. Rathmann loved watching the many animals, including ravens, deer and the occasional gopher, from the large porch. She even trained the resident towhees, small brown birds, to eat seed from her hand. So smitten were they with the wildlife, in fact, that they decided to return their ranch to a wilder state. For nearly a century, this had been dairy country, and the rounded, coastal hills were terraced from decades of grazing. Wick and Rathmann would often come home and find, to their annoyance, cows standing on their porch. The first step they took toward what they imagined would be a more pristine state was to revoke the access enjoyed by the rancher whose cows wandered their property.

Within months of the herd's departure, the landscape began to change. Brush encroached on meadow. Dried-out, uneaten grass hindered new growth. A mysterious disease struck their oak trees. The land seemed to be losing its vitality. "Our vision of wilderness was failing," Wick told me recently. "Our naïve idea was not working out so well."

Wick was especially bothered by the advance of a prickly, yellow-flowered invasive weed called the woolly distaff thistle. He pulled it, mowed it, doused it with herbicides. But the distaff kept moving into what had been pasture. He thought about renting goats to eat the weeds and brush, but they were too expensive. He even considered introducing wild elk, but the bureaucratic hurdles seemed too onerous.

Then Wick and Rathmann met a rangeland ecologist named Jeff Creque. Instead of fighting against what you dislike, Creque suggested, focus on cultivating what you want. Squeeze out weeds by fostering conditions that favor grasses. Creque, who spent 25 years as an organic-pear-and-apple farmer in Northern California before earning a Ph.D. in rangeland ecology, also recommended that they bring back the cows. Grasslands and grazing animals, he pointed out, had evolved together. Unlike trees, grasses don't shed their leaves at the end of the growing season; they depend on animals for defoliation and the recycling of nutrients. The manure and urine from grazing animals fuels healthy growth. If done right, Creque said, grazing could be restorative.

Peggy Rathmann and John Wick on their Marin County ranch, where an atypical approach to land conservation led to unexpected success. Jonno Rattman for The New York Times

This view ran counter to a lot of conservationist thought, as well as a great deal of evidence. Grazing has been blamed for turning vast swaths of the world into deserts. But from Creque's perspective, how you graze makes all the difference. If the ruminants move like wild buffalo, in dense herds, never staying in one place for too long, the land benefits from the momentary disturbance. If you simply let them loose and then round them up a few months later — often called the "Columbus method" — your land is more likely to end up hard-packed and barren.

Wick was persuaded. He began preparing for the cows' return. He dug wells for water, pounded in steel posts and strung nonbarbed wire. He even bought a molasses lick to supplement the animals' diet of dry thatch. He didn't want medicated livestock excreting drugs that might harm the worms and insects living in his soil — most cows are routinely dewormed — so he tracked down a herd of untreated cows and borrowed them for the summer of 2005.

The cows beat back the encroaching brush. Within weeks of their arrival, new and different kinds of grass began sprouting. Shallow-rooted annuals, which die once they're chewed on, gave way to deep-rooted perennials, which can recover after moderate grazing. By summer's end, the cows, which had arrived shaggy and wild-eyed after a winter spent near the sea, were fat with shiny coats. When Wick returned the herd to its owner that fall, collectively it had gained about 50,000 pounds. Wick needed to take an extra trip with his trailer to cart the cows away. That struck him as remarkable. The land seemed richer than before, the grass lusher. Meadowlarks and other animals were more abundant. Where had that additional truckload of animal flesh come from?

Creque had an answer for him. The carbohydrates that fattened the cows had come from the atmosphere, by way of the grass they ate. Grasses, he liked to say, were like straws sipping carbon from the air, bringing it back to earth. Creque's quiet observation stuck with Wick and Rathmann. It clearly illustrated a concept that Creque had repeatedly tried to explain to them: Carbon, the building block of life, was constantly flowing from atmosphere to plants into animals and then back into the atmosphere. And it hinted at something that Wick and Rathmann had yet to consider: Plants could be deliberately used to pull carbon out of the sky.

Climate change often evokes images of smokestacks, and for good reason: The single largest source of carbon emissions related to human activity is heat and power generation, which accounts for about one-quarter of the carbon we put into the atmosphere. Often overlooked, though, is how we use land, which contributes almost as much. The erosion and degradation of soil caused by plowing, intense grazing and clear-cutting has played a significant role in the atmospheric accumulation of heat-trapping gases. The process is an ancient one. Ice cores from Greenland, which contain air samples trapped thousands of years ago, reveal increases in greenhouse gases that correspond with the rise of farming in Mesopotamia.

Since the start of the Industrial Revolution, agricultural practices and animal husbandry have released an estimated 135 gigatons — 135 billion metric tons — of carbon into the atmosphere, according to Rattan Lal, a soil scientist at Ohio State University. Even at current rates, that's more than a decade's worth of carbon dioxide emissions from all human sources. The world is warming not only because fossil fuels are being burned, but also because soils, forests and wetlands are being ravaged.

In recent years, some scientists have begun to ask whether we can put some of that carbon back into the soil and into living ecosystems, like grasslands and forests. This notion, known as carbon farming, has gained traction as it becomes clear that simply reducing emissions will not sufficiently limit global warming. According to the 2014 report by the Intergovernmental Panel on Climate Change, an authority on climate science that operates under the auspices of the United Nations, humankind also needs to remove some of the carbon already in the atmosphere to avoid, say, the collapse of polar glaciers and the inundation of coastal cities worldwide. "We can't just reduce emissions," Keith Paustian, a soil scientist at Colorado State University and an author of an earlier I.P.C.C. report, told me. "It's all hands on deck. Things like soil and land use — everything is important."

Some of the proposed methods to begin this drawdown include scrubbing the air with great air-conditioner-like machines; fertilizing the oceans with iron dust to prompt algal blooms that, when they die, carry captured carbon to the bottom of the sea; capturing and storing the carbon dioxide that results when energy is produced by burning trees and other plants that removed carbon from the atmosphere during their growth; and crushing and spreading certain types of rock, like basalt, that naturally absorb atmospheric carbon. None of these approaches are yet proved or affordable at the scale needed to make a difference. The most obvious hurdle is the additional energy some of them require, which, unless it comes from a free, renewable source, adds more costs.

Plants, however, remove carbon from the atmosphere already, require no additional power and grow essentially free. During photosynthesis they harness the sun's energy to make sugars by combining hydrogen atoms (acquired from water molecules) with carbon atoms (from carbon dioxide), while emitting oxygen as a byproduct. (Lest we forget, the fossil fuels that now power civilization contain carbon removed from the air during photosynthesis millions of years ago.) Every spring, as the Northern Hemisphere greens, the concentration of carbon dioxide in the atmosphere dips, before rising again the following fall and winter as foliage dies. Some scientists describe this fluctuation as the earth breathing.

Nearly all the carbon that enters the biosphere is captured during photosynthesis, and as it moves through life's web, every organism takes a cut for its own energy needs, releasing carbon dioxide as exhaust. This circular voyage is the short-term carbon cycle. Carbon farming seeks to interfere with this cycle, slowing the release of carbon back into the atmosphere. The practice is often conceptualized and discussed in terms of storing carbon, but really the idea is to change the flow of carbon so that, for a time at least, the carbon leaving a given ecosystem is less than the carbon entering it.

Dozens of land-management practices are thought to achieve this feat. Planting or restoring forests, for one: Trees lock up carbon in woody material. Another is adding biochar, a charcoal made from heated organic material, directly to soil. Or restoring certain wetlands that have an immense capacity to hold carbon. (Coal beds are the fossilized remains of ancient marshes and peatlands.)

More than one-third of earth's ice-free surface is devoted to agriculture, meaning that much of it is already managed intensively. Carbon farming's fundamental conceit is that if we change how we treat this land, we could turn huge areas of the earth's surface into a carbon sponge. Instead of relying solely on technology to remove greenhouse gases from the air, we could harness an ancient and natural process, photosynthesis, to pump carbon into what's called the pedosphere, the thin skin of living soil at the earth's surface. If adopted widely enough, such practices could, in theory, begin to remove billions of tons of carbon dioxide from the atmosphere, nudging us toward a less perilous climate trajectory than our current one.

In a 2016 paper, Pete Smith, a soil scientist at the University of Aberdeen in Scotland, and the influential climate scientist James Hansen argued that land-management practices are one of the few affordable options available today for drawing down carbon. "What's surprising to me is that we've not done it sooner," says Smith, who is also a lead author on a recent U.N. report that explores carbon-dioxide-removal technologies. "This has the potential to make a huge difference." Otherwise, Hansen told me, we're leaving the problem to our grandchildren. "That assumption that somehow young people, and people later this century, are going to figure out how to suck it out of the air — that's a pretty big burden to place on them," he said.

The I.P.C.C. is preparing a special report on climate change and land use, to be finalized in 2019, that will consider in greater detail the potential of sequestering carbon in soil. But for now the biggest international effort to promote carbon farming is a French-led initiative called “four per 1,000.” The proposal aims to increase the amount of carbon in the soil of crop- and rangelands by 0.4 percent per year through a variety of agricultural and forestry practices. These include agroforestry (growing trees and crops together increases carbon retention), no-till agriculture (plowing causes erosion and carbon loss) and keeping farmland covered (bare dirt bleeds carbon). Doing so, the French argue, could completely halt the buildup of atmospheric carbon dioxide.

Few experts I spoke to think the impact would be quite that grand; Pete Smith, for example, estimates that soil could, at the most, store just 13 percent of annual carbon-dioxide emissions at current levels. “I appreciate that everyone wants to save the planet,” he told me, “but we shouldn’t fool ourselves that this is all we need to do.” Even so, the four-per-1,000 goal highlights how a relatively small annual increase in soil carbon could, on a large-enough scale, have a substantial impact. Increasing soil carbon could yield other benefits, too: Improvements in soil fertility, water retention and greater crop resilience would help agriculture adapt to a warming world. More soil carbon would also reduce the amount of fertilizer needed, decreasing emissions of the powerful greenhouse gas nitrous oxide, a byproduct of excess nitrogen fertilization. It would be profoundly appropriate if agriculture, whose modern practices have themselves contributed to climate change, could become part of its solution. Farming, responsible for the birth of civilization, could now help save it.

John Wick spreading compost on his ranch. His organization argues for widespread use of compost, not only to develop more productive soil but also to lower levels of climate-affecting gases in the atmosphere. Jonno Rattman for The New York Times

In 2007, at Jeff Creque’s behest, John Wick got in touch with Whendee Silver, an ecologist at the University of California, Berkeley. Letting cows graze on his property had certainly made the land look healthier, he told Silver. But he and Creque wanted to know: Had it put carbon in the ground? And if so, was it possible to measure how much?

Silver was skeptical that she could measure what was likely to amount to very small changes in his land’s soil carbon. The endeavor seemed akin to looking for cups of water added to a swimming pool. But she did sketch out a way to arrive at a definitive answer. When Wick offered to underwrite such a study, she warned him that he might not like the results. She wasn’t just going to tell him what he wanted to hear. “That’s when I knew I had to work with her,” Wick recalls.

Silver agreed to the project, which she began that year. Seeking baseline values for the carbon concentrations in the soil, she and her students collected samples from different rangelands in Marin and Sonoma Counties. The samples with the most carbon, it turned out, came from current and former dairy farms. What distinguished these operations, she learned, was that they often sprayed manure onto their pastures; this was done both to fertilize the land and dispose of waste. Apparently, how soil was treated could very much affect its carbon content — a surprise. The larger implication was that people could potentially "grow" soil carbon deliberately.

But how quickly could they do so? Silver found an answer, in part, by looking for nuclear fallout. In the mid-20th century, radioactive carbon isotopes were spewed into the atmosphere as a result of aboveground nuclear tests. Plants around the world absorbed those isotopes during photosynthesis, effectively turning them into a time stamp. Wherever that carbon shows up, it must have arrived there relatively recently. On dairy farms, Silver found the isotopes a full three feet below the surface. This was another surprise. Conventional wisdom holds that it takes perhaps hundreds of years for carbon-rich topsoil to accumulate. On these dairy farms, however, atmospheric carbon had pushed deep into the earth in a matter of decades.

Wick wanted to know if he could deliberately replicate this process on his ranch — but without manure, which, as it decomposes, can release potent greenhouse gases like methane and nitrous oxide. The former traps about 30 times as much heat as carbon dioxide, the latter 300 times as much. As a carbon-farming tool, manure might be self-defeating.

Jeff Creque, a onetime organic farmer, had a suggestion: Why not use compost? Compost can contain manure, but whereas manure alone can release nitrogen as nitrous oxide, the nitrogen in compost becomes locked up in complex molecules. At least in theory, that limits the escape of a powerful greenhouse gas. In 2008, Wick, Silver and Creque spread several semi trucks full of the stuff, purchased from a composting plant near Sacramento, onto Wick's ranch and on another ranch in the foothills of the Sierra Nevada. In total, it amounted to about half an inch spread over three acres.

After three years, Wick was disappointed to discover that grazing on its own wasn't leading to carbon sequestration. In fact, the soil lost carbon in untreated control plots. No one knows precisely why, but grasslands throughout California are bleeding carbon. European settlers introduced shallow-rooted annual grasses to the state, which partly displaced deeper-rooted perennial grasses. So carbon put into the ground long ago by deep-rooted grasses may now be seeping out. That's what made the treated plots so remarkable. They had the same history and were exposed to the same conditions, but instead of losing carbon, they absorbed it — at a rate equivalent to nearly 1.5 tons of carbon dioxide per acre per year. That's roughly equal to your car's emissions if you drove from Miami to Seattle.

Silver had thought that the compost would simply break down, releasing its carbon back into the atmosphere or, worse, produce nitrous oxide. But those emissions never occurred; moreover, judging by its chemical signature, most of the carbon moving into the soil came from the air, not the compost. The compost appeared to help the plants draw more carbon from the atmosphere than they otherwise would have.

When it comes to mitigating climate change, soil scientists are most interested in what Silver calls occluded carbon — organic material, often in the form of dead microbes, trapped in clods of dirt. This type of carbon can potentially stay locked away for centuries. (Another carbon type, called labile carbon, continuously cycles among the atmosphere, plants and organisms in the soil.) It was precisely this more durable carbon, Silver discovered, that increased in the treated plots.

Her findings corresponded with a shift in recent decades in scientists' understanding of how soil carbon forms. Previously they emphasized how dead organic material had to physically work its way into the soil. But the newer model stressed the importance of living plants. Their rootlets are constantly dying, depositing carbon underground, where it's less likely to go airborne. And perhaps more important, as plants pull carbon from the air, their roots inject some of it into the soil, feeding microorganisms and fungi called mycorrhiza. An estimated 12,000 miles of hyphae, or fungal filaments, are found beneath every square meter of healthy soil. Some researchers refer to this tangled, living matrix as the "world wood web." Living plants increase soil carbon by directly nourishing soil ecosystems.

In the years that followed, Silver's analyses of soil cores indicated that the treated land kept taking in carbon. Computer simulations suggest that it will continue to do so for decades. It also retained more moisture and grew about 50 percent more grass. One dose of compost ignited what Silver calls a state change: The plants and the soil — and everything that inhabited it — moved toward a new equilibrium in which the soil ecosystem pulled in and retained greater amounts of carbon.

Silver began publishing her findings in scientific journals in 2010. Her second paper, written with her postdoc Marcia DeLonge and the graduate student Rebecca Ryals, offered a remarkable bit of extrapolation. California has about 56 million acres of rangeland, the single largest type of land use in the state. If compost made with manure was applied to just 5 percent of that area, they calculated, it would offset emissions from about 80 percent of the state's agricultural sector — all the cows raised, crops grown,

fertilizer applied and tractors driven in California. Much of that offset came from diverting manure from festering lagoons — where it releases methane and nitrous oxide into the atmosphere — into compost, a one-time benefit. But the ongoing drawdown of carbon dioxide from enhanced grass growth could be important, too. If you treated 41 percent of the state's rangeland, Silver told me, carbon pumped into the earth by photosynthesis might render the entire agricultural sector of the world's sixth-largest economy carbon-neutral for years to come.

The soil-improving practices that Wick, Silver and Creque stumbled into have much in common with another movement known as regenerative agriculture. Its guiding principle is not just to farm sustainably — that implies mere maintenance of what might, after all, be a degraded status quo — but to farm in such a way as to *improve* the land. The movement emphasizes soil health and, specifically, the buildup of soil carbon. This happy coincidence is one reason that carbon-farming advocates repeatedly describe their project as a "win-win." Society could theoretically remove carbon from the atmosphere and store it in the earth, and at the same time enhance the fortunes of farmers and the overall stability of the nation's food supply.

Farmers' obsession with soil health isn't new, of course. It has been a preoccupation for ages. But modern, conventional agriculture has largely relied on synthetic fertilizer to compensate for losses in natural fertility. And while fertilizers help plants grow, some evidence suggests that they can, in excess, accelerate the loss of carbon from the soil. An influx of nutrients may feed precisely those microbes that release carbon back into the atmosphere. Plants may also excrete less carbon into the earth when bathed in synthetic fertilizers, causing the ancient relationship among plant roots, soil fungi and microbes — the symbiosis that increases soil carbon — to fray.

In recent years, the United States Department of Agriculture's Natural Resources Conservation Service, which was founded in response to the Dust Bowl crisis of the 1930s, has promoted the fostering of soil carbon as an important farming practice. But one of the more remarkable aspects of the regenerative-agriculture movement is that it has been driven largely by farmers themselves. Its proponents fret over soil carbon not necessarily because the N.R.C.S. tells them to, or because they worry about the planet's fate. They have discovered that doing so can help their bottom line.

Darin Williams is one such farmer. He lives near Waverly, Kan., with his wife, Nancy, in a tidy, gray-painted house with a stone chimney. A life-size plastic deer sits on his front lawn, run through with arrows; he uses it for target practice to sharpen his hunting skills. He's a big man with a baby face and a mischievous squint. When he drove me around his farm last October in his red "one-tonner" pickup truck, he talked incessantly about soil.

Darin Williams in the combine he uses to harvest soybeans in Kansas. Jonno Rattman for The New York Times

For nearly 20 years, Williams worked as a contractor, building houses in Kansas City. But work dried up after the financial crisis hit in 2007. Williams decided to return to the family farm near Waverly, an area of gently rolling plains, and give farming a try. His family had farmed some when he was a teenager before leasing the land to tenants for years, and he knew it was difficult to make ends meet. But he was inspired by an article about a North Dakota rancher and farmer named Gabe Brown, who claimed to have developed, through trial and error, a more efficient and cost-effective way to farm.

The gist of Brown's argument was that if you focus on the health of the soil and not on yield, eventually you come out ahead, not necessarily because you grow more corn or wheat per acre but because the reduction in spending on fertilizer and other inputs lets you produce each bushel of grain more cheaply. Williams decided to follow Brown's prescription. "If after three years, I'm bankrupt, I'll admit it was a bad joke," Williams remembers thinking.

Seven years later, his gamble seems to have paid off. He started with 60 acres, now farms about 2,000 and, when I visited last fall, had just purchased an additional 200. In one of his fields, we walked down a lane he had mowed through his warm-weather cover crops — plants grown not to be harvested, but to enrich the soil — which towered over us, reaching perhaps eight feet. They included sorghum, a canelike grass with red-tinted tassels spilling from the tops, mung beans and green-topped daikon radishes low to the ground. Each plant was meant to benefit the earth in a different way. The long radishes broke it up and drew nutrients toward the surface; tall grasses like sorghum produced numerous fine rootlets, adding organic material to the land; legumes harbored bacteria that put nitrogen into the soil. His 120-strong herd of British white cattle — he introduced livestock in 2013 — would eventually eat through the field, turning the plants into cow patties and enriching the soil further. Then he would plant his cash crops. "Had I not found this way to farm," he told me, "we would not be farming."

A mat of dead vegetation — from cover crops, cash-crop residue and dung — covered Williams's fields. The mulch, along with his cover crops, inhibited weeds from becoming established, a major concern for conventional farmers, because so many weeds have evolved resistance to herbicides. "I don't lie awake at night wondering how I'm going to kill weeds," Williams said.

Williams doesn't till his fields. By minimizing soil disturbance, no-till farming prevents erosion, helps retain moisture and leaves the soil ecosystem — worms, fungi, roots and more — mostly intact. At one of his soybean fields, Williams showed me how this translated to soil with "structure." "See how that crumbles into a cottage-cheese look?" he said, massaging a fistful of earth. Small clods fell through his fingers. "That's what you want." Worm holes riddled the dirt, giving it a spongelike quality that was critical, he said, for absorbing rain and preventing runoff. Weather patterns seemed to be changing, he noted. Rain used to arrive in numerous light storms. Now fewer storms came, but they were more intense. "We have to be able to capture rain and store it," he said.

By focusing on soil health, Williams says he has reduced his use of herbicides by 75 percent and fertilizers by 45 percent. He doesn't use pesticides — he relies instead on beneficial insects for pest control — and he saves money by not buying expensive genetically modified, herbicide-resistant seed. He estimates that he produces a bushel of soybeans for about 20 percent less than his conventionally farming neighbors. Last fall, he claims, his yields ranked among the highest in the county. While doing all this, he has so far raised the amount of soil organic matter, a rough predictor of soil carbon concentrations, from around 2 percent to 3.5 percent in some fields. Gabe Brown, for his part, says he has more than tripled his soil carbon since the 1990s. And an official with the U.S.D.A.'s Agricultural Research Service confirmed to me that the amount of carbon in Brown's soil — what his farming has pulled from the atmosphere — was between two and three times as high as it was in his neighbors' land.

The successes of Brown and Williams suggest that farmers can increase carbon in the soil while actually reducing their overall expenses. This could be vital, because in order for carbon farming to have an impact on the climate, as much land as possible, including both crop- and rangeland, will have to be included in the effort.

Critics of regenerative agriculture say that it can't be adopted broadly and intensively enough to matter — or that if it can, the prices of commodities might be affected unfavorably. Mark Bradford, a professor of soils and ecosystem ecology at Yale, questions what he sees as a quasi-religious belief in the benefits of soil carbon. The recommendation makes sense intuitively, he told me. But the extent to which carbon increases crop yield hasn't been quantified, making it somewhat "faith-based."

William Schlesinger, an emeritus soil scientist at Duke, points out that "regenerative" practices might inadvertently cause emissions to rise elsewhere. If you stop tilling to increase soil carbon, for example, but use more herbicides because you have more weeds, then you probably haven't changed your overall emissions profile, he says. He thinks the climate-mitigation potential of carbon farming has been greatly oversold.

Williams has reduced his herbicide use, not increased it, but Schlesinger's broader point — about the need for a careful overall accounting of greenhouse gases — is important. Williams, Brown and others like them aren't focused on climate change; no one really knows if the carbon they put in the ground more than offsets the methane produced by their cows, for example. What they do demonstrate is that augmenting soil carbon while farming is not only possible, but also beneficial, even in a business sense. And that makes the prospect of rolling out these practices on a larger scale much easier to imagine.

Measuring equipment used on a test plot on the Wick-Rathmann ranch, including time-lapse cameras that watch the grass grow. Jonno Rattman for The New York Times

The carbon-farming idea is gathering momentum at a time when national climate policy is backsliding. The Trump administration has reversed various Obama-era regulations meant to combat or adapt to climate change, including the Clean Power Plan, which required power plants to reduce their carbon emissions, and a rule instructing the federal government to consider sea-level rise and other effects of a changing climate when building new roads, bridges and other infrastructure.

In the absence of federal leadership on climate — and as emissions continue to rise globally, shrinking the time available to forestall worst-case outcomes — state and local governments (as well as nonprofits) have begun to look into carbon farming. Last year, Hawaii passed legislation meant to keep it aligned with the Paris agreement, which President Trump has said he will abandon; the state has also created a task force to research carbon farming. The New York state assemblywoman Didi Barrett introduced legislation that would make tax credits available to farmers who increase soil carbon, presumably through methods

like those employed by Darin Williams and Gabe Brown. A bill to educate farmers about soil has been proposed in Massachusetts. And in Maryland, legislation focused on soil health passed in 2017. Other carbon-farming projects are in the works in Colorado, Arizona and Montana.

But it is California, already in the vanguard on climate-mitigation efforts, that has led the way on carbon farming. By 2050, the state aims to reduce greenhouse-gas emissions to 20 percent of what they were in 1990. Nearly half its 58 counties have farmers and ranchers at various stages of developing and implementing carbon-farming plans. San Francisco, which already has the largest urban composting program in the country, hopes to become a model carbon-farming metropolis. Cities don't have much room to plant trees or undertake other practices that remove carbon from the atmosphere, says Deborah Raphael, the director of San Francisco's Department of the Environment. But they can certainly produce plenty of compost. "If we can show other cities how doable it is to get green waste out of landfills, we can prove the concept," Raphael told me. "We like to say that San Francisco rehearses the future."

Many of California's carbon-farming efforts owe a debt to Wick, Creque and Silver. In 2008, they founded the Marin Carbon Project, a consortium of ranchers, scientists and land managers. The goal is to develop science-based carbon-farming practices and to help establish the incentives needed to encourage California farmers to adopt them. Silver continues to publish her findings in respected journals. Creque also started a nonprofit, the Carbon Cycle Institute, that assists farmers and ranchers in making carbon-farming plans.

Wick has thrown himself into the policy realm, hiring a lobbyist in Sacramento to push a carbon-farming agenda. (In 2014, he even testified before Congress, outlining the project's discoveries and explaining how compost could increase soil carbon on public lands. He deliberately mentioned "climate" only once.) Educating policymakers matters because, as Torri Estrada, executive director of the Carbon Cycle Institute, points out, carbon-mitigation efforts that focus on agriculture can be much cheaper per ton of carbon avoided than the flashier energy-efficiency and renewable-energy projects that usually get most of the attention. The major obstacle to their implementation, he says, is that government officials don't understand or know about them.

California's Healthy Soils Initiative, which Wick helped shape, explicitly enlists agriculture in the fight against climate change. In principle, that means carbon farmers can receive money from the state's climate-mitigation funds not just for compost but also for 34 other soil-improving practices already approved by the Natural Resources Conservation Service. That's important because the compost needed to cover just a few acres can cost thousands of dollars. Wick has also tried to tap federal funding. Once N.R.C.S. scientists vet Silver's work, a compost amendment could become the service's 35th recommendation. As a result, farm bill money, which farmers receive to subsidize food production, could help finance carbon farming done according to Wick's protocol — not to fight climate change explicitly (which is now seen as politicized), but to bolster the health of soil (which isn't).

As a carbon-farming tool, compost bears some notable advantages — namely, it works both preventively and correctively. Composting prevents emissions from the starter material — manure, food scraps — that, if allowed to decompose, might emit potent greenhouse gases. (About one-fifth of United States methane emissions comes from food and other organic material decomposing in dumps.) By enhancing plant growth, it also aids in removing carbon from the atmosphere, a corrective process. And because the carbon in nearly all organic material was originally pulled from the atmosphere during photosynthesis, compost that enters the soil represents the storage of carbon removed from the air earlier — the grass eaten by cows that became manure, or the trees that became wood chips — and at a different location. That, too, is corrective.

Calla Rose Ostrander, Wick's right-hand person at the Marin Carbon Project, told me that the project's greater goal is to completely reframe how we think about waste, to see it as more than a nuisance — to recognize it as a resource, a tool that can help us garden our way out of the climate problem. Before the modern era, farmers had no choice but to return human and animal waste to the fields. (Wick is looking into the possibility of composting human waste as well; the end product is called humanure.) In a sense, Wick and Ostrander seek to resurrect these ancient practices and, with the aid of modern science, to close the loop among livestock, plants, air and soil — and between cities and the agricultural land that feeds them.

What seems to most impress experts about the Marin Carbon Project is the quality of Silver's research. Eric Toensmeier, the author of "The Carbon Farming Solution" and a lecturer at Yale, says that the project figured out a new way to increase carbon storage on the semiarid grasslands that cover so much of the world. Jason Weller, the former head of the Natural Resources Conservation Service, told me that "the level of science investment is out of the ordinary, or extraordinary, for a group that is really self-started." Weller added that the agency's scientists still needed to vet the research, which they are in the midst of doing. In late 2016 the agency oversaw the application of compost to different California regions — inland, Southern, Northern — to see if land in various conditions would, like Wick's ranch, suck up atmospheric carbon.

But the group also has critics. “I’m very skeptical of their results and their claims,” William Horwath, a soil scientist at the University of California, Davis, told me. He wants to see Silver’s experiments replicated. This is the project’s major weakness: Its big idea is based almost entirely on extrapolation from a few acres in California. At this point, it’s impossible to say whether compost can cause land to become a carbon sponge in all climates and conditions, and for how long treated grassland will continue to take in and retain its carbon.

Cows, a flash point in any discussion about climate change, may also present problems. Ruminants burp methane, and while carbon farming does not require their presence, some argue that merely accepting them on the land undermines the goal of reaching a carbon-neutral or -negative future. Livestock emissions account for almost half the heat-trapping gases associated with agriculture, so an obvious way to reduce emissions is to decrease the number of cows on the planet. Instead of dumping compost on rangeland, says Ian Monroe, a lecturer on energy and climate at Stanford University, why not allow forests cleared for pasture to regrow, and change people’s eating habits so they include less meat?

Criticism is directed at compost too. The stuff requires energy to produce; huge machines are required to shred the material and keep it aerated. And it’s unclear if compost, like synthetic fertilizer, can cause nitrogen pollution when put on the land, or how much greenhouse gas composting itself generates. (As long as compost mounds are regularly aerated to prevent low-oxygen conditions, composting is thought to produce few emissions.)

Organic material from municipal sources can contain bits of plastic and glass, which no one wants on their fields. Manure might carry seeds of invasive plants. (Silver has seen no evidence of this.) Spreading compost on public rangeland could disrupt plant communities, squeezing out species adapted to conditions of scarcity. And in any carbon-farming scheme, who will monitor and verify that far-flung stretches of land are really absorbing and storing the carbon as they’re supposed to?

Horwath considers the amount of compost used in Silver’s research — about 10 times the usual application, he estimates — to be unrealistically high for practical use. “It seems an inordinately large amount to apply to any system,” he told me. And given what he sees as the many unknowns in Silver’s research, that compost would be put to better use on cropland where, he says, scientists know with greater certainty that it could improve water retention and the efficiency of fertilizer.

Then there’s the problem of supply. Demand for San Francisco’s compost, which mostly goes to vineyards in California’s wine country, already outstrips what’s available. But Wick thinks more starter material shouldn’t be hard to find: Americans throw out between 30 and 40 percent of all the food they buy, sending it to landfills where it rots and generates greenhouse gases. Silver has calculated that there’s enough organic waste material in California to treat one-quarter of its rangeland every few decades.

Still, given the energy requirements, the logistical headaches and the cost, skeptics question whether spreading compost across extensive portions of the world’s surface — including conflict zones in the Sahel or Central Asia — is really feasible. Even if it is, soils probably can’t soak up carbon indefinitely. If they have a saturation point, increases in carbon will eventually stop when that moment is reached. And because soil degradation can cause the release of whatever carbon it holds, treated lands would have to be well cared for in perpetuity.

On a cool autumn day at Wick and Rathmann’s ranch house, Wick fielded phone calls while I wandered around the cluttered, semicircular room that served as his office and meeting space. A whiteboard displayed scribbles from a presentation on the carbon cycle. Coils of warmly hued yarn hung from the doorways. They came via a local nonprofit dedicated to climate-friendly ranching practices called Fibershed. And draped over a chair was a T-shirt bearing what might as well have been Wick’s battle cry: “seq-C,” it read, punny shorthand for “sequester carbon.” Under that it read, “Doing it in the dirt.”

Down the road, he showed me a composting facility that Creque dreamed up initially. He and Wick hoped it would serve as a self-sustaining prototype. “Anything that has ever been alive can be composted,” he told me, surveying the 10-foot-tall piles of chicken droppings and feathers, horse bedding (manure and straw) and shredded trees. A tractor mixed woody refuse with animal waste — to get the composting process started requires the right mix of carbon- and nitrogen-rich materials. (That’s why some backyard composters recommend urinating on the pile to kick things off: Urine is rich in nitrogen.)

John Wick holding compost. Jonno Rattman for The New York Times

Across the lot, a hulking machine straddled rows of steaming black compost, turning them with a metal spinner. Compost has to be regularly “fluffed,” or aerated, Wick explained, to prevent anaerobic microbes from producing methane and nitrous oxide. The manure piles were acrid, but the compost itself had a rich and pleasant odor, like cigars.

Wick hopes that facilities like this will someday dot the American agricultural landscape. The idea is to manufacture compost close to both its source material and the place where it will be used, obviating the emissions from carting heavy materials over long distances. The plant also embodied Wick’s contention that composting can help farm carbon and manage waste at the same time. The challenge of affordably creating millions of tons of compost and applying it to great expanses of land is formidable. But there is a pleasing symmetry to the idea that we could use waste to bring the excess carbon in the atmosphere back to Earth, all while making the world lusher and more bountiful.

When I first got in touch with Wick, in late 2016, he greeted me with a question: “Do you know how the earth’s atmosphere was oxygenated?” He was referring to a period 2.3 billion years ago when oxygen, produced by photosynthetic organisms, began building up in the atmosphere, prompting a mass extinction and clearing the way for multicellular life (and, eventually, humans).

“Cyanobacteria?” I guessed.

“Very good,” he said. “This might work.” Evidently I had passed some sort of scientific literacy test. But his bigger point was that living things — and particularly photosynthetic life — had always been the great engineers of the planet’s climate. Now, he believed, we could use that fact to our advantage.

That sort of cosmic thinking about the planet and its history is ultimately what makes Wick’s vision so compelling and potentially powerful. The essential insight is one often overlooked when we talk about climate change: The element that threatens to smother civilization is also, in different forms, the fundamental building block of life. To prevent carbon from causing misery and destruction, perhaps we just need to change its location. Perhaps we can find a way to pull it from the air and restore it to the earth.

EVOLUTION OF AGRICULTURE:

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Can Planet Earth Feed 10 Billion People?

Charles C. Mann

The Atlantic

William Vogt
(Denver Public Library, Western History Photographic Collections)

Norman Borlaug
(Courtesy of Rockefeller Archive Center)

All parents remember the moment when they first held their children—the tiny crumpled face, an entire new person, emerging from the hospital blanket. I extended my hands and took my daughter in my arms. I was so overwhelmed that I could hardly think.

Afterward I wandered outside so that mother and child could rest. It was three in the morning, late February in New England. There was ice on the sidewalk and a cold drizzle in the air. As I stepped from the curb, a thought popped into my head: When my daughter is my age, almost 10 billion people will be walking the Earth. I stopped midstride. I thought, How is that going to work?

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In 1970, when I was in high school, about one out of every four people was hungry—"undernourished," to use the term preferred today by the United Nations. Today the proportion has fallen to roughly one out of 10. In those four-plus decades, the global average life span has, astoundingly, risen by more than 11 years;

most of the increase occurred in poor places. Hundreds of millions of people in Asia, Latin America, and Africa have lifted themselves from destitution into something like the middle class. This enrichment has not occurred evenly or equitably: Millions upon millions are not prosperous. Still, nothing like this surge of well-being has ever happened before. No one knows whether the rise can continue, or whether our current affluence can be sustained.

Today the world has about 7.6 billion inhabitants. Most demographers believe that by about 2050, that number will reach 10 billion or a bit less. Around this time, our population will probably begin to level off. As a species, we will be at about "replacement level": On average, each couple will have just enough children to replace themselves. All the while, economists say, the world's development should continue, however unevenly. The implication is that when my daughter is my age, a sizable percentage of the world's 10 billion people will be middle-class.

Like other parents, I want my children to be comfortable in their adult lives. But in the hospital parking lot, this suddenly seemed unlikely. Ten billion mouths, I thought. Three billion more middle-class appetites. How can they possibly be satisfied? But that is only part of the question. The full question is: How can we provide for everyone without making the planet uninhabitable?

Bitter Rivals

while my children were growing up, I took advantage of journalistic assignments to speak about these questions, from time to time, with experts in Europe, Asia, and the Americas. As the conversations accumulated, the responses seemed to fall into two broad categories, each associated (at least in my mind) with one of two people, both of them Americans who lived in the 20th century. The two people were barely acquainted and had little regard for each other's work. But they were largely responsible for the creation of the basic intellectual blueprints that institutions around the world use today for understanding our environmental dilemmas. Unfortunately, their blueprints offer radically different answers to the question of survival.

The two people were William Vogt and Norman Borlaug.

Vogt, born in 1902, laid out the basic ideas for the modern environmental movement. In particular, he founded what the Hampshire College population researcher Betsy Hartmann has called "apocalyptic environmentalism"—the belief that unless humankind drastically reduces consumption and limits population, it will ravage global ecosystems. In best-selling books and powerful speeches, Vogt argued that affluence is not our greatest achievement but our biggest problem. If we continue taking more than the Earth can give, he said, the unavoidable result will be devastation on a global scale. Cut back! Cut back! was his mantra.

Borlaug, born 12 years after Vogt, has become the emblem of "techno-optimism"—the view that science and technology, properly applied, will let us produce a way out of our predicament. He was the best-known figure in the research that in the 1960s created the Green Revolution, the combination of high-yielding crop varieties and agronomic techniques that increased grain harvests around the world, helping to avert tens of millions of deaths from hunger. To Borlaug, affluence was not the problem but the solution. Only by getting richer and more knowledgeable can humankind create the science that will resolve our environmental dilemmas. Innovate! Innovate! was his cry.

Both men thought of themselves as using new scientific knowledge to face a planetary crisis. But that is

where the similarity ends. For Borlaug, human ingenuity was the solution to our problems. One example: By using the advanced methods of the Green Revolution to increase per-acre yields, he argued, farmers would not have to plant as many acres, an idea researchers now call the "Borlaug hypothesis." Vogt's views were the opposite: The solution, he said, was to use ecological knowledge to get smaller. Rather than grow more grain to produce more meat, humankind should, as his followers say, "eat lower on the food chain," to lighten the burden on Earth's ecosystems. This is where Vogt differed from his predecessor, Robert Malthus, who famously predicted that societies would inevitably run out of food because they would always have too many children. Vogt, shifting the argument, said that we may be able to grow enough food, but at the cost of wrecking the world's ecosystems.

I think of the adherents of these two perspectives as "Wizards" and "Prophets." Wizards, following Borlaug's model, unveil technological fixes; Prophets, looking to Vogt, decry the consequences of our heedlessness.

Borlaug and Vogt traveled in the same orbit for decades, but rarely acknowledged each other. Their first and only meeting, in the mid-1940s, led to disagreement—immediately afterward, Vogt tried to get Borlaug's work shut down. So far as I know, they never spoke afterward. Each referred to the other's ideas in public addresses, but never attached a name. Instead, Vogt rebuked the anonymous "deluded" scientists who were actually aggravating our problems. Borlaug branded his opponents "Luddites."

Both men are dead now, but the dispute between their disciples has only become more vehement. Wizards view the Prophets' emphasis on cutting back as intellectually dishonest, indifferent to the poor, even racist (because most of the world's hungry are non-Caucasian). Following Vogt, they say, is a path toward regression, narrowness, poverty, and hunger—toward a world where billions live in misery despite the scientific knowledge that could free them. Prophets sneer that the Wizards' faith in human resourcefulness is unthinking, ignorant, even driven by greed (because refusing to push beyond ecological limits will cut into corporate profits). High-intensity, Borlaug-style industrial farming, Prophets say, may pay off in the short run, but in the long run will make the day of ecological reckoning hit harder. The ruination of soil and water by heedless overuse will lead to environmental collapse, which will in turn create worldwide social convulsion. Wizards reply: That's exactly the global humanitarian crisis we're preventing! As the finger-pointing has escalated, conversations about the environment have turned into dueling monologues, each side unwilling to engage with the other.

Which might be all right, if we weren't discussing the fate of our children.

The Roads to Hell

vogt entered history in 1948, when he published Road to Survival, the first modern we're-all-going-to-hell book. It contained the foundational argument of today's environmental movement: carrying capacity. Often called by other names—"ecological limits," "planetary boundaries"—carrying capacity posits that every ecosystem has a limit to what it can produce. Exceed that limit for too long and the ecosystem will be ruined. As human numbers increase, Road to Survival said, our demands for food will exceed the Earth's carrying capacity. The results will be catastrophic: erosion, desertification, soil exhaustion, species extinction, and water contamination that will, sooner or later, lead to massive famines. Embraced by writers like Rachel Carson (the author of Silent Spring and one of Vogt's friends) and Paul Ehrlich (the author of The Population Bomb), Vogt's arguments about exceeding limits became the wellspring of today's globe-spanning

environmental movement—the only enduring ideology to emerge from the past century.

When Road to Survival appeared, Borlaug was a young plant pathologist working in a faltering program to improve Mexican agriculture. Sponsored by the Rockefeller Foundation, the project focused on helping the nation's poor corn farmers. Borlaug was in Mexico for a small side project that involved wheat—or rather, black stem rust, a fungus that is wheat's oldest and worst predator (the Romans made sacrifices to propitiate the god of stem rust). Cold usually killed stem rust in the United States, but it was constantly present in warmer Mexico, and every spring winds drove it across the border to reinfect U.S. wheat fields.

The sole Rockefeller researcher working on wheat, Borlaug was given so little money that he had to sleep in sheds and fields for months on end. But he succeeded by the mid-'50s in breeding wheat that was resistant to many strains of rust. Not only that, he then created wheat that was much shorter than usual—what became known as "semi-dwarf" wheat. In the past, when wheat was heavily fertilized, it had grown so fast that its stalks became spindly and fell over in the wind. The plants, unable to pull themselves erect, had rotted and died. Borlaug's shorter, stouter wheat could absorb large doses of fertilizer and channel the extra growth into grain rather than roots or stalk. In early tests, farmers sometimes harvested literally 10 times as much grain from their fields. Yields climbed at such a rate that in 1968 a USAID official called the rise the Green Revolution, thus naming the phenomenon that would come to define the 20th century.

The Green Revolution had its most dramatic effects in Asia, where in 1962 the Rockefeller Foundation and the Ford Foundation opened the International Rice Research Institute (irri) in the Philippines. At the time, at least half of Asia lived in hunger and want; farm yields in many places were stagnant or falling. Governments that had only recently thrown off colonialism were battling communist insurgencies, most notably in Vietnam. U.S. leaders believed the appeal of communism lay in its promise of a better future. Washington wanted to demonstrate that development occurred best under capitalism. irri's hope was that top research teams would transform Asia by rapidly introducing modern rice agriculture—"a Manhattan Project for food," in the historian Nick Cullather's phrase.

Following Borlaug's lead, irri researchers developed new, high-yielding rice varieties. These swept through Asia in the '70s and '80s, nearly tripling rice harvests. More than 80 percent of the rice grown in Asia today originated at irri. Even though the continent's population has soared, Asian men, women, and children consume an average of 30 percent more calories than they did when irri was founded. Seoul and Shanghai, Jaipur and Jakarta; shining skyscrapers, pricey hotels, traffic-jammed streets ablaze with neon—all were built atop a foundation of laboratory-bred rice.

It is as if humankind were packed into a bus racing through an impenetrable fog. Somewhere ahead is a cliff: a calamitous reversal of humanity's fortune.
Were the Prophets disproved? Was carrying capacity a chimera? No. As Vogt had predicted, the enormous jump in productivity led to enormous environmental damage: drained aquifers, fertilizer runoff, aquatic dead zones, and degraded and waterlogged soils. Worse in a human sense, the rapid increase in productivity made rural land more valuable. Suddenly it was worth stealing—and rural elites in many places did just that, throwing poor farmers off their land. The Prophets argued that the Green Revolution would merely postpone the hunger crisis; it was a one-time lucky break, rather than a permanent solution. And our rising numbers and wealth mean that, just as the Prophets said, our harvests will have to jump again—a second Green Revolution, the Wizards add.

Even though the global population in 2050 will be just 25 percent higher than it is now, typical projections claim that farmers will have to boost food output by 50 to 100 percent. The main reason is that increased affluence has always multiplied the demand for animal products such as cheese, dairy, fish, and especially meat—and growing feed for animals requires much more land, water, and energy than producing food simply by growing and eating plants. Exactly how much more meat tomorrow's billions will want to consume is unpredictable, but if they are anywhere near as carnivorous as today's Westerners, the task will be huge. And, Prophets warn, so will the planetary disasters that will come of trying to satisfy the world's desire for burgers and bacon: ravaged landscapes, struggles over water, and land grabs that leave millions of farmers in poor countries with no means of survival.

What to do? Some of the strategies that were available during the first Green Revolution aren't anymore. Farmers can't plant much more land, because almost every accessible acre of arable soil is already in use. Nor can the use of fertilizer be increased; it is already being overused everywhere except some parts of Africa, and the runoff is polluting rivers, lakes, and oceans. Irrigation, too, cannot be greatly expanded—most land that can be irrigated already is. Wizards think the best course is to use genetic modification to create more-productive crops. Prophets see that as a route to further overwhelming the planet's carrying capacity. We must go in the opposite direction, they say: use less land, waste less water, stop pouring chemicals into both.

Nobody can see exactly where it is, but everyone knows that at some point the bus will have to turn. Problem is, Wizards and Prophets disagree about which way to yank the wheel. Each is certain that following the other's ideas will send the bus over the cliff. As they squabble, the number of passengers keeps rising.

The Story of Nitrogen

almost everybody eats every day, but too few of us give any thought to how that happens. If agricultural history were required in schools, more people would know the name of Justus von Liebig, who in the mid-19th century established that the amount of nitrogen in the soil controls the rate of plant growth. Historians of science have charged Liebig with faking his data and stealing others' ideas—accurately, so far as I can tell. But he was also a visionary who profoundly changed the human species' relationship with nature. Smarmy but farsighted, Liebig imagined a new kind of agriculture: farming as a branch of chemistry and physics. Soil was just a base with the physical attributes necessary to hold roots. Pour in nitrogen-containing compounds—factory-made fertilizer—and gigantic harvests would automatically follow. In today's terms, Liebig was taking the first steps toward chemically regulated industrial agriculture—an early version of Wizardly thought.

But there was no obvious way to manufacture the nitrogenous substances that feed plants. That technology was provided before and during the First World War by two German chemists, Fritz Haber and Carl Bosch. Their subsequent Nobel Prizes were richly deserved: The Haber-Bosch process, as it is called, was arguably the most consequential technological innovation of the 20th century. Today the Haber-Bosch process is responsible for almost all of the world's synthetic fertilizer. A little more than 1 percent of the world's industrial energy is devoted to it. "That 1 percent," the futurist Ramez Naam has noted, "roughly doubles the amount of food the world can grow." The environmental scientist Vaclav Smil has estimated that nitrogen fertilizer from the Haber-Bosch process accounts for "the prevailing diets of nearly 45% of the world's population." More than 3 billion men, women, and children—an incomprehensibly vast cloud of hopes, fears,

memories, and dreams—owe their existence to two obscure German chemists.

Hard on the heels of the gains came the losses. About 40 percent of the fertilizer applied in the past 60 years was not absorbed by plants. Instead, it washed away into rivers or seeped into the air in the form of nitrous oxides. Fertilizer flushed into water still fertilizes: It boosts the growth of algae, weeds, and other aquatic organisms. When these die, they fall to the floor of the river, lake, or ocean, where microbes consume their remains. So rapidly do the microbes grow on the manna of dead algae and weeds that their respiration drains oxygen from the lower depths, killing off most other life. Nitrogen from Midwestern farms flows down the Mississippi to the Gulf of Mexico every summer, creating an oxygen desert that in 2016 covered almost 7,000 square miles. The next year a still larger dead zone—23,000 square miles—was mapped in the Bay of Bengal, off the east coast of India.

Rising into the air, nitrous oxides from fertilizers is a major cause of pollution. High in the stratosphere, it combines with and neutralizes the planet's ozone, which guards life on the surface by blocking cancer-causing ultraviolet rays. Were it not for climate change, suggests the science writer Oliver Morton, the spread of nitrogen's empire would probably be our biggest ecological worry.

Passionate resistance to that empire sprang up even before Haber and Bosch became Nobel laureates. Its leader was an English farm boy named Albert Howard (1873–1947), who spent most of his career as British India's official imperial economic botanist. Individually and together, Howard and his wife, Gabrielle, a Cambridge-educated plant physiologist, spent their time in India breeding new varieties of wheat and tobacco, developing novel types of plows, and testing the results of providing oxen with a superhealthy diet. By the end of the First World War, they were convinced that soil was not simply a base for chemical additives. It was an intricate living system that required a wildly complex mix of nutrients in plant and animal waste: harvest leftovers, manure. The Howards summed up their ideas in what they called the Law of Return: "the faithful return to the soil of all available vegetable, animal, and human wastes." We depend on plants, plants depend on soil, and soil depends on us. Howard's 1943 Agricultural Testament became the founding document of the organic movement.

Wizards attacked Howard and Jerome I. Rodale—a hardscrabble New York–born entrepreneur, publisher, playwright, gardening theorist, and food experimenter who publicized Howard's ideas through books and magazines—as charlatans and crackpots. It is true that their zeal was inspired by a near-religious faith in a limit-bound natural order. But when Howard lauded the living nature of the soil, he was referring to the community of soil organisms, the dynamic relations between plant roots and the earth around them, and the physical structure of humus, which stickily binds together soil particles into airy crumbs that hold water instead of letting it run through. All of this was very real, and all of it was unknown when Liebig shaped the basic ideas behind chemical agriculture. The claim Howard made in his many books and speeches that industrial farming was depopulating the countryside and disrupting an older way of life was accurate, too, though his opponents disagreed with him about whether this was a bad thing. Nowadays the Prophets' fears about industrial agriculture's exhausting the soil seem prescient: A landmark 2011 study from the United Nations' Food and Agriculture Organization concluded that up to a third of the world's cropland is degraded.

At first, reconciling the two points of view might have been possible. One can imagine Borlaugian Wizards considering manure and other natural soil inputs, and Vogtian Prophets willing to use chemicals as a sup-

plement to good soil practice. But that didn't happen. Hurling insults, the two sides moved further apart. They set in motion a battle that has continued into the 21st century—and become ever more intense with the ubiquity of genetically modified crops. That battle is not just between two philosophies, two approaches to technology, two ways of thinking how best to increase the food supply for a growing population. It is about whether the tools we choose will ensure the survival of the planet or hasten its destruction.

"Not One of Evolution's Finest Efforts"

all the while that Wizards were championing synthetic fertilizer and Prophets were denouncing it, they were united in ignorance: Nobody knew why plants were so dependent on nitrogen. Only after the Second World War did scientists discover that plants need nitrogen chiefly to make a protein called rubisco, a prima donna in the dance of interactions that is photosynthesis.

In photosynthesis, as children learn in school, plants use energy from the sun to tear apart carbon dioxide and water, blending their constituents into the compounds necessary to make roots, stems, leaves, and seeds. Rubisco is an enzyme that plays a key role in the process. Enzymes are biological catalysts. Like jaywalking pedestrians who cause automobile accidents but escape untouched, enzymes cause biochemical reactions to occur but are unchanged by those reactions. Rubisco takes carbon dioxide from the air, inserts it into the maelstrom of photosynthesis, then goes back for more. Because these movements are central to the process, photosynthesis walks at the speed of rubisco.

Alas, rubisco is, by biological standards, a sluggard, a lazybones, a couch potato. Whereas typical enzyme molecules catalyze thousands of reactions a second, rubisco molecules deign to involve themselves with just two or three a second. Worse, rubisco is inept. As many as two out of every five times, rubisco fumblingly picks up oxygen instead of carbon dioxide, causing the chain of reactions in photosynthesis to break down and have to restart, wasting energy and water. Years ago I talked with biologists about photosynthesis for a magazine article. Not one had a good word to say about rubisco. "Nearly the world's worst, most incompetent enzyme," said one researcher. "Not one of evolution's finest efforts," said another. To overcome rubisco's lassitude and maladroitness, plants make a lot of it, requiring a lot of nitrogen to do so. As much as half of the protein in many plant leaves, by weight, is rubisco—it is often said to be the world's most abundant protein. One estimate is that plants and microorganisms contain more than 11 pounds of rubisco for every person on Earth.

Evolution, one would think, should have improved rubisco. No such luck. But it did produce a work-around: C_4 photosynthesis (C_4 refers to a four-carbon molecule involved in the scheme). At once a biochemical kludge and a clever mechanism for turbocharging plant growth, C_4 photosynthesis consists of a wholesale reorganization of leaf anatomy.

When carbon dioxide comes into a C_4 leaf, it is initially grabbed not by rubisco but by a different enzyme that uses it to form a compound that is then pumped into special, rubisco-filled cells deep in the leaf. These cells have almost no oxygen, so rubisco can't bumblingly grab the wrong molecule. The end result is exactly the same sugars, starches, and cellulose that ordinary photosynthesis produces, except much faster. C_4 plants need less water and fertilizer than ordinary plants, because they don't waste water on rubisco's mistakes. In the sort of convergence that makes biologists snap to attention, C_4 photosynthesis has arisen independently more than 60 times. Corn, tumbleweed, crabgrass, sugarcane, and Bermuda grass—all of these very different plants evolved C_4 photosynthesis.

In the botanical equivalent of a moonshot, scientists from around the world are trying to convert rice into a C_4 plant—one that would grow faster, require less water and fertilizer, and produce more grain. The scope and audacity of the project are hard to overstate. Rice is the world's most important foodstuff, the staple crop for more than half the global population, a food so embedded in Asian culture that the words rice and meal are variants of each other in both Chinese and Japanese. Nobody can predict with confidence how much more rice farmers will need to grow by 2050, but estimates range up to a 40 percent rise, driven by both increasing population numbers and increasing affluence, which permits formerly poor people to switch to rice from less prestigious staples such as millet and sweet potato. Meanwhile, the land available to plant rice is shrinking as cities expand into the countryside, thirsty people drain rivers, farmers switch to more-profitable crops, and climate change creates deserts from farmland. Running short of rice would be a human catastrophe with consequences that would ripple around the world.

The C_4 Rice Consortium is an attempt to ensure that that never happens. Funded largely by the Bill & Melinda Gates Foundation, the consortium is the world's most ambitious genetic-engineering project. But the term genetic engineering does not capture the project's scope. The genetic engineering that appears in news reports typically involves big companies sticking individual packets of genetic material, usually from a foreign species, into a crop. The paradigmatic example is Monsanto's Roundup Ready soybean, which contains a snippet of DNA from a bacterium that was found in a Louisiana waste pond. That snippet makes the plant assemble a chemical compound in its leaves and stems that blocks the effects of Roundup, Monsanto's widely used herbicide. The foreign gene lets farmers spray Roundup on their soy fields, killing weeds but leaving the crop unharmed. Except for making a single tasteless, odorless, nontoxic protein, Roundup Ready soybeans are otherwise identical to ordinary soybeans.

What the C_4 Rice Consortium is trying to do with rice bears the same resemblance to typical genetically modified crops as a Boeing 787 does to a paper airplane. Rather than tinker with individual genes in order to monetize seeds, the scientists are trying to refashion photosynthesis, one of the most fundamental processes of life. Because C_4 has evolved in so many different species, scientists believe that most plants must have precursor C_4 genes. The hope is that rice is one of these, and that the consortium can identify and awaken its dormant C_4 genes—following a path evolution has taken many times before. Ideally, researchers would switch on sleeping chunks of genetic material already in rice (or use very similar genes from related species that are close cousins but easier to work with) to create, in effect, a new and more productive species. Common rice, Oryza sativa, will become something else: Oryza nova, say. No company will profit from the result; the International Rice Research Institute, where much of the research takes place, will give away seeds for the modified grain, as it did with Green Revolution rice.

When I visited irri, 35 miles southeast of downtown Manila, scores of people were doing what science does best: breaking a problem into individual pieces, then attacking the pieces. Some were sprouting rice in petri dishes. Others were trying to find chance variations in existing rice strains that might be helpful. Still others were studying a model organism, a C_4 species of grass called Setaria viridis. Fast-growing and able to be grown in soil, not paddies, Setaria is easier to work with in the lab than rice. There were experiments to measure differences in photosynthetic chemicals, in the rates of growth of different varieties, in the transmission of biochemical markers. Half a dozen people in white coats were sorting seeds on a big table, grain by grain. More were in fields outside, tending experimental rice paddies. All of the appurtenances of contemporary biology were in evidence: flatscreen monitors, humming refrigerators and freezers, tables

full of beakers of recombinant goo, Dilbert and XKCD cartoons taped to whiteboards, a United Nations of graduate students a-gossip in the cafeteria, air conditioners whooshing in a row outside the windows.

Directing the C_4 Rice Consortium is Jane Langdale, a molecular geneticist at Oxford's Department of Plant Sciences. Initial research, she told me, suggests that about a dozen genes play a major part in leaf structure, and perhaps another 10 genes have an equivalent role in the biochemistry. All must be activated in a way that does not affect the plant's existing, desirable qualities and that allows the genes to coordinate their actions. The next, equally arduous step would be breeding rice varieties that can channel the extra growth provided by C_4 photosynthesis into additional grains, rather than roots or stalk. All the while, varieties must be disease-resistant, easy to grow, and palatable for their intended audience, in Asia, Africa, and Latin America.

"I think it can all happen, but it might not," Langdale said. She was quick to point out that even if C_4 rice runs into insurmountable obstacles, it is not the only biological moonshot. Self-fertilizing maize, wheat that can grow in salt water, enhanced soil-microbial ecosystems—all are being researched. The odds that any one of these projects will succeed may be small, the idea goes, but the odds that all of them will fail are equally small. The Wizardly process begun by Borlaug is, in Langdale's view, still going strong.

The Luddites' Moonshot

for as long as Wizards and Prophets have been arguing about feeding the world, Wizards have charged that Prophet-style agriculture simply cannot produce enough food for tomorrow. In the past 20 years, scores of research teams have appraised the relative contributions of industrial and organic agriculture. These inquiries in turn have been gathered together and assessed, a procedure that is fraught with difficulty: Researchers use different definitions of organic, compare different kinds of farms, and include different costs in their analyses. Nonetheless, every attempt to combine and compare data that I know of has shown that Prophet-style farms yield fewer calories per acre than do Wizard-style farms—sometimes by a little, sometimes by quite a lot. The implications are obvious, Wizards say. If farmers must grow twice as much food to feed the 10 billion, following the ecosystem-conserving rules of Sir Albert Howard ties their hands.

Prophets smite their brows at this logic. To their minds, evaluating farm systems wholly in terms of calories per acre is folly. It doesn't include the sort of costs identified by Vogt: fertilizer runoff, watershed degradation, soil erosion and compaction, and pesticide and antibiotic overuse. It doesn't account for the destruction of rural communities. It doesn't consider whether the food is tasty and nutritious.

Wizards respond that C_4 rice will use less fertilizer and water to produce every calorie—it will be better for the environment than conventional crops. That's like trying to put out fires you started by dousing them with less gasoline! the Prophets say. Just eat less meat! To Wizards, the idea of making farms diverse in a way that mimics natural ecosystems is hooey: only hyperintensive, industrial-scale agriculture using superproductive genetically modified crops can feed tomorrow's world.

Productivity? the Prophets reply. We have moonshots of our own! And in fact, they do.

Wheat, rice, maize, oats, barley, rye, and the other common cereals are annuals, which need to be planted anew every year. By contrast, the wild grasses that used to fill the prairie are perennials: plants that come back summer after summer, for as long as a decade. Because perennial grasses build up root systems that reach deep into the ground, they hold on to soil better and are less dependent on surface rainwater and

nutrients—that is, irrigation and artificial fertilizer—than annual grasses. Many of them are also more disease-resistant. Not needing to build up new roots every spring, perennials emerge from the soil earlier and faster than annuals. And because they don't die in the winter, they keep photosynthesizing in the fall, when annuals stop. Effectively, they have a longer growing season. They produce food year after year with much less plowing-caused erosion. They could be just as productive as Green Revolution–style grain, Prophets say, but without ruining land, sucking up scarce water, or requiring heavy doses of polluting, energy-intensive fertilizer.

Echoing Borlaug's program in Mexico, the Rodale Institute, the country's oldest organization that researches organic agriculture, gathered 250 samples of intermediate wheatgrass (Thinopyrum intermedium) in the late 1980s. A perennial cousin to bread wheat, wheatgrass was introduced to the Western Hemisphere from Asia in the 1930s as fodder for farm animals. Working with U.S. Department of Agriculture researchers, the Rodale Institute's Peggy Wagoner, a pioneering plant breeder and agricultural researcher, planted samples, measured their yields, and crossbred the best performers in an attempt to make a commercially viable perennial. Wagoner and the Rodale Institute passed the baton in 2002 to the Land Institute, in Salina, Kansas, a nonprofit agricultural-research center dedicated to replacing conventional agriculture with processes akin to those that occur in natural ecosystems. The Land Institute, collaborating with other researchers, has been developing wheatgrass ever since. It has even given its new variety of intermediate wheatgrass a trade name: Kernza.

Like C_4 rice, wheatgrass may not fulfill its originators' hopes. Wheatgrass kernels are one-quarter the size of wheat kernels, sometimes smaller, and have a thicker layer of bran. Unlike wheat, wheatgrass grows into a dark, dense mass of foliage that covers the field; the thick layer of vegetation protects the soil and keeps out weeds, but it also reduces the amount of grain that the plant produces. To make wheatgrass useful to farmers, breeders will have to increase kernel size, alter the plant's architecture, and improve its bread-making qualities. The work has been slow. Because wheatgrass is a perennial, it must be evaluated over years, rather than a single season. The Land Institute hopes to have field-ready, bread-worthy wheatgrass with kernels that are twice their current size (if still half the size of wheat's) in the 2020s, though nothing is guaranteed.

Domesticating wheatgrass is the long game. Other plant breeders have been trying for a shortcut: creating a hybrid of bread wheat and wheatgrass, hoping to marry the former's large, plentiful grain and the latter's disease resistance and perennial life cycle. The two species produce viable offspring just often enough that biologists in North America, Germany, and the Soviet Union tried unsuccessfully for decades in the mid-1900s to breed useful hybrids. Bolstered by developments in biology, the Land Institute, together with researchers in the Pacific Northwest and Australia, began anew at the turn of this century. When I visited Stephen S. Jones of Washington State University, he and his colleagues had just suggested a scientific name for the newly developed and tested hybrid: Tritipyrum aaseae (the species name honors the pioneering cereal geneticist Hannah Aase). Much work remains; Jones told me that he hoped bread from T. aaseae would be ready for my daughter's children.

African and Latin American researchers scratch their heads when they hear about these projects. Breeding perennial grains is the hard way for Prophets to raise harvests, says Edwige Botoni, a researcher at the Permanent Interstate Committee for Drought Control in the Sahel, in Burkina Faso. Botoni gave a lot of thought to the problem of feeding people from low-quality land while traveling along the edge of the Sahara. One part of the answer, she told me, would be to emulate the farms that flourish in tropical places such as

Nigeria and Brazil. Whereas farmers in the temperate zones focus on cereals, tropical growers focus on tubers and trees, both of which are generally more productive than cereals.

Consider cassava, a big tuber also known as manioc, mogo, and yuca. The 11th-most-important crop in the world in terms of production, it is grown in wide swathes of Africa, Asia, and Latin America. The edible part grows underground; no matter how big the tuber, the plant will never fall over. On a per-acre basis, cassava harvests far outstrip those of wheat and other cereals. The comparison is unfair, because cassava tubers contain more water than wheat kernels. But even when this is taken into account, cassava produces many more calories per acre than wheat. (The potato is a northern equivalent. The average 2016 U.S. potato yield was 43,700 pounds per acre, more than 10 times the equivalent figure for wheat.) "I don't know why this alternative is not considered," Botoni said. Although cassava is unfamiliar to many cultures, introducing it "seems easier than breeding entirely new species."

Much the same is true for tree crops. A mature McIntosh apple tree might grow 350 to 550 pounds of apples a year. Orchard growers commonly plant 200 to 250 trees per acre. In good years this can work out to 35 to 65 tons of fruit per acre. The equivalent figure for wheat, by contrast, is about a ton and a half. As with cassava and potatoes, apples contain more water than wheat does—but the caloric yield per acre is still higher. Even papayas and bananas are more productive than wheat. So are some nuts, like chestnuts. Apples, chestnuts, and papayas cannot make crusty baguettes, crunchy tortillas, or cloud-light chiffon cakes, but most grain today is destined for highly processed substances like animal feed, breakfast cereal, sweet syrups, and ethanol—and tree and tuber crops can be readily deployed for those.

Am I arguing that farmers around the world should replace their plots of wheat, rice, and maize with fields of cassava, potato, and sweet potato and orchards of bananas, apples, and chestnuts? No. The argument is rather that Prophets have multiple ways to meet tomorrow's needs. These alternative paths are difficult, but so is the Wizards' path exemplified in C_4 rice. The greatest obstacle for Prophets is something else: labor.

The Right Way to Live

since the end of the second world war, most national governments have intentionally directed labor away from agriculture (Communist China was long an exception). The goal was to consolidate and mechanize farms, which would increase harvests and reduce costs, especially for labor. Farmworkers, no longer needed, would move to the cities, where they could get better-paying jobs in factories. In the Borlaugian ideal, both the remaining farm owners and the factory workers would earn more, the former by growing more and better crops, the latter by obtaining better-paying jobs in industry. The nation as a whole would benefit: increased exports from industry and agriculture, cheaper food in the cities, a plentiful labor supply.

There were downsides: Cities in developing nations acquired entire slums full of displaced families. And in many areas, including most of the developed world, the countryside was emptied—exactly what Borlaugians intended, as part of the goal of freeing agriculture workers to pursue their dreams. In the United States, the proportion of the workforce employed in agriculture went from 21.5 percent in 1930 to 1.9 percent in 2000; the number of farms fell by almost two-thirds. The average size of the surviving farms increased to compensate for the smaller number. Meanwhile, states around the world established networks of tax incentives, loan plans, training programs, and direct subsidies to help big farmers acquire large-scale farm machinery, stock up on chemicals, and grow certain government-favored crops for export. Because these systems remain in effect, Vogtian farmers are swimming against the tide.

To Vogtians, the best agriculture takes care of the soil first and foremost, a goal that entails smaller patches of multiple crops—difficult to accomplish when concentrating on the mass production of a single crop. Truly extending agriculture that does this would require bringing back at least some of the people whose parents and grandparents left the countryside. Providing these workers with a decent living would drive up costs. Some labor-sparing mechanization is possible, but no small farmer I have spoken with thinks that it would be possible to shrink the labor force to the level seen in big industrial operations. The whole system can grow only with a wall-to-wall rewrite of the legal system that encourages the use of labor. Such large shifts in social arrangements are not easily accomplished.

And here is the origin of the decades-long dispute between Wizards and Prophets. Although the argument is couched in terms of calories per acre and ecosystem conservation, the disagreement at bottom is about the nature of agriculture—and, with it, the best form of society. To Borlaugians, farming is a kind of useful drudgery that should be eased and reduced as much as possible to maximize individual liberty. To Vogtians, agriculture is about maintaining a set of communities, ecological and human, that have cradled life since the first agricultural revolution, 10,000-plus years ago. It can be drudgery, but it is also work that reinforces the human connection to the Earth. The two arguments are like skew lines, not on the same plane.

My daughter is 19 now, a sophomore in college. In 2050, she will be middle-aged. It will be up to her generation to set up the institutions, laws, and customs that will provide for basic human needs in the world of 10 billion. Every generation decides the future, but the choices made by my children's generation will resonate for as long as demographers can foresee. Wizard or Prophet? The choice will be less about what

The Unsettling of America: Culture & Agriculture

by Wendell Berry

CHAPTER FOUR

The Agricultural Crisis as a Crisis of Culture

In my boyhood, Henry County, Kentucky, was not just a rural county, as it still is—it was a *farming* county. The farms were generally small. They were farmed by families who lived not only upon them, but within and *from* them. These families grew gardens. They produced their own meat, milk, and eggs. The farms were highly diversified. The main money crop was tobacco. But the farmers also grew corn, wheat, barley, oats, hay, and sorghum. Cattle, hogs, and sheep were all characteristically raised on the same farms. There were small dairies, the milking more often than not done by hand. Those were the farm products that might have been considered major. But there were also minor products, and one of the most important characteristics of that old economy was the existence of markets for minor products. In those days a farm family could easily market its surplus cream, eggs, old hens, and frying chickens. The power for

field work was still furnished mainly by horses and mules. There was still a prevalent pride in workmanship, and thrift was still a forceful social ideal. The pride of most people was still in their homes, and their homes looked like it.

This was by no means a perfect society. Its people had often been violent and wasteful in their use of the land and of each other. Its present ills had already taken root in it. But I have spoken of its agricultural economy of a generation ago to suggest that there were also good qualities indigenous to it that might have been cultivated and built upon.

That they were not cultivated and built upon—that they were repudiated as the stuff of a hopelessly outmoded, unscientific way of life—is a tragic error on the part of the people themselves; and it is a work of monstrous ignorance and irresponsibility on the part of the experts and politicians, who have prescribed, encouraged, and applauded the disintegration of such farming communities all over the country.

In the decades since World War II the farms of Henry County have become increasingly mechanized. Though they are still comparatively diversified, they are less diversified than they used to be. The holdings are larger, the owners are fewer. The land is falling more and more into the hands of speculators and professional people from the cities, who—in spite of all the scientific agricultural miracles—still have much more money than farmers. Because of big technology and big economics, there is more abandoned land in the county than ever before. Many of the better farms are visibly deteriorating, for want of manpower and time and money to maintain them properly. The number of part-time farmers and ex-farmers increases every year. Our harvests depend more and more on the labor of old people and young children. The farm people live less and less from their own produce, more and more from what they buy. The best of them are more worried about money and more overworked than ever before. Among the people as a whole, the focus of interest has largely shifted from the household to the automobile; the ideals of workmanship and thrift have been replaced by the goals of leisure, comfort, and entertainment. For Henry County plays its full part in what Maurice Telleen calls "the world's first broad-based hedonism." The young people expect to leave as soon as they finish high school, and so they are without permanent interest; they are generally not interested in anything that cannot be reached by automobile on a good road. Few

of the farmers' children will be able to afford to stay on the farm—perhaps even fewer will wish to do so, for it will cost too much, require too much work and worry, and it is hardly a fashionable ambition.

And nowhere now is there a market for minor produce: a bucket of cream, a hen, a few dozen eggs. One cannot sell milk from a few cows anymore; the law-required equipment is too expensive. Those markets were done away with in the name of sanitation—but, of course, to the enrichment of the large producers. We have always had to have "a good reason" for doing away with small operators, and in modern times the good reason has often been sanitation, for which there is apparently no small or cheap technology. Future historians will no doubt remark upon the inevitable association, with us, between sanitation and filthy lucre. And it is one of the miracles of science and hygiene that the germs that used to be in our food have been replaced by poisons.

In all this, few people whose testimony would have mattered have seen the connection between the "modernization" of agricultural techniques and the disintegration of the culture and the communities of farming—and the consequent disintegration of the structures of urban life. What we have called agricultural progress has, in fact, involved the forcible displacement of millions of people.

I remember, during the fifties, the outrage with which our political leaders spoke of the forced removal of the populations of villages in communist countries. I also remember that at the same time, in Washington, the word on farming was "Get big or get out"—a policy which is still in effect and which has taken an enormous toll. The only difference is that of method: the force used by the communists was military; with us, it has been economic—a "free market" in which the freest were the richest. The attitudes are equally cruel, and I believe that the results will prove equally damaging, not just to the concerns and values of the human spirit, but to the practicalities of survival.

And so those who could not get big have got out—not just in my community, but in farm communities all over the country. But as a social or economic goal, bigness is totalitarian; it establishes an inevitable tendency toward the *one* that will be the biggest of all. Many who got big to stay in are now being driven out by those who got bigger. The aim of bigness implies not one aim that is not socially and culturally destructive.

And this community-killing agriculture, with its monomania of

bigness, is not primarily the work of farmers, though it has burgeoned on their weaknesses. It is the work of the institutions of agriculture: the university experts, the bureaucrats, and the "agribusinessmen," who have promoted so-called efficiency at the expense of community (and of real efficiency), and quantity at the expense of quality.

In 1973, 1000 Kentucky dairies went out of business. They were the victims of policies by which we imported dairy products to compete with our own and exported so much grain as to cause a drastic rise in the price of feed. And, typically, an agriculture expert at the University of Kentucky, Dr. John Nicolai, was optimistic about this failure of 1000 dairymen, whose cause he is supposedly being paid—partly with *their* tax money—to serve. They were inefficient producers, he said, and they needed to be eliminated.

He did not say—indeed, there was no indication that he had ever considered—what might be the limits of his criterion or his logic. Did he propose to applaud this process year after year until "biggest" and "most efficient" become synonymous with "only"? Did these dairymen have any value not subsumed under the heading of "efficiency"? And who benefited by their failure? Assuming that the benefit reached beyond the more "efficient" (that is, the bigger) producers to lower the cost of milk to consumers, do we then have a formula by which to determine how many consumer dollars are equal to the livelihood of one dairyman? Or is *any* degree of "efficiency" worth *any* cost? I do not think that this expert knows the answers. I do not think that he is under any pressure—scholarly, professional, moral, or otherwise—to ask the questions. This sort of regardlessness is invariably justified by pointing to the enormous productivity of American agriculture. But any abundance, in any amount, is illusory if it does not safeguard its producers, and in American agriculture it is now virtually the accepted rule that abundance will destroy its producers.

And along with the rest of society, the established agriculture has shifted its emphasis, and its interest, from quality to quantity, having failed to see that in the long run the two ideas are inseparable. To pursue quantity alone is to destroy those disciplines in the producer that are the only assurance of quantity. What is the effect on quantity of persuading a producer to produce an inferior product? What, in other words, is the relation of pride or craftsmanship to abundance? That is another question the "agribusinessmen" and their academic

collaborators do not ask. They do not ask it because they are afraid of the answer: The preserver of abundance is excellence.

My point is that food is a cultural product; it cannot be produced by technology alone. Those agriculturists who think of the problems of food production solely in terms of technological innovation are oversimplifying both the practicalities of production and the network of meanings and values necessary to define, nurture, and preserve the practical motivations. That the discipline of agriculture should have been so divorced from other disciplines has its immediate cause in the compartmental structure of the universities, in which complementary, mutually sustaining and enriching disciplines are divided, according to "professions," into fragmented, one-eyed specialties. It is suggested, both by the organization of the universities and by the kind of thinking they foster, that farming shall be the responsibility only of the college of agriculture, that law shall be in the sole charge of the professors of law, that morality shall be taken care of by the philosophy department, reading by the English department, and so on. The same, of course, is true of government, which has become another way of institutionalizing the same fragmentation.

However, if we conceive of a culture as one body, which it is, we see that all of its disciplines are everybody's business, and that the proper university product is therefore not the whittled-down, isolated mentality of expertise, but a mind competent in all its concerns. To such a mind it would be clear that there are agricultural disciplines that have nothing to do with crop production, just as there are agricultural obligations that belong to people who are not farmers.

A culture is not a collection of relics or ornaments, but a practical necessity, and its corruption invokes calamity. A healthy culture is a communal order of memory, insight, value, work, conviviality, reverence, aspiration. It reveals the human necessities and the human limits. It clarifies our inescapable bonds to the earth and to each other. It assures that the necessary restraints are observed, that the necessary work is done, and that it is done well. A healthy *farm* culture can be based only upon familiarity and can grow only among a people soundly established upon the land; it nourishes and safeguards a human intelligence of the earth that no amount of technology can satisfactorily replace. The growth of such a culture was once a strong possibility in the farm communities of this country. We now have only the sad remnants of those communities. If we allow another generation to pass without doing what is necessary to enhance and

embolden the possibility now perishing with them, we will lose it altogether. And then we will not only invoke calamity—we will deserve it.

Several years ago I argued with a friend of mine that we might make money by marketing some inferior lambs. My friend thought for a minute and then he said, "I'm in the business of producing *good* lambs, and I'm not going to sell any other kind." He also said that he kept the weeds out of his crops for the same reason that he washed his face. The human race has survived by that attitude. It can survive *only* by that attitude—though the farmers who have it have not been much acknowledged or much rewarded.

Such an attitude does not come from technique or technology. It does not come from education; in more than two decades in universities I have rarely seen it. It does not come even from principle. It comes from a passion that is culturally prepared—a passion for excellence and order that is handed down to young people by older people whom they respect and love. When we destroy the possibility of that succession, we will have gone far toward destroying ourselves.

It is by the measure of culture, rather than economics or technology, that we can begin to reckon the nature and the cost of the country-to-city migration that has left our farmland in the hands of only five percent of the people. From a cultural point of view, the movement from the farm to the city involves a radical simplification of mind and of character.

A competent farmer is his own boss. He has learned the disciplines necessary to go ahead on his own, as required by economic obligation, loyalty to his place, pride in his work. His workdays require the use of long experience and practiced judgment, for the failures of which he knows that he will suffer. His days do not begin and end by rule, but in response to necessity, interest, and obligation. They are not measured by the clock, but by the task and his endurance; they last as long as necessary or as long as he can work. He has mastered intricate formal patterns in ordering his work within the overlapping cycles—human and natural, controllable and uncontrollable—of the life of a farm.

Such a man, upon moving to the city and taking a job in industry, becomes a specialized subordinate, dependent upon the authority and judgment of other people. His disciplines are no longer implicit in his own experience, assumptions, and values, but are imposed on him from the outside. For a complex responsibility he has substituted

a simple dutifulness. The strict competences of independence, the formal mastery, the complexities of attitude and know-how necessary to life on the farm, which have been in the making in the race of farmers since before history, all are replaced by the knowledge of some fragmentary task that may be learned by rote in a little while.

Such a simplification of mind is easy. Given the pressure of economics and social fashion that has been behind it and the decline of values that has accompanied it, it may be said to have been gravity-powered. The reverse movement—a reverse movement *is* necessary, and some have undertaken it—is uphill, and it is difficult. It cannot be fully accomplished in a generation. It will probably require several generations—enough to establish complex local cultures with strong communal memories and traditions of care.

There seems to be a rule that we can simplify our minds and our culture only at the cost of an oppressive social and mechanical complexity. We can simplify our society—that is, make ourselves free—only by undertaking tasks of great mental and cultural complexity. Farming, the *best* farming, is a task that calls for this sort of complexity, both in the character of the farmer and in his culture. To simplify either one is to destroy it.

That is because the best farming requires a farmer—a husbandman, a nurturer—not a technician or businessman. A technician or a businessman—given the necessary abilities and ambitions—can be made in a little while, by training. A good farmer, on the other hand, is a cultural product; he is made by a sort of training, certainly, in what his time imposes or demands, but he is also made by generations of experience. This essential experience can only be accumulated, tested, preserved, handed down in settled households, friendships, and communities that are deliberately and carefully native to their own ground, in which the past has prepared the present and the present safeguards the future.

The concentration of the farmland into larger and larger holdings and fewer and fewer hands—with the consequent increase of overhead, debt, and dependence on machines—is thus a matter of complex significance, and its agricultural significance cannot be disentangled from its cultural significance. It *forces* a profound revolution in the farmer's mind: once his investment in land and machines is large enough, he must forsake the values of husbandry and assume those of finance and technology. Thenceforth his thinking is not determined by agricultural responsibility, but by financial account-

ability and the capacities of his machines. Where his money comes from becomes less important to him than where it is going. He is caught up in the drift of energy and interest away from the land. Production begins to override maintenance. The economy of money has infiltrated and subverted the economies of nature, energy, and the human spirit. The man himself has become a consumptive machine.

For some time now ecologists have been documenting the principle that "you can't do one thing"—which means that in a natural system whatever affects one thing ultimately affects everything. Everything in the Creation is related to everything else and dependent on everything else. The Creation is one; it is a uni-verse, a whole, the parts of which are all "turned into one."

A good agricultural system, which is to say a durable one, is similarly unified. In the 1940s, the great British agricultural scientist, Sir Albert Howard, published *An Agricultural Testament* and *The Soil and Health*, in which he argued against the influence in agriculture of "the laboratory hermit" who had substituted "that dreary principle [official organization] for the soul-shaking principle of that essential freedom needed by the seeker after truth." And Howard goes on to speak of the disruptiveness of official organization: "The natural universe, which is one, has been halved, quartered, fractioned. . . . Real organization always involves real responsibility: the official organization of research tries to retain power and avoid responsibility by sheltering behind groups of experts." Howard himself began as a laboratory hermit: "I could not take my own advice before offering it to other people." But he saw the significance of the "wide chasm between science in the laboratory and practice in the field." He devoted his life to bridging that chasm. His is the story of a fragmentary intelligence seeking both its own wholeness and that of the world. The aim that he finally realized in his books was to prepare the way "for treating the whole problem of health in soil, plant, animal, and man as one great subject." He unspecialized his vision, in other words, so as to see the necessary unity of the concerns of agriculture, as well as the convergence of these concerns with concerns of other kinds: biological, historical, medical, moral, and so on. He sought to establish agriculture upon the same unifying cycle that preserves health, fertility, and renewal in nature: the Wheel of Life (as he called it, borrowing the term from religion), by which "Death supersedes life and life rises again from what is dead and decayed."

It remains only to say what has often been said before—that the best human cultures also have this unity. Their concerns and enterprises are not fragmented, scattered out, at variance or in contention with one another. The people and their work and their country are members of each other and of the culture. If a culture is to hope for any considerable longevity, then the relationships within it must, in recognition of their interdependence, be predominantly cooperative rather than competitive. A people cannot live long at each other's expense or at the expense of their cultural birthright—just as an agriculture cannot live long at the expense of its soil or its work force, and just as in a natural system the competitions among species must be limited if all are to survive.

In any of these systems, cultural or agricultural or natural, when a species or group exceeds the principle of usufruct (literally, the "use of the fruit"), it puts itself in danger. Then, to use an economic metaphor, it is living off the principal rather than the interest. It has broken out of the system of nurture and has become exploitive; it is destroying what gave it life and what it depends upon to live. In all of these systems a fundamental principle must be the protection of the source: the seed, the food species, the soil, the breeding stock, the old and the wise, the keepers of memories, the records.

And just as competition must be strictly curbed within these systems, it must be strictly curbed *among* them. An agriculture cannot survive long at the expense of the natural systems that support it and that provide it with models. A culture cannot survive long at the expense of either its agricultural or its natural sources. To live at the expense of the source of life is obviously suicidal. Though we have no choice but to live at the expense of other life, it is necessary to recognize the limits and dangers involved: past a certain point in a unified system, "other life" is our own.

The definitive relationships in the universe are thus not competitive but interdependent. And from a human point of view they are analogical. We can build one system only within another. We can have agriculture only within nature, and culture only within agriculture. At certain critical points these systems have to conform with one another or destroy one another.

Under the discipline of unity, knowledge and morality come together. No longer can we have that paltry "objective" knowledge so prized by the academic specialists. To know anything at all becomes a moral predicament. Aware that there is no such thing as a special-

ized—or even an entirely limitable or controllable—effect, one becomes responsible for judgments as well as facts. Aware that as an agricultural scientist he had "one great subject," Sir Albert Howard could no longer ask, What can I do with what I know? without at the same time asking, How can I be responsible for what I know?

And it is within unity that we see the hideousness and destructiveness of the fragmentary—the kind of mind, for example, that can introduce a production machine to increase "efficiency" without troubling about its effect on workers, on the product, and on consumers; that can accept and even applaud the "obsolescence" of the small farm and not hesitate over the possible political and cultural effects; that can recommend continuous tillage of huge monocultures, with massive use of chemicals and no animal manure or humus, and worry not at all about the deterioration or loss of soil. For cultural patterns of responsible cooperation we have substituted this moral ignorance, which is the etiquette of agricultural "progress."

Wendell Berry started this argument. His most recent book, **The Unsettling of America** *(1977, Sierra Club Books), "deals at length with the assumptions and policies of former Secretary of Agriculture Earl L. Butz," as Wendell says in the preface. It's an eloquent book and a popular and influential one, without a kind word for Butz' ideas in it. We printed a goodly portion of the book in the Spring 1977* **CQ** *and are pleased to be around for this brawl, a debate that really is one.*

Dr. Butz, 69, during his tenure as Secretary of Agriculture from 1971 to 1976 was a highly visible, forceful spokesman for agribusiness and was popular with his farmer constituency. When fired by President Ford for the offense of having a fine vicious joke overheard by press, he left office gracefully and without apparent rancor. At present he is Dean Emeritus of Agriculture at his alma mater, Purdue.

Ed McClanahan, an old friend of Wendell's and ours, put us wise to the debate at Manchester College, North Manchester, Indiana, on November 13, 1977. It seems that an English teacher named Charles Boebel put together the occasion as part of the Life Schools Community Forum — The Crisis in American Agriculture, sponsored by the Indiana Committee for the Humanities. We're grateful for photographs to Debbie Lampert Dupré at the **Wabash Plain Dealer** *and for photographs and additional tape to Jeffrey Hooper of the Appalshop, Whitesburg, Kentucky, who filmed the event. —SB*

Earl Butz VERSUS Wendell

Butz: I see we're supposed to debate about "The Crisis in American Agriculture." I think the word "crisis" is grossly overworked. I think if we asked what the crisis was, we'd get all kinds of answers here and some people would have a great deal of difficulty in even giving their own concept of what the crisis is, if indeed there is a crisis. It's a word that I refuse to place very high in my vocabulary, because if you look very hard on the other side of every coin you call crisis, it's opportunity.

So often I think we cry crisis when we want to resist change. We have a nostalgia for what was — the good old days. Somebody told me, the best thing about the good old days is a faulty memory. There were some good things about them, to be sure, but I don't especially like some of the other things when I begin to remember in detail about the good old days.

I want to make some comments about the positive side of American agriculture — some of the reasons why American agriculture is *not* in crisis, some of the reasons why modern American agriculture is the very foundation of the strength in America. I have read **The Unsettling of America.** There are a few paragraphs in it with which I agree, not many. I don't want to go back to the good old days. I don't want to go back to the outdoors pump and you carry water into the kitchen. I don't want to go back to the old round wood stove we had up here in Noble County 40 miles up the road, where the fire went out at night and mother got up to build a fire the next morning and dad did once in a while but not very often. I don't want to go back to the oil lamp by which I studied until we got a Delco light system which seemed like heaven itself — and by today's standards would be very obsolete.

I don't want to go back to the lantern I carried doing chores. I don't want to go back to the back-breaking toil of cleaning out the stables by hand on Saturdays. Dad always left the barn to clean until Saturdays 'cause the boys were home from school. I don't want to go back to the hard toil we had and the long days. I don't want to go back to the fact that our entertainment on those long winter nights was the Sears Roebuck wishbook that we looked at. In the spring we got an order off — we were all winter putting it together.

I don't want to go back to the very short cash days we had growing up back there. I don't want to go back to riding to high school three years in a horse and buggy. The last year Dad got a Model T Ford and we drove. I don't want to go back to the low level of cash income we had on the farm, the high degree of self-sufficiency where we made our own clothes in the main, and made our own baseballs at school by unravelling sock and puttin' carpet warp in it to hold it together, until it got wet and came to pieces. Well, I can go ahead and name things I don't want to go back to.

I only want to go forward. I want to live in a changing society. That's the kind we're living in. I don't want to live in a static society.

What about American agriculture and some of the contributions it has made and is making? I sat in Brezhnev's office in Moscow a few years ago and we were discussing agriculture with remarkable frankness. He said, "Forty-five percent of my people are on the land. And I can't put my people into the business of producing consumer goods — TVs and radios and automobiles and that kind of stuff — 'till I can learn somehow to feed my population with less than 45 percent of my people on the land." And I thought, 'Yes sir, Mr. Brezhnev, you are right now where my country was when I was born.' (Sixty-eight years ago that was — just to save you arithmetic.) We were an

Dupré

Berry

Butz: I have read **The Unsettling of America.** There are a few paragraphs in it with which I agree, not many.

agrarian nation — 45 percent of us were on farms. If we had known then how to make nice automobiles and radios and TVs and bathtubs and nice schoolhouses like this one here, if we had known how to do that, we couldn't have spared the manpower to do it. We had to have 'em out in the field with a pair of plow handles in their hands. I can feel those lines around my back right now, guiding the horses like that.

Today we not only feed 216 million Americans much better than we did then, but we've got 24 billion dollars worth in the last year to send abroad — our number one source of foreign exchange. We've moved from 45 percent on the land to about 4 percent on the land now. I know that causes some sociological problems. Change always does. On the other hand, all of us live better because of it — including those remaining on the land. They're in the commercial stream now. They too have electricity. They too have indoor plumbing. I didn't grow up with five rooms and a bath up here in Noble County, I grew up with four rooms and a path. How many of you did? Can I see your hands? . . . For you youngsters, it wasn't all that bad. On those cold winter mornings you learned to do things in a hurry. You can't find one in this county now, except at the resort out at the lake and you brag about it.

We've learned how to feed ourselves with a little manpower and a shirt-tail full of resources. Let's never forget that. I'm talking about modern, scientific, technological agriculture. It's big business, to be sure. We are still family farms. We talk about the corporation farm — less than 1 percent of our farms in America are corporation farms, and 9 out of 10 of them are incorporated for the purpose of passing title from father to son without breaking it up as they pass the tax collector.

What's it all amounted to then for America? It means that today we feed ourselves for a little less than 17 percent of our take-home pay in America. That's less than any place else on the face of the Earth. It's less than any time previously in the history of America. Now, I know food prices have gone up and I know people talk about it. The other day I was on one of these one-on-one TV shows, somewhere in Chicago I think. We had this smart-aleck young reporter. He thought, "I'll get Butz" right with his first question. His question was, "When are food prices going to go down?" And I said, "Well, food prices are going to go down about the same time the cost of advertising food on this station goes down. They're going to go down about the same time they reduce your salary. When do you want to start the cycle?" He said, "Well, since you put it that way, let's talk about something else."

Now, he asked the right question. He asked the question that every housewife listening wanted to know. He just got the wrong answer to it. The plain truth is we buy our food today in America for a smaller share of our take-home pay than ever before in the history of America.

And we get all that built-in maid service with it — the frozen TV dinners that you poked in the oven tonight before you came down here. You take that ounce and a half of meat in one of those TV dinners and multiply it up to price per pound, it's not for cheap. I was out in Idaho a couple weeks ago, and they took me to one of these potato-processing plants. They said we now process at or near the point of production two-thirds of the potatoes we eat in America. You got to peel the potato to make it go in the American kitchen any more, it won't go in unpeeled. And that's not for cheap — somebody has to do that.

[more →]

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Hooper

Butz: When I was born in 1909 we were an agrarian nation — 45 percent of us were on farms, instead of 4 percent as we have now. If we had known then how to make nice automobiles and radios and TVs and bathtubs and nice schoolhouses like this one here, we couldn't have spared the manpower to do it. We had to have 'em out in the field with a pair of plow handles in their hands. I can feel those lines around my back right now, guiding the horses like that.

I've heard a lot about the wonderful agriculture in China. I've heard a lot about the way that there isn't any hunger in China. Well, hunger's relative. But they've got 80 percent of their people on the land. When I hear some of these characters out here talk about we have to reverse the flow and put people back on the land, I wonder how far back you want to go. You want to go back to where Russia is, with 45 percent on the land? You want to go back to where India is with 60 percent? You want to go back to where China is with 80 percent? How far back do you want to go anyway?

When I was a kid and there were 40 percent of us on farms in America we didn't have any school houses like this. We had the little one-room country schools — that's the best we could afford. If you taxed yourself then like you do now the economy simply wouldn't have supported it, the surplus wasn't there to pay for it. Ninety-six percent of our families in America have a TV set. And 55 percent have two TV sets. The programs aren't good enough for one. Because we spend only 17 percent of take-home pay for food is the reason that nearly 90 percent of our families have an automobile. And 45 percent have 2 automobiles. If you've got a youngster in high school — three. We have an average of two people per automobile in America. In Russia, the super race, 40 people per automobile. You don't have to look very long for a parking place there.

That's why I refuse to accept the word crisis here. We have our problems to be sure. There are adjustments to be made, as is always the case. We're losing people on farms — by definition — as the family farm gets bigger. There're only so many acres in Wabash County, and you divide it among fewer operators. They're still family farms. At some point you reach an irreducible minimum, but never forget that the farmers in Wabash County are still family farmers. I shook a good many of your hands here tonight. I could tell which of you worked for a living. The callouses were here.

The other day this circus train was speeding across Illinois out here. They had this car with a baboon in it. The car door flew open, the baboon jumped out and hit a telegraph pole, and it killed him dead right there. A few hours later a couple farmers came along. They didn't recognize what it was. One of 'em said, I wonder who this is? The other one said, Well I don't know but judgin' from the location of his callouses, he must be a government worker.

We support a lot of government workers, because one worker on an American farm can now feed and clothe himself and approximately 70 other people. When I was a youngster up there in Noble County, he could feed and clothe himself and about 9 other people. I think it's a remarkable story of success. Not only do we feed our people in America better than ever before and cheaper than ever before, we got 24 billion dollars worth of surplus products to send abroad. It's our number one source of foreign exchange. It's the way we paid for this Sony microphone. What kind of recorder is that there — Panasonic? Where was it made? Japan. Somebody got a still camera? It may be American, but you look at the parts — they came from Japan. We didn't pay for a single one of those things with Japanese yen. We paid for 'em with Indiana-produced corn and soybeans and wheat. And I think it was a pretty good exchange myself. We just make soybeans better than they do and they make cameras better than we do.

Twenty-four billion dollars worth of that we sold abroad last year. And when you subtract what we paid for imported foodstuffs — half the sugar we eat, and coffee and tea and bananas and that kind of stuff — we spent 11 or 12 billion dollars for that. So we made a net plus contribution last year in American agriculture to our balance of payments of 12 billion dollars. Believe me, that's rather important in this year when our overall balance of payments is running about a negative 25 billion. It's a serious matter — the dollar's under attack in the international exchanges of the world.

Well, that's American agriculture. It's in change to be sure. I know that some of the rural institutions are under pressure. I know the old country church is under pressure. The little church I went to up there in Noble County just 40 rod down the road, it's torn down. It's not there any more. The little one-room school I went to is now a hay-storage place for my sister and brother-in-law. But our challenge is not to yield before the nostalgia of yesteryear. Our challenge is not to turn the clock back. Our challenge is not to go back to more inefficient ways. Our challenge is *not* to put more people back on the land and therefore decrease the efficiency of American agriculture. Our challenge is to adapt to the

Berry: Mr. Butz and I may never meet, because he's arguing from quantities and I'm arguing from values.

Dupré

changing situation in which we find ourselves. We need to evolve a new community structure. I'm fully aware as everybody else is that we've lost our old community identification around the rural school and the rural church. And yet there is a cohesiveness in this group here tonight. There is a cohesiveness in this North Manchester community, and our job is to develop that, is to give it strength, and give it meaning to move ahead. I've often thought that if I live long enough, that I'm going to adopt Butz's Law of Economics – it's a very simple one: Adapt or Die. It's a harsh one. But those who cling to the moldering past are the ones who die. They truly are the ones to which the word crisis would apply.

In my time I have seen so many improvements in the overall level of living of America and I've seen it tied right back to this efficient agriculture, that has applied change, that has applied technology, that's using capital, that has increased its efficiency, so that all America lives better in any way you want to measure. The people on welfare in this country live better in terms of the things they have than the top half of any population any place else on the face of the Earth.

The overriding objective of all of us in this world is peace. I've travelled the world a great deal. I've been behind the Iron Curtain. I've broken ranks in Moscow and Warsaw and Hungary and Yugoslavia to talk with people on the streets I wasn't supposed to talk to. In their hearts beats the urge for peace the same as in ours. Perhaps more than ours, because they've seen their countries destroyed. They've seen their loved ones killed before their eyes. They may want it on different terms than ours.

I am convinced that in this tremendously productive American agriculture we have the building blocks on which the diplomats of the world can build a structure of peace. And I think that peace is something more enduring than the absence of war. It's a positive thing.

In India shortly after the Indians got their independence from Great Britain, one day Gandhi very sagely remarked, "Even God dare not approach a hungry man except in the form of bread." I've seen starving men. No use talking to a man like that about human dignity. No use talking about democracy. No use talking about freedom. He listens only to the man who has a piece of bread.

And that is precisely the language we are prepared to speak in the United States. To speak loudly, to speak eloquently. We're kind of awkward with it, it's a new role for us. We're learning how to do it. But we have the capacity to do it. And we have that capacity because modern agriculture in this country is what it is. It's efficient. It's progressive. It's productive. And it's relatively free.

Thank you very much.

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Berry: My basic assumption in talking about agriculture is that there's more to it than just agriculture. That you can't disconnect one part of a society from all the other parts and just look at the results in that alone.

Let me give you as an example of what I'm talking about – a little parable that hundreds of people are acting out all the time. This country is full of people now who've been liberated by modern agriculture from having to do any of what Dr. Butz called backbreaking work. And they look forward to a life of leisure. They've got nothing to do with their bodies except enjoy themselves. But when they get started on this life of leisure they discover that even to enjoy the many physical pleasures that are now available to them they've got to get in shape. So they go and take out a membership in a health spa and lift weights all day so they will be in shape to enjoy themselves at night. They've been liberated from meaningful work in order to pay to do meaningless work in order to keep healthy.

There's bound to be some kind of a connection between the liberation, so-called, of millions of people in this country from so-called backbreaking or menial work and the health problem. I don't know if you'd call it a health crisis or not; crisis is not a favorite word of mine either. But there is a health problem. The last figures I read were that everybody in the country now is paying $500 a year medical expenses. That's $2000 a year for a family of four. That's too much. It seems to me that it might be conducive to health if people were doing more work.

And I don't want to go backward. I don't think that there's ever been a moment in history that's had enough net good in it to lure people back to try it

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again. I think what we all want to try is the future. It's just a question of how we try and who gets to make the attempt. Rather than talk very long and general, I'd like to talk about the part of the country where I come from and I hope that my feelings on agriculture and policy implications will be clear to you from what I have to say about it.

I come from Henry County, Kentucky, not too far from Indiana. It's easy for us to come over to Madison sometimes to shop. Henry County is a place of fertile land but a very broken rolling topography. It's a topography that makes the ground subject to erosion, especially since it's clay soil. Historically it's been highly productive agricultural country. It's one of the best tobacco counties in the state, but tobacco's always been part of a fairly diversified farming program, and so if you look back in Kentucky history, you find Henry County way up there among the livestock producing counties in the state. Traditionally Henry County was farmed by small farmers. When I was a boy there a two-hundred acre farm was a pretty big farm. For the reasons of topography that I have mentioned, it still needs to be farmed by small farmers. It needs to be farmed by people who know it very well, who care very much about it, and who will stay at home and pay attention to it.

What's happening in Henry County is what's happening every place. The farms are getting bigger, more mechanized, and the farmers are disappearing at a great rate. Henry County lies in what the real estate people call the golden triangle — between the interstate highways connecting Louisville, Kentucky, and Cincinnati, Ohio, and Lexington, Kentucky. This is driving the land costs at home way up, and the farmers aren't able to buy.

People who're buying it are city people — doctors and lawyers and businessmen of various kinds. They are able to pay the costs and the high interest rates and they get as a reward a place to come out to with their friends on the weekends. They make some of the worst neighbors that history has ever known. They don't know anything at all about a line fence. They don't know what their obligations are. I had a neighbor like that who told me he didn't need to build his part of the line fence because he didn't have any cattle. One of them told his neighbor that he was sure that he didn't need to build his part of the line fence because the hillside was so steep that the cattle would never go up where the fence was anyway. Well, I could tell you a lot of fascinating illustrations of the aptitude these people have for farming and for being neighbors, but I won't.

This is the pattern of modern agriculture where I live, and I think it's repeated in many places. The land has fallen into the hands of first the farmers' widows and then of these moneyed people who aren't farmers. The land is then cash rented to young farmers who've made their investment not in land — which is appreciating — but in machinery — which is depreciating. And they're renting the land with cash, breaking it whole farms at a time, planting them to corn and soybeans. They're not using any animals. Not rotating back through pasture — which probably 90 percent of that land needs to be. They're not sowing any cover crops. They're plowing up the waterways and cutting the fences. Farm houses are going down. They're driving in, producing the crop, loading it and driving out with it. In other words, in their patches the industrialization of farming is complete. They're treating the farm exactly as you would treat a factory or a mine.

This land is highly productive. And it will be for a while. But already the stories are beginning to circulate of land cleared with bulldozers, put in corn one year, and ruined. None of this land is being better farmed now than it was 30 years ago. In fact it's being neglected, abused, and wasted as never before. I've told you the grain farming angle of it. Another angle is for somebody to go in on one of those steep farms and capitalize it heavily with silos, dairy barn, loafing shed, and so on, contract a heavy debt on it, and then cover it up with Holstein cows that require it to be grazed far beyond its carrying capacity, and what isn't damaged that way they tramp into the hollers.

Henry County is a county of little farms now gathered into ever-larger ones or turned out to bushes. There isn't any land in that county that's beneath notice. All of it's potentially good for cropland or for pasture or for forest land. It's probably never been so neglected in its history. You'd have to ask, then, where are the families that used to be on that land? Well, some of them are in professions. Some of them have done extremely well. Some of them are no doubt very glad that they don't have to go back to farm those farms. Some of them are working in factories in the city. Some of them are on welfare — that is, instead of supporting themselves on what we now think of as negligible little farms, they are being supported by us. In the shifting down of people among jobs, some people as a consequence of abandonment of those farms are in the ghettoes. My point is that wherever those people are, they are not as independent now as they were.

About a year ago a young neighbor of mine came to see me. He wanted to talk about buying a farm. He's the son of a tenant farmer who just lately finally got well enough off to buy a little farm for himself. This is a fine boy. I'd had him come help me some. I'd known him since he was a child. He's as cleancut, fine, honest a young man as you'll ever see, done a lot of hard work in his young life. He's married now, got a baby. He was living in a house trailer, growing as much crop every year as he could manage and working in construction. It's a familiar pattern, I'm sure.

Well, he'd seen a vision. He'd seen a little farm, a hilly farm, one of those marginal farms, 100 or so acres. He wanted to live on it. He wanted to buy it. He's a carpenter, he'd fix the house up. He and his family would have a place there. It would be something under foot, you see. It wouldn't be the house trailer. It wouldn't be depreciating.

I knew what he'd seen. I'd seen it myself. I know my forefathers have seen it. How it'd be to have a place of your own and be independent? You know how it is, you walk out, you see a piece of land and you know very quickly how you'd farm it, how it

Butz: Because we spend only 17 percent of take-home pay for food is the reason that nearly 90 percent of our families have an automobile and 96 percent have a TV set.

Dupré

would look if you had it, right? Well, this young fellow had seen that vision. I think it's a grand vision. And an ennobling vision. And an indispensable one. I said, "What does it cost?" "$60,000."

He began to hustle around and see about the little money that he could lay down and what help he could get from his daddy and what help he could get then from the loan agencies and banks. And he'd come and tell me and I'd say, "Find out what the total cost will be after interest." He found that very hard to discover but he finally did. It was twice the amount – $120,000 – and he can't do it.

Well, it was one of the hardest times I'd ever had. With myself. Because I thought from all I knew about this boy that he belonged on a farm – he wanted to be, he knew how to be – and if I was right about his character, he would've deserved to be. And you understand that you have to deserve to be. You have to prove that by being there and doing right on it.

Well, it seems to me that we lost something there. And I'm afraid we gained something. I'm afraid we gained a disillusioned, thwarted citizen who will not try quite so hard again maybe. Now, there're a lot of people like that in this country, who would like to have a piece of it. And we've chosen to keep them from having it.

It's not as though the biggest farm was the most efficient farm. It's beginning to be widely circulated – the news is out – there's a size beyond which size doesn't get any more efficient, and it's possible for small farms to be highly efficient. It depends on how you rate efficiency. If you're talking about efficiency as the output per man per day, maybe high mechanization is the most efficient. If you're talking about the highest output per acre, the smaller operations tend to become the most efficient.

I was driving through Indiana today. I didn't see very many corn fields that had been sowed back to a winter grain crop. That means that there're going to be a lot of days in any year when those fields won't be processing solar energy into something that we can use. Sunlight falling on those fields today was wasted. If the farms were smaller, the crop could be taken off and those fields sowed back. I know it can be done this far north because I was on an Amishman's hillside in Holmes County, Ohio, last year and saw where he'd harvested his corn and shocked it, carried the shocks off the field, and he had a good stand of winter grain. That's the kind of care I'm talking about.

The Amish are doing very well, on a small scale. They're highly productive. They've been putting the money in the bank too, while a lot of mainliners been going out of business.

Somebody told me the other day that out of every thousand dollars of government money that goes to subsidize industry in this country, five dollars goes for agriculture. I don't know. Maybe it's the free enterprise system to subsidize railroads but not farms. For my money, I would subsidize the farm. That's where I would place my tax money. I don't mean in give-away programs either. I mean in programs where price supports would be coupled with production control. Where the public outlay would be for administration. I'd like to provide some low-interest loans for fellows like my young neighbor. I don't think that's giving him an undue advantage. Think of the thousands of dollars we invest in the educations of doctors. You can put a young man on a little farm and educate him and realize a grand increment from that investment.

As I see it, the farmer standing in his field is not simply a component of a production machine. He stands where lots of cultural lines cross. The traditional farmer, that is the farmer who first fed himself off his farm and then fed other people, who farmed with his family, who passed the land on down to people who knew it and had the best reasons to take care of it – that farmer stood at the convergence of traditional values, our values: independence, thrift, stewardship, private property, political liberties, family, marriage, parenthood, neighborhood – values that decline as that farmer is replaced by a technologist whose only standard is efficiency.

Our values have very clearly and markedly declined as the urban industrial values have replaced the old agricultural ones. Private property seems to me to be in a kind of crisis, because how can you expect people to defend the principle if they don't own any of the substance? What's private property to somebody who doesn't have any property? Did we really

Hooper

Butz: In India shortly after the Indians got their independence from Great Britain, one day Gandhi very sagely remarked, "Even God dare not approach a hungry man except in the form of bread." I've seen starving men. No use talking to a man like that about human dignity. No use talking about democracy. No use talking about freedom. He listens only to the man who has a piece of bread. And that is precisely the language we are prepared to speak in the United States.

think that we were going to get people in the cities, who own no land at all, to vote or fight or whatever they're gonna have to do to protect our farms? I don't know why they should, unless we can get clever enough propagandists to brainwash them.

But these values are not native just to small farms, they're native to all small enterprises. And again by policy we've wiped these out – neighborhood grocers, little shoe shops. We have to drive 40 miles now to get our shoes fixed. Maybe you're not supposed to get your shoes fixed any more. Maybe you're supposed to throw them away. I try to get mine fixed.

I think when the traditional people disapper, the traditional values will disappear. How could they survive? The lines of values converge on the traditional small operator, the small man of enterprise. They all diverge from the profiteer. I'm assuming that when I say traditional values everybody knows what I'm talking about – democracy, neighborliness, kindness, and so on. If you're going to be neighborly you have to know your neighbor. You can't be neighborly in a convocation of strangers. It's what lots of people have been telling us for a long time – you can't have these things in the abstract. I don't think that you can love those old values and love what has come to be American agriculture at the same time.

REBUTTALS

Butz: I've got a feeling that Dr. Berry and I haven't met here tonight. Perhaps we won't. Because we are spending $500 a year in health insurance he says there is a crisis in health. I've lived past my life-expectancy when I was born by 30 years. My little granddaughter, two years old, now can expect that extra 30 years. I don't call that much of a crisis. When I was in high school up here at Wawaka, we always expected to have a couple of families out of school sick. You'd go out to see where the kids were and you'd see the sign on the door saying, "Quarantine – diptheria here," or "Smallpox here." You can't find that in this county now – we've wiped it out. We eat better. We're healthier. We're bigger. And of course we spend money for hospital insurance, because we're affluent enough now to afford the hospital. We didn't even have a hospital when I was a kid. I'll take right now beside the old days any day in this health business.

Let's get back to this young boy who wanted to farm, Wendell. I was interested. You were citing a specific case. We stopped at McDonald's out here a while ago. I was standing there at the counter waiting and this young fellow about in his early thirties recognized me. I said, "You a farmer?" "I certainly am," he said. "Where you farm?" "Oh, four - five miles out of town here."

We made some small talk, and I said, "Dad's farm?" "Nope." I said, "Did Dad get you started farming?" "Nope. I started on my own." I said, "How much of it's yours?" He said, "I own 400 acres." I guess he was farming about 600 acres; he said he had two or three landlords. Now that's the other story.

I see that taking place all over America all the time. I know some doctors are buying farms, and that's quite all right. Some farmer's kids are going into medicine, too. But the great bulk of farm purchases is done by farmers who are buying piece by piece, and the great bulk of the landlords in this county are farmers who've retired, or farmer's widows. The percentage of absentee ownership of farm land in Indiana is lower now than it has been for years and years. That's true in America too. Those figures are beyond dispute.

I asked Dr. Berry this evening how big a farm he had, and he said 50 acres. I said, "Do you farm with horses?" He said, "Yes." But you see, Dr. Berry can do that because he has a substantial income as a poet, as a writer, as a professor at the University of Kentucky. He can afford to pay the electric bill – he doesn't have to have kerosene lights. He can afford to have an automobile – he doesn't have to drive a horse and buggy. He can afford to do those things because he takes outside income. Let's never forget that. That's true of many writers who write about such things as he does.

People say, "Butz, you're not for the family farmer." Of course I am. I'm for the family farm to make a decent living for the farm family. I don't want that

Berry: The idea that human beings could starve for want of oil is something new under the sun all right. I won't mind a bit when we go backwards from that, just as an alcoholic oughtn't to mind if he goes backwards from his addiction.

Dupré

family to starve to death slowly. I want that family to be able to enjoy some of the amenities of life — a color TV set, electric lights, indoor toilets. I want them to be able to afford an automobile and a vacation trip once in a while. Now, about saying that if you don't have a piece of farm land, you're not independent, you're not democratic, you don't have an interest in America . . . Don't tell me that the people who live in North Manchester, Indiana, and are home owners, who work somewhere in a factory — don't tell me they don't have a sense of independence. Don't tell me they don't have a sense of community involvement. Don't tell me that they're not responsible citizens, I think more surely than if they were on a small piece of land which was so small as to be uneconomic.

I know you make some trade-offs in this world. You lose some of the old family entity that used to be out there. This is unfortunate, I think. But that's not because you live on a farm or don't live on a farm. That's because we've got automobiles and TV sets and roller skating rinks and that type of thing, and that's just as true of farm kids as it is of city kids. Those TV waves don't respect city limit signs a bit.

We talk about the crisis in culture, "because of no private property." There's a lot of private property in this country. You don't even have to own a house to have private property. We've all got life insurance. We've got interest in America. We've got interest in the very profit process in America.

So I say, when we get to dreaming about yesteryear and the nice things we like to remember about yesteryear, let's set it off against the advantages of what we have. When you do that, the comparison is so obvious that the choice is easy.

Berry: Well, since Mr. Butz referred to my life, which is something I didn't intend to do, I may as well tell you about it. I know a little bit more about it than Mr. Butz. I am a school teacher and a writer. I've written a lot of books, which haven't exactly sold like hotcakes. I may have made a year's salary out of it by now — not a large year's salary. I turned away from the main line of a teaching career. I was living in New York City, and I got a chance to come home and teach in the University of Kentucky. And then I went all the way home, to Henry County where my family, seven generations of my family, have lived and now live — not on the farm I live on, but on the next farm.

I just had 12 acres for a while, most of it steep, and I could hardly have called myself a farmer then. But a developer bought the 40 acres next to me and was going to cover it up with little cottages, without any plumbing or sewage. He did some rather bad bulldozer work on it and made a hideous mess of it and failed. Then I bought him out, and I've spent the last four years restoring that 40 acres. It has been expensive. The land could never have paid for the operation. I paid for it out of my salary. It's productive land now — steep; by modern standards, marginal. It's producing enough cattle now to pay the taxes, and we're taking our subsistence from it.

I should say that subsistence taken off that little farm makes our domestic economy extremely sound. I've done the work with horses. I've done it because I like horses, and because driving horses, I'm independent of the oil companies. I like that. Also, having horses makes economic sense. A good broke team of young mares now brings from $2,000 - $10,000 without any trouble at all. So I don't want any of you all to worry about me, because I farm with horses.

I was wondering how my neighbors were thinking about it until one stopped — an old man — and told me how proud he was of me, and until another stopped just the other day, a young man, and asked me if I could find him a team. He said that he thought he'd cultivate his crops with them and do — one — a better job, and — two — a cheaper job than he could with his tractor. He's right on both counts.

I've done a lot of work. I've gotten a lot of exercise. I've eaten well. I don't feel that I'm the least bit damaged; it hasn't dulled my mind. I was on a panel with the vice-president of John Deere a while back, and he was congratulating himself on the number of people he'd liberated from groveling in the earth in order to use their minds. Well, then I went to New

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York, and I saw all those people up there, vomiting in the gutters and passed out in the subways and lying along the street, and I said, "Uh-huh. This is what people do when they're liberated to use their minds." I was delighted to find that out.

Now, Mr. Butz has given you a lot of quantitative arguments. Let me just take a few of them. We may never meet, because he's arguing from quantities and I'm arguing from values. Life expectancy is not a value in and of itself. Some things, our tradition tells us, are worse than death — among them, too long a life and bad circumstances. Quality of life has to do with morals and with spiritual good health. It doesn't necessarily have to do with a flush toilet.

One thing I do on my farm is use a composting outhouse. One of the most damaging things we've got in this country is the flush toilet. The nutrients of the earth that we eat pass through our bodies, and according to the laws of biology, if the land is to stay in good health, those nutrients have to go back on it. We use millions and millions of dollars worth of soil nutrients that we eat and then put into the rivers to become pollution, and then spend millions of dollars purifying it again to drink it. It doesn't make any sense. If we ran our own households on that kind of an economy, people would think we were stupid. Suppose you put a pump in your septic tank, ran the effluent through an expensive processing system, and then drank it. You'd have people in white coats at your front door. But this is the way this whole society works.

Independence? If you've got your own land, you're sure as hell independent if you grow your food from it. You won't be starved by a shortage of oil. The idea that human beings could starve for want of oil is something new under the sun all right. I won't mind a bit when we go backwards from that, just as an alcoholic oughtn't to mind if he goes backwards from his addiction.

There's a lot of private property, Mr. Butz says, in insurance policies in America. Those are abstract. I don't love my insurance policy. But I sure love my farm. I haven't laid awake at night thinking about my insurance policy. Lord god, I hope I never do lie awake at night thinking about it. I hope I never depend on it.

Mr. Butz has made two references to this nice schoolhouse. This one here, has it got a skylight in it? School takes place in the day time. Modern educators don't know it. They've never been out of their air-conditioned solid-walled offices long enough to find out that school still takes place mostly in the day time. You'd think that to save the taxpayers' money — everybody's aching to save the taxpayers' money — that some of these people'd build a school with a window or a skylight in it. It's same as with agriculture. We've based it on petroleum. We've based it on industry. Mr. Butz says, 70 people are being fed by one farmer. One farmer plus how many truck drivers, middle men, packagers, processors, precookers, road builders, oil companies, employees, how many? That's a sheer . . . It's misleading, is what it is.

Hooper

I don't ask that my values be adopted over night, and a bunch of people who've never farmed move to the country. What I'm advocating is a change of values, and I assume that changes of behavior will follow changes of values.

QUESTIONS

Question about the young man who inquired about buying a team. (Questions were indistinct in the tape, so they'll be paraphrased.)

Berry: He's not stupid, and he doesn't have 600 acres. He raises some tobacco, and even with the tractor, that's very slow work, cultivating tobacco. I don't know if you've ever used a two-horse riding cultivator. It's the best cultivating tool that was ever made, as far as I know.

Question about the Amish.

Berry: Well, they're still doing very well farming with horses. They're doing well by cooperating in neighborhoods, as a lot of people used to. I don't know how old you are, but probably not old enough to remember when people used to get together and work, but they did. They still do in my part of the country. There's something to be said for the value of people helping each other, don't you think? I don't think that anybody's going to get to heaven by being efficient. I don't think St. Peter, when he meets us up there, he's going to ask a single one of us how efficient we were. I think he's gonna ask us, did we help our neighbors. And I think in our hearts that's what we ask ourselves. If we're going to trade the possibility of working with our neighbors for a four-row cultivator, I think we've made a bad trade. I like working with my neighbors. We talk to each other. Most of the stuff I know that I really enjoy knowing is from listening to my neighbors talk when we work together.

Voice: You can't go backwards.

Berry: I'm not talking about going backwards in history, I'm talking about going backwards in character.

Question about a lot of new people getting into farms.

Berry: People who're buying agricultural land now are city people — doctors and lawyers and businessmen of various kinds. They are able to pay the costs and the high interest rates and they get as a reward a place to come out to with their friends on the weekends. They make some of the worst neighbors that history has ever known.

One thing I've been fascinated with recently is watching some of the city people who come to the farm and are trying to learn how to farm. It takes longer than I thought it would. It gives you some sense of what a complex thing a farmer's mind is.

Berry: I don't think it can happen very quickly. One thing I've been fascinated with recently is watching some of the city people who come to the farm and are trying to learn how to farm. It takes longer than I thought it would. To look at this happen gives you some sense of what a complex thing a farmer's mind is. I don't think I appreciated it enough, although I appreciated it a good deal. It'll take a long time to get those people established and well off. What would you say, you farmers? It takes five years for a farmer to learn to use a new farm, learn the condition of it and how to get along on it. Never learn? I understand what you mean.

Question about limits to the trend of fewer farmers.

Butz: Obviously there is an irreducible minimum and we are approaching that. Right now we've got, by the census definition, 2.8 million farms in the United States. On over half of those, however, the operator makes more money off the farm than he does on the farm — he's a Wendell Berry. They're really rural residents who have some of the things that Dr. Berry's talking about here tonight. Approximately 600,000 farms in the United States produce better than 80% of our commercial farm products. There won't be much more reduction.

Voice: If farmers are so important in the world, why don't more people listen to us?

Butz: It's a good question. I know we're in some economic stress right now, depending somewhat on the kind of farming you're in. In Iowa the other day I asked this farmer, "How's your cash flow?" He said, "My cash flow is pretty good, the trouble is I ain't stopping none of it." Well, why don't more people listen to you? I think in the current political situation, it wasn't farmers that elected Mr. Carter. I'm sure he must have gotten up the morning after the election, looked at the map of the United States, and he saw everything west of the Mississippi, plus Illinois, Indiana, and Michigan, colored the wrong color. He must have decided, "Nuts to those birds, they're not the guys who elected me. I'll take care of labor with the higher minimum wages and the cargo preference bill, I'll take care of people for free food-stamps for everybody." I guess it's just a matter of paying those that took care of you.

Berry: I'd like to answer that question too. I think they don't listen to farmers because there aren't enough of you. You're a negligible quantity, politically. I don't see how you're going to protect yourselves without some friends in the cities, and I don't know how you're going to get them. You see, this is the split that I'm talking about. You're feeding people who are not interested in raising food, they're interested in eating it. So when you've got a declining small population in which nobody is interested, I don't see how you stop it at an irreducible minimum. It seems to me that farmers are in rapid precipitous decline, they're without political friends, and I don't see how they can do anything except expect to decline some more. Unless values change.

Question about how we get more people on the land.

Berry: I think that more people ought to be able to buy it. I was interested in what Mr. Butz said about the prevalence of farm buyers on the market. It seems to me that when we think about land prices and the income that's coming off the land, it's not a very good situation. People are selling out of farming at a great rate. It seems to me that the way the land is priced and the way interest is going, it's getting more and more likely that non-farmers are going to buy the land. And it doesn't seem to me to violate good sense in any way, or good economics either, to take steps through tax benefits to young beginning farmers and through low-interest loans.

Question about how serious the consequences of the current agricultural situation are.

Berry: One thing I think you've got to have your eye on is the young people. My farm is a very negligible operation in Mr. Butz's terms, but one of the increments I've had from it is that when my kids have been home I've had something for them to do. They've been surrounded by a complex structure that they had to understand before they could work in it, and working in it taught them something about the complexity of it and the way it depended on them. They have some kind of sense of responsibility. I don't have a TV and so my kids have been thrown back on books a little bit.

What my kids have had, I'm beginning to see now that the oldest one's getting away from home. What they have — that I think is running pretty short in this country — is the capacity to entertain themselves. They don't get bored if somebody's not putting on a show for them.

A lot of kids now are getting credit cards and charge accounts at stores. And you know what they're doing? They're going to those stores and stealing stuff, to amuse themselves. In my classes, it's getting harder and harder to talk about traditional values now. It's getting awful hard to find a kid who's ever run into the 23rd Psalm. I asked my class the other day, "How many of you have read Tom Sawyer?" Not a soul. So, you've got color TV, charge accounts, new cars, no work, and you've lost Mark Twain. I think it's a bad bargain. ■

AGRICULTURE'S ROLE IN SOCIETY

The complex intertwining of agriculture and the rest of the world is hard to define.

BOOKS

Omnivores Dilemma - Michael Pollan
Farming While Black: Soul Fire Farm's Practical Guide to Liberation on the Land - Leah Penniman
My Work is That of Conservation: An Environmental Biography of George Washington Carver - Mark Hersey
The Soil and Health: A Study of Organic Agriculture - Albert Howard
Lentil Underground: Renegade Farmers and the Future of Food in America - Liz Carlisle
Grain by Grain: A Quest to Revive Ancient Wheat, Rural Jobs, and Healthy Food - Bob Quinn and Liz Carlisle
Nourishment: What Animals Can Teach Us about Rediscovering Our Nutritional Wisdom - Fred Provenza
Who Really Feeds the World?: The Failures of Agribusiness and the Promise of Agroecology - Vandana Shiva
Freedom Farmers: Agricultural Resistance and the Black Freedom Movement - Monica M. White

My Work Is That of Conservation

Mark D. Hersey

Published by University of Georgia Press

Hersey, Mark D.
My Work Is That of Conservation: An Environmental Biography of George Washington Carver.
University of Georgia Press, 2011.
Project MUSE.muse.jhu.edu/book/11446.

CHAPTER 3

The Ruthless Hand of Mr. Carenot

Despite his thorough scientific training, Carver was unprepared in some significant ways for the world he encountered when he stepped down from the train in Macon County, Alabama. As a native of the Midwest, Carver found himself in unfamiliar social, political, and ecological terrain. Understanding that terrain is essential to understanding Carver's environmental vision, for his efforts to reform the prevailing agricultural landscape are unintelligible considered outside the agroecological context of Alabama's Black Belt—along with the socioeconomic and political world that shaped it. Furthermore, this was the world in which he went for daily nature walks, collected mycological specimens, plowed, planted, and communed with "the Great Creator." It was the world he needed to understand if he was to fulfill the plan he believed God had ordained for his life, a world full of secrets for him to reveal to his people.

Macon County, Alabama, of which Tuskegee is the seat, was a relatively new world in its own right. Less than one hundred years earlier it had been situated in territory belonging to the largest and arguably most feared group of southeastern Indians; indeed, it lay in the very heart of Creek country.[1] Although Creek towns were concentrated along the Coosa, Tallapoosa, and Chattahoochee rivers in eastern Alabama and western Georgia, the Creeks

claimed sovereignty over a substantially larger area. At the time of naturalist William Bartram's expedition in the 1770s, Creek country amounted to some 62,130 square miles stretching from the Tombigbee River in the west, where it bordered Choctaw and Chickasaw territories in what today is eastern Mississippi and western Alabama, to the Oconee River in present-day east-central Georgia in the east. To the south the Creeks' territory blended with that of their close allies, the Seminoles, along the Gulf Coast; to the north their territorial claims ended in Cherokee country along the Tennessee River.

In the very middle of Creek country—along the Upper Trading Path connecting Tuckabatchee, the most important town of the Upper Creek, with Coweta, its counterpart among the Lower Creek along the Chattahoochee—lay the area that would become Macon County. Located along the fall line, an ecotone marking the convergence of the longleaf pine forest of Alabama's coastal plain and the mixed southern forest of the piedmont, Macon County held the southeasternmost settlements of the Upper Creek. As the Creeks generally built their towns along the alluvial terraces of the three main rivers, it is not surprising that the towns of Autosee, Tallassee, and a small portion of Tuckabatchee were on the Tallapoosa, along what would later be Macon County's western border. Smaller towns such as Chattuckchufaula (on Uphapee Creek in what would become Macon County) and satellite settlements (distinguished by their lack of ceremonial centers) occupied sites on secondary and tertiary streams. In general, however, the area from which Macon County was carved was sparsely populated, and the impressive and diverse landscape of "savannahs, groves, cane swamps and open pine forests, watered by innumerable rivulets and brooks" that Bartram described was more often crossed and hunted on than lived in.[2]

At the fall line, the Tallapoosa River and Macon County's numerous streams break into waterfalls, then widen and slow down, and so are more prone to flooding. That factor provided a significant incentive for the Creek to live at or above the fall line. The location was prudent for reasons other than flood avoidance as well. The waters just below the falls and the shoals above them contained abundant fish. Anthropologist Robbie Ethridge pointed out that "even today the freshwater ecosystems of the southeastern United States contain the greatest variety of freshwater fish in North America, and they are famous for their diversity of mollusks."[3] Macon County was particularly blessed in terms of fishing. Benjamin Hawkins,

the U.S. Creek Indian agent from 1796 to 1816, reckoned Uphapee Creek to be "the most valuable creek known here for fish in the spring and summer," listing "sturgeon, trout, perch, rock, [and] red horse [red drum]" as being among them.[4] The shoals above the falls provided a nearly ideal environment for waterfowl and proved especially conducive to the growth of moss naturally rich in salt that attracted game, especially deer.

The wetlands along many of the waterways at the fall line offered an ideal habitat for many plants and animals, from river cane to berries, from birds to black bears. Depending on their purpose for being in Creek country, white observers either feared the swamps or saw possibilities in them. Those merely passing through the area avoided the swamps, and when forced to cross them often refused to dismount for fear of stepping on a "serpent" or "viper."[5] To be sure, Alabama's swamps are home to a number of venomous snakes—copperheads, cottonmouth moccasins, and coral snakes. Even a few alligators ventured as far north as Macon County. Whites who hoped to develop Creek country along the lines of the rest of the nation, however, saw potential farmland. Hawkins, for instance, described a wetland near the Creek town of Cooloome as "a rich swamp . . . which, when reclaimed, must be valuable for corn or rice, and could easily be drained."[6] Indeed, the canebrakes along rivers and creeks—swampy places where bamboo-like river cane had proliferated—were already well known as markers of unusually rich soil.[7]

The fall line also represents a transitional ecological zone, and thus marks changes not only in the waterways themselves but in the flora and fauna of the region. To the north lay the mixed forests of the southern uplands. As its name implies, the southeastern mixed forest contained large numbers and varieties of both coniferous and deciduous trees; its undergrowth proved equally diverse. Certain hardwood trees, such as the American chestnut, could be ten feet in diameter and so tall that the trunk did not branch until forty feet or more above the ground, with branches reaching fifty feet on either side of the trunk. In some years, the mast from the chestnut, oak, and hickory trees could be measured in inches. "To keep within the bounds of truth and reality, in describing the magnitude and grandeur of these trees," Bartram wrote, "I fear, fail of credibility."[8]

To the south of the fall line lay Bartram's "open pine forests" of the coastal plain, which though interspersed with other species were dominated by longleaf pines. The trunks of the pines often extended seventy or eighty feet above the forest floor, and when the wind blew, the branches whistled, sang,

or whispered. In Creek country the pines were widely spaced, leaving wiregrass as the dominant ground cover. Other grasses grew there as well, as did some three thousand species of wildflowers. Given the region's substantial rainfall, the predilection of its waterways to flood, and the general flatness of the coastal plain, swamps were more prevalent below the fall line.

Where the two regions converged along the fall line, their biotas overlapped, producing an extraordinarily diverse assembly of plant and animal resources. In large measure this biodiversity was the driving force behind the location of the vast majority of Creeks' towns within the transitional zone between the longleaf pine forest and southeastern mixed forest. The towns of Macon County were no exception.

In addition to the advantages provided by the diverse biota, the transition zone along the fall line had one more significant feature peculiar to its environment: the savannah-like plains of the Black Belt, a name that describes a distinctive geology and soil rather than the demographic preponderance of African Americans as a result of the plantation culture that would thrive there. From Macon County, which sits on its eastern edge, the Black Belt curves along the fall line west and north into northeastern Mississippi, following the ancient shoreline of a sea that lapped the hills rolling up toward the Appalachians during the Cenozoic Era. Over millions of years, plates of drifting microscopic algae settled on the bottom and formed limestone subsoil known today as Selma Chalk. In what amounted to a geological perfect storm, large pockets of this limestone remained near the surface after the sea receded. Because the limestone was impermeable, plant nutrients collected near the surface, creating an organically rich and responsive topsoil with few equals in the South, albeit a comparatively difficult one to work as it was a rather sticky clay.[9]

The fact that the soils were shallow—generally less than a foot deep—and alkaline rather than acidic (in marked contrast to most southern soils) made them less than ideal for longleaf pine but ideally adapted to prairie bunchgrasses and wildflowers. The result was a series of smallish prairies dotted across the landscape that eighteenth-century white observers referred to as "savannahs," "plains," or "meadows." Bartram, for instance, noted "expansive, illumined grassy plains" paralleling the Tallapoosa. The "upper stratum or vegetable mould of these plains is perfectly black, soapy and rich . . . [and] lies on a deep bed of white, testaceous, limestone rocks, which in some places resemble chalk."[10] Bartram's description of the soil explains why the region would subsequently be dubbed the "Black Belt,"

though in recent years scientists have often called it the "Black Prairie" in order to avoid confusion with the demographic Black Belt.

Bartram described glades of trees from the surrounding forests "project[ing] into the plains on either side, dividing them into many vast fields."[11] The British naturalist Philip Henry Gosse likewise observed these fields during his brief stay in the region in 1838. Each, he noted, was surrounded by woods "on every side like an abrupt wall" and ranged in size from a few acres to a square mile.[12] While the Creeks did not farm the prairies because the clay soil was too difficult to work—rich alluvial soil was as readily available, easier to cultivate, and plenty responsive—the Black Belt prairies provided rich browse and graze for white-tailed deer and other game animals. White observers, however, noted the agricultural potential of the organically rich soil and the ease with which the prairies might be brought into cultivation because little was needed in the way of clearing. As a further inducement to future white settlers, the limestone subsoil had dissolved away over millions of years, creating in essence a funnel that brought Alabama's major rivers through the region: the Tombigbee from the northwest, and the Alabama, formed from the confluence of the Coosa and Tallapoosa rivers about thirty miles west of Macon County, from the east. In an era in which water transportation was paramount, this was no small matter, and it made the region even more desirable to would-be settlers.

With its mild climate, high annual rainfall, long growing season, and Black Belt soils, Macon County was thus—to borrow a phrase Carl Ortwin Sauer applied to the entirety of the territory belonging to the southeastern Indians—"an especially favored country for extensive agriculture."[13] The county's Creek residents could indeed boast, as Carver would later assert of the South as a whole, of having "natural advantages of which [they] may justly feel proud."[14]

Of course, Creek country was not an Eden entirely unstressed by its human population. The Creeks manipulated the environment both for their sustenance and for economic and political leverage against colonial powers and later the United States. Their growing dependence on European manufactures over the course of the eighteenth century prevented Creeks living along the major trading paths from moving away when their fields became less responsive, and so by the time of the American Revolution there were localized soil crises.[15] The introduction of livestock led Creeks to be of one mind with European Americans in pushing for the extirpation of predators such as wolves and cougars. Even in the absence of predators,

however, white-tailed deer had been pushed to the brink of extinction by the explosion of the deerskin trade in the wake of the Yamasee War (1715).[16] Considering the extraordinary reproductive capabilities of the white-tailed deer, their relative scarcity by the dawn of the nineteenth century provides a clear example of large-scale environmental transformation prior to white settlement.[17]

The decline in the deer population coincided with another event that would bode ill for the Creeks. Eli Whitney's cotton gin, patented in 1793, facilitated the extraction of seeds from the bolls of short-staple cotton. That in turn made growing cotton away from the coast (where the more finicky Sea Island cotton was already a highly profitably raised crop) a lucrative endeavor, the more so since it coincided with an international boom in the demand for cotton as a less expensive alternative to woolen, silk, and linen textiles. White Americans, especially Georgians, turned their eyes inland toward Creek country and saw something they had not seen before—a compelling reason to expropriate it (to borrow a phrase from Chief Justice Earl Warren) with all deliberate speed. During the height of the deerskin trade, Creek hunters had been a vital part of the global economy. By the 1790s, however, as Ethridge pointed out, "the Creeks as well as all of the southern interior Indian societies found themselves not only unnecessary to the American economy, but in fact . . . impediments to it."[18]

The Creeks' struggle to keep their land stretched out over decades, but by 1826 they had been forced to cede their claims to all but 5 million acres in eastern Alabama.[19] Macon County, which remained part of this diminished Creek territory, saw its population boom, leaping from about 1,500 in 1800 to roughly 6,000 in the wake of the 1826 treaty.[20] Where there had been four towns there were now fifteen, among them the town of Tuskegee along Calebee Creek, situated not far from where the federal road connecting New Orleans with Washington, D.C., crossed the creek and began to follow its south bank toward the Tallapoosa River. Its location along the federal road made Tuskegee a reasonably important trading town, and Creeks there (and elsewhere along the road) hocked wares to migrating settlers, stage passengers, and postal carriers and provided shelter when rains washed out the road or wagons broke down.[21]

Even though it was still legally occupied by the Creeks, Macon County was formally incorporated in 1832 and completely surveyed and mapped by early the following year. Predictably, the county's chief business was land speculation. Bystanders and victims by turn in the speculative rush,

the Creeks began making plans to emigrate west. When in the spring of 1836 armed conflict broke out as small bands of Creeks launched "a reprisal against the land speculators" who sought to take advantage of them, white settlers feared that the scattered attacks would result in a full-fledged uprising.[22] Some counseled caution, such as the editors of the *Montgomery Advertiser* in neighboring Montgomery County, which "deprecate[d] the conduct of those who are continually sounding the cry of danger when there is none to be apprehended." But their words were drowned out by the shouts of those who wanted the Creeks gone forever, and the governors of Alabama and Georgia appealed to the federal government to intervene and crush the Indian "uprising."[23]

In June 1836 a U.S. Army contingent under General Thomas Jesup arrived in the white town of Tuskegee, a speculative endeavor a couple of miles north of "Indian Tuskegee" to which the federal road had been rerouted. By the end of the month, Jesup considered the Creek War concluded. On August 17 he issued orders for the removal of 2,700 Creeks, and on September 2 the forced exodus began. The following February, whites raided the remaining Creek communities, burning and plundering Creek landholdings. The Creeks fled the county and were escorted by the army to Mobile and from there to the West.

Despite the environmental changes that had attended the previous half-century, at the time of Creek removal Macon County still looked more like the environment through which Bartram had passed in 1775 than the one Carver would encounter in 1896. Mrs. Basil Hall, for instance, marveled in 1828 that the forest was sufficiently open to permit horses to pull a carriage through "the very heart of it." Her husband, Captain Basil Hall, acknowledged that the region was marked by "very pretty woods." Six years later, G. W. Featherstonaugh passed through the county and commented on the "pleasantly running" streams and their banks "covered with laurels, live oaks and other evergreens," and noted that "wild grass was growing everywhere in profusion." Other travelers commented on the clarity of the water, the beauty of the wildflowers, and the general aesthetic appeal of the place. Europeans in particular were fulsome in their praise of the region's beauty.[24] To be sure, the landscape itself was changing: white-tailed deer were virtually gone; wolves and river cane were fading fast; fences surrounded the now-abandoned Creek fields; and cattle and hogs foraged in the woods. The changes wrought by the Creeks' successors, however, would far outstrip these.

Indeed, the newcomers would push back the forest, strip the soil of its humus, and turn the region's signature waterways brown with silt. Those ecological changes did not occur overnight. For some time following Creek removal and the failure of two speculative endeavors along the Tallapoosa, white Tuskegee remained the only inhabited town in Macon County.[25] Settlers had begun farming along the county's two main roads and along the rich bottomlands of its streams, but the real business there was still land speculation. Eighty-seven percent of the land forcibly appropriated from the Creeks was bought by individuals (or land companies) whose purchases in the county met a minimum standard of 2,000 acres. One company, Watson, Walker, Harris, et al., for example, purchased some 477,000 acres in the late 1830s and early 1840s, and realized a nearly 100 percent profit in selling the land, primarily to planters emigrating from South Carolina and Georgia.[26]

Typical of the men investing in the county was T. S. Woodward, who is remembered as the founder of Tuskegee. Woodward had first seen the area in 1813 and 1814 as a soldier under Andrew Jackson, and had passed through it again in 1818 on his way to fight the Seminoles in Florida. Following the county's incorporation in 1832, Woodward had organized and laid out white Tuskegee, and then had begun buying Indian allotments. Relatives of his won the contract to regrade the federal road through the county, and rerouted it through white Tuskegee. His own company, Woodward, Strange, Harris, Jones, et al., purchased more than 46,000 acres in the county, and he was a silent partner with his brother-in-law, J. C. Watson, in Watson, Walker, Harris, et al. By the end of the 1830s Woodward had speculated on some of the choicest land in the county, including a three-square-mile block along the county's main thoroughfare.[27]

Although some 142,000 acres—slightly less than a quarter of the county's land—were open to public purchase at auction, speculators had no difficulty unloading their property. By 1840 the county was booming. Tuskegee, with a population of three hundred, remained the largest town, but others, including Union Springs and Auburn, had been established and were growing quickly. Within a few years many of the speculators, including Woodward, had sold the last of their land and moved on. Woodward, like his counterparts, had profited handsomely, as is indicated by the $20,000 dowry he left to a slave daughter he freed on his death. At the end of the 1840s, a debating society could meet in Tuskegee to discuss whether or

not the government was justified in appropriating Indian lands without so much as a hint of irony.[28]

By virtue of sheer numbers, the county's new residents placed an increased strain on its environment. The Creek population of the county had never exceeded 6,000, even at its densest, but the 1840 census counted more than 11,000 people living in the county. The forest was pushed back continually as white settlers and their slaves moved in. The Creeks had cleared land almost exclusively in the floodplain, where the forest was in various stages of succession. Not so with their white successors, who cleared the old-growth forest along the ridges as well. In a recently cleared section of the west-central portion of the county, one contemporary counted some 320 rings on the stump of a felled tree.[29]

By 1850 the population of Macon County had peaked at 26,898 people. The fact that 15,612 of them were slaves indicates the degree to which its residents were engaged in commercial agriculture. A decade earlier the population of the county had been nearly evenly divided between slaves and free. To be sure, some large slaveholders had settled in the county by 1840 and more were moving in, but much of the land was still held by independent white farmers, many of whom were essentially squatters. Over the course of the 1840s, however, the planters had consolidated their landholdings and political power, and by 1850 the solidification of a plantation culture in Macon County was very nearly complete.[30]

Only about one-third of the 1,273 farming households that the 1850 census reported living in the county owned no slaves. And of these 420 non-slave-owning households, only 224—slightly more than one-half—owned the land they worked. Thus, fewer than 20 percent of the farmers in the county could be considered yeomen, and most of their holdings were relegated to marginal soils of the rolling ridges in the northeastern portion of the county. By contrast, 444 farming households owned between one and nine slaves, with the average small slaveholder owning five; only 82 households owned a single slave. Virtually all of these 444 households owned their own land, and they farmed, on average, an area twice as large as their non-slave-holding counterparts but were eight times wealthier. These small slaveholders, who often pooled their slaves' labor at harvest and other busy times, were still considered small farmers inasmuch as they devoted most of their attention to the production of subsistence rather than cash crops.[31]

The real power—political, economic, and social—rested with the plantation owners who controlled the 409 farming households with ten or more slaves. They owned roughly 80 percent of the slaves and a large majority of the land in the county. A quick survey of some statistics from the 1850 census confirms their economic dominance. Non-slave-holding households had an average landholding wealth of $445; the average small slaveholder, $1,113. The county's 275 small plantations (those with at least ten but fewer than twenty-five slaves) had an average landholding wealth of $2,550. The average land wealth of the one hundred medium-sized plantations (with more than twenty-five but fewer than fifty slaves) amounted to $5,854; the thirty large plantations (of between fifty and one hundred slaves) could claim average landholdings of $8,912; and the four largest plantations (of more than one hundred slaves) had an average landholding wealth of $15,650, better than fourteen times that of the households owning fewer than ten slaves. When slave wealth was factored in, even the small plantation owners controlled three times the wealth of their small slaveholding counterparts, and the largest plantations had an average wealth nearly eight times that of the small plantations.[32]

Though the specific figures differed, what was true of Macon County in 1850 was true of other Black Belt counties as well. Macon County was not exceptional among them in having slaveholders constitute roughly two-thirds of its households, or in the fact that one-third of its farming households were considered plantations. As in other Black Belt counties, the planters held a monopoly on the best lands, including the rich Black Belt soil, and virtually all the political power. In many ways, then, the foundation for the world Carver encountered had been laid by 1850 with the emergence of a plantation culture in which a few people dominated the political, economic, and social community, and African Americans worked the fields.

The planters' wealth and power was directly related to their production of the crop Alabamians held most dear: cotton. Historian Weymouth T. Jordan noted that plantation owners produced almost all of the cotton grown in the state and "made a ritual of their homage to cotton." They cultivated other crops as well, of course. The collapse of the boom market that had helped fuel the rise of cotton production—which more than tripled in the state during the 1830s—fostered a good bit of crop diversification in the early 1840s. Even so, cotton remained the principal source of the state's wealth, and perhaps more important, it retained an elevated place in planters' hearts—and nowhere more so than in the Black Belt, where, as Jordan

succinctly and elegantly phrased it, "Alleluias were showered on agriculture; hosannas were reserved for cotton."[33]

As of 1850 Alabama led the nation in cotton production, and a decided majority of its cotton bales found their way down the state's rivers to Mobile, which was second only to New Orleans as a cotton port. A British visitor caught the spirit of Mobile in the 1850s, aptly describing it as "a pleasant cotton city of some 30,000 inhabitants—where people live in cotton houses and ride in cotton carriages. They buy cotton, sell cotton, think cotton, eat cotton, drink cotton, and dream cotton. They marry cotton wives, and unto them are born cotton children." Cotton was "the great staple, the sum and substance of Alabama."[34] The relocation of the state capital from Tuscaloosa to Montgomery, the chief trading hub of the Black Belt, in 1846 was one telling indication of how deeply Alabamians valued the cotton plantations of the Black Belt. By 1850, then, the political geography of the state reflected the overwhelming importance of cotton: its locus of power resided in the Black Belt, and cotton shipping was the chief business of the state's largest city.

The natural environment of Alabama bore the imprint of cotton no less than did the state's politics and culture. Macon County planters produced the nation's leading export in much the same way, and with the same sort of pride, as planters elsewhere. Winters generally found the slaves clearing new land, generally in the same way the Creek inhabitants had done before them: girdling trees and returning a few years later to burn the deadfalls, debris, and stumps. In addition to preparing what Macon County planter James M. Torbert called "newground," slaves cleared ditches; slaughtered livestock; burned "stubbleground" where the previous year's crops had been; planted spring wheat, oats, and potatoes; and hauled manure to the fields so that no time would be wasted when temperatures warmed sufficiently to plant corn.[35]

As spring arrived—typically in late February or early March in Macon County—corn was planted, followed quickly by garden crops. In 1856, for example, Torbert followed his corn with radishes, watermelons, squash, and peas. By April planters focused on getting their cotton in the ground, though if time allowed after the crops were in, slaves might return to "deadening" pines and clearing plots where girdled trees had already died.[36] May, June, and early July were typically spent chopping cotton and pulling grass to prevent it from choking out the cotton before it could be laid by (cultivated for the last time). July and August were spent harvesting grains,

and by September the cotton was ripening and all hands were sent to the fields for picking. Shortly after the last of the cotton had been picked (and generally before all of it had been ginned), it was time to begin the process once again.

Torbert ran a medium-sized plantation near Society Hill in the eastern portion of the county, and his operation was typical of the place and time. In 1856 Torbert planted 165 acres in cotton and reaped 29 bales weighing an average of 586 pounds. Smaller plantations generally produced less than that; larger ones produced considerably more. His 120 acres of corn produced a scant 1,100 bushels of poor quality ("too much wet weather then too much dry," he noted in his journal). In addition he harvested 37 acres of oats and 12 of wheat, gathered 41 bushels of peas, and slaughtered 23 hogs (averaging slightly over 170 pounds) and "2 beefs."[37] The following year he put in 5 additional acres of corn and 10 of cotton. By 1860 he had 195 acres in cotton, 155 acres in corn, 20 acres in wheat, 40 in oats, and 7 in potatoes.[38] Thus, while he grew more cotton than any other single crop, other crops made up more in the aggregate.

Torbert's interest in raising cotton led him to protect the plantation community's investment in slaves. By comparison to many of his neighbors, Torbert treated his slaves relatively well—permitting them, for example, to plant 6 acres of their own cotton, which he later ginned and sold with his own, returning the profits to the adults—but he did not share the abolitionists' sentiment that African Americans could ever be his equals. Motivated partly by practical concerns and partly by cultural mores, he patrolled the local roads with his fellow planters to watch for runaways and verify slave passes. This was by no means an effective way to monitor the movements of slaves, however, because a secondary network of footpaths connected the slave quarters of neighboring plantations. Slaves could move almost unnoticed along the paths when they wanted to visit nearby family members. These footpaths would be expanded in the wake of the Civil War and would serve, in the words of sociologist Charles S. Johnson, "as the threads of neighborliness" in the county's black community well into the twentieth century: the law of unintended consequences at work in shaping the landscape Carver would encounter.[39]

Although agriculture was not the only economic engine for the county—Torbert, for instance, opened a sawmill in 1857—it was the plantation agriculture of Macon County that most altered and degraded its ecosystems. There is no evidence that planters were willfully "butchering the soil," but

intent is no fair measure of outcome. Even by the 1840s soil exhaustion was becoming an increasing problem, especially in the poorer soil of the county's uplands. This was largely due to the county's (and state's) second-largest crop, corn. (Cotton does not place especially large demands on the soil.) The county's single greatest agricultural problem was erosion, however, and cotton cultivation was the single biggest contributor to it. Where plows rip into the earth to expose and loosen the tilth, the vulnerability of soil to erosion increases exponentially.[40] And in Macon County, where the forest was being pushed back over rolling land and few planters (or small farmers) were employing conservation measures, the rich humus of the topsoil was washed year after year into the county's numerous creeks and streams, turning them brown with silt and carrying away the land's very fertility. To be sure, the rich clay soils of the flatter Black Belt prairies eroded less easily, and so accounted for comparatively little of the silt muddying the waterways, especially in the antebellum years. But the shallow prairie soils were not immune to erosion, which posed perhaps a greater threat to them because once the limestone subsoil had been exposed, the fields could not be salvaged.

The planters sought to counteract the declining fertility by spreading fertilizer over their fields, most notably Peruvian guano (though by the late 1850s some planters, including Torbert, had turned to cottonseed as a fertilizer).[41] But whatever benefits such fertilizers might have had were more than undercut (at least in the long run) by the damage caused by the intensive cultivation of cotton and corn. The cotton planters' hatred of grass provides a particularly vivid illustration of the way planters waged "a petite war"—as one contemporary described it—against the soil in a misguided and self-defeating attempt to protect their investment in cotton.[42]

While the cotton was still immature, grass and other weeds could choke its growth, and planters like Torbert had to battle hard to save their cotton from the encroaching grass every spring—an annual ritual that caused a great deal of consternation. On May 23, 1856, for instance, Torbert noted in his journal, "I don't think I ever Saw More young grass Come up in My life." His fears mounted over the next month and a half. On May 27 he complained, "Oh the grass, I must Stay Clost to the hands a while and try to Keep the grass under if it Should rain and a few days wet I would have a bad road to travel with the grass." His fears lingered throughout June. In the middle of the month he reported, "Oh, the Grass My Crop I am afraid will be badly injured with the grass." By July 1 panic had set in: "I never

Saw grass grow as fast in My Life tis So large I can Scarcely plow it with a Shovel." It was not until July 9 that Torbert was able to note with some satisfaction that "at last the grass begins to die."[43] Planters generally had their field hands run plows up and down the furrows in a labor-intensive effort to kill the grass. Plowing the same furrows again and again opened the soil to even more extensive erosion. Worse, as was the case for Torbert in 1856, the practice was largely unsuccessful. His grass problem ended only when the spring rains stopped in early July; the repeated plowings did nothing to solve it.

While the vast majority of planters in Macon County followed similar policies, employing few, if any, conservation measures, some did advocate restraint in clearing new land and caution in cultivating it. The best known of these—indeed, one of the best-known advocates of scientific agriculture in the entire South in the late antebellum era—was Noah B. Cloud, whose farm, La Place, a few miles west of Tuskegee became an experiment station of sorts from which Cloud attempted to persuade the region's planters to develop their plantations more sustainably. Indeed, to the extent that Carver's agricultural vision harkened back to the high-minded husbandry of the nineteenth century, it carried echoes of Cloud's calls for reform.

Reformers such as John Taylor and Edmund Ruffin, along with such "green paternalists" as James Hamilton Couper and James Henry Hammond, are familiar figures to historians of the antebellum South, as are the agricultural interests of many of the leading southerners of the Early Republic—George Washington, James Madison, Patrick Henry, and Thomas Jefferson among others. Overwhelmingly, however, histories of antebellum agricultural reform have focused on the old states along the Atlantic Ocean and have devoted comparatively little ink to agricultural reformers of the Old Southwest.[44]

In part this imbalance reflects the relative interest in agricultural reform in the two regions. The older states had a much longer history of European-style cultivation, experienced soil erosion and exhaustion sooner, and sought solutions for those problems (albeit largely unsuccessfully) well before the forests of the southern frontier had been cleared and put under the plow. Indeed, when agricultural journals began to proliferate in the 1820s, few places in the Old Southwest had been cultivated long enough to warrant much concern over their well-being. In part, however, the imbalance reflects the larger understanding of the root cause of the antebellum reform efforts. In his seminal study of soil exhaustion in the South, Avery

Craven portrayed agricultural reform as the logical outgrowth of the frontier mentality. On the frontier, so the rationale went, waste was the rule. Only after the soils had been exhausted would a more responsible means of cultivation be embraced. Thus, for Craven—who in some ways resurrected the work of Taylor and Ruffin, whom he portrayed as heroes who sought to replace frontier-style waste with enlightened, progressive agricultural practices—soil exhaustion in Maryland and Virginia was not due to "any features that belong to the South alone as a section." Lest readers miss his oblique reference to slave-based plantation agriculture, he added or "its peculiar institutions and characteristics."[45] Craven instead blamed economic calculi in a situation where land was cheaper than labor. Though subsequent scholars would amend Craven's argument (most especially in revising the significance of slavery for southern land use), they have yet to fundamentally challenge it.[46]

Certainly there are solid grounds for embracing such a view, not the least being the fact that the agricultural reformers framed their reforms in just that context. Writing to the noted British agriculturist Arthur Young, for instance, Jefferson explained that Virginians did not practice convertible husbandry based on composting cattle manure and field rotation in the manner of their counterparts in the North and in Europe "because we can buy an acre of new land cheaper than we can manure an old one."[47] But such a focus has minimized the attention historians have devoted to the Old Southwest, which, being "frontier" (at least relative to the states along the Atlantic seaboard), has been assumed to have harbored a less vibrant reform impulse. While historians are well aware of the degree to which southern agricultural reformers advocated contour plowing to minimize erosion, encouraged (without much success) cover crops, founded agricultural and horticultural societies, corresponded with agriculturists in the North and abroad, and decried the exhaustion of agricultural lands, they are considerably less aware of the activities of men such as Cloud and Martin W. Phillips of Mississippi. Indeed, in his environmental history of the American South, Albert Cowdrey asserted that "complaints of planters about soil exhaustion were commonly heard, at least until the late 1840s," when sectional tensions muted them to some degree.[48] Such a narrative leaves little room for Cloud, who did not begin his career as a reformer until the late 1840s.

Born in South Carolina, Cloud was by training a physician, having graduated from Philadelphia's Jefferson Medical College in 1835, but at heart he

was a husbandman. He moved to Russell County, Alabama, in 1838 before joining his father in neighboring Macon County five years later. While he was still in Russell County, living on a farm he dubbed Planter's Retreat, he began to undertake agricultural experiments. At about the time he moved to La Place he began publishing his findings, hoping to undermine what he labeled the "kill and cripple, and every way injurious system" of cotton cultivation in the South. His goal was to replace the prevailing cotton culture with "an entirely new and improved system of culture, predicated upon the principle of scientific and enlightened policy."[49]

Cloud overstated the novelty of his "improved system of culture"; he borrowed liberally from the convertible husbandry that agricultural societies in England and the North had long advocated.[50] The sine qua non of this sort of husbandry was livestock penning, and it is thus no surprise that Cloud denounced the South's open-range policy. Though many of the best-known agricultural reformers of the Old South (including Ruffin) downplayed the benefits of penning livestock and compost manuring, Cloud was not the first southerner to advocate convertible agriculture in the region.[51] John Taylor had proposed a program rather similar to Cloud's more than three decades earlier. In a collection of essays titled *Arator*, Taylor echoed English reformers (who, among other things, had sought to justify the enclosure movement) in maintaining that landowners—particularly those with extensive holdings—were better stewards of the land than the general public was under a commons system. Calling into question the region's open-range policy, he advocated the adoption of convertible husbandry with its extensive manuring. But while his essays bolstered the interests of the planter class, Taylor had little use (on a theoretical level, anyway) for slavery, which he considered an inefficient form of agricultural labor.[52] Cloud would disagree with Taylor's view of slavery and instead embrace the notion that only a carefully managed labor force such as that provided by slavery could implement the sort of labor-intensive agricultural regime he espoused. Cloud likewise diverged from other advocates of convertible husbandry in the South, including James Henry Hammond, who advocated keeping and penning livestock but insisted that "more can be made by planting [cotton] largely, than by making manure as a crop."[53] Convinced that "compost manuring, in connection with stock raising and pasturage" was "the true renovator of all agricultural exhaustion," Cloud would make no such compromise.[54]

If Cloud's system was not as novel as he maintained, it was not entirely derivative either. Over the course of the late 1840s and early 1850s he developed and advocated a remarkably strict agricultural program of his own. By the eve of the Civil War, the "Cloud system" had become one of the most talked-about plans for southern agriculture, inasmuch as it laid out a very specific regimen for cotton culture based on extensive compost manuring and deep plowing, which allowed the cotton plant's taproot to take "such hold upon the manure below as to enable the plant to outstrip either grass or weeds." The Cloud system thus solved two problems: it alleviated the erosion brought on by plowing to eliminate grasses and weeds, and it facilitated a more stable slave-based agriculture that did not entail continual expansion west as soils were exhausted.[55]

Cloud had little use for the prevailing method of controlling grass, explaining that repeated plowing weakened cotton plants by cutting their roots. Planters who blamed poor growth on dry spells or rainy weather, he continued, were refusing to admit that their war on grass was self-destructive, that their "*grass killing* policy" wrought "disastrous consequences." He likened adding guano to soil treated in such fashion to feeding hogs after knocking out their teeth.[56] Cloud believed that once a cotton plant had begun to grow, there was "no further use for a plough in its subsequent culture." Instead he advocated the use of a "sweep," a scooter plow modified in such a way that it could not "enter the ground deeper than one inch, if so deep." The sweep could be dragged over the ground "so as to kill any grass and weeds that may appear" without threatening the cotton itself.[57]

Other details of Cloud's system included terracing, establishing specific distances between rows (and plants within rows), arranging piles of fertilizer in a particular way prior to plowing, and following a complicated system of crop rotation in which cotton was planted on the same land only once in four years, and then only after the field had been allowed to lie fallow for a year. He believed that only rigid adherence to such details could ensure success, measured in terms of both profitability and improved soil. His own farms, he maintained, had improved as a "result of a *strict and scrupulous adherence to* [the] *system in its management*," and he promised a bushel of his improved seed to anybody who "strictly" followed his plan and did not see at least a fivefold increase in the amount of cotton produced per acre.[58] In essence, Cloud was interested in rationalizing cotton production, comparing, for instance, his "*systematic, economical and philosophic* policy"

with the "*inconsistent*, the *reckless* and *grassy* policy of the present practices of the country."[59]

The aim of this rationalization was not to increase the cotton yield aggregately—though he claimed that his system provided "*an infallible insurance* for 5000 lbs. of a superior staple per acre" (a remarkable promise considering that Torbert's farms produced roughly 175 pounds of cotton per acre).[60] Rather, he sought to attain the same production, but on less land through more diligent (and responsible) husbandry. In fact, his system expressly limited the planting of cotton: "The crop of cotton thus planted . . . should not exceed *three to four acres* to the hand."[61] According to Cloud's thinking, then, the exploitative social relations manifest in slavery need not lead to exploitative agricultural practices. On the contrary, slavery was essential to this remarkably labor-intensive plan to "make poor land rich, and rich land richer."[62]

What was possible in theory, however, had little basis in the reality of the Black Belt. Looking around Macon County, Cloud saw "a total absence and disregard of . . . the improvement and protection of the fertility of the soil," and was reminded of Ben Franklin's Poor Richard, who had assured Cloud and his fellow planters "that by constantly taking out of the meal tub and never putting in, we shall soon find the bottom." The typical planter's "acquaintance with this golden truth," Cloud feared, was "theoretic entirely. His exhausted fields and dwarfish, puny cotton, tell tales more positively contradictory and gloomy, than I have room or inclination now to enumerate."[63]

Cloud's peers lavished praise on him, but very few altered their methods of cultivation. Predictably, he grew frustrated at the disjuncture between his reputation—which by the 1850s had grown to the point that noted British agriculturist Robert Russell, on a tour of the South, was willing to walk nearly eight miles to see him—and his inability to persuade farmers to put his plan into practice.[64] He could only conclude that "this beautiful forest must be felled by the ruthless hand of Mr. Carenot, all this maiden and fertile soil must first be exhausted and washed into the branches, gurgling in pure and limpid water . . . and the fields defaced by gullies and poverty grass" before his fellow planters would be willing "to give in to a complete and perfect system of improvement."[65] Considering that he was writing within a tradition that implicitly acknowledged virtue as the actuating principle of a republic and treatment of the soil as a fair barometer of that supposed virtue, this was a serious indictment of his fellow

southerners, particularly because it was written amid escalating sectional tensions.[66]

His indictment notwithstanding, Cloud joined a long list of agricultural reformers who earned the praise of their fellow southerners but ultimately failed in their efforts. Cloud would not be the last prophet of agricultural reform in Macon County to find himself praised but not heeded. Carver would offer similar laments, although his proposals were less rigid and he offered them to undermine rather than bolster the plantation system. In time, Carver too would join the ranks of reformers whose efforts wrought more praise than results.

For their part, planters liked the idea of crop diversification because it fit neatly with their growing sense of southern nationalism: self-sufficiency, decreased dependence on the North, and perhaps a chance to stick it to their abolitionist foes (whose cotton mills in the North and England were driven in large measure by slave labor in the Cotton Belt). They flocked to agricultural conventions, subscribed to agricultural papers, and eagerly listened to agriculturists' calls for more rational production. By the eve of the Civil War, for instance, Cloud's paper had a remarkable circulation of some 10,000 (it was rivaled in popularity only by the *Southern Cultivator*, a Georgia periodical).[67] The planters were clearly not unaware of or indifferent to the environmental degradation that attended cotton culture, and they certainly had the wherewithal to make the substantial capital investment fixing the problem would require, but they rejected the critique of southern culture implicit in Cloud's indictment. They saw no need to make serious conservation efforts either to make a profit or to keep their view of themselves as virtuous farmers intact. Thus, as long as growing cotton was profitable—and planters like Torbert certainly found it to be so—they had no intention of altering their means of production.

While southern nationalism blunted the efforts of agricultural reformers to some extent, it did influence the landscape Carver would encounter in Macon County and that of Alabama's Black Belt generally. Many planters were embarrassed by the sorry appearance of their dwellings. Few were made of brick or stone; even fewer could be considered elegant. Most were single-story log buildings with between four and six rooms, and none impressed Frederick Law Olmsted when he passed through Macon County on the Montgomery and West Point Railroad in the early 1850s. He noted a "few dreary villages, and many isolated cotton farms, with comfortless habitation for black and white upon them."[68]

In an address before the Alabama horticultural society in 1851, John Forsyth blamed the general lack of comfort and elegance on a lingering frontier spirit. He had never known, he claimed, a farmer in Alabama "who would not sell out and move for the price of his land." In consequence, the "planter's home is generally a rude ungainly structure, made of logs, rough hewn from the forest." It "is not regarded as a home," he continued, "but only a temporary abiding place." Such an attitude "is a blight on our land. . . . We murder our soil with wasteful culture because there is plenty of fresh land in the West—and," he concluded, echoing a common complaint of antebellum reformers before getting to the heart of his concern, "we live in tents and huts when we might live in rural palaces."[69]

Planters began taking steps to beautify their property and improve their living conditions. As part of their rejection of all things northern, Alabamians embraced a very different sort of landscape design than that recommended by Andrew J. Downing and other northern authorities. Men such as Charles A. Peabody—the horticultural editor of Cloud's paper—advocated a "southern" style of landscape architecture. The result of the campaign to establish a self-consciously southern landscape design led to the re-creation of the environment in Alabama in a thousand different corners, none especially significant in itself, but collectively sufficient to alter the state's environment.

Predictably, the new landscape had little room for grass—a characteristic still evident when Carver arrived in 1896. A visitor to Tuskegee in the first decade of the twentieth century, for instance, was astonished to find that its white cemetery was a "wholly grassless waste of sand, relieved only by clumps of flowering shrubs and scattered trees." Tuskegeans were "very proud" of it, however, and gave it "constant care."[70] While there was room for trees and shrubbery, their longtime association with disease—as late as 1857 the *Southern Cultivator* linked the death of a planter's wife and children to barren mulberry trees growing too near the house—meant that they were cultivated cautiously and sparingly, generally lining the avenue to the house or set in copses to break up open spaces.[71] The most significant changes were in the decorative plants southerners chose to cultivate in their yards and gardens. Prior to the 1850s, such nonnative plants as buckthorn dominated gardens of the Deep South. In the decade before the Civil War, native plants like the magnolias now associated with the region began to replace "exotics" in Macon County and elsewhere in the Black Belt, and there was something of a push to encourage the preservation of old-growth

forests. The fact that "Europe, Asia, and Africa had been ransacked for diminutive shrubs to take the place of those great forests" suggested to Peabody, at a minimum, that some planters lacked taste.[72]

But it was southern nationalism's most obvious result that set in motion the events that were primarily responsible for shaping the world Carver encountered in Alabama's Black Belt. The initial jubilation of some in Macon County at Alabama's secession proved short-lived. By the end of 1861, the last year he planted cotton during the Civil War, Torbert's outlook was positively gloomy: "This is the year Commenceing lincoln's wars, and . . . from all appearances we are bound to have harder times than I ever before experienced in My life time."[73] By April 1865 the county had endured two raids by Union cavalry. The reality of the Confederacy's defeat was brought home the following month when Federal troops under Colonel J. B. Moore occupied the county and declared martial law. Whites like Carrie Hunter, a young woman living in Tuskegee, found the loss and occupation "a sickening and humiliating subject."[74]

In 1860 only 2,690 free African Americans lived in the entire Yellowhammer State; at the close of the Civil War more than 18,000 newly freed African Americans called Macon County home.[75] Many would leave in the ensuing years. The 1870 census reported only 12,620 blacks in the county (though some were lost to Lee and Bullock counties in 1867 when county lines were redrawn). For those who stayed, freedom brought both promise and uncertainty. For the first time, the state recognized their marriages. And when the congregations of white churches could not bring themselves to allow their former slaves equal seating and participation, the freedmen established parallel, independent churches that quickly became the chief social centers of the black community.

The aftermath of the Civil War brought uncertainty for the planters as well because it entailed the loss of their slave wealth along with the only social order they had ever known. Fears of black insurrection led to armed patrols. When Congress refused to seat Cullen Battle, a former firebrand and Confederate general elected to represent a district that included Macon County, the county's white residents feared the worst. Their most significant problems, however, were tied to their plantations. Confederate and Union soldiers alike had appropriated much of their livestock, and large-scale theft after the war took most of the rest. Ironically, the planters' fields had never been more vulnerable to livestock, a consequence of the destruction of fences by the Union Army. The most significant problem,

however, lay in the fact that the labor system of the county had been thrown into flux.

Over the course of the war, planters' foreign markets had crumbled, their financial institutions had collapsed, and their transportation infrastructure had been devastated. In addition, the loss of wealth in the form of slaves—and in 1859 Torbert was paying more than $1,300 per slave—undermined their ability to get credit. They had kept their land, but as economist and historian Gavin Wright noted, "nineteenth century bankers did not consider real estate to be an acceptable backing for loans," as was evidenced by the fact that "such loans were prohibited by the national bank."[76] Even had such loans been possible, land values had dropped more than 40 percent since 1860, primarily because of the uncertainty surrounding southern agriculture, and planters' collateral worth was concomitantly lower.[77] The failure of the southern banks and the planters' difficulty in acquiring cash loans left them cash poor. Many could not offer freedmen cash wages and had little recourse but to arrange to pay their hands after the harvest.

Given the racial tensions in Macon County, planters were pleasantly surprised in early 1866 when their former slaves proved willing to sign contracts to farm their land. The Civil War had forced agricultural diversification in Alabama's Black Belt, but the planters were eager to see their fields again turn white with the bolls of their beloved cotton—the more so since the pent-up demand for cotton in the wake of the war had driven up its price. Cotton alone held out the possibility of putting cash in their pockets and allowing them to settle their debts. Macon County resident William Varner provides an example of what having cotton could do. He had managed to produce and acquire from his peers some 760 bales of cotton over the course of the war, and his close connections with some northern bankers enabled him to sell them for better than $130,000 after its end. Varner, however, was clearly an exception. James Torbert's experience was more typical. He hired six freedmen, along with three of their children, to tend his fields in 1866 in return for room and board, 25 percent of the corn, and 20 percent of the cotton. Unfortunately for Torbert, his experiment failed and he lost "by the operation about $1,400 counting provisions." The next year Torbert made a small profit by hiring five freedmen, a white man, and his own son for cash.[78]

Socially, it was no small struggle for planters to accept their sudden legal equality with the freedmen. The fact that the planters had gone from holding virtually all the political power of the region to holding almost none

added to their woes. The numerical preponderance of African Americans forced white conservatives not disfranchised by Congress to lobby for black votes. For its part, the county's black community, which had mobilized politically by 1867, predictably disregarded whites' claims that they had always been and would continue to be the freedmen's best friends and staunchest supporters. Led by James Alston, a former slave of Cullen Battle, black voters in the county went to the polls that year to support the call for a new state constitution, and the following year to ratify it. Planters were mortified when former slaves, including Alston, were elected to the state legislature that year.

African American political power in the county proved ephemeral. By the summer of 1870 white Democrats had begun to reestablish their authority. It began when a band of unidentified men fired into Alston's house on a June night. Alston and his wife escaped with relatively minor injuries, but Alston was forced to leave the county—by way of a ten-day detour through its swamps to avoid his white pursuers. Over the ensuing months, white conservatives patrolled the county's roads, black churches were burned, and two local scalawags were hanged in effigy in Tuskegee's town square. White Democrats discounted evidence implicating whites in the burning of the churches and the assault on Alston and blamed the violence and racial tension on the black community.[79]

Though Republicans managed to retain power in the county through the 1872 election, "Redemption" came to Alabama with the inauguration of Democrat George Smith Houston in 1874; it came to Macon County the same year. More than anyone else, a local circuit court judge named James E. Cobb was responsible for the reestablishment of white rule in the county. Cobb's position as a judge gave him the power to do things the ballot could not in a county where African Americans constituted better than 70 percent of the population. The county's black state representatives were arrested—one for adultery, the other for grand larceny—and tried in Cobb's courtroom. Both were convicted and sentenced to chain gangs (a source of state-funded labor for local plantations). Cobb further ruled that a Republican judge had not fixed sufficient bond to hold his office and appealed to Governor Houston to name a replacement; of course, the newly elected governor chose a Democrat. With hostile judges in place, African Americans could only expect the legal system to work against their interests.[80]

Perhaps more important, by the mid-1870s planters had largely settled on a labor system that suited their needs—one that trapped most of the

county's African Americans in a circular system of debt peonage. Like Torbert, the planters had initially tried to hire groups of unrelated workers. Because the laborers were working for a fixed share of a crop, however, they had every incentive to leave the work to others and still collect an equal portion. Such a system left planters with two significant problems: an inefficient labor force and resentment on the part of those who did the work. A wage labor system was impractical for any number of reasons, lack of cash being a good place to start. Given the nature of cotton production, planters needed a reliable labor force at certain times of the year, especially for the harvest, when a single heavy rain could ruin all of the cotton on the boll. Planters simply could not risk having to scramble for labor because their hands quit at the wrong time. Likewise, the former slaves, especially those with families to support, did not want to rely on seasonal wages that would either leave them unemployed most of the year or force them into migrant labor. The end result was sharecropping and crop liens.[81]

In return for the use of the land, and often seed, mules, and farm equipment, the sharecropper agreed to give a certain percentage of his crop—usually between 25 and 50 percent, depending on whether or not seed and equipment had been advanced to him—to the landowner. Theoretically, a diligent sharecropper could in time become a cash tenant, and eventually a yeomen farmer. The catch came in the fact that tenants often lacked the capital to feed and clothe their families prior to the harvest and were thus compelled to ask merchants to advance them the credit to do so in exchange for a lien on their share of the cotton crop. The merchants frequently charged exorbitant interest rates, and they, along with the property owners—and in Macon County there was a good deal of overlap between merchants and planters—had priority over tenants in collecting any money earned from the profits. The result for the sharecroppers—an overwhelming majority of whom were black in Macon County and elsewhere in Alabama's Black Belt—was a system in which the interest from debts in bad years more than negated the profits of the good years.[82]

Consequently, by the mid-1870s most African Americans in Macon County found themselves perpetually in debt and obligated to ask whites to advance them many of the essentials of day-to-day life. No credit-rating system or "credit number" existed in the late nineteenth century; credit markets were profoundly local, and the only way poor farmers could get credit was to stay in the same area, return to the same creditors, and make good on their bills. Not surprisingly, considering the racial mores of Macon

County's white leaders, African Americans who refused to treat whites deferentially or who insisted on becoming independent had difficulty securing advances. Unable to extract themselves from the endless cycle of debt, by the mid-1870s African Americans were forced to concede white control.

Macon County's African Americans thus found themselves in a peculiar place, socially and economically. In many ways black tenants could operate relatively independently. They could live with their families and benefit from the labor of their wives and children, and they had the freedom to change creditors, albeit within a highly circumscribed system. "Planters can never tell which of their tenants will be with them the following year, but of one thing they can be fairly certain—that they will not leave the county," sociologist Charles Johnson later noted of Macon County tenants. The local nature of the credit market all but ensured that in time the tenants would "rotate, of their own choice, back to the point of beginning."[83] Tenants were free to fish, hunt, and gather firewood on the property they worked, but they had to plant cotton to satisfy their creditors. As of the late nineteenth century, they were still free to vote, but if they wanted credit, they had to acknowledge white authority.

The emergence of sharecropping did more than help planters establish a cheap and reliable labor base. As Gavin Wright and others have argued, it entailed a shift in how planters thought of themselves: they were now landlords rather than "laborlords."[84] In Macon and other Black Belt counties, planters sought to protect their property through passing stock laws. Fencing in crops was an expensive, time-consuming, labor-intensive process, and the planters no longer had slaves whom they could compel to do it. Furthermore, most planters had significantly curbed their livestock production in the wake of the Civil War as a result of widespread theft and saw no reason, as one frustrated planter noted, why "all the negroes and whites *who own no land*" should be allowed to profit from theirs.[85] Because planters often doubled as merchants in the Black Belt, there was an economic motive to close the range as well: advancing credit for foodstuffs was more profitable than allowing tenants to raise their own. Indeed, historian Grady McWhiney went so far as to assert that "one reason why cotton became so popular with postbellum landowners and merchants alike was because the tenants could not eat it."[86] In short, free-range livestock undermined the very dependency the planters, as landlords, sought to reinforce. By 1880 thirty-three of Alabama's sixty-six counties had passed stock laws; Macon County and the rest of the Black Belt counties were among them.[87]

The closing of the range did reinforce black dependency in Macon County, but its impact was probably most felt by independent white farmers. Inasmuch as it undercut perhaps the chief means by which yeomen farmers could subsist in bad years, an already small margin of error was made smaller, and many had to abandon their farms. Over the course of the 1870s the total population of the county fell. For all practical purposes, the loss was due to white migration; in fact, the number of African Americans rose in the county in the same decade. In 1879 alone, nearly 175 parcels of land, the majority of which were between 80 and 160 acres, were put up for auction on tax sales. The taxes generally amounted to less than ten dollars, an indication of how narrow the margin between success and failure had been for independent farmers, and of how vital an open range had been to their livelihood.[88]

Now firmly back in control of Macon County, the planters had reasons to reach out to the black community in the 1870s. They were not unaware of the threat a large-scale migration posed to their plantations and region, and they still held long-cherished, if ill-conceived, notions of beneficent paternalism. And as a pragmatic stimulus, African Americans still had the vote. Consequently, the planters began extending goodwill offerings to the black community, and out of these overtures came the establishment of Tuskegee Institute in 1881.

The county's African American community had first suggested such a school in a letter to the *Macon Mail* in 1878; the next summer a more detailed letter followed. The county representatives to the state legislature, on behalf of the white community, approached Lewis Adams, a leader in the black community, about sponsoring the idea in 1880. In part this may have been an election-year ploy to secure black votes, but the representatives had already been elected in 1878, and voter fraud—not altogether unheard of in the county—would likely have secured their reelection. The white community's willingness to establish a black school probably had more to do with keeping African Americans in the county than with winning elections. (The exoduster movement to Kansas the previous year had attracted a good deal of national attention and caused consternation across the South.) Doubtless, pride in the fact that the county had long been a center of education—home to four of the state's twelve colleges in the 1850s—played a role as well.[89] Whatever the immediate reasons were for founding Tuskegee Institute, its establishment reflected a not-so-subtle transformation in the attitude of white conservatives toward the black community. That white

authorities recognized the need to take blacks' demands seriously is evident in the fact that some of the men who had threatened James Alston in 1870, including prominent merchant and banker George W. Campbell, became members of the school's board of trustees.[90]

On behalf of the trustees, Campbell wrote General Samuel C. Armstrong, the white founder of Hampton Institute, requesting the name of a white man who might head the school. Armstrong knew of no white man who would be interested and qualified for the job but eagerly recommended a former pupil and good friend, Booker T. Washington. Campbell, with whom Washington would form a close relationship, and the rest of the board accepted Armstrong's recommendation and hired Washington as the school's principal. The institute opened on July 4, 1881, despite fears in some quarters that it "might result in bringing about trouble between the races." Its thirty students met in "a rather dilapidated shanty near the coloured Methodist church, . . . with the church itself as a sort of assembly room."[91]

Whites' fears that the new school would upset race relations proved unfounded. The twenty-five-year-old Washington cultivated a close relationship with Tuskegee's white community, facilitated by Washington's belief that the solution to the "race problem" rested in black economic progress rather than political agitation for social and political equality. Even so, his first years were frustrating ones. "I do not deny that I was frequently tempted, during the early years of my work," he later wrote in *My Larger Education*, "to join in the general denunciation of the evils and injustices that I saw about me. But when I thought the matter over, I saw that such a course would accomplish no good, and that it would do a great deal of harm."[92] Given the racial realities in Macon County and the plantation regions of the South generally, Washington was probably correct in his assessment that political agitation for social equality would result in more harm than good, though following his ascent to fame, many educated blacks in urban areas and the North came to see his "tactical retreat" as a "surrender." As Edward Ayers astutely pointed out, however, the debate over the relative merits of Washington's "solution" after he burst on the national scene with his 1895 Atlanta Exposition address "were arguments among blacks over the best response to an impossible and deteriorating situation."[93]

Washington did qualify his willingness to accept segregation. "In all things that are purely social," he had conceded in the Atlanta address, "we can be as separate as the fingers, yet one as the hand in all things essential to mutual progress."[94] Mutual progress, however, hinged on economic

cooperation. Consequently, as Ayers observed, Washington "encouraged boycotts because such resistance fell into the economic rather than political realm." Thus, he lent his support to a boycott of Atlanta streetcars in 1894, using "the leverage of blacks as paying customers to win their fair rights in the marketplace."[95]

Washington's abandonment of public demands for African American political and social equality mollified fears that his school would threaten the status quo in the county because it put the onus for resolving the "race problem" squarely on African Americans. Indeed, in Tuskegee's early years, local whites aided in fundraising and proved willing to sell land to the institute. The first major acquisition—an abandoned plantation purchased three months after the school opened—was made possible by a personal loan to Washington from the treasurer of Hampton Institute, General J. F. B. Marshall. This purchase allowed the school to move to a more permanent location and facilitated student enrollment, which had roughly doubled in its first three months. By the 1890s the school would own some 1,500 acres and enroll more than 1,000 students.[96]

Given Washington's philosophy, it is not surprising that Tuskegee modeled its coursework after Hampton's, which had a largely "industrial" curriculum. A primary goal of Tuskegee was "to send every graduate out feeling and knowing that labour is dignified and beautiful."[97] Consequently, Washington insisted that the students work: tilling fields for their food, making bricks with which they could construct buildings, and aiding in the general upkeep and maintenance of the grounds. In fact, everything at the school was to be built and maintained by the students themselves, overseen (and aided) by a steadily growing faculty. The school was to stand as a monument to what African Americans were capable of accomplishing, and by the turn of the century it served that purpose, impressing national and international dignitaries who made the otherwise unlikely trek to Macon County for the express purpose of seeing Washington's school.

If the school was a monument, it was also an island, and the orderliness of the campus did not spill over into the surrounding communities. Washington asserted in *Up from Slavery* that he had "found relations between the two races pleasant" when he first arrived in Macon County, a claim belied on the very next page when he recalled being told by members of the black community that they chose candidates in elections by finding out who the whites supported, then voting "'xactly de other way."[98] But he was most struck by the conditions African American tenants faced in the country-

side. Whole families were sleeping in one-room cabins without windows and eating virtually nothing but "fat pork and cornbread." After breakfast, they "would, as a general thing, proceed to the cotton-field." "Their one object," Washington discovered, "seemed to be to plant nothing but cotton; and in many cases cotton was planted up to the very door of the cabin." With "few exceptions . . . the crops were mortgaged."[99]

The conditions of the plantation districts surrounding the institute did not differ markedly from conditions elsewhere in the Black Belt. Dominated by black tenants who had every incentive to plant as much cotton as they could and virtually no incentive to care for soil they did not own and from which they could be removed at the whim of a landlord, the region's environment suffered even more than it had during the antebellum years. King Cotton was triumphant as never before, and the deleterious effects of his reign could not go unnoticed. In an 1884 report on Alabama's cotton production, Dr. Eugene Allen Smith, a geology professor at the University of Alabama, lamented the diminishing fertility of the Black Belt: "Where the blacks are in excess of the whites are originally the most fertile lands of the state," he began. "The natural advantages of the soils are, however, more than counterbalanced by the bad system prevailing in such sections." Leaving no doubt as to which system he had in mind, he continued, "viz., large farms rented out in patches to laborers who are too poor and too much in debt to . . . have any interest in keeping up the fertility of the soil."[100]

Indicative of the fact that the efforts of Noah Cloud and other antebellum reformers had been largely forgotten, E. C. Betts, the state's first commissioner of agriculture, asserted that the need to restore nutrients to the soil "is a subject . . . wholly new to our people."[101] In contrast to Smith, however, he accounted for the sorry condition of the Black Belt counties by pointing to their black laborers, whom he insisted were "wholly unqualified" for "the position of independent tenants" and consequently, "almost invariably fail." The problem was aggravated by the fact that whites there tended to "congregate in towns . . . leaving the lands for the most part to the exclusive possession of negroes, thereby relieving them from the moral restraint of the presence of the superior race, as well as from their industrial supervision and control."[102]

In the immediate aftermath of the Civil War, some scientific agriculturists advocated policies similar to Noah Cloud's. The *Rural Alabamian* published a letter that suggested "turning under green crops" and gathering "pond muck or swamp muck . . . for composting purposes." The journal's

editor, C. C. Langdon, argued that the best way to restore the "comparatively worn out" land was through "the easiest process imaginable, to wit: *deep plowing, thorough pulveration of the soil, and heavy manuring*." Even so, he believed that the growing availability of "preparations known as commercial or concentrated fertilizers" portended the dawn of an era in which the earth would "yield its abundance regularly, continuously and with unwavering certainty."[103] But by the 1880s agriculturists were focusing on two solutions: diversification and the use of chemically compounded commercial fertilizer.

Diversification failed to gain much traction. If anything, farmers heeded pleas to grow something other than cotton less than they had in the years preceding the Civil War. To be sure, some agriculturists had hailed the "overthrow" of the "system of labor [slavery] which brought the all-cotton policy into existence."[104] Any hopes they may have harbored for a more diverse agricultural economy, however, had been quickly dashed. As early as 1872, the *Rural Alabamian* had expressed alarm at the rapid proliferation of cotton and pleaded with the state's farmers to produce "all the necessaries of life," before growing "*all you can of cotton*."[105] The emergence of sharecropping and tenancy had increased cotton production, which both lowered prices on the cotton market and further denuded the environment. By the early 1880s two-thirds of the cultivated land in Macon County was in cotton, a marked contrast to the antebellum years when more land was in other crops aggregately than was in cotton.[106]

On the other hand, Alabama's planters and farmers eagerly embraced agriculturists' pleas for the use of commercial fertilizers. Like farmers in the rest of the nation, those from the Yellowhammer State turned to chemically compounded fertilizers in record numbers. In 1869, 126 factories manufactured fertilizer; by 1889 that number had leapt to 390, employing, on average, nearly half again as many workers as they had in 1869 and marking a growth in the total capital investment in the industry from $4.5 million to $40 million.[107] In 1880 Alabama farmers were spending $2 million a year on commercial fertilizers; six years later the state's agriculture commissioner was pleased to report that fertilizer use was "rapidly spreading."[108] Speaking before the state agricultural convention in February 1888, Dr. N. T. Lupton argued that commercial fertilizers were at the very center of "scientific" farming, insisting that the "manufacture of scientifically prepared fertilizers and their application to the soil is the best means of estimating the progress a country is making in agriculture." As the state chemist, it was Lupton's

job to analyze fertilizer samples submitted by planters and farmers. If Lupton found that a fertilizer failed "to come up to the guarantee placed upon it by the manufacturer and dealer," the purchaser did not have to pay for it.[109] In fact, the proliferation of commercial fertilizers had played no small role in the establishment of the state's Department of Agriculture in 1883. Not only was the department responsible for regulating fertilizers, it was charged with "promoting their extension and use."[110]

To be sure, some agriculturists did advocate the use of organic fertilizers. Eugene Smith, in the 1883 *Geological Survey of Alabama*, for example, recommended composting plant debris with Alabama minerals such as lignite, "quick lime," and "calcareous and gypseous marls." He likewise lamented wasted night soil, which was either "accumulated in receptacles" or, worse, channeled into sewers and streams "through which the fertility of our land is . . . drained into the ocean." The holding receptacles for night soil, he claimed, "are in reality so many Guano Islands, whose benefits we can realize with only a nominal cost of transportation." But even Smith argued that failure to use chemical fertilizers indicated the lack of "systematic efforts at the maintenance of the fertility of the soils in Alabama."[111] Thus, if agriculturists' promotion of commercial fertilizer did not preclude their advocating organic fertilizers, the latter certainly received much less attention. Few agriculturists emphasized soil building, or for that matter any notion of "paying back" to the soil. More commercial fertilizer was applied each year, but Alabama's soil continued to degrade rather than improve.

As fertilizer use rose, fertilizer distributors appeared in Macon County. The Macon County Oil Company, which owned six cotton ginneries that collected seeds to be pressed for oil, also operated a fertilizer mixing plant.[112] Even so, the application of commercial fertilizers for cotton production in Macon County and the rest of the Alabama's Black Belt did not match that elsewhere in the state. Eugene Smith noted in 1883 "that in the great cotton-producing areas of Alabama the use of commercial fertilizers in cotton planting is comparatively unknown."[113] The use of commercial fertilizers in Black Belt counties might better be understood, however, as having reached something akin to a saturation point. Not only did landlords believe that their black tenants were incapable of properly applying the fertilizer, they had little incentive to help their tenants produce a banner crop for the market and thereby perhaps escape their crippling dependency. While advancing tenants the credit to purchase fertilizer could reinforce their dependency by adding to their debt, Macon County landlords saw no

reason to advance the funds for large amounts of fertilizer—certainly not the amounts recommended by agronomists and the fertilizer companies.

Content to be back in power, the planters largely ignored both the long-term effects of failing to nourish their soil and the complaints of agriculturists. It was the planters Betts had in mind when, in the state's first *Report of the Commissioner of Agriculture*, he argued that "the time is come when we may cease to bewail the condition of the farmer. . . . They live well, take care of their families, and I think are less in debt . . . than they have been for the last twenty years."[114] The formation of the Farmers' Alliance the following year and its subsequent transformation into the Populist Party confirm that Betts' finger was on the pulse of the state's planters, not its independent farmers.

In contrast to the Alabama Grange (whose first chapter had been organized in Tuskegee), neither the Alliance nor the Populists had much influence in Macon County. In large measure this was because African Americans, who did most of the actual farming in the county, were never afforded status as equals either by Alliance members or by the Populists. Further, because white unity against a black majority was paramount in the political calculi of county leaders, when the need arose, the Democrats resurrected the tactics of voter fraud and intimidation they had used during the 1870s and defeated the Populists, removing them from the equation. In Macon County, James E. Cobb, the judge who had helped purge the county of "black rule," was elected to Congress in 1884 in a district that included six predominantly white counties and four Black Belt counties. In 1892 and 1894 he staved off Populist challenges, losing the white counties but winning even bigger in the Black Belt ones. After the 1894 election, the Populist candidate charged Cobb with voter fraud. The charge was subsequently substantiated, and Cobb was removed from office. The Populist victory, however, was short-lived as Democrats regained the seat in 1896.[115] In Macon County, then, the rise of the Alliance and the Populist Party meant little to black farmers.

Indeed, Betts' contention that farmers were in better financial shape than they had been for twenty years was even less applicable to Macon County's African Americans than it was to the state's white yeomen farmers. By the close of the 1890s only 157 African Americans owned their own farms in Macon County, which had nearly 19,000 black residents.[116] For the most part, these black landowners employed every means within their power to be self-sufficient: they had larger families (to provide more labor);

their children married later (and so labored longer for the family); and they sought to limit their borrowing so as not to get drawn back into the slough of debt peonage.[117]

At the time of Carver's arrival, most of Macon County's African Americans were tenants of various sorts; many were sharecroppers. Most lived in crowded, dilapidated cabins with their families on parceled-out plots of land. The cabins were grouped into roughly fifty small farming communities, which were connected to each other by roads winding along the county's ridges—a nod to the many streams that still regularly flooded—and by footpaths through its fields and forests, the very same paths first navigated by slaves prior to the Civil War.[118] Blacks' landholdings were either on the hilly land in the county's north or the sandy soils that lay to the south of the Black Belt soils. The best soils belonged to whites.

The founding of Tuskegee notwithstanding, few educational opportunities existed for African Americans in the county; consequently, illiteracy rates were high. The courts were wholly on the side of white landlords, and all the political momentum in the state indicated that African Americans could expect only a further contraction of their rights. By the late 1890s Jim Crow laws were sweeping the South. In 1901, Carver's fifth year in the state, Alabama would convene a new constitutional convention that disfranchised virtually all of the state's black population. Following its ratification, only sixty-five black voters remained in Macon County where more than two thousand had voted during Reconstruction.[119]

Although there had been no lynchings in Macon County since the establishment of Tuskegee Institute, there remained a good deal of racial distrust and resentment. Vulnerable to fraud, perpetually in debt, and politically powerless, black tenants had little incentive to labor diligently. As they did not own the land and were not tied to it, they had no reason to take good care of it. Whites, in turn, saw what they were conditioned to expect when they looked at black tenants: laziness and negligence. As in other plantation communities across the South, the logic of racial animosity became circular and self-perpetuating. Black tenants "are careless," W. E. B. DuBois explained, "because they have not found that it pays to be careful; they are improvident because the improvident ones of their acquaintance get on about as well as the provident." But most of all, DuBois continued, "they cannot see why they should take unusual pains to make the white man's land better. . . . On the other hand," he concluded, "the white landowner . . . shows his Northern visitor the scarred and wretched land; the

ruined mansions, the worn-out soil and mortgaged acres, and says, This is Negro freedom!"[120]

This was the Macon County that Carver saw when he arrived in 1896. It was a far cry from Iowa. Outside Tuskegee Institute's walls, Carver found himself surrounded by "devastated forests, ruined estates, and a thoroughly discouraged people, many just eking out a miserable sort of existence from the furrowed and guttered hillsides and neglected valleys called farms."[121] He was optimistic, however, that he could help remake it.

COMMUNITY & CULTURE

Who we do it with and what we do it for.

BOOKS

A New Earth: Awakening Your Life's Purpose - Eckhart Tolle
Coming Back to Life: Practices to Reconnect Our Lives, Our World - Joanna Macy
Deep Ecology for the Twenty-First Century: Readings on the Philosophy and Practice of the New Environmentalism - George Sessions
Emergent Strategy: Shaping Change, Changing Worlds - Adrienne Maree Brown
Finding Beauty in a Broken World - Terry Tempest Williams
How to Fight - Thich Nhat Hanh
How Nonviolent Struggle Works - Gene Sharp
Pedagogy of the Oppressed - Paulo Freire
Permaculture: A Designers' Manual - Bill Mollison
The Ecology of Wisdom - Arne Naess
The One-Straw Revolution: An Introduction to Natural Farming - Massanobu Fukuoka
The Rebel: An Essay on Man in Revolt - Albert Camus
The Smell of Rain on Dust: Grief and Praise - Martin Prechtel
Women Who Run with the Wolves: Myths and Stories of the Wild Woman Archetype - Clarissa Linkola Estes

ESSAYS & ARTICLES

"Small Gods" - Martin Shaw

POETRY & NOVELS

Ecotopia - Ernest Callenbach
Ishmael - Daniel Quinn
The Spell of the Sensuous: Perception and Language in a More-Than-Human World - David Abram

SMALL GODS

Martin Shaw

We hear it everywhere these days. Time for a new story. Some enthusiastic sweep of narrative that becomes, overnight, the myth of our times. A container for all this ecological trouble, this peak-oil business, this malaise of numbness that seems to shroud even the most privileged. A new story. Just the one. That simple. Painless. Everything solved. Lovely and neat.

So, here's my first moment of rashness: I suggest the stories we need turned up, right on time, about five thousand years ago. But they're not simple, neat or painless. This mantric urge for a new story is actually the tourniquet for a less articulated desire: to behold the Earth-actually-speaking-through-words again, something far more potent than a shiny, never contemplated agenda. As things stand, I don't believe we will get a story worth hearing until we witness a culture broken open by its own consequence.

No matter how unique we may consider our own era, I think that that these old tales – fairy, folk tales and myths – contain much of the paradox we face in these stormriven times. And what's more they have no distinct author, are not wiggled from the penned agenda of one brain-boggled individual, but have passed through the breath of a countless number of oral storytellers.

Second moment of rashness: the reason for the generational purchase of these tales is that the richest of them contain not just – as is widely purported – the most succulent portions of the human imagination, but a moment when the our innate capacity to consume – lovers, forests, oceans, animals, ideas – was drawn into the immense thinking of the Earth itself, what aboriginal teachers call Wild Land Dreaming. We met something mighty. We didn't just dream our carefully individuated thoughts – We. Got. Dreamt. We let go of the reins. Any old Gaelic storyteller would roll their eyes, stomp their boot and vigorously jab a tobacco-browned finger toward the soil if there was a moment's question of a story's origination.

In a time when the Earth is skewered by our very hands, could it not be the deepest ingredient of the stories we need is that they contain not just reflection on, but the dreaming of a sensual, reflective, troubled being, whilst we erect our shanty-cultures on its great thatch of fur and bone?

It is a great insult to the archaic cultures of this world to suggest that myth is a construct of humans shivering fearfully under a lightning storm, or gazing at a corpse and reasoning a supernatural narrative. That implies a base line of anxiety, not relationship. Or that anxiety is the primary relationship. It places full creative impetus on the human, not the sensate energies that surround and move through them, it shuts down the notion of a dialogue worth happening, it shuts down that big old word animism. Maybe they knew something we have forgotten.

Two routes towards the cultivation of that very dreaming was through wilderness initiation and, by illumination of the beautiful suffering it engendered, a crafting of it into story to the waiting community. Old village life knew that the quickest way to a deep societal crack up was to negate relationship to what stood outside its gates. Storytellers weren't always benign figures, dumping sugary allegories into children's

mouths, they were edge characters, prophetic emissaries. More in common with magicians. As loose with the tongue of a wolf as with a twinkly fireside anecdote. These initiations facing the rustle-roar of the autumn oaks or grey speared salmon had banged their eloquence up against a wider canopy of sound, still visible on the splayed hide of their language.

Part of a storyteller's very apprenticeship was to be caught up in a vaster scrum of interaction, not just attempting to squat a-top the denizens of the woods. To this day, wilderness fasting disables our capacity to devour in the way the West seems so fond of: in the most wonderful way I can describe, we get devoured.

The big, unpalatable issue is the fact that these kind of initiations have always involved submission. For a while you are not the sole master of your destiny, but in the unruly presence of something vaster. You may have to get used to spending a little time on one knee. May have to bend your head.

Without a degree of submission, healing, ironically, cannot enter. It is not us in our remote, individuated state that engenders true health, but soberly labouring towards a purpose and stance in the world that is far more than our own ambitions, even our fervent desire to 'feel better'.

So, I claim that the stories are here. And they include all these difficult conditions. That's the price tag. This is not in any way to claim redundancy to modern literature, but simply to hold up the notion of living myth.

So the stories are here, but are we?

I think we are losing the capacity to behold them. We see them for sure – our eyes swiftly scan the glow of computer screen for the bones of the tale, we audition them for whatever contemporary polemic is forefront in our minds, and then we impatiently move on. It is not hard then to suggest that we are fundamentally askew in our approach: we are simply not up to the intelligence of what the story is offering. Our so-called sophistication has our sensual intelligence in a head-lock and is literally squeezing the life out of it. When we see something we have stayed pretty firmly in devouring mode, when we behold it, we are in a lively conversation.

But these stories I speak of are not being brought slowly into our bodies, wrought deep by oral repetition. We have lost a lot of the fundamental house-making skills for how to welcome a story.

PSYCHE

Around halfway through the last century, something wonderful happened. Mythology and fairy tales regained a legitimacy amongst adults as a viable medium to understand the workings of their own psychological lives. By the development of metaphor, tales of sealskins and witches' huts became the most astonishing language with which to apprehend much of what seemed to lurk underneath their everyday encounters and decision making. It granted greater dignity and heightened poetics to the shape of their years.

What was the glitch that lurched alongside? A little too much emphasis on these stories as entirely interior dramas, that, clumsily handled, became something that removed, rather than forged relationship to the Earth. The inner seemed more interesting than anything going on 'out there'. Us and our feelings still

squatted pretty happily at the centre of the action. This is not an indigenous perspective on the purpose of story.

When the Grimms and others collected their folktales they effectively reported back the skeletons of the stories, the local intonation of the teller, and some regional sketching out was often missing from the tale. Ironically, this stripped-back form of telling has been adopted into the canon as a kind of traditional style that many imitate when telling stories – a kind of 'everywhere and nowhere' style.

Now whilst it's certainly true that there are stories designed for travel, for thousands of years even a story arriving in a entirely new landscape would be swiftly curated into the bog lands and granite outcrops of its new home. It would shake down its feathers, shape-leap a little, or grow silent and would soon cease to be told. No teller worth their salt would just stumble through the outline and think it was enough, the vital organs would be the mnemonic triggers of the valley or desert it now abided in. This was a protracted courtship to the story itself. It was the business of manners.

Oral culture has always been about local embedding, despite the big human questions that cannot help but sweep up between cultures. These are details that may seem unimportant when only seeking to poke around your childhood memories in a therapist's office, but they start to fall woefully short when this older awareness of story as hinge between village and forest is reignited – the absence becomes acute, the tale flat and anthropocentric.

I don't think we have the stories, these stories have us. They charge vividly through our betrayals, illicit passions, triumphs and generosities. Psyche is not neatly contained in our chest as we scuttle between appointments, but we dwell within psyche: gregarious, up-close, chaotic, astonishing, sometimes tragic, often magical.

Well, something piratical is happening. It is time to rescue the stories, re-hydrate the language, scatter dialectical inflection amongst the blunt lines of anthropological scribbles, muck up the typewriter with the indigo surge of whale ink.

We're unlocking the cage.

ECHO

For the past twenty years, I've been a wilderness rites-of-passage guide. The whole thing had begun in earnest when, way back, I had taken myself up to the hills of Snowdonia and simply sat in a small oak gully without watch, food, tent or fire for four days.

The energies of that place had a feast on my grief-racked bones, and then set up conditions and tutoring on the understanding that I would, in some incomplete but sincere way, speech out some of their atmosphere into the wider world. I'm not sure I quite understood what I was getting into. This led to four years in a black tent in the valleys and little copses of the south west of Britain.

Myths seemed the way to go. To give voice. A bridge. At best their insights gives us a glimpse of that archaic word cosmos; that our own story is no longer held in some neurotically distanced interior, but free ranging.

So I have long found myself in love with oral culture, and the diligent act of slowly returning book-bound tales to their place by the fire-side, my tellings intertwined with rook call, billows of fireside smoke, whisky-splashed libations on the roots of the Rowan tree, the midnight loon with her caressing tones of friendly loneliness. This practice has led me to a long standing sensation:

Myth, in the way I am thinking about it, is an echo-location arising from the Earth itself.

In the living world, when certain animal calls collide with another being, they send an echo back to the caller, giving even an almost blind creature a sense of what is in their surrounding domain. I think the Earth has always done something similar. It transmits pulses, coded information, lucid image, and then sits back to see what echoes return from its messaging. This is not the deadening thump of just one note but a multiplicity.

Sometimes we get lucky. It may be a Inuit perched on the ice round a fishing hole, a tramp wandering Welsh lanes, a woman gardening early on a summer's morning that receives it. These pulses tell us something about how to live. I would call this beholding.

Oral cultures have often demonstrated great skill at honouring this, and crafting art around it until it becomes a two-ways-looking that confirms a kind of holy thinking existing between wolf and caribou, silvered rain and tangled byre. This mystical morse code is the true underlying pattern of any myth deserving of the name. It is the sound of the Earth and its inhabitants thinking about itself.

When the call hits whoever is tuned to receive it, it sends an echo back to its source; it confirms relationship, and in some way edifies that origination point. These pulses can get picked up when fasting on the mountain top, in the temple during a silent retreat, whilst grieving for an old love by a still lake. It is very mysterious, and requires a certain aliveness to pick it up. It's not a fashionable sentiment, but the kind of multi-tasking that modernity celebrates is a direct hindrance to receiving it.

THE SEDUCTION OF THE WOUND

When echo-location is lost, we fall out of myth. We fall out of relationship. We start to get an atrophy of image, thinned-out allegories that are a reckless attempt to promote ideas of the state. A kind of human focused, social mythology. A mimic. The hallucination of empire ensues.

So to follow a wild mythology involves a lot of listening, a stilling, to get connected to this ancient form of calling. It is a love story really. Some old lover is gently trying to call us home. When confronted with panicked ideas about ecological 'narratives for now', I suggest that this awareness is paramount. We need bush soul.

One of the most salient layers of these stories is an emphasis on service. The clearer the articulation of trouble, the greater the expectancy that the very trouble is crafted up into a gift for a wider circle. And that's not just a human circle. So these old stories have more than a degree of accountability about them.

For many of us, wound means truth. In a sugared world, holding your gaze to something broken, bereft or damaged seems like the deepest, most articulate position we can take. We see this move all the way

through the modern arts. It's what gets the big grants. Myths say no. The deepest position is the taking of that underworld information and allowing it to gestate into a lived wisdom that, by its expression, contains something generative. The wound is part of a passage, not the end in itself. It can rattle, scream and shout, but there has to be a tacit blessing, or gift, at its core.

Many stories we are holding close right now have the the scream but not the gift. It is an enormous seduction on behalf of the West to suggest that jabbing your pen around in the debris of your pain is enough. It's not. That's uninitiated behaviour masquerading as wisdom. Lead is not gold, no matter how many times you shake it at the sun.

TURNING OUR HEAD FROM THE PELT

Once upon a time there was a lonely hunter. One evening, returning to his hut over the snow, he saw smoke coming from his chimney. When he entered the shack, he found a warm fire, a hot meal on the table, and his threadbare clothes washed and dried. There was no one to be found.

The next day, he doubled back early from hunting. Sure enough, there was again smoke from the chimney, and he caught the scent of cooking. When he cautiously opened the door, he found a fox pelt hanging from a peg, and woman with long red hair and green eyes adding herbs to a pot of meat. He knew in the way that hunters know that she was fox-woman-dreaming, that she had walked clean out of the Otherworld. 'I am going to be the woman of this house,' she told him.

The hunter's life changed. There was laughter in the hut, someone to share in the labour of crafting a life, and, in the warm dark when they made love, it seemed the edges of the hut dissolved in the vast green acres of the forest and the stars.

Over time, the pelt started to give off its wild, pungent scent. A small price, you would think, but the hunter started to complain. The hunter could detect it on his pillow, his clothes, even on his own skin. His complaints grew in number until one night the woman nodded, just once, her eyes glittering. In the morning she, and the pelt, and the scent, was gone. It is said that to this day the hunter waits by the door of his hut, gazing over snow, longing for the fox woman.

I would suggest that we are that hunter, societally and most likely personally. The smell of the pelt is the price of real relationship to wild nature; its sharp, regal, undomesticated scent. While that scent is in our hut there can be no Hadrian's wall between us and the living world.

Somewhere back down the line, the West woke up to the fox woman gone. And when she left she took many stories with her. And, when the day is dimming, and our great successes have been bragged to exhaustion, the West sits, lonely in its whole body for her. Stories that are more than just a dagger between our teeth. More than just a bellow of conquest. As I say, we have lost a lot of housemaking skills for how to welcome such stories. We turned our face away from the pelt. Underneath our wealth, the West is a lonely hunter.

CULTURAL LAYERS

Archaeologists can drink. I mean really. The table is gleaming with pint glasses settled with chewy, warm, resolutely flat beer. A pile of paper plates, foil tins and the remain of a curry slump on the far end, still issu-

ing their come-hither scent of spice, salt and grease. We're in a small coastal town in the north of Dorset. Globs of late October rain boom-patter the window.

Glancing up, the oldest man, a ceramics expert, finally says what the other men certainly appear to be thinking: 'So why have they stuck a storyteller into a dig with archeologists? We want the facts and you just want the story!' There's a boozy grump of approval. Two days digging in the rain for a priory that may or may not be there has not exactly sweetened the mood.

I'd seen this discomfort coming in the runes, I tell you. So, awkwardly I stand up and deliver my little speech: 'Well, point taken. But a mythologist is more like you lot than you may think. First of all, I know you'll often just walk the mud ridges of an old field looking for, just on the off chance, something worth excavating. Well, that's what we do, we just happen to be looking in anthologies or listening to other tellers to find something to get us digging. So let's say you find something. You wave your machines about and stick in your spade. You find objects, you detect changes in soil, you begin to get a sense of the time-span and the cultural history of the objects – if you're very lucky maybe an Anglo-Saxon broach, or Pictish ring – well for us the stories give all sorts of little clues to the time and attitudes of the storyteller who archived the story, or the tradition they were trying to maintain.

'So you guys bring the objects up from the slow time of their resting place. Eventually they will be painfully examined, brushed down and confined to a cabinet. They will certainly assist research, and the gathered facts will support scholarship. But here's what a storyteller does. When they get to the depths of the dig, they tenderly bring up the story, gather themselves, and start to speak it. Animation. They are in the business of revival, of bone-gathering, of bringing back to life something many thought were lost – they give us a living myth, a living excavation.'

Bless 'em, the ruddy-faced team took it with a few groans, the throw of a mucky towel, and another exhausted shuffle to get the tankards filled.

I bring up this story just as an acknowledgment of those cultural implications as we dig, that surrounding myths' echo-location is often the imprint of history and tribal inflection. I love all that; the stories continued journey, and I study it diligently. Once the tale has reared up into the human community, of course, it will collect details of the time periods of its initial tellings, they are not meant to be kept as some kind of pristine expression of Eden. But they're not to lose this earthed root system either, otherwise the tree collapses.

What I'm really looking for is this deepest contact; the moment when the breath hits the bones and the story has its way with us. That's a scary place, many would rather stay nice and safe with just the historic layers, but if you're still reading, I suspect you are not one of those.

Oh, and guess what? Two hours later we found that priory.

THE STORIES THE WEST TELLS IN PRIVATE

Connection to where we come from is starting to matter. I guess it always did. I started to notice it about a decade ago. At the end of an evening of stories or extended teaching they would appear. The weight of the West on their shoulders. Beautiful folks usually. Almost always white, hair often dreaded, neck laden with

cowrie shells, dream-catchers on legs, maybe a whiff of patchouli oil, exotic animals indeed, who would patiently stand in line till its their turn, and then, shuddering with emotion, speak vividly about their experiences in the Amazon with visionary plants, their apprenticeship to a Vietnamese medicine woman, their pilgrimage to Tibet, their name change from Bert to 'dragon-bull-rainbow man'. With absolute sincerity in their Scots-Irish, Polish, Norwegian or Welsh eyes they relaid their tale and then expected me to be approving of it. By now you will be getting the emphasis – I'm not. Maybe I was for the first hundred times.

Now to be clear: these folks are signposts to being real human beings. In a numbed out, glow-screen world, this is a vivid attempt to wake up, to feel something real for once, to take up a little more space in hard, neurotic times. I've stood in line just like them, twisting my braids and trying hard to think non-attached thoughts. It's a step to sanity when the cards are decked so horribly against the soul.

But I think it's just a first step, to maintain it year after year is the posture of a child, and the last thing our children need is to be raised by kids with the faces of adults. And there's the rub: to orientate to a life to nourish our children's, children's, children. To understand the labour of raising something. When we have people in their thirties and forties attempting to self-initiate, something that most tribal groups would say should happen at adolescence, the lintel of security over a child's head gets awfully thin, maybe a balsa wood plank. We're too busy getting our chakras balanced to tell them stories, take them for walks.

But why the impulse to be any where but here? I suggest it is the stories the West tells itself in private. Because when the taxes have been paid, Siberia has been Google-Earthed to the last inch, when the last sinew of oil has been drained from the North Sea, I suggest the stories we secretly tell ourselves are little more than nightmares. The West's esteem is far lower than we expect.

Our bones know the cost of the degree of the speed-magic we are harnessing, our bellies are acid strewn with the price. Hobbling alongside this hero-myth is the terrible Banshee of the Blood Pool, that claims the storyteller's chair by our bed when we rest. It can be no other way if the picture is so imbalanced. So where else can we go but out of where we come from? How could we stay in the madness? Well, I'm proposing we don't let ourselves off the hook so easily. We shouldn't be feeling so groovy.

Let's squat down in the gunk.

FROM IS OVERRATED

So what happens if we try and root? Rather ironically, the latest addition to hip-speak is a desire to be indigenous. No work history required. Well, indigenous is a complicated word. I've seen whole gatherings grind to a deathly halt as growingly red-faced folks try and get clear about what the word could mean. Funnily enough, I've never heard anyone who could qualify for the word actually use it. We turn up at the gate of the Crow reservation with our arms open and expect to get a warm reception.

So how do we work with this longing? Maybe let's dial it down a little. I won't be using anything so inflammatory as an offer for you suddenly becoming 'indigenous' overnight, that's distasteful, but I will gamble a little, throw my hat in the ring and say that I think coming 'from' somewhere can be highly overrated.

I can't tell you much about being 'from' a place – I meet people who are so 'from a place' that they are bigoted, numb and miserable.

I also suggest that if you don't have the bones of loved ones in the ground of that land, then you have no legitimate aboriginal claim for from-ness. Until the wiggling denizens of the soil have a good chew on the composting lump of Aunt Agatha or Grandpa Terry, then any sense of from-ness is pretty abstract.

GETTING CLAIMED

I know this stuff can make your head spin. Feel impossible to calibrate, not worth the time, just another paradox. Well I suggest a re-tuning of intention, a slightly more sober directive: to be 'of' a place. To labour under a related indebtedness to a stretch of Earth that you have not claimed, but has claimed you.

To be of is to hunker down as a servant to the ruminations of the specific valley, little gritty vegetable patch, or swampy acre of abandoned field that has laid its breath on the back of your neck. Maybe it's a thin crest of swaying weeds between brokendown sheds. As David Abrams' extraordinary work reminds us, Earth is air too; the myriad of wind tongues, the regal pummelling of the clouds – regardless of being in a city, hamlet or tent on a Norfolk beach. Remember to look up.

To be of means to listen. To commit to being around, to a robust pragmatism as to what this wider murmuring may require of you. It's participation, not as a conqueror, not in the spirit of devouring, but of relatedness. I think this takes a great deal of practice. It doesn't mean you never take a life, live on apples and peas, or forget that any stretch of Earth holds menace and teeth, just as it does the rippling buds of April.

You learn from the grandeur of its shadow as much as the many abundances. To be of means to be in. To have traded endless possibility for something specific. That over the slow recess of time you become that part of the land that temporarily abides in human form. That your delightful curvature and dialectical brogue is hewn deep, wrought tough, by the diligence of your service to the sensual tangle you find yourself in.

It means not talking about a place but with a place – and that's not a relationship available indiscriminately, wherever you travel, but something that may claim you once or twice in a lifetime. It means staying when you don't feel like staying. Cracking the ice on the water butt, climbing into your mud-encrusted boots and walking out into the freezing dark with a bale of hay. It's very little to do with how you feel, because guess what? Feelings change. Knowing the stories of a place is bending your ear to its neighbourly gossip.

Some of us are trying to re-enter the countries of our birth in a different way. To walk the shores not with a shield but with speech, with seeds rather than slaughter. To open a dimension of this country that is not just Britain but Albion. Not Devon but Dumnonia, or Defenascir, or somewhere else again:

Flank of Wolf Mind,
Confirming Shepherd's Staff
Timber-Wains and
the Fulsome Corn
Copper Caved,
Riven by Apples
Blessed Trout –
Glitter Dragon

ECONOMY

Capital is at the core of how we make decisions, and influences our ability to regenerate.

BOOKS

Cradle to Cradle: Remaking the Way We Make Things - Michael Braungart
The Economy of Commerce: A Declaration of Sustainability - Paul Hawken
Let My People Go Surfing: The Education of a Reluctant Businessman - Yvon Chouinard
The Responsible Company: What Weve Learned from Patagonia's First 40 Years -Yvon Chouinard and Vincent Stanley
The Regenerative Business - Carol Sanford
The Upcycle: Beyond Sustainability - Michael Braungart and William McDonough
Decolonizing Wealth: Indigenous Wisdom to Heal Divides and Restore Balance - Edgar Villanueva
Sacred Economics: Money, Gift, and Society in the Age of Transition - Charles Eisenstein
Natural Capitalism: Creating the Next Industrial Revolution - Paul Hawken, Amory Lovins and Hunter Lovins

ESSAYS & ARTICLES

50-Year Farm Bill - Wes Jackson, Wendell Berry and Fred Kirschenmann
"An Ecomodernist Manifesto: A manifesto to use humanity's extraordinary powers in service of creating a good anthropocene" - Ecomodernist
"Unto This Last" - John Ruskin
"Corn Maze: There is no 'simple fix' for commodity farming" - Tom Laskawy
"Impact Investing in Sustainable Food and Agriculture Across Asset Classes" - Croatan Institute
"Private Capital for Working Lands Conservation" - The Conservation Finance Network

A 50-Year Farm Bill

proposed by

The Land Institute
Salina, Kansas
785-823-5376

June 2009

www.landinstitute.org

Index

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A 50-year Farm Bill

Introduction

Long-term food security is our issue. We begin with the knowledge that essentially all of nature's ecosystems feature perennial plants growing in species mixtures and that they build soil. Agriculture reversed that process nearly everywhere by substituting annual monocultures. As a result, ecosystem services—including soil fertility—have been degraded. Most land available for new production is of marginal quality that declines quickly. The resulting biodiversity loss gets deserved attention, soil erosion less.

Acknowledgment of coalitions

To address diminishing agricultural potential with a new vision, The Land Institute sponsored ten meetings coast-to-coast with farmers and representatives of sustainable agriculture organizations. This loose coalition can help to build a broader constituency.

Organic and local food organizations, including some represented in our coalition, provide vision, education and models of greater sustainability. With those constituencies, we share common principles and the goals of returning the world's grain-producing landscapes to perennial plants in the rotation for grain production.

Green Lands Blue Waters is an Upper Midwest coalition advocating the need to perennialize the landscape of the Mississippi Basin out of concern for soil erosion and the leaching of nitrogen, which is responsible for one of the largest dead zones of the world. GLBW partners include the University of Illinois, Iowa State University, including the Leopold Center for Sustainable Agriculture, Louisiana State University, the University of Minnesota, North Dakota State University and the University of Wisconsin, and the Audubon Society, the Illinois Stewardship Alliance, the Institute for Agriculture and Trade Policy, The Land Institute, The Land Stewardship Project, the Minnesota/Iowa Farmers Union, The Nature Conservancy, Trout Unlimited, Practical Farmers of Iowa, and the Rural Advantage and Agricultural Watershed Institute.

What is required?

Promote systemic change
A 50-Year Farm Bill is a proposal for gradual systemic change in agriculture. Perhaps what has been missing is an available vision with scientific feasibility. Implementation will depend on endorsement by the Secretary of Agriculture, the President, Congress, nonprofit organizations, corporations, and citizens.

Plan
Enclosed are charts which illustrate changes over ten 5-year farm bill periods. Each 5-year bill, in addition to its existing programs for subsidies, food programs, etc., moves incrementally toward the 50-year goal of stopping the deficit spending of ecological

capital necessary for food production. Thus, the 50-year Farm Bill becomes an instrument for increasing sustainability and food security.

In the short run, we can achieve a significant measure of success through farm policy that encourages farmers to increase the use of perennial grasses and legumes in crop rotations. But that will not be enough. Options for farmers will take a major leap when perennial grains are available. Their input costs will decline as the landscape benefits. USDA and other researchers will need policy to sustain funding. Breeding perenniality into a broad spectrum of our current grain crops will take time. Even so, prototypes have thrived for several years in Kansas. As their yields increase, they will replace their annual relatives—one in as few as 10 years.

Our project would employ the ecosystem as the standard. Once that standard is adopted, an array of technologies can become useful tools. Technology would follow, rather than lead the vision.

Cost

USDA funding

We do not seek USDA funding for The Land Institute, or The Leopold Center, or any particular organization. The Land Institute will offer to the project free germplasm and more than 30 years of experience with perennials. Its staff in this decade has greatly enhanced the diversity of crops and speed of change. We have hybrid prototypes of perennial wheat, sorghum, sunflower and other crops (see Attachment II). We are giving people small samples of flour from a perennial wheat relative we have named Kernza™ . Biochemical analysis shows it to be superior to annual wheat in nutrition. People like it. We expect it to be farmer-ready in a decade.

During three decades, we have collaborated with several land grant universities and other institutions. We include them as assets. **Because the change needed is systemic, we believe that USDA should take the lead.** The Obama administration's devotion to change makes our proposal now seem possible.

We propose that, over an eight-year period, federal funding would sponsor 80 plant breeders and geneticists who will develop perennial grain, legume, and oilseed crops, and 30 agricultural and ecological scientists who will develop the necessary agronomic systems. They will work on six or eight major crop species at diverse locations. Budgeting $400,000 per scientist-year for salaries and research costs would add less than $50 million annually. This is eight percent of the amount that the public and private sectors have been spending on plant breeding research alone, according to a late-1990s survey.

Reversing ecological damage

Our vision is predicated on the need to end the ecological damage to agricultural land associated with grain production—damages such as soil erosion, poisoning by pesticides,

and biodiversity loss. The most cost-effective way to do so and stay fed is to perennialize the landscape.

The transition of agriculture from an extractive to a renewable economy in the foreseeable future can now be realistically imagined. Our proposal is ambitious but it is necessary and it is possible. We have little doubt that we can make the agricultural transition faster than the adjustments imposed upon us by climate change and the end of the fossil fuel era. If we can keep ourselves fed, we have a chance to solve the other problems.

Conclusions

Perennialization of the 70 percent of cropland now growing grains has potential to extend the productive life of our soils from the current tens or hundreds of years to thousands or tens of thousands. New perennial crops, like their wild relatives, seem certain to be more resilient to climate change. Without a doubt, they will increase sequestration of carbon. They will reduce the land runoff that is creating coastal dead zones and affecting fisheries, as well as saving and maintaining the quality of scarce surface and ground water. U.S. food security will improve.

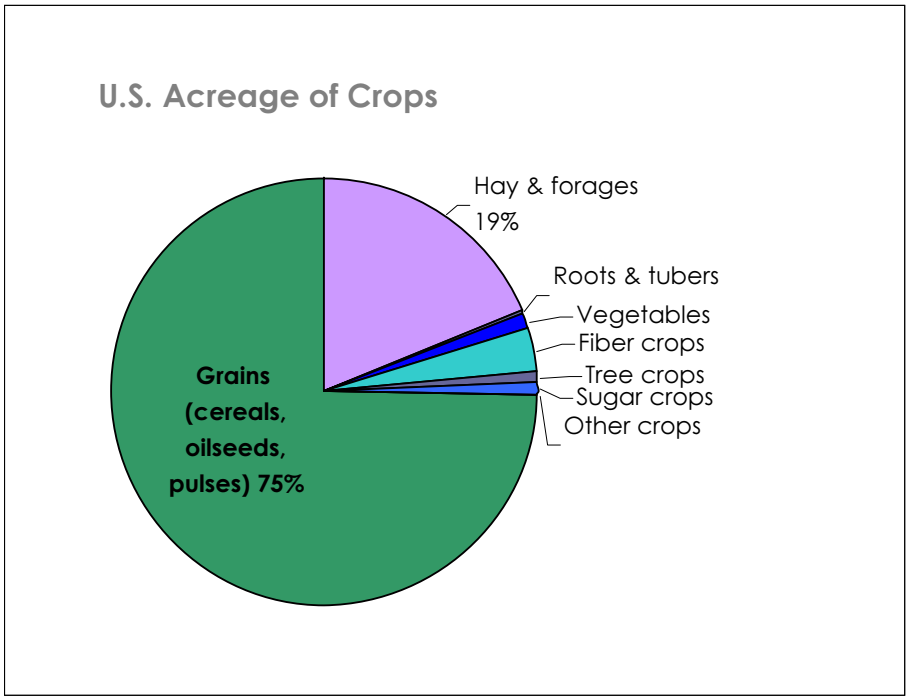
Social stability and ecological sustainability resulting from secure food supplies will buy time as we are forced to confront the intersecting issues of climate, population, water and biodiversity.

Five-year farm bills address:

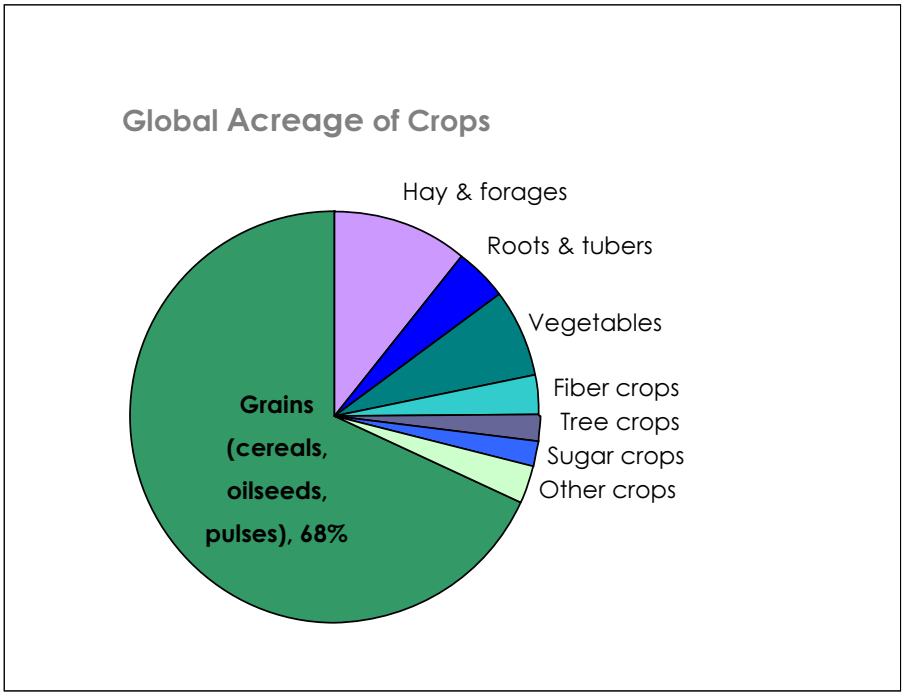
- Exports
- Commodities
- Subsidies
- Some soil conservation measures
- Food programs

A 50-Year Farm Bill would be a program using 5-year farm bills as mileposts, adding larger, more sustainable end goals to existing programs:

- Protect soil from erosion
- Cut fossil fuel dependence to zero
- Sequester carbon
- Reduce toxics in soil and water
- Manage nitrogen carefully
- Reduce dead zones
- Cut wasteful water use
- Preserve or rebuild farm communities



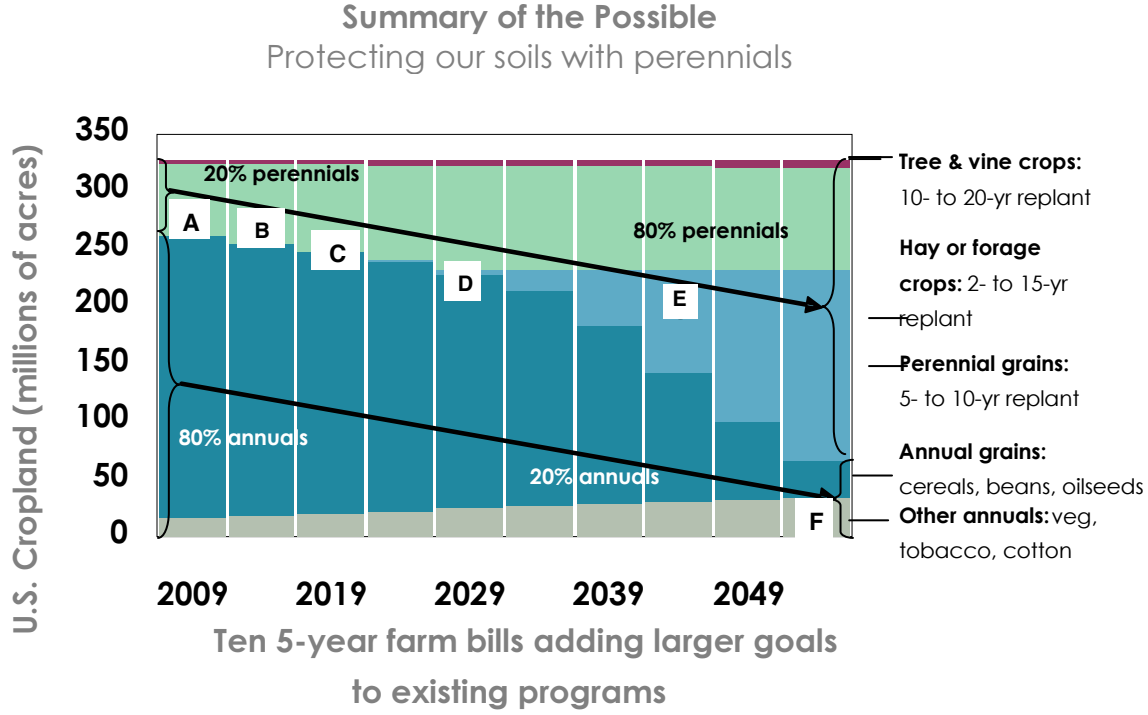
Although we start with our own country's soils and food supply, negative results of our present agriculture—soil erosion, chemical contamination, fossil fuel dependency for food production, and dead zones—are global problems, so this 50-year farm bill ultimately is for the world.



Protecting our soil with perennials: national acreage goals

Half a century of concerted investment in research, education and incentives to conserve soil with deep-rooted, long-lived perennial crops could increase the protected acreage from 20 to 80 percent.

Pastures and perennial forage crops area already available either in permanent stands or in rotations. We propose incentives which would maintain the present perennial acreage and increase perennials in rotations. When perennial grains become available, they will require no financial subsidy, since they would represent a compelling alternative.



The chart above projects what is possible if we assume that the following are achieved in the 5-year periods shown above.

A, 2009 Hay or grazing operations will continue as they exist. Preparations for subsidy changes begin.

B, 2014 Subsidies become incentive to substitute perennial grass in rotations for feed grain in meat, egg and milk production.

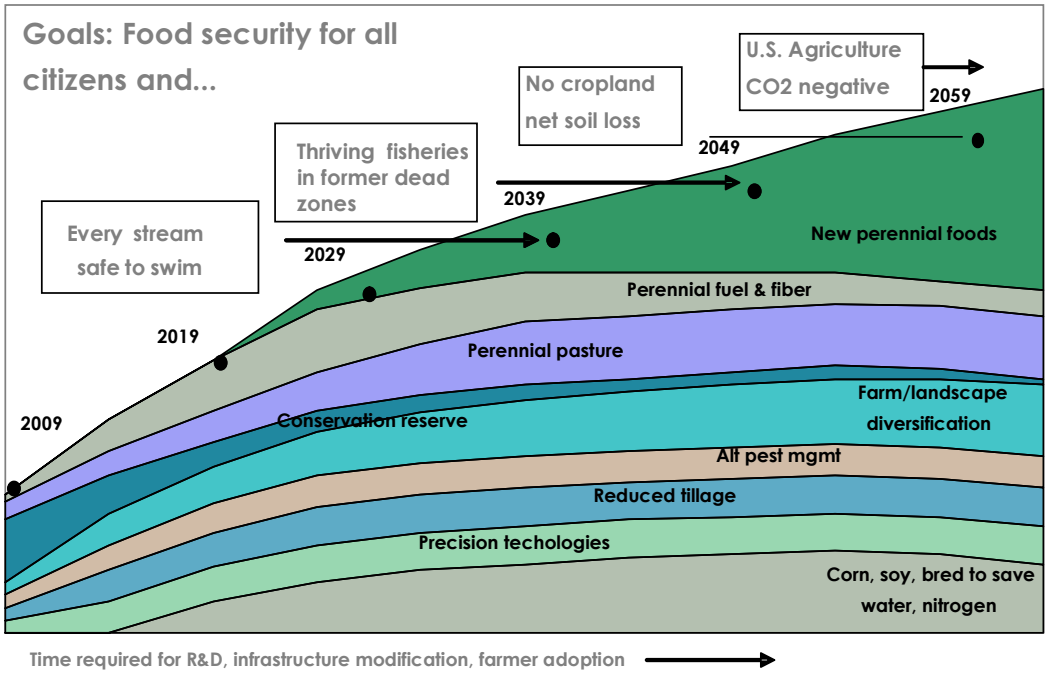
C, 2019 The first perennial grain, Kernza™ (a wheat) will be farmer-ready for limited acreage.

D, 2029 Educate farmers and consumers about new perennial grain crops.

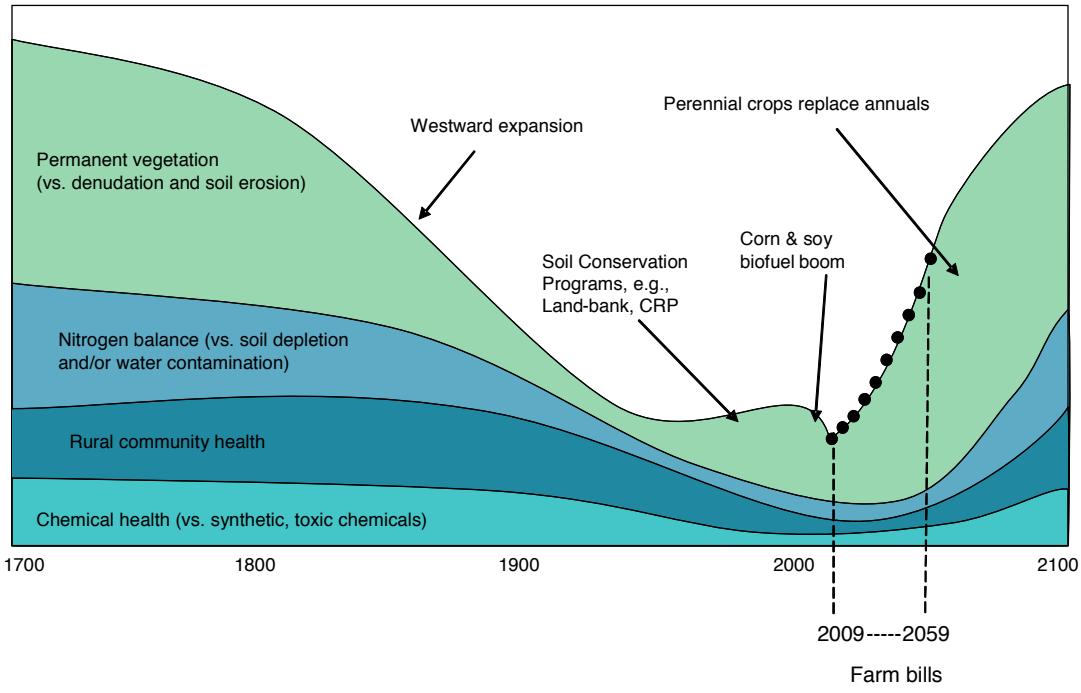
E, 2044 New perennial grain varieties will be ready for expanded geographical range. Also potential for grazing and hay.

F, 2054 High-value annual crops are mainly grown on the least erodible fields as short rotations between perennial crops.

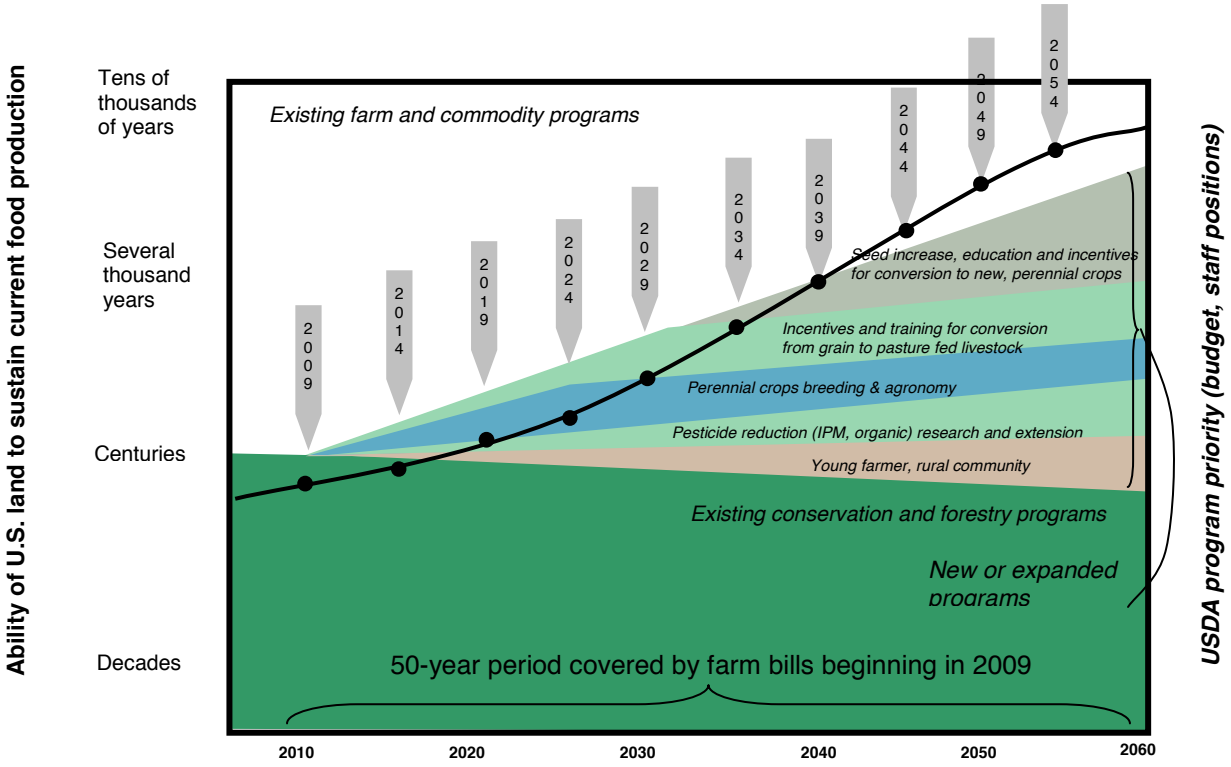
Long-term changes in U.S. agriculture



Components of agricultural sustainability



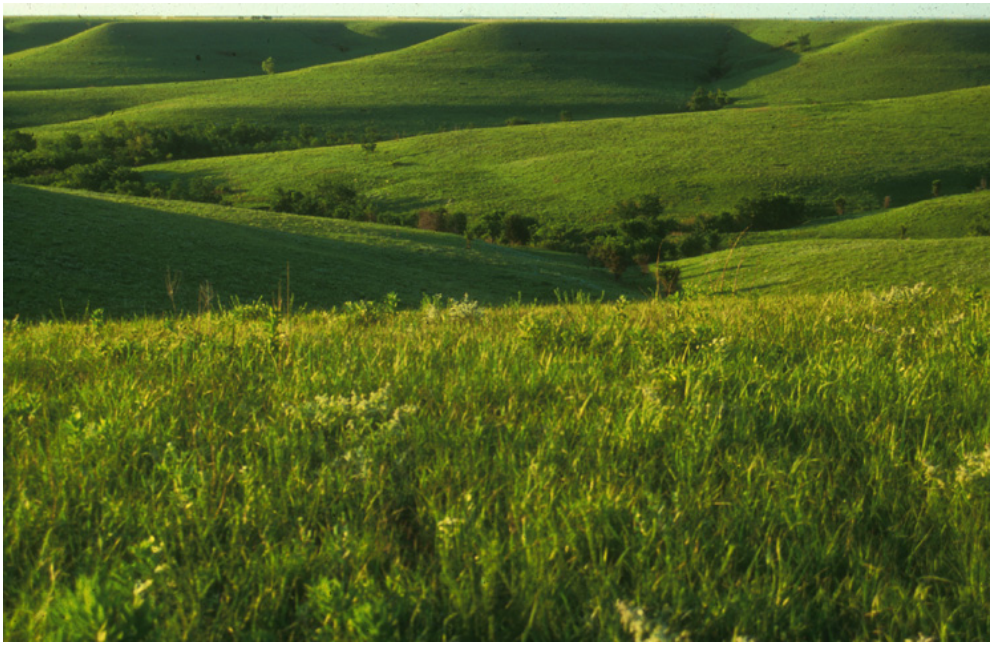
Changes in USDA program priorities to increase the productive lifespan of US cropland



Estimates—changing over time as annual grains are replaced by perennial crops—of the remaining productive life of U.S. agriculture are shown on the left-hand axis. Colored areas and captions in italics refer to change in USDA priorities (right-hand axis) as the result of new policies in the next ten farm bills.

Erosion in Illinois
Flint Hills Prairie

Illinois cornfield, June 2008 / Kansas Native Prairie, June 2008



Attachment I

Problems and Solutions

Problems to be addressed

- According to the Millennium Ecosystem Assessment (MEA), agriculture is the "largest threat to biodiversity and ecosystem function of any single human activity."

- Agriculture is responsible for 70% of U.S. water contamination.

- 40% of US waters are unfit for swimming and fishing.

- "No Pesticide-Free Zones" – pesticides are present in nearly every water and fish sample in agricultural areas.

- Global agricultural expansion (assuming the business as usual approach):
  - 18% increase in cropland.
  - 300% increase in fertilizer.
  - 75% increase in pesticide production.
  - Primarily onto less resilient soils where, "if there is a choice, these soils must not be used for grain crop production." (Eswaran et al, 1999)

- Global implications:
  - 2.4 – 2.7 fold increase in eutrophication.
  - Increase greenhouse gas emissions.
  - Further soil degradation.
  - Loss of biodiversity.
  - Loss of critical ecosystem services: water and nutrient cycling, biocontrol, pollination.

Which forces the following conclusion:

The key ecological question: …intensive management with high yields, versus…lower-yielding systems" (Mooney et al, 2005) is a dichotomy forced upon us because our grains are annuals.

Conclusion: Production at the expense of conservation OR conservation at the expense of production.

Solutions proposed

- Diverse, perennial plant communities, domestic or wild, have been successful micro-managers of landscapes for millions of years.
  - This is due to perennial roots of varying architectures, alive year-round.
  - The same roots also bind the soil, making it less susceptible to wind and water erosion.

    - Perennials have greater access to water and nutrients over a longer growing season.

- From the point of view of the plant breeder, perennials have "excess capacity" that can be reallocated to grain production.

- The revolutionary transformation of wild species into crops has been done before (with annuals).

Conclusion: Conservation as the consequence of production is possible.

Attachment II

Perennial Grains Research at The Land Institute

Wheat has been hybridized with several different perennial species to produce viable, fertile offspring. We have produced thousands of such plants. Many rounds of crossing, testing and selection will be necessary before perennial wheat varieties are available for use on the farm.

Kernza™ is our trademark name for **Intermediate wheatgrass** (*Thinopyrum intermedium*). It is a perennial relative of wheat. Using parental strains from the USDA and other sources, we have established genetically diverse populations. We will harvest 30 acres in 2009 and an additional 100 acres will be planted in 2009. The overall quality is superior to annual wheat.

Grain sorghum is a drought-hardy feed grain in North America and a staple human food in Asia and Africa, where it provides reliable harvests in places where hunger is always a threat. It can be hybridized with perennial species *Sorghum halepense*. We have produced large plant populations from hundreds of such hybrids and have selected perennial strains with seed size and grain yields up to 50 percent those of annual grain sorghum.

Illinois bundleflower (*Desmanthus illinoiensis*) is a native prairie legume that fixes atmospheric nitrogen and produces abundant protein-rich seed. It is one of our strongest candidates for domestication as a crop. We have assembled a large collection of seed from a wide geographical area and have a breeding program. We see it as a partial substitute for soybean.

Sunflower is another annual crop we have hybridized with perennial species in its genus, including *Helianthus maximiliani*, *H. rigidu*s and *H. tuberosus* (commonly known as Jerusalem artichoke). Breeding work has turned out strongly perennial plants. Genetic stabilization will improve their seed production.

Perennial upland rice: Uplands fields of annual rice are highly vulnerable to erosion. Yet millions of people in Asia depend on it. In the 1990s, the International Rice Research Institute achieved significant progress toward breeding a perennial upland rice using crosses between annual rice, *Oryza sativa*, and the two wild perennial species, *Oryza rufipogon* and *O. longistaminata*. The project was terminated in 2001, but the breeding and genetic populations were transferred to the Yunnan Academy of Agricultural Sciences in southwestern China, where work has been continued with funding support from The Land Institute. The focus is on the more difficult work with the distantly related *O. longistaminata*, which, when crossed with rice, produces plants with underground stems called rhizomes. In recent breakthroughs, a small number of perennial plants with good seed production have been produced.

Corn and **soybeans** are two species, one could argue, which more than any other crop, need to be perennialized. **Corn** is a top carbohydrate producer and is grown on 70 million acres annually. Until soybean acres increased, corn caused the greatest amount of soil erosion in the United States. It is always number one or two. It will be a challenge to perennialize this crop, but serious consideration is being given to doing so by exploring two main paths. 1) We could

obtain genes from a few distant relatives of corn which are in the genus *Tripsicum*. All are perennial and at least one is winter-hardy. 2.) The other, more likely route would be to cross with two much closer perennial relatives of corn. Unfortunately, both species (*Zea perennis* and *Zea diploperennis*) are tropical and non-winter-hardy. Professor Seth Murray at Texas A&M favors using them in crosses rather than *Tripsicum*. Dr. Jim Holland, a USDA corn geneticist at North Carolina State University says that perennial corn development comes down to a few technical issues which need solved.

Several Australian species of the **soybean** genus *Glycine* are perennial; they are difficult to breed with soybean but are potential targets for direct domestication, without crossing to soybean. Our exploration for perennializing soybeans has been very limited. We have been working to make Illinois bundleflower a satisfying substitute.

There is potential for many more perennial grain species, including **rosinseed, Eastern gamagrass, chickpea, millets, flax** and a range of **native plants**.

Ecological Research

To mimic a natural ecosystem to some degree will require some degree of crop diversity. We have elected not to wait until perennial grain crops are fully developed to gain experience about the ecological context in which they will grow. At The Land Institute we have established long-term ecological plots of close analogs in which to compare methods of perennial crop management. These perennial-grain prototypes, including Kernza™ and bundleflower, are allowing us to initiate long-term ecological/ production research in these plots. Eventually, true perennial grain mixtures will succeed them. Additionally, ongoing studies of natural ecosystems, such as tallgrass prairie, provide insight into the functioning of natural plant communities. The prairie is now and likely always will be a valued teacher.

The Road Ahead

At The Land Institute we have laid out a route to follow in breeding perennial grains and developing the agro-ecosystems in which they will grow. To expand research on perennial grains across the nation and planet, we freely distribute germplasm—seed of perennials and hybrids. Other plant breeders are using these seeds as parents in establishing or enhancing their own perennial grain programs. Seeds are available for basic research to answer fundamental questions. We are building a body of knowledge about perennial grain systems through publication in the refereed journals.

Attachment III

Frequent Questions

Over the past three decades, interested people have asked some good questions. The most frequently asked follow and are followed by our best answer.

1. It is expected to take at least twenty-five years to achieve more than two or three profitable, productive perennial grain crops. Isn't that too late to address the problems facing the world today?

We do expect two or three of our grains to be available within 10-15 years. But in answer to the question— as with the climate and population problems with no quick solutions—we need to move as fast as possible. New strategies are needed that emphasize efficient nutrient use in order to lower production costs and minimize negative environmental impacts. The sooner that successful alternatives are available, the more land we can save from degradation. It is likely that global agricultural acreage will expand over the next two to three decades especially if the human population increases to 8 to 10 billion people. Recent projections predict an 18% or more increase in agricultural land by 2020. The best soils on the best landscapes are already being used for agriculture. Much of the future expansion of agriculture will be onto marginal lands (Class IV, V, and VI) where risk of irreversible degradation under annual grain production is high. As these areas become degraded, expensive chemical, energy, and equipment inputs will become less effective and much less affordable.

Thirty-eight percent of global agricultural lands are currently designated as degraded, and the area is increasing. To minimize encroachment onto non-agricultural lands in the future, currently degraded lands will need to be kept in production AND restored to higher productive potential. In regions of the world where high inputs of fertilizers, chemicals and fuels are not an option, agricultural systems that are highly efficient, productive, and conservative of natural resources are needed—and will be needed even more 25 years from now.

2. Can we expect perennial grain crops to be as productive as annual grain crops and, if not, won't they actually worsen environmental problems by requiring more land for agricultural production?

a) There is sufficient evidence that "reasonable reference yields" of annual crops can be matched on high-quality lands and exceeded on poor-quality lands by diverse perennial systems with fewer negative impacts.

b) It depends on which annual yields are used as a standard. For example, the world record wheat yield was harvested in the Palouse region of Eastern Washington State where wheat yields can top 100 bushels per acre. Annual wheat production in that region, though, has resulted in extensive erosion. All of the topsoil has been lost from over ten percent of the region's landscapes. On eroded sites Palouse wheat yields may be less than 25-30 bushels per acre. Crop yields that come at such a high cost to the

soil resource—or that depend on an extravagant use of chemical fertilizers—should not be used as a standard of comparison.

3. But won't the seed yield of perennials always be limited by the need to save some energy for overwintering that could have been used to produce seed?

The short answer is no. The theoretical limitations to seed yield in perennials are no more serious than in annuals. In annuals, yield is limited by shorter growing seasons, water shortage due to short roots and poor seedling establishment. In perennials, yield can be constrained by the need to overwinter, but rapid spring growth of perennials, combined with season-long access to water deep in the soil profile, means that perennials such as alfalfa are over-all more productive than related annuals like soybeans. Much of the journey-work of plant breeders has been to shift the allocation of resources from leaves, stems, crowns, and roots toward seed in the development of perennial grain crops.

4. With advances in no-till production of annual grain crops, do we need perennial grains to mitigate the environmental problems associated with agriculture?

Unfortunately, yes. Although no-till technology has reduced erosion in many areas, some problems remain due to the biological limitations of annual plants. Chief among the problems associated with no-till is water quality. Annual crops, even in no-till situations, are relatively inefficient in capturing nutrients and water. In the Midwest, as much as 45% of precipitation may be lost through the soil profile under annual cropping. Rates of water loss through profiles may be five times greater under annuals than under perennials. No-till compared with conventional tillage systems can have losses as great or greater.

Annual crop plants are either absent or too small to use and manage water during times of precipitation. Water flowing through the soil profile transports downward soil nutrients and agrichemicals. Poor water quality is the consequence. This problem can be compounded under no-till production which often requires greater inputs of agrichemicals and fertilizers. A 2002 EPA survey of the nation's water quality shows a downward trend from the late 1990s. The problem is getting worse, despite widespread adoption of no-till and minimum-till systems.

Crop seeds need warm, well-drained seedbeds in order to properly germinate. No-till limits this. That is why tillage remains an attractive practice in northern regions. Warming and drying of the seedbed can be hastened. Advances in plant breeding may eventually allow for optimal germination in cooler, wetter conditions, but in the Midwest, seedlings will still be small when the rains come.

5. If our farming systems "mimic," to some degree, natural ecosystems, what level and kind of plant diversity is needed and how will it be deployed?

The answer to both parts of the question is, "It depends." It depends on the resilience and fertility of the soil, climate, disease pressures, and types of crops. Nearly all of nature's land-based ecosystems feature perennial plants grown in diverse mixtures. Natural ecosystems, in general, use and manage water and nutrients most efficiently and build and maintain soils. For that reason alone nature is our standard. The level and spread of diversity varies. The characteristics of the region in which they are to be grown will have to be assessed.

Diversity is of two kinds: multiple species and genetic diversity within species. Current grain production practices commonly involve planting a single genotype (near-zero genetic diversity) across a field often larger than 100 acres. Furthermore, that single genotype and other genetically similar plants are being grown on millions of acres in a region. Increases in genetic diversity at the species, field, and landscape levels are needed. The final ordering of the components of that diversity will be determined by what is useful and can be practically achieved by local farmers.

6. Several serious attempts have been made in the past to perennialize grain crops and we have none to date. What has changed that offers promise of success now?

History need not be a source of discouragement. In the case of wheat, most involvement with perennials had to do with bringing desirable genes—for resistance, say—from a wild perennial relative into the annual crop. The perennialization effort, in most cases, was carried on, more or less as a hobby, by an interested researcher but with no institutional commitment for a sustained program to guarantee continuity. When the researcher retired, the effort ended. The Soviets had the most ambitious perennial wheat program, but political decisions halted these efforts in the late '50s or early '60s.

We are now in a new era in two ways:

a) In recent years, the costs to our soils and waters due to annual cropping are increasingly weighed against bushels per acre, making some reduction in yields acceptable.

b) With recent advances in plant breeding, more knowledge of the genome and greatly increased computational power, thinking about breeding limits has changed.

7. Since mechanical tillage and annual rotations are largely eliminated in perennial systems, don't the perennial plants become "sitting ducks" for pests and disease?

Here proof is in the pudding. Perennials dominate most native landscapes and constitute roughly 80% of North America's native flora. Perennials have thrived throughout the evolutionary history despite the pressures of pests and disease.

In some fields or some regions, some perennial crops will prove to be more problematic than others and breeding for complex traits like yield and perenniality can

unintentionally purge genes involved in resistance responses. There will undoubtedly be pest and disease problems. But these problems also afflict our most productive annual crops. And there are many examples of herbaceous perennial plants—alfalfa, switchgrass, brome—that remain highly productive for many years despite exposure to pests or disease. Diversity (whether at the field or landscape scale or over time), field burning, and selecting for resistance in a plant breeding program are essential elements of our work.

8. How do alternative methods of production such as permaculture, biointensive, or organic fit in with perennial grain crops? What about vegetables and fruits? How do community-supported agriculture farms fit in?

We focus on the crops that occupying 68 percent of global cropland and provide about the same percentage of food calories: annual grain crops grown primarily in monocultures. Any number of approaches, alternative or conventional, could be used in managing perennial crops and distributing the harvest.

This is not to say that efforts aimed at reducing the scale of industrial agriculture and increasing local food security are misguided. They are not! They are necessary to transform our food system over the long term. While promoting local, small-scale, organic agriculture we must also assess how and where the bulk of our calories can best be produced. If all or even a large portion of the calories consumed by New Yorkers came from New York state there would be few trees left and the state's thin, poor soils would be quickly degraded. The bulk of the calories consumed by New Yorkers must come directly or indirectly from grain crops which grow well in the Midwest and Great Plains states.

9. Will the public eat perennial grains?

People like our Kernza™ (a perennial wheat) and we see little reason for people to find significant or undesirable taste differences in perennial grains generally. Greatest short-term success in developing suitable perennial crops will come with perennializing current grain crops with which the public are already familiar. Indeed, one of the strongest arguments for perennializing those grains is that it does not require large dietary shifts.

10. Finally, how are you going to harvest a perennial grain polyculture?

This question arose so frequently over the years that we finally decided to plant a polyculture of four annual crop species: corn, soybean, sorghum, and sunflower. The seed mixture was planted with an air drill. At harvest we opened the concave on the combine and cut the air (so as not to blow the sunflower seeds out the back). Progress through the field was slow, but not prohibitively so. Seeds were separated with a seed cleaner. The point is that mechanical equipment already in existence, with a little fine tuning can do the job. The larger problems are agronomic, not engineering.

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BY

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AN ECOMODERNIST MANIFESTO

To say that the Earth is a human planet becomes truer every day. Humans are made from the Earth, and the Earth is remade by human hands. Many earth scientists express this by stating that the Earth has entered a new geological epoch: the Anthropocene, the Age of Humans.

As scholars, scientists, campaigners, and citizens, we write with the conviction that knowledge and technology, applied with wisdom, might allow for a good, or even great, Anthropocene. A good Anthropocene demands that humans use their growing social, economic, and technological powers to make life better for people, stabilize the climate, and protect the natural world.

In this, we affirm one long-standing environmental ideal, that humanity must shrink its impacts on the environment to make more room for nature, while we reject another, that human societies must harmonize with nature to avoid economic and ecological collapse.

These two ideals can no longer be reconciled. Natural systems will not, as a general rule, be protected or enhanced by the expansion of humankind's dependence upon them for sustenance and well-being.

A good Anthropocene demands that humans use their growing social, economic, and technological powers to make life better for people, stabilize the climate, and protect the natural world.

Intensifying many human activities — particularly farming, energy extraction, forestry, and settlement — so that they use less land and interfere less with the natural world is the key to decoupling human development from environmental impacts. These socioeconomic and technological processes are central to economic modernization and environmental protection. Together they allow people to mitigate climate change, to spare nature, and to alleviate global poverty.

Although we have to date written separately, our views are increasingly discussed as a whole. We call ourselves ecopragmatists and ecomodernists. We offer this statement to affirm and to clarify our views and to describe our vision for putting humankind's extraordinary powers in the service of creating a good Anthropocene.

1

Humanity has flourished over the past two centuries. Average life expectancy has increased from 30 to 70 years, resulting in a large and growing population able to live in many different environments. Humanity has made extraordinary progress in reducing the incidence and impacts of infectious diseases, and it has become more resilient to extreme weather and other natural disasters.

Human technologies, from those that first enabled agriculture to replace hunting and gathering, to those that drive today's globalized economy, have made humans less reliant upon the many ecosystems that once provided their only sustenance, even as those same ecosystems have often been left deeply damaged.

Violence in all forms has declined significantly and is probably at the lowest per capita level ever experienced by the human species, the horrors of the 20th century and present-day terrorism notwithstanding. Globally, human beings have moved from autocratic government toward liberal democracy characterized by the rule of law and increased freedom.

Personal, economic, and political liberties have spread worldwide and are today largely accepted as universal values. Modernization liberates women from traditional gender roles, increasing their

control of their fertility. Historically large numbers of humans — both in percentage and in absolute terms — are free from insecurity, penury, and servitude.

At the same time, human flourishing has taken a serious toll on natural, nonhuman environments and wildlife. Humans use about half of the planet's ice-free land, mostly for pasture, crops, and production forestry. Of the land once covered by forests, 20 percent has been converted to human use. Populations of many mammals, amphibians, and birds have declined by more than 50 percent in the past 40 years alone. More than 100 species from those groups went extinct in the 20th century, and about 785 since 1500. As we write, only four northern white rhinos are confirmed to exist.

Given that humans are completely dependent on the living biosphere, how is it possible that people are doing so much damage to natural systems without doing more harm to themselves?

The role that technology plays in reducing humanity's dependence on nature explains this paradox. Human technologies, from those that first enabled agriculture to replace hunting and gathering, to those that drive today's globalized economy, have made humans less reliant upon the many ecosystems that once provided their only sustenance, even as those same ecosystems have often been left deeply damaged.

Despite frequent assertions starting in the 1970s of fundamental "limits to growth," there is still remarkably little evidence that human population and economic expansion will outstrip the capacity to grow food or procure critical material resources in the foreseeable future.

To the degree to which there are fixed physical boundaries to human consumption, they are so theoretical as to be functionally irrelevant. The amount of solar radiation that hits the Earth, for instance, is ultimately finite but represents no meaningful constraint upon human endeavors. Human civilization can flourish for centuries and millennia on energy delivered from a closed uranium or thorium fuel cycle, or from hydrogen-deuterium fusion. With proper management, humans are at no risk of lacking sufficient agricultural land for food. Given plentiful land and unlimited energy, substitutes for other material inputs to human well-being can easily be found if those inputs become scarce or expensive.

There remain, however, serious long-term environmental threats to human well-being, such as anthropogenic climate change, stratospheric ozone depletion, and ocean acidification. While these risks are difficult to quantify, the evidence is clear today that they could cause significant risk of catastrophic impacts on societies and ecosystems. Even gradual, non-catastrophic outcomes associated with these threats are likely to result in significant human and economic costs as well as rising ecological losses.

Much of the world's population still suffers from more-immediate local environmental health risks. Indoor and outdoor air pollution continue to bring premature death and illness to millions annually. Water pollution and water-borne illness due to pollution and degradation of watersheds cause similar suffering.

2

Even as human environmental impacts continue to grow in the aggregate, a range of long-term trends are today driving significant decoupling of human well-being from environmental impacts.

Given current trends, it is very possible that the size of the human population will peak this century and then start to decline.

Decoupling occurs in both relative and absolute terms. *Relative* decoupling means that human environmental impacts rise at a slower rate than overall economic growth. Thus, for each unit of economic output, less environmental impact (e.g., deforestation, defaunation, pollution) results. Overall impacts may still increase, just at a slower rate than would otherwise be the case. *Absolute* decoupling occurs when total environmental impacts — impacts in the aggregate — peak and begin to decline, even as the economy continues to grow.

Decoupling can be driven by both technological and demographic trends and usually results from a combination of the two.

The growth *rate* of the human population has already peaked. Today's population growth rate is one percent per year, down from its high point of 2.1 percent in the 1970s. Fertility rates in countries containing more than half of the global population are now below replacement level. Population growth today is primarily driven by longer life spans and lower infant mortality, not by rising fertility

rates. Given current trends, it is very possible that the size of the human population will peak this century and then start to decline.

Trends in population are inextricably linked to other demographic and economic dynamics. For the first time in human history, over half the global population lives in cities. By 2050, 70 percent are expected to dwell in cities, a number that could rise to 80 percent or more by the century's end. Cities are characterized by both dense populations and low fertility rates.

Cities occupy just one to three percent of the Earth's surface and yet are home to nearly four billion people.

Cities occupy just one to three percent of the Earth's surface and yet are home to nearly four billion people. As such, cities both drive and symbolize the decoupling of humanity from nature, performing far better than rural economies in providing efficiently for material needs while reducing environmental impacts.

The growth of cities along with the economic and ecological benefits that come with them are inseparable from improvements in agricultural productivity. As agriculture has become more land and labor efficient, rural populations have left the countryside for the cities. Roughly half the US population worked the land in 1880. Today, less than 2 percent does.

As human lives have been liberated from hard agricultural labor, enormous human resources have been freed up for other endeavors. Cities, as people know them today, could not exist without radical changes in farming. In contrast, modernization is not possible in a subsistence agrarian economy.

These improvements have resulted not only in lower labor requirements per unit of agricultural output but also in lower land requirements. This is not a new trend: rising harvest yields have for millennia reduced the amount of land required to feed the average person. The average per-capita use of land today is vastly lower than it was 5,000 years ago, despite the fact that modern people enjoy a far richer diet. Thanks to technological improvements in agriculture, during the half-century starting in the mid-1960s, the amount of land required for growing crops and animal feed for the average person declined by one-half.

Agricultural intensification, along with the move away from the use of wood as fuel, has allowed many parts of the world to experience net reforestation. About 80 percent of New England is today forested, compared with about 50 percent at the end of the 19th century. Over the past 20 years, the amount of land dedicated to production forest worldwide declined by 50 million hectares, an area the size of France. The "forest transition" from net deforestation to net reforestation seems to be as resilient a feature of development as the demographic transition that reduces human birth rates as poverty declines.

Human use of many other resources is similarly peaking. The amount of water needed for the average diet has declined by nearly 25 percent over the past half-century. Nitrogen pollution continues

to cause eutrophication and large dead zones in places like the Gulf of Mexico. While the total amount of nitrogen pollution is rising, the amount used per unit of production has declined significantly in developed nations.

Taken together, these trends mean that the total human impact on the environment, including land-use change, overexploitation, and pollution, can peak and decline this century. By understanding and promoting these emergent processes, humans have the opportunity to re-wild and re-green the Earth — even as developing countries achieve modern living standards, and material poverty ends.

Indeed, in contradiction to the often-expressed fear of infinite growth colliding with a finite planet, demand for many material goods may be saturating as societies grow wealthier. Meat consumption, for instance, has peaked in many wealthy nations and has shifted away from beef toward protein sources that are less land intensive.

As demand for material goods is met, developed economies see higher levels of spending directed to materially less-intensive service and knowledge sectors, which account for an increasing share of

economic activity. This dynamic might be even more pronounced in today's developing economies, which may benefit from being late adopters of resource-efficient technologies.

Taken together, these trends mean that the total human impact on the environment, including land-use change, overexploitation, and pollution, can peak and decline this century. By understanding and promoting these emergent processes, humans have the opportunity to re-wild and re-green the Earth — even as developing countries achieve modern living standards, and material poverty ends.

3

The processes of decoupling described above challenge the idea that early human societies lived more lightly on the land than do modern societies. Insofar as past societies had less impact upon the environment, it was because those societies supported vastly smaller populations.

The technologies that humankind's ancestors used to meet their needs supported much lower living standards with much higher per-capita impacts on the environment.

In fact, early human populations with much less advanced technologies had far larger individual land footprints than societies have today. Consider that a population of no more than one or two million North Americans hunted most of the continent's large mammals into extinction in the late Pleistocene, while burning and clearing forests across the continent in the process. Extensive human transformations of the environment continued throughout the Holocene period: as much as three-quarters of all deforestation globally occurred *before* the Industrial Revolution.

The technologies that humankind's ancestors used to meet their needs supported much lower living standards with much higher per-capita impacts on the environment. Absent a massive human die-off, any large-scale attempt at recoupling human societies to nature using these technologies would result in an unmitigated ecological and human disaster.

Ecosystems around the world are threatened today because people over-rely on them: people who depend on firewood and charcoal for fuel cut down and degrade forests; people who eat bush meat for food hunt mammal species to local extirpation. Whether it's a local indigenous community or a foreign corporation that benefits, it is the continued dependence of humans on natural environments that is the problem for the conservation of nature.

Conversely, modern technologies, by using natural ecosystem flows and services more efficiently, offer a real chance of reducing the totality of human impacts on the biosphere. To embrace these technologies is to find paths to a good Anthropocene.

The modernization processes that have increasingly liberated humanity from nature are, of course, double-edged, since they have also degraded the natural environment. Fossil fuels, mechanization and manufacturing, synthetic fertilizers and pesticides, electrification and modern transportation and communication technologies, have made larger human populations and greater consumption possible in the first place. Had technologies not improved since the Dark Ages, no doubt the human population would not have grown much either.

It is also true that large, increasingly affluent urban populations have placed greater demands upon ecosystems in distant places — the extraction of natural resources has been globalized. But those same technologies have also made it possible for people to secure food, shelter, heat, light, and mobility through means that are vastly more resource- and land-efficient than at any previous time in human history.

Decoupling human well-being from the destruction of nature requires the conscious acceleration of emergent decoupling processes. In some cases, the objective is the development of technological substitutes. Reducing deforestation and indoor air pollution requires the *substitution* of wood and charcoal with modern energy.

Urbanization, aquaculture, agricultural intensification, nuclear power, and desalination are all processes with a demonstrated potential to reduce human demands on the environment, allowing more room for non-human species.

In other cases, humanity's goal should be to use resources more productively. For example, increasing agricultural yields can reduce the conversion of forests and grasslands to farms. Humans should seek to liberate the environment from the economy.

Urbanization, agricultural intensification, nuclear power, aquaculture, and desalination are all processes with a demonstrated potential to reduce human demands on the environment, allowing more room for non-human species. Suburbanization, low-yield farming, and many forms of renewable energy production, in contrast, generally require more land and resources and leave less room for nature.

These patterns suggest that humans are as likely to spare nature because it is not needed to meet their needs as they are to spare it for explicit aesthetic and spiritual reasons. The parts of the planet that people have not yet profoundly transformed have mostly been spared because they have not yet found an economic use for them — mountains, deserts, boreal forests, and other "marginal" lands.

Decoupling raises the possibility that societies might achieve peak human impact without intruding much further on relatively untouched areas. Nature unused is nature spared.

4

Plentiful access to modern energy is an essential prerequisite for human development and for decoupling development from nature. The availability of inexpensive energy allows poor people around the world to stop using forests for fuel. It allows humans to grow more food on less land, thanks to energy-heavy inputs such as fertilizer and tractors. Energy allows humans to recycle waste water and desalinate sea water to spare rivers and aquifers. It allows humans to cheaply recycle metal and plastic rather than to mine and refine these minerals. Looking forward, modern energy may allow the capture of carbon from the atmosphere to reduce the accumulated carbon that drives global warming.

Plentiful access to modern energy is an essential prerequisite for human development and for decoupling development from nature.

However, for at least the past three centuries, rising energy production globally has been matched by rising atmospheric concentrations of carbon dioxide. Nations have also been slowly decarbonizing — that is, reducing the carbon intensity of their economies — over that same time period. But they have not been doing so at a rate consistent with keeping cumulative carbon emissions low enough to reliably stay below the international target of less than 2 degrees Centigrade of global warming. Significant climate mitigation, therefore, will require that humans rapidly accelerate existing processes of decarbonization.

There remains much confusion, however, as to how this might be accomplished. In developing countries, rising energy consumption is tightly correlated with rising incomes and improving living standards. Although the use of many other material resource inputs such as nitrogen, timber, and land are beginning to peak, the centrality of energy in human development and its many uses as a substitute for material and human resources suggest that energy consumption will continue to rise through much if not all of the 21st century.

For that reason, any conflict between climate mitigation and the continuing development process through which billions of people around the world are achieving modern living standards will continue to be resolved resoundingly in favor of the latter.

Climate change and other global ecological challenges are not the most important immediate concerns for the majority of the world's people. Nor should they be. A new coal-fired power station in Bangladesh may bring air pollution and rising carbon dioxide emissions but will also save lives. For millions living without light and forced to burn dung to cook their food, electricity and modern fuels, no matter the source, offer a pathway to a better life, even as they also bring new environmental challenges.

Meaningful climate mitigation is fundamentally a technological challenge. By this we mean that even dramatic limits to per capita global consumption would be insufficient to achieve significant climate mitigation. Absent profound technological change there is no credible path to meaningful climate mitigation. While advocates differ in the particular mix of technologies they favor, we are

aware of no quantified climate mitigation scenario in which technological change is not responsible for the vast majority of emissions cuts.

The specific technological paths that people might take toward climate mitigation remain deeply contested. Theoretical scenarios for climate mitigation typically reflect their creators' technological preferences and analytical assumptions while all too often failing to account for the cost, rate, and scale at which low-carbon energy technologies can be deployed.

Transitioning to a world powered by zero-carbon energy sources will require energy technologies that are power dense and capable of scaling to many tens of terawatts to power a growing human economy.

The history of energy transitions, however, suggests that there have been consistent patterns associated with the ways that societies move toward cleaner sources of energy. Substituting higher-quality (i.e., less carbon-intensive, higher-density) fuels for lower-quality (i.e., more carbon-intensive, lower-density) ones is how virtually all societies have decarbonized, and points the way toward accelerated decarbonization in the future. Transitioning to a world powered by zero-carbon energy sources will

require energy technologies that are power dense and capable of scaling to many tens of terawatts to power a growing human economy.

Most forms of renewable energy are, unfortunately, incapable of doing so. The scale of land use and other environmental impacts necessary to power the world on biofuels or many other renewables are such that we doubt they provide a sound pathway to a zero-carbon low-footprint future.

High-efficiency solar cells produced from earth-abundant materials are an exception and have the potential to provide many tens of terawatts on a few percent of the Earth's surface. Present-day solar technologies will require substantial innovation to meet this standard and the development of cheap energy storage technologies that are capable of dealing with highly variable energy generation at large scales.

Nuclear fission today represents the only present-day zero-carbon technology with the demonstrated ability to meet most, if not all, of the energy demands of a modern economy. However, a variety of social, economic, and institutional challenges make deployment of present-day nuclear technologies at scales necessary to achieve significant climate mitigation unlikely. A new generation of nuclear technologies that are safer and cheaper will likely be necessary for nuclear energy to meet its full potential as a critical climate mitigation technology.

In the long run, next-generation solar, advanced nuclear fission, and nuclear fusion represent the most plausible pathways toward the joint goals of climate stabilization and radical decoupling of

humans from nature. If the history of energy transitions is any guide, however, that transition will take time. During that transition, other energy technologies can provide important social and environmental benefits. Hydroelectric dams, for example, may be a cheap source of low-carbon power for poor nations even though their land and water footprint is relatively large. Fossil fuels with carbon capture and storage can likewise provide substantial environmental benefits over current fossil or biomass energies.

The ethical and pragmatic path toward a just and sustainable global energy economy requires that human beings transition as rapidly as possible to energy sources that are cheap, clean, dense, and abundant.

The ethical and pragmatic path toward a just and sustainable global energy economy requires that human beings transition as rapidly as possible to energy sources that are cheap, clean, dense, and abundant. Such a path will require sustained public support for the development and deployment of clean energy technologies, both within nations and between them, though international collaboration and competition, and within a broader framework for global modernization and development.

5

We write this document out of deep love and emotional connection to the natural world. By appreciating, exploring, seeking to understand, and cultivating nature, many people get outside themselves. They connect with their deep evolutionary history. Even when people never experience these wild natures directly, they affirm their existence as important for their psychological and spiritual well-being.

We write this document out of deep love and emotional connection to the natural world.

Humans will always materially depend on nature to some degree. Even if a fully synthetic world were possible, many of us might still choose to continue to live more coupled with nature than human sustenance and technologies require. What decoupling offers is the possibility that humanity's material dependence upon nature might be less destructive.

The case for a more active, conscious, and accelerated decoupling to spare nature draws more on spiritual or aesthetic than on material or utilitarian arguments. Current and future generations could survive and prosper materially on a planet with much less biodiversity and wild nature. But this is not a world we want nor, if humans embrace decoupling processes, need to accept.

What we are here calling nature, or even wild nature, encompasses landscapes, seascapes, biomes and ecosystems that have, in more cases than not, been regularly altered by human influences over centuries and millennia. Conservation science, and the concepts of biodiversity, complexity, and indigeneity are useful, but alone cannot determine which landscapes to preserve, or how.

In most cases, there is no single baseline prior to human modification to which nature might be returned. For example, efforts to restore landscapes to more closely resemble earlier states ("indigeneity") may involve removing recently arrived species ("invasives") and thus require a net *reduction* in local biodiversity. In other circumstances, communities may decide to sacrifice indigeneity for novelty and biodiversity.

Along with decoupling humankind's material needs from nature, establishing an enduring commitment to preserve wilderness, biodiversity, and a mosaic of beautiful landscapes will require a deeper emotional connection to them.

Explicit efforts to preserve landscapes for their non-utilitarian value are inevitably anthropogenic choices. For this reason, all conservation efforts are fundamentally anthropogenic. The setting aside

of wild nature is no less a human choice, in service of human preferences, than bulldozing it. Humans will save wild places and landscapes by convincing our fellow citizens that these places, and the creatures that occupy them, are worth protecting. People may choose to have some services — like water purification and flood protection — provided for by natural systems, such as forested watersheds, reefs, marshes, and wetlands, even if those natural systems are more expensive than simply building water treatment plants, seawalls, and levees. There will be no one-size-fits-all solution.

Environments will be shaped by different local, historical, and cultural preferences. While we believe that agricultural intensification for *land-sparing* is key to protecting wild nature, we recognize that many communities will continue to opt for *land-sharing*, seeking to conserve wildlife within agricultural landscapes, for example, rather than allowing it to revert to wild nature in the form of grasslands, scrub, and forests. Where decoupling reduces pressure on landscapes and ecosystems to meet basic human needs, landowners, communities, and governments still must decide to what aesthetic or economic purpose they wish to dedicate those lands.

Accelerated decoupling alone will not be enough to ensure more wild nature. There must still be a conservation politics and a wilderness movement to demand more wild nature for aesthetic and spiritual reasons. Along with decoupling humankind's material needs from nature, establishing an enduring commitment to preserve wilderness, biodiversity, and a mosaic of beautiful landscapes will require a deeper emotional connection to them.

6

We affirm the need and human capacity for accelerated, active, and conscious decoupling. Technological progress is not inevitable. Decoupling environmental impacts from economic outputs is not simply a function of market-driven innovation and efficient response to scarcity. The long arc of human transformation of natural environments through technologies began well before there existed anything resembling a market or a price signal. Thanks to rising demand, scarcity, inspiration, and serendipity, humans have remade the world for millennia.

Technological solutions to environmental problems must also be considered within a broader social, economic, and political context. We think it is counterproductive for nations like Germany and Japan, and states like California, to shutter nuclear power plants, recarbonize their energy sectors, and recouple their economies to fossil fuels and biomass. However, such examples underscore clearly that technological choices will not be determined by remote international bodies but rather by national and local institutions and cultures.

Too often, modernization is conflated, both by its defenders and critics, with capitalism, corporate power, and laissez-faire economic policies. We reject such reductions. What we refer to when we speak of modernization is the long-term evolution of social, economic, political, and technological arrangements in human societies toward vastly improved material well-being, public health, resource productivity, economic integration, shared infrastructure, and personal freedom.

Modernization has liberated ever more people from lives of poverty and hard agricultural labor, women from chattel status, children and ethnic minorities from oppression, and societies from

capricious and arbitrary governance. Greater resource productivity associated with modern socio-technological systems has allowed human societies to meet human needs with fewer resource inputs and less impact on the environment. More-productive economies are wealthier economies, capable of better meeting human needs while committing more of their economic surplus to non-economic amenities, including better human health, greater human freedom and opportunity, arts, culture, and the conservation of nature.

Decoupling of human welfare from environmental impacts will require a sustained commitment to technological progress and the continuing evolution of social, economic, and political institutions alongside those changes.

Modernizing processes are far from complete, even in advanced developed economies. Material consumption has only just begun to peak in the wealthiest societies. Decoupling of human welfare from environmental impacts will require a sustained commitment to technological progress and the continuing evolution of social, economic, and political institutions alongside those changes.

Accelerated technological progress will require the active, assertive, and aggressive participation of private sector entrepreneurs, markets, civil society, and the state. While we reject the planning fallacy of the 1950s, we continue to embrace a strong public role in addressing environmental problems and accelerating technological innovation, including research to develop better technologies, subsidies, and other measures to help bring them to market, and regulations to mitigate environmental hazards. And international collaboration on technological innovation and technology transfer is essential in the areas of agriculture and energy.

7

We offer this statement in the belief that both human prosperity and an ecologically vibrant planet are not only possible but also inseparable. By committing to the real processes, already underway, that have begun to decouple human well-being from environmental destruction, we believe that such a future might be achieved. As such, we embrace an optimistic view toward human capacities and the future.

We value the liberal principles of democracy, tolerance, and pluralism in themselves, even as we affirm them as keys to achieving a great Anthropocene.

It is our hope that this document might contribute to an improvement in the quality and tenor of the dialogue about how to protect the environment in the 21st century. Too often discussions about the environment have been dominated by the extremes, and plagued by dogmatism, which in turn fuels intolerance. We value the liberal principles of democracy, tolerance, and pluralism in themselves, even as we affirm them as keys to achieving a *great* Anthropocene. We hope that this statement advances the dialogue about how best to achieve universal human dignity on a biodiverse and thriving planet.

ECOLOGY

The science of systems, of collective being and interrelations.

BOOKS

Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants - Robin Wall Kimmerer
The Hidden Half of Nature: The Microbial Roots of Life and Health - David Montgomery
The Soil and Health: A Study of Organic Agriculture - Sir Albert Howard
Eating the Sun: How Plants Power the Planet - Oliver Morton
The Forest Unseen: A Year's Watch in Nature - David George Haskell
Systems Thinking - Donella Meadows
Nature and the Human Soul: Cultivating Wholeness and Community in a Fragmented World - Bill Plotkin
The Hidden Life of Trees: What They Feel, How They Communicate - Peter Wohlleben
How to Read Water: Clues and Patterns from Puddles to the Sea - Tristan Gooley
Growing a Revolution: Bringing Our Soil Back to Life - David Montgomery
Darwinian Agriculture: How Understanding Evolution Can Improve Agriculture - R. Ford Denison
The Farm as Natural Habitat - Dana Jackson and Laura Jackson

ESSAYS & ARTICLES

"Status of the World's Soil Resources - 2015" - Food and Agriculture Organization of the United Nations
"Thinking Like a Mountain" - Aldo Leopold

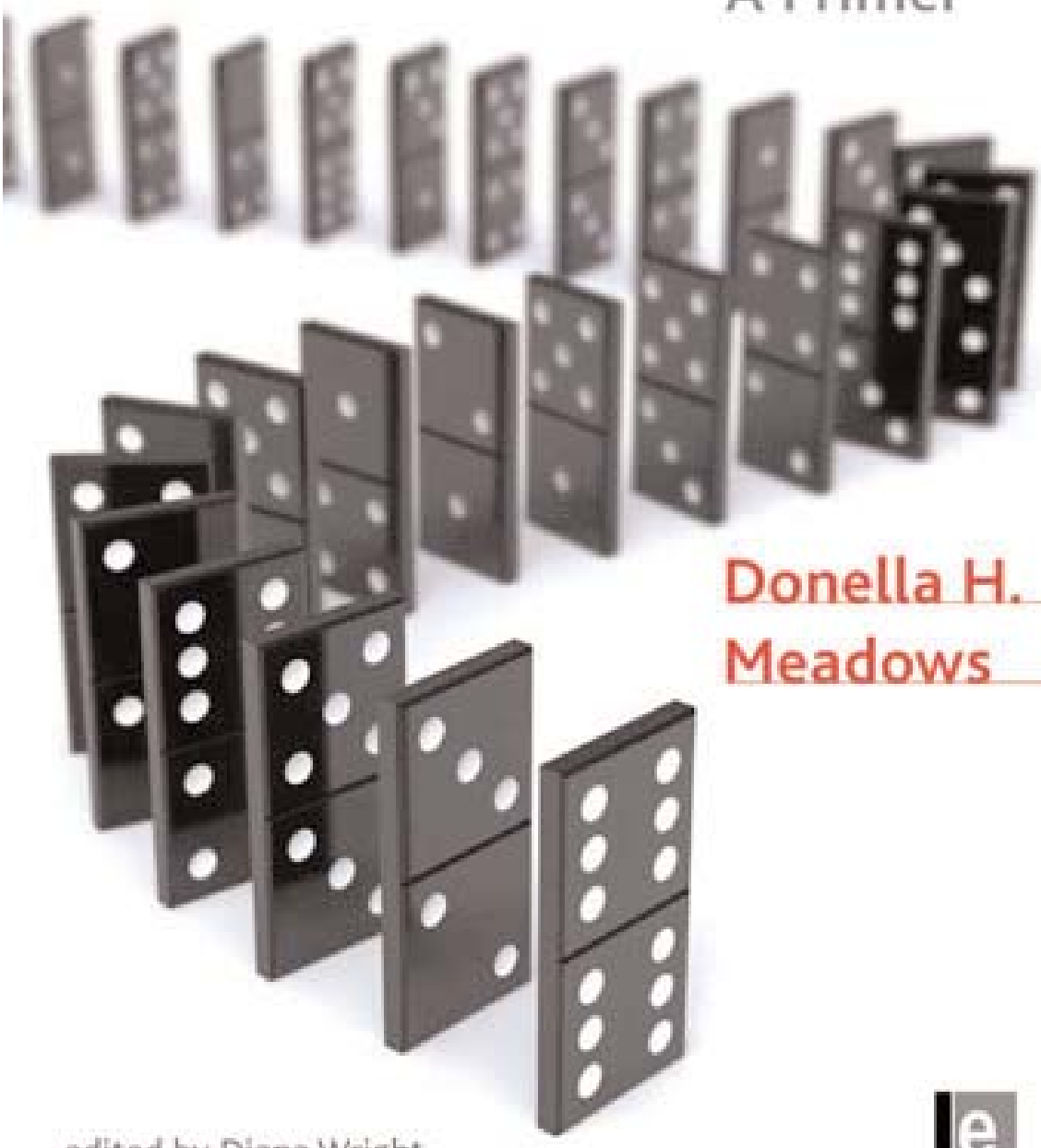
POETRY & NOVELS

The Overstory: A Novel - Richard Powers

From the lead author of the international bestseller *Limits to Growth*

Thinking in Systems

A Primer



Donella H. Meadows

edited by Diana Wright

Introduction: The System Lens

> Managers are not confronted with problems that are independent of each other, but with dynamic situations that consist of complex systems of changing problems that interact with each other. I call such situations messes. . . . Managers do not solve problems, they manage messes.
>
> —Russell Ackoff,[1] operations theorist

Early on in teaching about systems, I often bring out a Slinky. In case you grew up without one, a Slinky is a toy—a long, loose spring that can be made to bounce up and down, or pour back and forth from hand to hand, or walk itself downstairs.

I perch the Slinky on one upturned palm. With the fingers of the other hand, I grasp it from the top, partway down its coils. Then I pull the bottom hand away. The lower end of the Slinky drops, bounces back up again, yo-yos up and down, suspended from my fingers above.

"What made the Slinky bounce up and down like that?" I ask students.

"Your hand. You took away your hand," they say.

So I pick up the box the Slinky came in and hold it the same way, poised on a flattened palm, held from above by the fingers of the other hand. With as much dramatic flourish as I can muster, I pull the lower hand away.

Nothing happens. The box just hangs there, of course.

"Now once again. What made the Slinky bounce up and down?"

The answer clearly lies within the Slinky itself. The hands that manipulate it suppress or release some behavior that is latent within the structure of the spring.

That is a central insight of systems theory.

Once we see the relationship between structure and behavior, we can begin to understand how systems work, what makes them produce poor results, and how to shift them into better behavior patterns. As our world

continues to change rapidly and become more complex, systems thinking will help us manage, adapt, and see the wide range of choices we have before us. It is a way of thinking that gives us the freedom to identify root causes of problems and see new opportunities.

So, what is a system? A system is a set of things—people, cells, molecules, or whatever—interconnected in such a way that they produce their own pattern of behavior over time. The system may be buffeted, constricted, triggered, or driven by outside forces. But the system's response to these forces is characteristic of itself, and that response is seldom simple in the real world.

When it comes to Slinkies, this idea is easy enough to understand. When it comes to individuals, companies, cities, or economies, it can be heretical. The system, to a large extent, causes its own behavior! An outside event may unleash that behavior, but the same outside event applied to a different system is likely to produce a different result.

Think for a moment about the implications of that idea:

- Political leaders don't cause recessions or economic booms. Ups and downs are inherent in the structure of the market economy.
- Competitors rarely cause a company to lose market share. They may be there to scoop up the advantage, but the losing company creates its losses at least in part through its own business policies.
- The oil-exporting nations are not solely responsible for oil-price rises. Their actions alone could not trigger global price rises and economic chaos if the oil consumption, pricing, and investment policies of the oil-importing nations had not built economies that are vulnerable to supply interruptions.
- The flu virus does not attack you; you set up the conditions for it to flourish within you.
- Drug addiction is not the failing of an individual and no one person, no matter how tough, no matter how loving, can cure a drug addict—not even the addict. It is only through understanding addiction as part of a larger set of influences and societal issues that one can begin to address it.

Something about statements like these is deeply unsettling. Something else is purest common sense. I submit that those two somethings—a resistance to and a recognition of systems principles—come from two kinds of human experience, both of which are familiar to everyone.

On the one hand, we have been taught to analyze, to use our rational ability, to trace direct paths from cause to effect, to look at things in small and understandable pieces, to solve problems by acting on or controlling the world around us. That training, the source of much personal and societal power, leads us to see presidents and competitors, OPEC and the flu and drugs as the causes of our problems.

On the other hand, long before we were educated in rational analysis, we all dealt with complex systems. We are complex systems—our own bodies are magnificent examples of integrated, interconnected, self-maintaining complexity. Every person we encounter, every organization, every animal, garden, tree, and forest is a complex system. We have built up intuitively, without analysis, often without words, a practical understanding of how these systems work, and how to work with them.

Modern systems theory, bound up with computers and equations, hides the fact that it traffics in truths known at some level by everyone. It is often possible, therefore, to make a direct translation from systems jargon to traditional wisdom.

> Because of feedback delays within complex systems, by the time a problem becomes apparent it may be unnecessarily difficult to solve.
> — *A stitch in time saves nine.*

> According to the competitive exclusion principle, if a reinforcing feedback loop rewards the winner of a competition with the means to win further competitions, the result will be the elimination of all but a few competitors.
> — *For he that hath, to him shall be given; and he that hath not, from him shall be taken even that which he hath (Mark 4:25)*
> or
> —*The rich get richer and the poor get poorer.*

> A diverse system with multiple pathways and redundancies is

more stable and less vulnerable to external shock than a uniform system with little diversity.
— *Don't put all your eggs in one basket.*

Ever since the Industrial Revolution, Western society has benefited from science, logic, and reductionism over intuition and holism. Psychologically and politically we would much rather assume that the cause of a problem is "out there," rather than "in here." It's almost irresistible to blame something or someone else, to shift responsibility away from ourselves, and to look for the control knob, the product, the pill, the technical fix that will make a problem go away.

Serious problems have been solved by focusing on external agents—preventing smallpox, increasing food production, moving large weights and many people rapidly over long distances. Because they are embedded in larger systems, however, some of our "solutions" have created further problems. And some problems, those most rooted in the internal structure of complex systems, the real messes, have refused to go away.

Hunger, poverty, environmental degradation, economic instability, unemployment, chronic disease, drug addiction, and war, for example, persist in spite of the analytical ability and technical brilliance that have been directed toward eradicating them. No one deliberately creates those problems, no one wants them to persist, but they persist nonetheless. That is because they are intrinsically systems problems—undesirable behaviors characteristic of the system structures that produce them. They will yield only as we reclaim our intuition, stop casting blame, see the system as the source of its own problems, and find the courage and wisdom to *restructure* it.

Obvious. Yet subversive. An old way of seeing. Yet somehow new. Comforting, in that the solutions are in our hands. Disturbing, because we must *do things*, or at least *see things* and *think about things*, in a different way.

This book is about that different way of seeing and thinking. It is intended for people who may be wary of the word "systems" and the field of systems analysis, even though they may have been doing systems thinking all their lives. I have kept the discussion nontechnical because I want to show what a long way you can go toward understanding systems without turning to mathematics or computers.

I have made liberal use of diagrams and time graphs in this book

because there is a problem in discussing systems only with words. Words and sentences must, by necessity, come only one at a time in linear, logical order. Systems happen all at once. They are connected not just in one direction, but in many directions simultaneously. To discuss them properly, it is necessary somehow to use a language that shares some of the same properties as the phenomena under discussion.

Pictures work for this language better than words, because you can see all the parts of a picture at once. I will build up systems pictures gradually, starting with very simple ones. I think you'll find that you can understand this graphical language easily.

I start with the basics: the definition of a system and a dissection of its parts (in a reductionist, unholistic way). Then I put the parts back together to show how they interconnect to make the basic operating unit of a system: the feedback loop.

Next I will introduce you to a systems zoo—a collection of some common and interesting types of systems. You'll see how a few of these creatures behave and why and where they can be found. You'll recognize them; they're all around you and even within you.

With a few of the zoo "animals"—a set of specific examples—as a foundation, I'll step back and talk about how and why systems work so beautifully and the reasons why they so often surprise and confound us. I'll talk about why everyone or everything in a system can act dutifully and rationally, yet all these well-meaning actions too often add up to a perfectly terrible result. And why things so often happen much faster or slower than everyone thinks they will. And why you can be doing something that has always worked and suddenly discover, to your great disappointment, that your action no longer works. And why a system might suddenly, and without warning, jump into a kind of behavior you've never seen before.

That discussion will lead to us to look at the common problems that the systems-thinking community has stumbled upon over and over again through working in corporations and governments, economies and ecosystems, physiology and psychology. "There's another case of the tragedy of the commons," we find ourselves saying as we look at an allocation system for sharing water resource among communities or financial resources among schools. Or we identify "eroding goals" as we study the business rules and incentives that help or hinder the development of new technologies. Or we see "policy resistance" as we examine decision-making power and the nature of relationships in a

family, a community, or a nation. Or we witness "addiction"—which can be caused by many more agents than caffeine, alcohol, nicotine, and narcotics.

Systems thinkers call these common structures that produce characteristic behaviors "archetypes." When I first planned this book, I called them "system traps." Then I added the words "and opportunities," because these archetypes, which are responsible for some of the most intransigent and potentially dangerous problems, also can be transformed, with a little systems understanding, to produce much more desirable behaviors.

From this understanding I move into what you and I can do about restructuring the systems we live within. We can learn how to look for leverage points for change.

I conclude with the largest lessons of all, the ones derived from the wisdom shared by most systems thinkers I know. For those who want to explore systems thinking further, the Appendix provides ways to dig deeper into the subject with a glossary, a bibliography of systems thinking resources, a summary list of systems principles, and equations for the models described in Part One.

When our small research group moved from MIT to Dartmouth College years ago, one of the Dartmouth engineering professors watched us in seminars for a while, and then dropped by our offices. "You people are different," he said. "You ask different kinds of questions. You see things I don't see. Somehow you come at the world in a different way. How? Why?"

That's what I hope to get across throughout this book, but especially in its conclusion. I don't think the systems way of seeing is better than the reductionist way of thinking. I think it's complementary, and therefore revealing. You can see some things through the lens of the human eye, other things through the lens of a microscope, others through the lens of a telescope, and still others through the lens of systems theory. Everything seen through each kind of lens is actually there. Each way of seeing allows our knowledge of the wondrous world in which we live to become a little more complete.

At a time when the world is more messy, more crowded, more interconnected, more interdependent, and more rapidly changing than ever before, the more ways of seeing, the better. The systems-thinking lens allows us to reclaim our intuition about whole systems and

- hone our abilities to understand parts,

- see interconnections,
- ask "what-if" questions about possible future behaviors, and
- be creative and courageous about system redesign.

Then we can use our insights to make a difference in ourselves and our world.

INTERLUDE • *The Blind Men and the Matter of the Elephant*

Beyond Ghor, there was a city. All its inhabitants were blind. A king with his entourage arrived nearby; he brought his army and camped in the desert. He had a mighty elephant, which he used to increase the people's awe.

The populace became anxious to see the elephant, and some sightless from among this blind community ran like fools to find it.

As they did not even know the form or shape of the elephant, they groped sightlessly, gathering information by touching some part of it.

Each thought that he knew something, because he could feel a part. . . .

The man whose hand had reached an ear . . . said: "It is a large, rough thing, wide and broad, like a rug."

And the one who had felt the trunk said: "I have the real facts about it. It is like a straight and hollow pipe, awful and destructive."

The one who had felt its feet and legs said: "It is mighty and firm, like a pillar."

Each had felt one part out of many. Each had perceived it wrongly. . . .[2]

This ancient Sufi story was told to teach a simple lesson but one that we often ignore: The behavior of a system cannot be known just by knowing the elements of which the system is made.

Thinking Like a Mountain

By Aldo Leopold

A deep chesty bawl echoes from rimrock to rimrock, rolls down the mountain, and fades into the far blackness of the night. It is an outburst of wild defiant sorrow, and of contempt for all the adversities of the world. Every living thing (and perhaps many a dead one as well) pays heed to that call. To the deer it is a reminder of the way of all flesh, to the pine a forecast of midnight scuffles and of blood upon the snow, to the coyote a promise of gleanings to come, to the cowman a threat of red ink at the bank, to the hunter a challenge of fang against bullet. Yet behind these obvious and immediate hopes and fears there lies a deeper meaning, known only to the mountain itself. Only the mountain has lived long enough to listen objectively to the howl of a wolf.

Those unable to decipher the hidden meaning know nevertheless that it is there, for it is felt in all wolf country, and distinguishes that country from all other land. It tingles in the spine of all who hear wolves by night, or who scan their tracks by day. Even without sight or sound of wolf, it is implicit in a hundred small events: the midnight whinny of a pack horse, the rattle of rolling rocks, the bound of a fleeing deer, the way shadows lie under the spruces. Only the ineducable tyro can fail to sense the presence or absence of wolves, or the fact that mountains have a secret opinion about them.

My own conviction on this score dates from the day I saw a wolf die. We were eating lunch on a high rimrock, at the foot of which a turbulent river elbowed its way. We saw what we thought was a doe fording the torrent, her breast awash in white water. When she climbed the bank toward us and shook out her tail, we realized our error: it was a wolf. A half-dozen others, evidently grown pups, sprang from the willows and all joined in a welcoming melee of wagging tails and playful maulings. What was literally a pile of wolves writhed and tumbled in the center of an open flat at the foot of our rimrock.

In those days we had never heard of passing up a chance to kill a wolf. In a second we were pumping lead into the pack, but with more excitement than accuracy: how to aim a steep downhill shot is always confusing. When our rifles were empty, the old wolf was down, and a pup was dragging a leg into impassable slide-rocks.

We reached the old wolf in time to watch a fierce green fire dying in her eyes. I realized then, and have known ever since, that there was something new to me in those eyes - something known only to her and to the mountain. I was young then, and full of trigger-itch; I thought that because fewer wolves meant more deer, that no wolves would mean hunters'

paradise. But after seeing the green fire die, I sensed that neither the wolf nor the mountain agreed with such a view.

Since then I have lived to see state after state extirpate its wolves. I have watched the face of many a newly wolfless mountain, and seen the south-facing slopes wrinkle with a maze of new deer trails. I have seen every edible bush and seedling browsed, first to anaemic desuetude, and then to death. I have seen every edible tree defoliated to the height of a saddlehorn. Such a mountain looks as if someone had given God a new pruning shears, and forbidden Him all other exercise. In the end the starved bones of the hoped-for deer herd, dead of its own too-much, bleach with the bones of the dead sage, or molder under the high-lined junipers.

I now suspect that just as a deer herd lives in mortal fear of its wolves, so does a mountain live in mortal fear of its deer. And perhaps with better cause, for while a buck pulled down by wolves can be replaced in two or three years, a range pulled down by too many deer may fail of replacement in as many decades. So also with cows. The cowman who cleans his range of wolves does not realize that he is taking over the wolf's job of trimming the herd to fit the range. He has not learned to think like a mountain. Hence we have dustbowls, and rivers washing the future into the sea.

We all strive for safety, prosperity, comfort, long life, and dullness. The deer strives with his supple legs, the cowman with trap and poison, the statesman with pen, the most of us with machines, votes, and dollars, but it all comes to the same thing: peace in our time. A measure of success in this is all well enough, and perhaps is a requisite to objective thinking, but too much safety seems to yield only danger in the long run. Perhaps this is behind Thoreau's dictum: In wildness is the salvation of the world. Perhaps this is the hidden meaning in the howl of the wolf, long known among mountains, but seldom perceived among men.

FOOD JUSTICE

Race & Food are inextricable.
Equity in food access, land access
and differing foodways matters.

BOOKS

Farming While Black: Soul Fire Farm's Practical Guide to Liberation on the Land - Leah Penniman

Freedom Farmers: Agricultural Resistance and the Black Freedom Movement - Dr. Monica M. White

The Value of Nothing: How to Reshape Market Society and Redefine Democracy - Raj Patel

Stuffed and Starved: The Hidden Battle for the World Food System - Raj Patel

Systematic Land Theft - Jillian Hishaw

All We Can Save: Truth, Courage, and Solutions for the Climate Crisis - Edited by Ayana Elizabeth Johnson, Katharine Wilkinson

ESSAYS & ARTICLES

Perils of Pesticides Address to Lutheran University, 1989 - Cesar Chavez

Plant-Based Diets Won't Stop American Imperialism - Chris Newman

POETRY & NOVELS

Being Human - Naima Penniman

Being Human

I wonder if the sun debates dawn
some mornings
not wanting to rise
out of bed
from under the down-feather horizon
if the sky grows tired
of being everywhere at once
adapting to the mood
swings of the weather
if clouds drift off
trying to hold themselves together
make deals with gravity
to loiter a little longer

I wonder if rain is scared
of falling
if it has trouble
letting go
if snow flakes get sick
of being perfect all the time
each one
trying to be one-of-a-kind
I wonder if stars wish
upon themselves before they die
if they need to teach their young
how to shine
I wonder if shadows long
to just-for-once feel the sun
if they get lost in the shuffle
not knowing where they're from
I wonder if sunrise
and sunset
respect each other
even
though they've never met
if volcanoes get stressed
if storms have regrets
if compost believes in life
after death
I wonder if breath ever thinks of suicide
if the wind just wants to sit
still sometimes
and watch the world pass by
if smoke was born

knowing how to rise
if rainbows get shy back stage
not sure if their colors match right
I wonder if lightning sets an alarm clock
to know when to crack
if rivers ever stop
and think of turning back

if streams meet the wrong sea
and their whole lives run off-track
I wonder if the snow
wants to be black
if the soil thinks she's too dark
if butterflies want to cover up their marks
if rocks are self-conscious of their weight
if mountains are insecure of their strength
I wonder if waves get discouraged
crawling up the sand
only to be pulled back again
to where they began
if land feels stepped upon
if sand feels insignificant
if trees need to question their lovers
to know where they stand
if branches waver at the crossroads
unsure of which way to grow
if the leaves understand they're replaceable
and still dance when the wind blows
I wonder
where the moon goes
when she is in hiding
I want to find her there
and watch the ocean
spin from a distance
listen to her
stir in her sleep
effort give way to existence

By Naima Penniman, Climbing Poetree

MAD AGRICULTURE READER

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