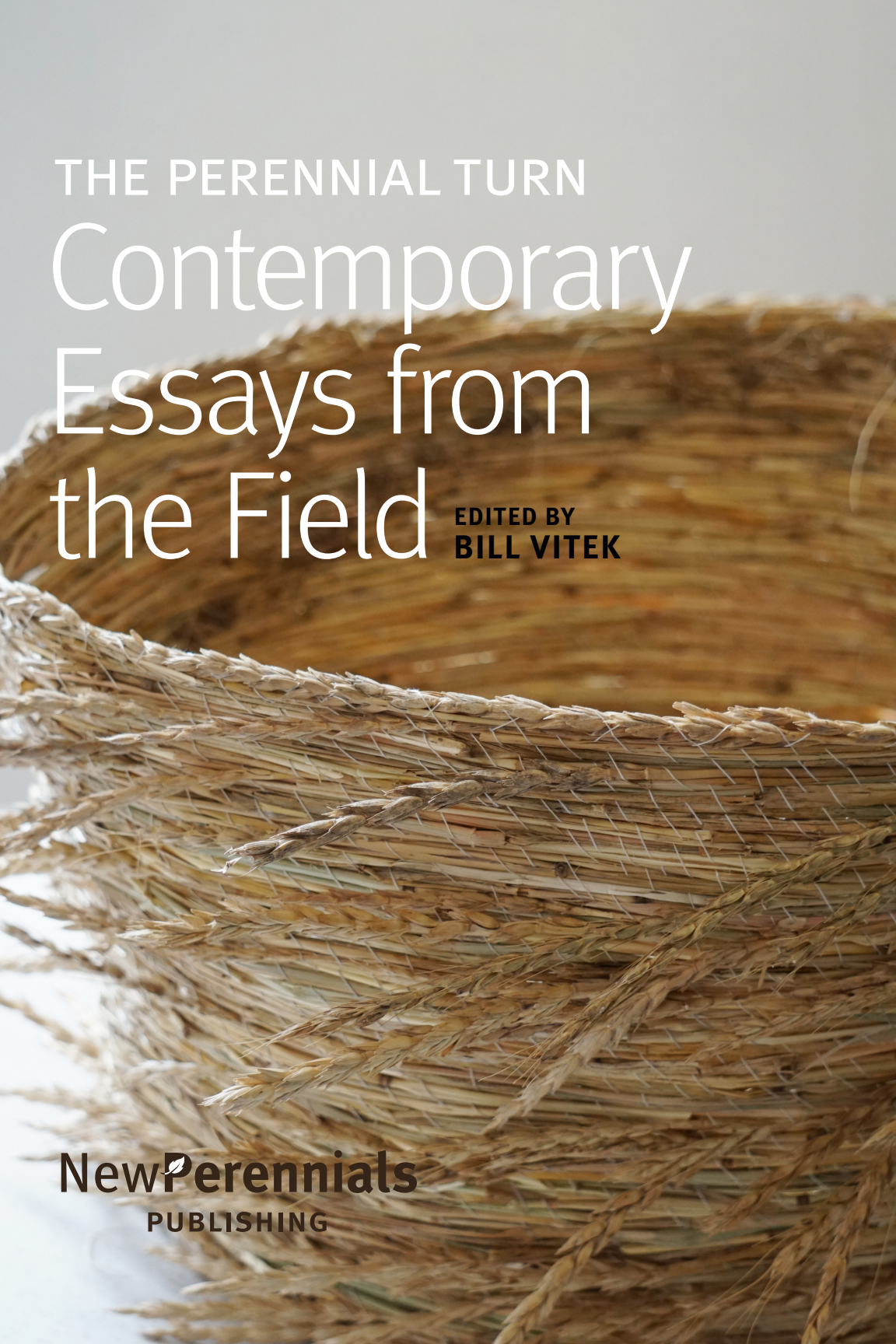
THE PERENNIAL TURN
Contemporary Essays from the Field
EDITED BY
BILL VITEK
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INTRODUCTION

ESSAYS

INTRODUCTION

Making the perennial turn

Bill Vitek

Thanks for being willing to consider *The Perennial Turn*. You didn't pay for this collection of essays and art, but that alone is not sufficient reason to look between the covers. Perhaps it was assigned to you in a course, or a friend recommended an essay. Or maybe the title caught your eye. And it was, after all, free.

How did this free book come to be?

This is the first volume from New Perennials Publishing, the open-access, electronic publishing platform of the New Perennials Project (NPP). We look forward to publishing essays, monographs, pamphlets, art, and teaching materials that can nurture perennial thought and action in agriculture and education, contributing to the much-needed shift in the way we treat each other and the larger living world.

NPP is a multi-year exploration of the role of agriculture and education as primary feedstocks of the culture and, therefore, crucial places to pursue change. The project draws inspiration from The Land Institute's (TLI) work to develop perennial grains (crops that don't need to be replanted every year) that can be grown in polycultures (mixtures of crops). Middlebury College in Vermont and TLI in Kansas serve as regional hubs of NPP, combining educational and agricultural expertise to explore perennial practices in food and socio-cultural systems. The authors and artists in this collection represent a first harvest of perennial ideas and insights.

Beginnings

In 1976, Wes and Dana Jackson founded a school on the banks of the Smoky Hill River outside Salina, Kansas. TLI mixed homesteading skills with traditional classroom learning and field trips, with a commitment to an education that

The early years at The Land Institute. *Terry Evans*.

was informed and practical, with deep roots in the land. Unlike the university Wes left behind, TLI's curriculum never let abstractions linger too long without finding expression in the particularities of everyday life. Study how the ecologists have defined and described ecosystems, and then figure out how to dig a drainage ditch that respects the flows of a particular ecosystem.

While TLI never abandoned this educational mission, it became best known for its pioneering work to develop an alternative agriculture that would address not just the problems "in" agriculture today—such as the use of industrial chemicals to fight pests, pathogens and weeds; fossil fuel dependence for fertilizers and mechanical traction; and accelerated species extinction from monocultures—but the longer-standing problem "of" agriculture. Starting about 10,000 years ago, humans around the globe have become dependent on annual varieties of the major grain crops (such as rice, wheat, and corn) and the necessary disturbance of soils, which has led to persistent global soil erosion and degradation, while also creating social hierarchies that undermine human flourishing. TLI is today

Storm clouds brew above small plots of perennial cereal grains under development at The Land Institute in Salina, Kansas.
Scott Seirer / The Land Institute

Prairie Festival attendees make themselves comfortable outside the Big Barn, listening to lectures from lawn chairs or the ground. *Scott Seirer / The Land Institute*

a global leader in this work, with perennial rice and wheatgrass in limited production, and other perennial crops on the horizon.

In the summer of 2015, Wes Jackson convened a group of colleagues from around the globe—artists, educators, humanists, social and natural scientists—to reimagine "the curriculum," the intellectual infrastructure that in today's universities tends to contribute to the abuse of land and people, typically in the name of "progress." Jackson called this curricular work "Ecosphere Studies." The Ecosphere, as described in a recent presentation by colleague and contributor Aubrey Streit Krug, is "the dynamic mantle of life on this sun-fed planet in the Milky Way—the nexus of airs, waters, rocks, and creatures whose interactions together with light make life: the lithosphere, hydrosphere, atmosphere, biosphere, and, ethnosphere: the intellectual and spiritual layer of thoughts, ideas, concepts, and stories." An ecospheric curriculum requires us to connect food and farming with the deeper cultural attitudes about human supremacy embedded in our ideas about economics and ethics, about what constitutes a good life.

We gathered that June morning in TLI's "big barn," which Jackson built with his own hands and help from friends and neighbors. Over the years, that barn has served as a lecture hall, seminar room, music venue, dance hall, equipment garage, and site of TLI's annual fall Prairie Festival. Jackson welcomed us with a reference to *The Divine Comedy* and Dante's fearful entrance into a dark wood

Students from Oklahoma State University meet and discuss with Ecosphere Studies Director Aubrey Streit Krug in The Land Institute's 'big barn' as part of a visit to The Land Institute.
Scott Bontz / The Land Institute

guarded by three beasts with neither map nor guide, at least until Virgil arrived. He suggested our guide would be an affection for our Ecosphere and the will to negotiate a corrective course. We could extend an ecological worldview beyond agriculture, and into economics, education, science, technology, and medicine.

Moving forward

Many of the authors and artists in this collection have attended one or more of the annual summer Ecosphere Studies gatherings in Kansas (or, more recently, online), and others are associated with the NPP hub at Middlebury College and in Vermont's Champlain Valley. Our authors write of the intellectual, pedagogical, policy and care work needed to provision perennial and just communities, and with an honest willingness to respect the limits of ecosystems and people. The artists offer both a respite from the urge to keep reading and living in our heads, and the inspiration and insight beyond words.

We strove for writing that is jargon-free and accessible to all who like to think for themselves about how to respond to a world in crisis. The essays—which have an intentional order but can be read separately and out of sequence—are theoretical, historical and practical. We hope they inspire and invite conversation, debate and creative digressions.

The world is a mess of emergencies, catastrophic events, collapses, and brutal hierarchies that exist alongside creativity, joy, beauty, resilience, and calls for justice against unbearable odds. This paradox is summarized well by philosopher Alfred North Whitehead's (1932, p. 13) definition of dramatic tragedy as "the remorseless working of things" and his optimistic call for "refreshment of the imagination" (1967, p. 159) How do we both experience the grief and imagine new alternatives? We think it begins with others (all the others, human and not); with straight talk and deep listening; with all of our senses. And with the courage to give up cherished beliefs, and the grace that invites redirection, reconciliation, and renewal.

August, 2020
Middlebury, Vermont

Thanks to Aubrey, Stan, and Wes—the Ecosphere Studies team at TLI—for their support and inspiration; to Paul Dahm for design; and Robert Jensen for editing.

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Transforming human life on our home planet, perennially

Wes Jackson, Aubrey Streit Krug,
Bill Vitek, and Robert Jensen

For those who are willing to face the multiple, cascading crises that humans have created, one task is analysis: How did we get here? In the 200,000 years of *Homo sapiens*, what have been key thresholds of systemic change?

A good case can be made for agriculture, which the polymath scientist Jared Diamond (1987) called "the worst mistake in the history of the human race." Three decades later, historian Yuval Noah Harari (2015, p. 77) called the Agricultural Revolution "history's biggest fraud." When we started taking control of animals' lives and breaking the soil to produce energy-rich grain, we intervened in ecosystems in ways we could not predict or control, to the detriment of many organisms, including humans.

With nearly eight billion people on the planet, we aren't going back to hunting and gathering. But around the world, often under the banner of agroecology, people are using modern science and traditional knowledge to develop ways of farming that are less ecologically and socially destructive.

Over the past four decades, one of the most promising projects in sustainable agriculture has been Natural Systems Agriculture (perennial grains grown in mixtures rather than annuals grown in monocultures) at The Land Institute. The institute's Ecosphere Studies program nurtures and explores this perennial thinking through research and education based in an ecological worldview that challenges the dominant industrial model defining contemporary ways of feeding bodies and minds. This essay outlines our approach, including a diagnosis of our agricultural past and present in a broader ecospheric context, which resonates with other ecocentric projects while building on the lessons learned on the Kansas prairie that is home to The Land Institute.

The history: The 10,000-year problem of agriculture

When humans began to generate surpluses by domesticating plants and animals about 10,000 to 12,000 years ago, a conceptual split between "culture" and "nature" emerged, with human culture assumed to be separate and privileged. This domination/subordination relationship—humans claiming dominion over the world—also came to define relationships within the human family. Social hierarchies—organized around such statuses as sex/gender, class, race/ethnicity, and national citizenship—structure most societies today and influence the control of surpluses. Deep disparities in wealth and power are the norm within and between contemporary human societies.

Humans' depletion of soil and other resources intensified with industrialization. Ongoing imperial and settler-colonial structures, ideologically justified as advancing "civilization," have been particularly dependent upon material scaffolding from the five relatively nonrenewable sources of carbon: soil, trees, coal, oil, and natural gas. Highly dense fossil-carbon energy and the advanced technology used to extract and process resources have destroyed local wisdom by reducing whole ecosystems to inanimate parts, leading to crises that affect essentially all ecosystems.

The conceptual shift: Earth alive!

Moving from a human-centric to an eco-centric perspective begins with a critique of the living/dead dualism. J. Stan Rowe (2003) suggested imagining that inside a cell it might appear there are some moving/living parts and other non-moving/non-living parts. But from an outside view, the whole cell is seen as living, the result of the participation of all components.

Viewing "life" only as a property of organisms has led some humans to treat the planet as a mine from which to extract resources and a dump into which to discard wastes, rather than as a home to care for. Viewing humans as supreme among creatures has led to the instrumental treatment of fellow organisms. What is "dead" or "not-human" is deemed relevant only to the extent it can be exploited for human use.

Earth's atmosphere, lithosphere, and hydrosphere are not separate from the biosphere but essential parts of a living whole—the ecosphere, our foundational unit of analysis. Because of the priority of the ecosphere over humans (in time, inclusiveness, complexity, evolutionary creativity, and diversity), the ecosphere is a proper "boundary of causation" (understanding the complex forces that create our world) within the cosmos. At the next level down in the hierarchy of structure, ecosystems become the primary focus for human investigations, as the "boundaries of consideration" (the scope of what humans reasonably can, and should, pay attention to).

What knowledge and practices are needed to create and maintain stable and just communities that can remain in a sustainable relationship with our ecosphere? The Land Institute's mission statement emphasizes, "When people, land, and community are as one, all three members prosper" (The Land Institute, n.d.). We hold this to be a truth that must become self-evident: Our shared human responsibility is to live on, not dominate, our home planet.

To address the social-ecological trauma of agriculture and the industrial world, we must voluntarily live within biophysical limits to make possible a post-growth, sunshine-powered future. We must evaluate human systems and projects not by short-term productivity for humans but by the long-term flourishing of ecosystems, including people.

The process: Driving knowledge out of its categories

This requires that we integrate insights from all academic disciplines—core sciences, applied sciences, engineering, social sciences, humanities, the arts—and recognize the value of disparate ways of knowing, from modern to indigenous/traditional perspectives.

We don't reject reductionist science completely but promote caution and greater awareness of the emergent properties of complex systems. If the scale is small enough, a graceful backing out of our messes—created from the inevitable unintended consequences of our actions—is more likely. The scientific method remains our best hope to turn away from unsustainable practices if we think rigorously and act with humility. The analytical expression of knowledge produced by science must be both challenged and complemented with artistic and spiritual inquiry, always with history as a guide.

Given the damage humans have done to ecosystems, we cannot assume human knowledge is adequate to control the world and should adopt an "ignorance-based worldview" (Jackson, 2005). Because we are always far more ignorant than knowledgeable—a fact captured in the truism, "The more you know, the more you know you don't know"—we must become better students of exits, looking for the soft landings necessary when knowledge-based plans go awry.

Eco-social knowledge will be attentive to the ecological realities that shape culture, politics, and economics. Human creativity, expansive as it has been, cannot transcend biophysical limits for long and is always subordinate to the creativity of the ecosphere. Arrogance in the short term reduces options in the future.

Driving knowledge out of its categories—learning from, but transcending the boundaries of, academic disciplines—can be fostered by bringing together scholars, activists, teachers, and students to pursue collaborative research and to learn through experimental and experiential workshops. To address how young people are socialized into an extractive worldview in ideas and resources, we seek a transformation of education and economy—of ways of thinking and making a living.

Natural Systems Agriculture is a model for moving forward deliberately, rather than waiting for collapsing ecosystems and chaos. Growing plants with deep roots in a diverse community suggests a model for human communities. Instead of rootless modern life that incessantly strives for upward mobility, a perennial culture would encourage communities rooted in a place but capable of dealing with inevitable change—places where difference will generate tension and conflict but ultimately build strength and resiliency.

The practice: The human estate of grief and joy

Revolutionary change in theory and practice, not minor course corrections, are needed; we cannot assume that modifying the existing trajectory of the human species is adequate. If there is to be an ongoing large-scale human presence on Earth, the energy/resource consumption that most affluent humans take for granted—and which many non-affluent humans aspire to—cannot continue. We reject fantasies of unlimited growth.

Conventional thinking naïvely asserts we can solve these problems with increasingly sophisticated technology powered by renewable energy (Cox, 2017), but such "technological fundamentalism" is a dead end. Rather than pretending to solve the problem of maintaining the current population or affluent consumption patterns, Ecosphere Studies imagines a different world, without guarantees but with foundational ideas consistent with an ecologically tuned future.

Since agriculture began, humans have become a species out of context, with many of us living in arrangements far beyond the scale in which we evolved, requiring us to work far beyond the scope of our competence. We cannot return to a pre-agricultural past, and we can no longer pretend that technological miracles will secure our future. We must reconsider our quest for surplus and the domination/subordination dynamic that arises out of grain agriculture's generation of surplus.

People are imagining such satisfying futures, but it is naïve to ignore the grief that we will experience. Humans have always lived, as Wendell Berry (1996, p. 106) put it, on "the human estate of grief and joy," but the accumulated harm of the past 10,000 years means we face a grief that will be unprecedented in human history. Our best course embraces the joy and refuses to turn away from the grief.

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Nick and Joyce Fent's 80 acre virgin prairie north of Salina, KS, 2018. *Terry Evans*.

Who is *we*?

Robert Jensen

***We* humans have made a mess of things**, which is readily evident if *we* face the avalanche of studies and statistics describing the contemporary ecological crises *we* face. But even with the mounting evidence of the consequences for people and planet, *we* have not committed to a serious project to slow the damage that *we* do.

One reasonable response to those statements is, "Who is 'we'?" That is, exactly who has made a mess of things and who has failed to take action? Who's to blame for the problems and who's responsible for the costs? Put more bluntly, borrowing from the often-quoted exchange between the Lone Ranger and Tonto, "What do you mean, *we*, white man?"

The global North—which is to say, fossil-fuel powered capitalism as it developed in Europe—bears primary responsibility for the contemporary crises, and those societies have failed to meet their obligations, or in some cases to even acknowledge obligations, to change course. And within those societies, it is the wealthy and powerful who bear the greatest responsibility for destructive policies.

Today, "we" is not everyone, equally culpable. But if there is to be a decent human future—indeed, if there is to be any human future—we have to realize that human-carbon nature is at the core of the problem, a reality that exempts no one.

Because this sounds harsh in a world with so much human suffering, so unequally distributed, let me be clear: My argument does not minimize or trivialize that suffering, or ignore the profound moral and political failures that exacerbate it. Strategies for a sustainable human presence must involve holding the wealthy and powerful accountable for damage done, and moving toward

a more equitable distribution of wealth and power—goals that are desirable independent of ecological realities. But if that realignment were accomplished, then what? With nearly eight billion people and most of the world's infrastructure built with, and dependent on, highly dense energy, then what?

It's tempting to believe that we can identify low-energy societies from the past, or communities in the contemporary world with lower-energy living arrangements, and reproduce them more widely. It's tempting to believe that breaking concentrated wealth and power and expanding democratic decision-making would lead to sustainable societies. But such hopes are based on a misunderstanding of the problem.

We should learn from the low-energy societies and experiments within today's societies, but those good examples don't offer a program for moving from the current state of most of the planet (high-energy, unsustainable) to where we need to be (low-energy, sustainable). Because no one can imagine what such a program would look like, people are quick to embrace a "technological fundamentalism" that pretends we can continue at high-energy levels through some magical combination of innovation and renewable energy, which are important but cannot keep the contemporary world afloat.

We can't pretend that people, if freed from hierarchal social systems, will suddenly find it easy to avoid the comforts and pleasures associated with dense energy, to which people have become accustomed (in the more affluent societies) or to which others aspire (most everywhere else). While much irrational consumption is driven by capitalist propaganda (that is, advertising and marketing), fossil fuels and other sources of energy also make people's lives easier in many ways that are not frivolous. There is variation in people's assessment of their needs, but capturing and using dense energy for comfort and pleasure is not a unique goal of imperialists and capitalists.

In short, there are no solutions, if by solutions we mean ways to support anything like the existing number of people at anything like the existing level of aggregate consumption. Wishing it to be possible, simply because the alternatives are difficult to imagine—let alone achieve—does not make it possible.

Again, for emphasis

So as not to be misunderstood: We live amid dramatically different levels of energy consumption, resource exploitation, waste production, and overall contribution to ecosystem instability. This highly skewed distribution of wealth is a product of crimes of the past (especially, but not limited to, the barbarism of European nations in their world conquest over the past 500 years) and ongoing economic domination (when imperial armies go home, private firms continue to exploit resources and labor, typically with local elites as collaborators).

The profoundly unsustainable nature of human economic activity today is the result primarily of a rapacious transnational corporate capitalism. Because capitalism is, and always has been, a wealth-concentrating system, a relatively small number of people reap most of the financial benefits from this ecological destruction. In short: The First World is rich, and much of the wealth of the First World is concentrated in the hands of a relatively small segment of those societies' populations.

Some people who benefit from these arrangements are dedicated to maintaining the hierarchical systems at the heart of the unsustainable economy and its unjust distribution of wealth. Other people who benefit will condemn those systems but take no action to disrupt them. And some people will work for change. We all should do a self-inventory, uncomfortable though it may be, to assess honestly where we fit in these categories.

I am white, male, born and raised in the United States, educated, retired from a professional job—all realities that have enhanced my opportunities and reduced impediments. While I have been an active member of various movements for sustainability and justice, I will never have a satisfactory answer to a troubling challenge: "Why have you not done more?" And while I am reasonably frugal and consume less than most people of my class in the United States, I have no illusions that I live at a sustainable level.

To repeat, one more time: We are not all similarly situated, and this inequality within the human family must never drop out of our analysis. But when analyzing the ecological crises facing humans today, I believe it is important to talk about a "we" that includes everyone—on biological, historical, philosophical, and political grounds.

We are one species

First, it should be uncontroversial to assert an anti-racist principle anchored in basic biology: We are one species, and while there are observable differences in such things as skin color and hair texture, there are no known biologically based differences in intellectual, psychological, or moral attributes between human populations from different regions of the world. There is individual variation *within* any human population in a particular place (obviously, individuals in any society differ in a variety of traits) but no meaningful differences *between* populations in the way people think, feel, or make decisions. Again, we are one species. We are all basically the same animal.

Second, although we are one species, there are obvious cultural differences among human populations around the world. If those differences aren't a product of human biology—that is, if they aren't the product of any one group being significantly different genetically from another, especially in ways that could be labeled cognitively superior or inferior—then development of different cultures in different places must be the result of humans living under different material

conditions. The type of living arrangements that groups of humans develop arise out of the differences in geography, climate, and environmental conditions. The different material realities under which humans have lived shape the different forms of human culture.

Third, we know that we make decisions, individually and collectively, in ways we do not and cannot fully understand. Our experience of freely choosing does not mean that all of our choices are 100% freely made. Without attempting to resolve the age-old debate on free will, we can self-reflect on how we often come to recognize that our choices, which we believed that we made freely at one moment in time, were shaped and constrained by material conditions we could not understand at that moment, and maybe never fully understand. While we continue to act day-to-day on the assumption of free will, we also should continue to be alert for ways behavior is to some degree determined.

Finally, the implications of all this: We should condemn the unsustainable and unjust actions of others and be critically self-reflective about our own contributions to unsustainable and unjust systems. We also should extend such critique not only to individuals but to the systems that reward pathological behavior and impede virtuous behavior. But thinking historically, we also should recognize that any group of humans living under the same material conditions would most likely have developed in roughly the same way.

That is, there's nothing particularly special about any one of us or any one group of people.

This caution is a way of extending "there but for the grace of God go I" beyond the individual to cultures. That phrase emerged from Christian testimony to God's mercy, but I use it here in secular fashion: If one has lived an exemplary life, that's great, but be aware that life might have been very different if some of the material conditions in which one lived were different. To those who believe they have accomplished something and made a positive contribution to the world, that's great, but a reminder: Change up any one of the conditions in our lives, especially in our formative years, and perhaps we would have found ourselves failing instead of succeeding. That doesn't imply that we have no control over our lives, but simply that we likely don't have as much control as we tend to assume.

This is true of us individually and collectively. The conditions under which a culture emerged may have led to ecologically sustainable living arrangements, but those arrangements might have been very different if initial conditions had been different. If Culture A created an ecologically sustainable way to live and Culture B created an unsustainable system, it is important to highlight the differences, endorse Culture A, and try to change Culture B. But if the geography, climate, and environmental conditions out of which the two cultures emerged had been different, then what would A and B look like? There but for the grace of God go we.

For example, not all cultures developed the technology to plow the ground, smelt ores, or exploit fossil fuels to do work in machines. The cultures without those technologies have not depleted the carbon in soils, forests, coal, oil, and natural gas at the same rate as societies with those technologies. If the development of those technologies was not the product of inherently superior intelligence—remember, we are committed to an anti-racist principle that flows from basic biology—the forces that led to the creation of such technologies must have been a result of the specific environmental conditions under which that culture evolved. Likewise, the lower rate of carbon depletion that results from the absence of those technologies cannot be a marker of inherently superior intelligence, but rather a product of environmental conditions. In a significant sense, the trajectory of people and their cultures is the product of which continent and in which region they have lived (Crosby, 2004; Diamond, 1997; Morris, 2010).

Humility all around

Recognizing that material realities shape our lives does not absolve anyone or any society today of moral accountability for actions, or lack of action. For those of us holding a disproportionate share of the world's wealth who are responsible for a disproportionate share of ecological destruction, an awareness of some level of environmental determinism is not a free pass. Whatever people knew about ecological consequences when today's cultures first developed, we now know more than enough to act on what our own moral principles demand of us—pursuing living arrangements consistent with ecological sustainability and social justice. If we fail to live up to those principles, we are appropriately the targets of demands for corrective action.

But in trying collectively to find a way out of the mess we've made, the assigning of different levels of responsibility for the mess is only a first step. No culture has a plan for transitioning from an unsustainable high-energy, interdependent global society of eight billion people to sustainable low-energy societies with smaller populations. While lessons from low-energy societies will undoubtedly be valuable, there is no way to flip a switch and return to a previous era's living arrangements. Technological innovation and renewable energy will play a role but cannot replace the infrastructure of a world built with highly dense carbon. Breaking the grip of concentrated wealth on politics won't change the fact that dense energy makes our lives easier in many ways that most people enjoy and will not want to give up.

Said differently: Human nature is relevant.

People advocating for social justice and ecological sustainability typically are nervous around talk of human nature, given capitalists' success in defining our nature as inherently greedy and self-interested. Humans have the capacity to act in greedy and self-interested fashion, of course, but capitalism's critics point out

that we also have the capacity to collaborate and cooperate, which is also part of our nature—a crucial part in the story of human expansion across the globe (Despain, 2010).

My concern is with another aspect of human nature, what we might call our human-carbon nature, a phrase that reminds us that we are carbon-based like all other life on Earth. What is life? What is the nature of living things? Wes Jackson suggests that one answer is, "Life is the scramble for energy-rich carbon" (Jensen, 2021). It is our human nature, like the nature of all life, to seek out energy-rich carbon. Over time, humans have gotten exceedingly good at it, maximizing the extraction of all the carbon we can get our hands on. Exceptions to that pattern are rare.

Coping with the consequences of that carbon-seeking—an aspect of our human-carbon nature—is now our daunting challenge. Our greatest success as a species has become our most profound failure. This is a new challenge for which we have no road map. No existing ideology or culture is going to provide us with a template for dealing with what lies ahead.

It is too glib to say it's ironic that some of the places in the world that contributed the least to climate change are going to suffer the most from climate disruption. It is too glib to observe that the world is not fair. Ecological realities challenge our policy-making capacities and threaten to overwhelm our moral imaginations. But we can agree not to hide from such realities and press forward.

Renouncing First-World dominance is a start, as is imagining a world beyond capitalism's obsession with growth and consumption. The end of those systems is a necessary but not sufficient condition for change. If we start with an awareness of the scope of the change needed and the lack of a plan, we can at least be clear about the direction in which we need to move. And that requires committing to being the first species that will have to impose limits on itself, which means a cap on the carbon we use and rationing to ensure fairness (Cox, 2020).

Our chances are better if we take the long view and realize that the problems we face aren't just the consequence of the past 250 years of fossil-fuel use or the past 500 years of European colonialism. We have to go back further, to the origins of agriculture 10,000 years ago, the crucial fault line in human history, when humans began exploiting carbon at levels beyond replacement levels (Montgomery, 2012), particularly where grains (e.g., wheat and rice) were farmed by annual plowing that disrupted and degraded the soil.

Agriculture did not develop in the same way everywhere on the planet; geography, climate, and environmental conditions set the parameters within which people farmed. Especially where grain crops dominated, the ability to create and store surpluses generated the hierarchies that have produced profound social inequality (Scott, 2017). Surplus-and-hierarchy predate agriculture in a few resource-rich places (Pringle, 2014), but the domestication

of plants and animals spread that dynamic across the globe, and agriculture was the beginning of the idea that we humans, rather than the ecospheric forces, control the world.

The "we" is us, *Homo sapiens*, the primate with the big brain. The first farmers, the first smelters of ore, the first people who tapped fossil fuels to do work in machines—all of them contributed to the mess we are in, but without knowledge of the consequences of their actions. We can say of those early carbon-seekers, "Forgive them, for they know not what they did" (Luke 23:34).

Today, we know what we do. The question is, can we—all of us—face what lies ahead without diversion and without illusion?

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The economic legacy of the Holocene

Lisi Krall

The untenable trajectory of the human economic order on Earth risks unprecedented ecological decay and mass extinctions. Many people deny there is a crisis and pursue business-as-usual, and even those who acknowledge the need to change course can grasp for illusory "solutions" that ignore the depth of the crises, which is another form of denial. Instead, we should face reality: The other-than-human-world now has become almost entirely eclipsed by an unassailable "superorganism"—us, the human species—that continues to expand in evermore destructive fashion.

I begin with how my own approach to this complicated matter of economy and Earth began to change. In the mid-1990s, I worked closely with my stepfather, the human ecologist Paul Shepard, whose interdisciplinary scholarship expanded our understanding of the relationship between humans and the other-than-human world. I helped him bring closure to his life's work in the two years it took him to die of lung cancer. My role was modest—organizing papers, pursuing references, and doing the mundane tasks associated with helping him publish his last books (Shepard, 1996, 1998)—which connected me with the ideas of his world and eventually altered my thinking.

I have many poignant recollections of this time but one is particularly relevant here. In the week before he died, when the lines of time and space began to break down as they reliably do, Paul turned to my mother one night and said that she shouldn't be alarmed if when she awoke he was not there—she would find him in the backyard, scything. At the time, it seemed to me a strange place for him to go, given that he had dedicated his life work to a critical appraisal of the impact of agriculture on humans and Earth, highlighting all that had

been lost when humans began to domesticate plants and animals. I thought he would rather return to the Pleistocene, the era before agriculture, but instead he embraced an act of the Holocene, scything. Paul was not finished thinking about the importance of agriculture. I have since internalized his deathbed inclination, the impulse to understand what happened to humans and Earth when humans began the cultivation of annual grains and embarked on animal agriculture, bringing with me my training as an economist.

The significance of the agricultural revolution

The human population went from around six million people at the start of the Holocene, some 10,000 years ago, to at least 100 million a mere 8,000 years later. Agriculture, particularly annual grain crops and domesticated animals, accelerated human population growth and led to concentrated and sedentary living, eventually in state societies, in a relatively short period of time. Agriculture was not a continuation along a linear path of human alteration of the other-than-human world but rather an abrupt turn—an altogether new trajectory and a major evolutionary transition for humans.

The Agricultural Revolution is the direct antecedent of the present-day collision course between the global economy and Earth, and capitalism is merely one particular institutional rendering of a system change that had been in motion for 10,000 years, long before the market economy. Yet many critics assume today's crises are the product of the Industrial Revolution, advanced technology, and capitalism. The importance of the Agricultural Revolution is obscured, never fully discounted but never wholly acknowledged. An example is the work of Jason W. Moore (2016), who argues we should speak of a distinctive "Capitalocene." Moore is right to expand our view of capitalism to a *longue durée*—not just the past 250 years but perhaps beginning in the 14th century when capitalism's "world ecology" took hold—but he discounts the importance of the Agricultural Revolution in his analysis. Certainly capitalism's specific version of domination, exploitation, and expansion have led to extinction and ecological decay, but a broader historical context and deeper ecological perspective is necessary to understand the emergence and complexity of capitalism's economic order.

While it may be true in some very general sense that humans always change the environment and the environment always changes humans, epochal changes come long before the emergence of capitalism. The Agricultural Revolution of the Neolithic/Holocene period brought a huge qualitative shift in the relative influence of one on the other. The domestication of annual grains and livestock was a distinct, momentous change that set the stage for the emergence of capitalism's world ecology. Advanced globalized capitalism and state societies

arising out of agriculture are part of a continuum—the shift from gathering/hunting to state societies was the key rupture.

Agricultural insects

Are we the only species that farm? No other primates practice agriculture, but ants and termites do. As far as I know, social insects are the only other species to share this mode of production with us. It turns out that the structure and dynamic of the economy of agricultural insects is very similar to that of agricultural humans—interdependent with an extensive and hierarchical division of labor, expansionary, and autocatalytic.[1] A similar outcome in two cases does not mean that ultimate causes are the same, but the comparison of social insects and humans deserves a closer look.

The most highly evolved agricultural ants are in the genus *Atta*, commonly known as leafcutter ants, which cut leaves and process them in assembly-line fashion that involves a complex division of labor. The largest ants cut big pieces that are transferred to smaller ants, who further cut them and so on until the pieces end up with the smallest assembly line ants that "mold the fragments into pellets, add fecal droplets" and insert them in a place where an even smaller ant can plant "loose strands of fungus" on them (Hölldobler & Wilson, 2011, p. 55). There are also ants in charge of defense, waste removal, brood care, and so forth. With this extensive division of labor, they build underground colonies that are architecturally sophisticated and can unify as many as a million ants around a focused enterprise of fungus farming. As a species, the leafcutter ants have clearly tapped into collective benefits in their ability to articulate and reproduce themselves efficiently around such fungal production.

The colony's ants are so profoundly interdependent that individual autonomy is essentially non-existent and cooperation is so intensive that some members of the colony are sterile. No single ant has knowledge of fungal production; that knowledge is embedded in the collective and the way it works around the common purpose. Following the lead of Hölldobler & Wilson (2011), it does not seem a stretch to say the ants have "civilization" and to refer to the colony as a "superorganism" in virtue of its intelligence and order. The colony, as a unit of natural selection, has standing in evolutionary terms. These species are extremely successful by biological and evolutionary standards, as the autocatalytic interplay of fungal production and population growth allows for tremendous expansion in colony size. There is also expansion through migration to a new nest site and the establishment of new colonies.

[1] The term autocatalytic refers to the presence of endogenous system variables (that is, things produced within the system) that feed back on themselves and each other, thereby reinforcing the system

Other observers have noted the parallels. For example, in his review of Hölldobler and Wilson's book *The Superorganism* (2008), Tim Flannery (2009) states that "it is the changes wrought in attine societies by agriculture that the principal interest for the student of human societies lies." When I became aware of these similarities in economic organization and population dynamics in connection with agriculture, I felt compelled to identify the processes and mechanisms that gave rise to strikingly similar economic configurations in otherwise very dissimilar species. The Agricultural Revolution of humans did not appear to be only a matter of ingenuity, intentionality, reason, institutions, and culture, since agricultural insects had achieved the same milestone, the same configuration, and the same "success" millions of years before humans.

As an aside, I also wonder whether Adam Smith and his tome on capitalism might have turned out differently had he been aware of *Atta* ants. He could not have claimed that the human capacity for a division of labor "is common to all men, and to be found in no other race of animals" (Smith, 1796/1976, p. 17). Perhaps in his discourse on the invisible hand, Smith might have concentrated more on the co-evolutionary fabric of cultivation and the species proclivities.

Economic order and its drivers in the matrix of evolution

In researching agricultural species, I looked to evolutionary biology, something progressive social scientists generally avoid. Understanding agriculture's rupture of the structure and dynamic of human economic life is illuminated by evolutionary theory—particularly an extended evolutionary framework that embraces the complexity of evolution as it relates to the formation of groups, the evolution of cooperation, and niche construction (Margulis, 1970; Okasha, 2006; Wilson & Wilson, 2007; Pigliucci & Muller, 2010; Jablonka & Lamb, 2014; Laland et al., 2015). This extended evolutionary theory allows analyses to move beyond the narrow confines of genes and kin selection. John Gowdy and I have argued that the use of population biology and evolutionary theory to understand societies can help explain the formation of the economic collective as a force, and unit of selection, in evolution (Gowdy & Krall, 2013, 2014, 2016).

I realize that for some there is something off-putting about this approach because using evolution to explore economic order can make the latter seem deterministic (and, for that matter, make the former seem theoretically loose). An expanded evolutionary framework doesn't answer all questions but provides insights in understanding the emergence and success of an economic order by focusing on *collective* rather than *individual* behavior. Much of economic theory emphasizes the role of the individual—from the simplistic reading of Adam Smith to the banal assumptions of the behavior of "rational economic man." Yet the more appropriate emphasis may be on the collective, where the whole becomes something greater than the sum of its parts. Again, once formed, agricultural groups outcompeted non-agricultural groups by the standard used in evolution: fitness.

In the case of agricultural insects and humans, the division of labor is a particularly important species capability that helped to give rise to agriculture, to structure group cohesion and to extend its influence, especially via the expansionist and warring proclivities of agricultural societies. In human agriculture, I separate examination of division of labor from specific cultures because insect species practicing agriculture do not have culture as we think of it. Culture permeates human social order, of course, but this separation of the two forces gets at something elemental, especially in thinking about economic order *across* species.

The ant and termite species that practice agriculture clearly have the same species potential to engage a division of labor. Humans came into the Holocene with this propensity already established, but in gathering/hunting it had been engaged rather modestly and loosely, mostly based on age and gender. Agriculture expanded division of labor to create an interdependent collective focused around grain and livestock production, driving a new economic order evolution (Gowdy & Krall, 2013, 2014, 2016).

From an economistic perspective, division of labor offers efficiency benefits—greater output produced per unit of species input, which in agriculture created food surpluses. Hence there are adaptive, positive feedback loops for societies (be they human, ant, or termite) that engage this strategy. The new interdependence of agricultural societies produced greater cohesion and unity. Over 10,000 years, this was accentuated with human institutions and technologies that reinforced the fundamental structure and dynamics of interdependence, surplus, and geographical expansionism that began with agriculture—all leading to the human takeover of the biosphere.

Human agriculture: The engagement of an economic superorganism

A categorically different human ecology and economy emerged from the cultivation of grains and domestication of animals. As with colonies of agricultural insects, the human economy became something of a "superorganism" with formidable evolutionary advantage. The Holocene warming and its climate stability were necessary for successful agriculture, and a good stock of fertile soil also helped to jump-start the process. These external conditions tipped the scale favorably in the direction of agriculture but were not the whole story. We also have to consider the interplay or co-evolution of internal factors and their force as a collective whole.

Agriculture required good co-evolutionary potential between people, plants, and animals to create a new integrated and structurally interdependent collective order. There was cultural cohesion in human groups before agriculture, and the human capacity for cooperation was well developed (Richerson & Boyd, 2006; Bowles & Gintis, 2011; Moffett, 2013). But it was only with agriculture that humans became a superorganism: an insular, autocatalytic interdependently

ordered whole. Individual autonomy in material life all but disappeared, and the material interdependence gave new power to the collective enterprise focused and structured around agriculture's demands. Importantly, the ecology of human material life took on a dynamic of expansionism and conquest, and a related duality between humans and the-other-than-human world emerged.

Annual grains were quick to give co-evolutionary results because they were planted and thereby selected every year. Any attribute of a plant that worked well for humans, such as non-shattering seeds and large seed size, could be accentuated in a relatively short time (Cox, 2009). And grains, which could be easily stored, allowed accumulation of significant surpluses. But growing grains and grazing livestock also led to loss of soil fertility, soil erosion, and landscape degradation, continuously pushing human territorial expansion to secure food supplies.

Humans also were reconfigured, perhaps more profoundly than the annual grains and domesticated animals. This was not apparent in the human genome (with a few exceptions), but in the structure and power of the collective formation and cohesion of agricultural groups. The human capacity for cooperation and a division of labor had never integrated humans with such machine-like precision and extensive interdependence in material procurement, until agriculture honed this human propensity in concert with cultivated grains.

It is possible that without the propensity for a division of labor, humans would not have overcome the initial challenges of agriculture and certainly would not have fully realized the productive benefits. Gathering/hunting continued alongside early experiments with cultivation, creating more tasks for people. The efficiencies inherent in a division of labor created surpluses, extending the division of labor in a positive feedback cycle and reinforcing grain cultivation as a viable material strategy for humans. This occurred despite declines in human health, stature, and intelligence (agricultural diets tend to be less healthy than gathering/hunting), with increasing numbers of humans relegated to slavery, coerced labor, military conscription, and other forms of hierarchical subjugation (Larson, 2006; Scott, 2017).

The positive feedback loops pushing the expansion of population and the division of labor did not produce a steady-state equilibrium but instead expansion, with vast state societies developing in a relatively short time after domestication. A new economic order had taken hold of humans that would direct the path of society, culture, and technology for millennia.

The ecology of dualism embodied in the organization of work

Annual grains demanded work that could be routinized, rationalized, and standardized. The structure of agricultural work was dictated by the needs of its domesticates in the same way that the diversity of plants and animals that were utilized by hunters and gatherers to procure their material life dictated the structure of those peoples' work. However, the knowledge and skill associated

with gathering/hunting resided primarily in the individual, and in the quality of observation and understanding of a varied and complex nonhuman world. Engagement with this world was not amenable to standardization and rationalization in the way it came to be with agriculture. Richard Lee observed that pre-agricultural societies (bands) had "a degree of freedom unheard of in more hierarchical societies. In the organization of production foragers could work their own schedules" (Lee, 1998, p. 12).

Agriculture demanded control of nature, creating, as Bill Vitek put it in his essay in this volume, a "powerful dualism pitting crop against weed and pest, and livestock against predator." The duality of human-nature separation emerged out of agriculture, as life became a more insular, focused, routinized, rationalized, and integrated collective enterprise, dictated by the demands of annual grains and livestock. Humans as a whole easily adapted to this regiment, while as individuals they had no choice but to submit to it.

Agriculture reduced the complexity in the provisioning of food to mundane and routinized tasks, leading James Scott to characterize the late Neolithic revolution as "something of a deskilling" (Scott, 2017, pp. 91–92). With cereal production, knowledge and skill came to reside in the routines of "fixed-field farming" of cereal grains. The routines were daily and seasonal; sowing, weeding, watering, cutting, bundling, threshing, gleaning, winnowing chaff, sieving, and drying dictated the rhythm and structure of life. Scott argues that we became subordinated to crops. "Once *Homo sapiens* took that fateful step into agriculture, our species entered an austere monastery whose taskmaster was mostly of the genetic clockwork of a few plants" (Scott, 2017, p. 92). This routinized work, for a species well-adapted to working with a division of labor, tipped the trajectory of human social evolution in the direction of the expansionary "superorganism."

The human domination that resulted is not some pinnacle of evolutionary perfection. The gain was in the economic efficiencies, which provided the raw material for expansion, state civilizations, and hierarchy, but the quality of the day-to-day interaction of humans with the other-than-human world had been irrevocably altered. What was once symbiotic and ritual coexistence for gatherers/hunters became drudgery and an agonistic relationship for farmers. Material provisioning of life no longer expanded the human imagination nor reinforced a sense of belonging in the ecosphere; instead, it dulled the senses and distanced humans from the other-than-human world in an interminable self-referential economic bubble. And it has led to ecological degradation that now threatens human survival.

The other side of despair

My best judgement tells me that there is much to lose in this historical moment by relying on naive optimism—especially when it comes to economic matters.

Economic order for humans is something more than the interplay of intelligence, culture, intentionality, and technology. It goes deep into foundational aspects of how we collectively became what we are. This is no simple matter. It is not simply that the "dark side" of our nature (the capacity for greedy and violent behavior) has landed us here but a more subtle and unintentional—but very real—evolutionary play around the inherent tendencies of our species and annual grains in the rich Pleistocene soils and the Holocene warming. Seemingly small initial changes can end in more profound outcomes; evolution is not a teleological process that aims at perfection, but a process that unfurls on the basis of short- to medium-range advantage in fitness. What is successful in the short run can be disastrous down the road.

The dynamic of expansion and surplus production, the profound material interdependence, and the alienated relationship with the other-than-human world remain with us in the contemporary form of global capitalism and its attendant technologies, ideologies, and institutions. So much the worse for us and for Earth. Ten-thousand years with this agricultural system has only served to enhance and cement certain tendencies. If we want to stop the wholesale extermination of the other-than-human world and leave reasonable possibilities for future generations of humans, we will have to dismantle this "economic superorganism." This is no easy matter, and the question of the effectiveness of human agency on this front obviously looms large.

On the hopeful side, while our social order is the legacy of the Holocene, *Homo sapiens* is a species evolved to resonate in the rhythm and dynamic of a rich biosphere (Shepard, 1982). In this sense, we are very much a Pleistocene species. It is only because of the converging contingencies of the peculiar Holocene trajectory that we have forgotten this and succumbed to a cultural amnesia engendered by human supremacy, which the dominant culture calls "progress" (Crist, 2017). We have to override the force of this Holocene legacy with Pleistocene sensibilities that remind us that we need to be careful about our numbers and recognize that population growth is a pernicious part of an autocatalytic agricultural dynamic that we ignore at our own peril.

Our Pleistocene sensibilities also tell us that we need to be careful about our propensity for cooperation and, in particular, how we order ourselves collectively around material life. It is one thing to work together in small groups and help each other out but quite another to become mechanistically structured around technologies and institutions that reduce us to mere cogs, to casualties or appendages of the collective's expansionism; that alienate us from, and diminish and destroy, the other-than-human world. Annual grains, a bloated livestock industry, industrial technology, state societies, and market capitalism are problematic outcomes, technologies, and institutional arrangements that come straight out of the Holocene manual. Unfortunately, they have been good at offering up economic efficiency, surplus, and increased population, and historically these have been

treated as improvements. Again, evolution cannot see ahead; a strategy has been evolutionarily successful in the short-haul is no guarantee in the long-haul.

Paul Shepard's scything was the meditation of someone standing on a border between two worlds. Looking back, he could still meet the eye of a wolf at the edge of a field. He could still glimpse the finely tuned human ecology of our Pleistocene evolution with its demography of "a slow-breeding, large intelligent primate" (Shepard, 1998, p. 169). Looking forward, he understood that a madness had overtaken us. The death-knell of the other-than-human-world is ringing loud and clear. We have two billion more people on earth now than we did two decades ago when Paul did his scything, global GDP has doubled in that time, and mass extinction is the order of the day.

Our debt to the other-than-human world is past due. Our goal should be a finely tuned human ecology where we are not a dominant species but simply one of many. It seems fitting to begin this change with agriculture, such as The Land Institute's Natural Systems Agriculture research on perennial grains, but the reach of a different agriculture must be expansive, extending beyond the fields of food production and giving rise to a fundamentally different landscape of economic order

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ABOVE: Deciphering the Lyrics of Lichen (cropped), *Cameron Davis*
OPPOSITE: MERCY, Wood and stone, 2017. *Matthew Burke*

The past and future of sustainability

Kathleen R. Smythe

In the face of intensifying ecological crises, many decisionmakers have tried to fashion policies to right environmental wrongs of the past by embracing "sustainability." The most common framework for that concept in the global North has been a three-pronged approach that integrates economic, social, and environmental factors for planning and decision-making. But after more than 20 years of this triad's use in business, community development, and academia, there has been little success. In this essay, I offer an explanation of why this framework is inadequate and outline a more complelling approach.

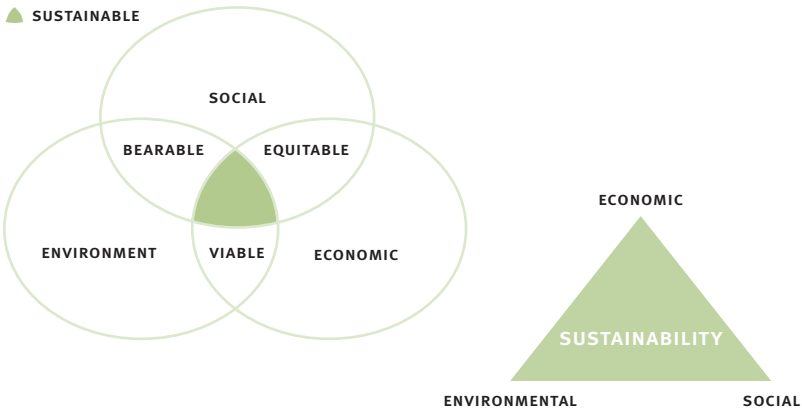

FIGURE 1: Sustainability triad graphics

The problem: Isolating economics

One of the primary impediments to achieving sustainability or sustainable development, is the isolation of economics—treating economic systems as if they were separate from, rather than part of and embedded in, societies. Economics is a societal construct and does not exist outside of a human society. Unfortunately, the prevailing neoclassical and neoliberal economic views in virtually all the world today offer a particularly narrow construct.

The field of ecological economics is growing rapidly and does take these critiques into account, recognizing that humans are interested in not just utility or efficiency but also in fairness and ecological and social resilience. But even ecologically informed models sometimes isolate economics. For example, *The Resilience Imperative*, Michael Lewis' and Pat Conaty's (2012) argument for a steady-state economy, still emphasizes the primacy of the economic leg.

Problems with current economic thought are more obvious in the developing world, still burdened by the economic assumptions of the global North. African experiences with colonialism illustrate how economic policies can produce consequences for culture that were not always anticipated. Encouraging cash crops for export, such as coffee and tea, is a good example. That policy meant that men, who had often played a secondary role in agriculture, now had government-sanctioned access to agricultural technology and the cash associated with export crops. Meanwhile, women and children became the subsistence producers. In many African societies, a strong gender divide in access to the cash economy has prevailed ever since. Gender roles have been shaped by policies that affected access to the market economy.

More generally, subsistence agriculture—which provides significant benefits to human and ecological welfare—has often been disrupted by conventional notions of development and the policies put forth under the banner of the "Green Revolution." Starting in the 1960s in countries such as Mexico and India, this new dependence on hybrid seeds, fossil-fuel based fertilizers, pesticides, herbicides, and biotechnology led to increased yields but also intensified environmental degradation and increased social inequality.

Economic history behind the triad

The sustainability triad captures a history of ideas. We can see how economics became isolated from the natural world and society, then how policymakers and politicians sought to restore the connections.

We inhabit a planet blessed by lots of solar energy. All of our efforts to harness earth's resources for our welfare depend on the process of photosynthesis. The

unprecedented economic growth and economic policies associated with the last two centuries, the 20th century in particular, was made possible largely from abundant and cheap supplies of fossil fuels—what is essentially stored photosynthesis, available to us only once and not renewable.

The Industrial Revolution was made possible by the concentrated energy of coal, which released people and animals from a variety of tasks, making work more efficient. Economic development surged again with the commercial use of petroleum in the early 20th century. By the 1920s, oil was the lifeblood of national power for the United States and Great Britain. Such abundant and cheap energy, which is an historical anomaly, seems to have lured most economists and politicians away from a focus on the biophysical foundations of our economy—that is, our dependence on photosynthesis, either from current or past solar energy.

With increased use of cheap hydrocarbon energy, economists stopped worrying about the limits of solar flow and of the biophysical world, essentially ignoring energy and turning to social explanations for economic questions. Economists focused almost exclusively on production and wealth generation. Oil and minerals remain the means by which modern societies add value through labor and capital to produce goods, and our daily lives depend on the extraction, processing, and transportation of fossil fuels, either for direct energy use or embedded energy in the machines and tools upon which we rely. When we write under electric lights, take a warm shower, or cook on a stovetop, we are harnessing energy in quantities that would not be available to us if we relied only on our own labor and photosynthesis.

The capitalist pursuit of endless growth intensified in the 1970s and 1980s through neoliberal policies, especially in the U.S. and U.K., and the imposition of such policies globally through institutions such as the International Monetary Fund and the World Bank. While state-planned economies and capitalist economies both placed value on extracting resources at faster and faster rates to fuel economic growth, capitalism favored allegedly free markets ("free," that is, until markets fail and government intervention is necessary to aid the wealthy) rather than centrally planned economies.

So, with the fall of communism in the late 1980s, greater faith was placed on the largely unregulated market as the arbiter for economic production, emphasizing economics' disconnect from both environment and society. This neoliberal economics asserted that if societies reduced government and encouraged free markets, more people would have more goods and live better lives. This obsession with markets pushed out actual people as a central concern in economic policy. After the Great Depression, the dominance of Keynesian economics had foregrounded employment as an important element of economic policy, alongside promoting production. After the 1970s, economic theorists argued that the best possible way to improve the global economy was through

policies that favored production, not full employment or fair wages. Wages became disconnected from corporate growth and success, except in the upper ranks of corporate leadership. Non-economic forms of human relationships were eclipsed by a stronger focus on the market.

The past five decades have been marked by divergent paths for the industrialized countries in the global North (as they accumulated wealth and capital) and the less-industrialized, usually previously colonized countries in the global South (as their labor and resources contribute to Northern wealth). Yet the citizens in both places faced similar policies. In the South, the 1980s was marked by "structural adjustment," including budget austerity and market liberalization that led to unemployment and a rapidly rising informal economy. Both in the North and the South, the well-being of the vast majority of the population was suborindated to the imperatives of the market economy. Access to basic services, such as health care and education, declined in much of both the North and South.

Material poverty and the devaluing of manual labor

What concerns me most about this turn toward fossil fuels and contemporary economics is the undermining of subsistence economies and devaluing of physical labor, through the guise of reducing poverty. Since the 1950s, a view of the world as being made up of rich and poor countries dominated in the global North. Dividing the world into "rich" and "poor" has its origins in the post-World War II era. President Truman's inaugural address in 1948—in which he identified the "ancient enemies" of "hunger, misery, and despair" as problems to be overcome—is an oft-cited early public statement of this belief.

Truman saw technology and international cooperation as means to eradicate global poverty. He invited other countries to pool technological resources to benefit people elsewhere, as "our commerce with other countries expands as they progress industrially and economically." Cheap fossil fuels led to agricultural production up to 1,000 times greater than those for the slash-and-burn agriculture of the tropics, suggesting that hunger could be eradicated. Many believed that economic growth and social welfare could be joined.

Conventional plans for economic development sought to train specialist workers for an urban economy rather than encourage youth to develop multiple capacities necessary for subsistence living, such as building, gardening, sewing, and cooking. Economist Jeffrey Sachs' "ladder of development" in the 2000s is an example of such thinking. Sachs, the director of the Center for Sustainable Development at Columbia University and former director of the university's Earth Institute, argued that climbing the ladder of economic development requires increasing wealth per capita (Sachs, 2005). Such development leads to a materially more complex lifestyle that comes with more vulnerability, and sometimes catastrophe, when individuals and societies must rely on the

marketplace for most of their needs rather than satisfying some of them directly through their own labor and relationships.

The contemporary have/have-not social division was created by Northern power and has been perpetuated by it. The World Trade Organization (WTO) promotes corporate agriculture, driving farmers off their land, while the World Bank seeks to eradicate poverty—a poverty that is most readily apparent in urban slums, to which failing subsistence farmers typically flee. The WTO's success is also its failure because while there is abundant food for sale, there are also a billion people in poverty. How, when, and if we use the term "poverty" is important if we wish to have a sustainable future.

So-called "liberation" from hard physical work has consequences that include disengagement and dissatisfaction, diminution of the human spirit, and reduction in employment and meaningful work. The ability of individuals to meet some of their own needs is not part of general economic discussions. People do not necessarily want to be liberated from self-directed work. In fact, most want to be relatively free as they pursue their work—whether that is farming, craftwork, art, or service.

The Brundtland Commission

In the 1980s, in this context of de-humanized economics with its very conventional understanding of "progress," the World Commission on Environment and Development wrote the seminal document for sustainability and sustainable development. The term sustainable development was already used by a number of international organizations, but this United Nations document popularized it.

The report of the Brundtland Commission (as it was commonly known, named after its chairperson) recognized that human activities, particularly ones associated with development, were destroying the environment. But poorer peoples deserved more development, the report concluded. The Commission wanted to reintegrate economics, human welfare, and environmental sustainability. The triad placed all three in relation and carved out a space in the center for sustainability, but the dominant economic system was not flexible enough to accommodate the holistic thinking necessary for complete reintegration.

The Brundtland Commission report, later published as the book *Our Common Future*, states:

> Humanity has the ability to make development sustainable—to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development does imply limits—not absolute limits but limitations imposed by

> the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities. But technology and social organization can both be managed and improved to make way for a new era of economic growth. The Commission believes that widespread poverty is no longer inevitable. Poverty is not only an evil in itself, but sustainable development requires meeting the basic needs of all and extending to all the opportunity to fulfill their aspirations for a better life. A world in which poverty is endemic will always be prone to ecological and other catastrophes (World Commission on Environment and Development, 1987).

In this passage, the emphasis is on more development through better technology and social organization in order to eradicate poverty. Elsewhere in the document, they note "the possibility for a new era of economic growth, one that must be based on policies that sustain and expand the environmental resource base." The message is that human technology will overcome environmental limits for the sake of development. The report concludes that ending material poverty through economic development is the only way to ensure societal sustainability, ignoring that societal vulnerability is due as much, if not more, to investment in endless growth without concern for limits.

The sustainability triad was created in order to end economics' longstanding isolation, but instead it has reinforced the autonomy of the economy from the two systems of which it is an inherent part. And it is part of a global effort to bring an end to subsistence economies, to physical labor that benefits people directly. A more successful sustainability model starts with human nature and what people need in order to thrive, to have meaningful work and meaningful lives.

A new paradigm

The lessons from long-term history (rather than short-term fossil fuel history) point to a more sustainable path to ensure our future, illustrated in the idea of sustainability circles. In this conception, nature is the foundation of holistic human welfare. Human societies grounded in nature (i.e., hydrosphere, lithosphere, atmosphere, and biosphere), and then in human nature, can promote optimal welfare for all.

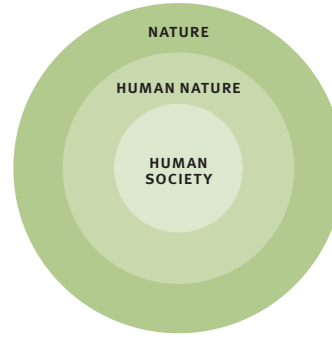

FIGURE 2: Sustainability circles

Instead of isolating economics from nature or society, the sustainability circles understand economics as part of human society, just like politics, religion, and other human constructs. These circles bear a resemblance to ecological economics' reformulations that call for nesting our economic system within our social systems, and nesting both within the ecosystem. But this one differs in allocating special attention to human nature.

Sustainable development as it is commonly conceived, particularly with its distaste for self-reliance and subsistence, is not going to "save the planet" and cannot adequately promote human welfare with meaningful work and meaningful lives. A vision grounded in history and evolutionary biology can help us fashion policies and make decisions that allow us *to live as if we are nature*. Sustainability circles are a means for reimagining optimal lives—for us and for all biological creatures and earth systems.

Three qualities of human nature in nature

Evolutionary biology and long-term history of humans, particularly our agricultural history, suggest three ways we are of nature, three essential components of human nature: spiritual, utilitarian, and cultural. Without policies and infrastructure to support all three forms of engagement, human societies will continue on the current path, increasing our distance from the resources and the earth upon which we are dependent.

First, humans have had, and still have, a spiritual relationship with the natural world. This perspective includes a sense of vulnerability in the face of natural forces, such as hurricanes and tsunamis, as well a sense of wonder and awe. Within both is a recognition of human frailty and inescapable connection to the larger scheme of things. Second, humans have had, and still have, a utilitarian relationship with the natural world because we need the earth's resources for our survival. Third, humans have had, and still have, an intellectual and cultural relationship with the natural world; for both utilitarian and less practical reasons, we seek to understand animal behavior, weather patterns, and countless other aspects of the larger living world. This perspective includes culture, particularly the meaning that people make of the natural world, like the stories we tell about our place within it. These three qualities are not distinct—humans live them all at one time.

Transcendental

Romantic-era writers caught the central tension in the relationship between humans and nature in their writing. In *The Prelude*, William Wordsworth writes of how he feels both terror and the presence of the Divine. This perspective—a sense of sacredness, of what might be called transcendence—can be both positively and negatively awesome. As Henry Beston explains in *The Outermost House* (1988, p. xxxv): "Nature is a part of our humanity, and without some awareness and experience of that divine mystery man ceases to be man."

Both science and philosophy lead us to a humble view of our relationship to nature. We need nature to make us whole; we are made human by our profound interaction with weather, water, flora, and fauna. E.O. Wilson's (1984) term "biophilia" captures the innate emotional attraction between humans and other living organisms. Our biophilia evolved bioculturally, enhancing survival and fitness, and thus spreading more widely in the population. Behaviors that have been successful in integrating us with the natural world (biophilia) or avoiding it (biophobia) have been woven into our culture. Our attraction to bodies of water, large trees, and grassland is likely due to the important role they played for our ancestors for millennia, serving as sources for water and food, protection, and the dominant ecosystem in which humans evolved.

An outward focus, or lack of self-consciousness, can produce positive emotions. Research in many fields indicates that people think better, heal more rapidly, and work more efficiently when connected to other living organisms, both plant and animal. Children with access to nature have more imaginative and social play than kids who play on built structures and asphalt. Humans respond physiologically to nature because we are creatures that evolved in nature, so we respond to it unconsciously. Humans are at their best in relation to others—both human and nonhuman.

Human communities have always been vulnerable, and we still are. The destruction of the Bahamas by Hurricane Dorian in 2019, Puerto Rico by Hurricane Maria in 2017, and the eastern United States by Hurricane Sandy in 2012 remind us that some forces of nature are so strong that attempts to thwart them are futile; we can do nothing except evacuate beforehand and cope afterward. Even so, many humans now routinely assume that advanced technology allows us to control nature. We forget our vulnerability in the face of nature on a regular basis.

We need to accept our human need for, and history of, bodily engagement with the world, including bodily risk. Philosopher David Abram believes technology is a fearful response to our vulnerable natures:

> Indeed, most of this era's transcendent technological visions remain motivated by a fright of the body and its myriad susceptibilities, by a fear of our carnal embedment in a world ultimately beyond our control—by our terror of the very wildness that nourishes and sustains us. We cannot abide our vulnerability, our utter dependence upon a world that can eat us (Abram, 2010, p. 69).

Ancient scholars had a strong sense of how important the natural world was to our humanity. According to philosopher Alan Holland, the Stoics, Cynics, and Skeptics all believed life's goal should be ataraxia, or tranquility and freedom from disturbance, which was achieved by "aligning one's aspirations with nature,

or with the way the world works." This is in stark contrast to the reigning market culture philosophy of aligning one's aspirations to the human-made world. For Holland, a worthwhile life requires us to be alive to the presence "of a sufficiency of meaning and meaningful relationships." He sees the "burning question" of human existence as: What are we doing here? Not: What is it all worth? Humans are at their best in relation to others—both human and nonhuman (Holland, 2011, p. 391).

Humans have spent much energy and resources trying to escape our vulnerability. This tendency is apparent with global climate change. All the conferences, money, and research going into geoengineering embrace the illusion that humans are in control. We are not.

For this and other reasons, I embrace my vulnerability to nature. I often choose to walk in the rain, camp and bike in it. I go out in all temperatures, including increasingly warm ones, and find most of them refreshing and not nearly as insufferable as the local weather forecasters have led me to believe. I also teach a history class on bicycles, encouraging students to take risks and be vulnerable as well. They almost universally embrace the experiences. Without some risk, some reminder of how comfortable it is to be inside heated or cooled walls with a roof over my head, I find I am less content.

Utilitarian

Homo sapiens began as weak, vulnerable animals on a predator-heavy African savanna, and later lived in inhospitable climates in Europe, Asia, and the Americas. We evolved, like all organisms, to make the best use of the natural environment around us to ensure our own survival. Millions of years ago, our ancestors' survival depended on their ability to respond quickly to threats. As a species, we still worry more about today's needs than tomorrow's, even as life for many has become more secure.

Humans created civilization from the nature around them. We still do. We eat plants and animals, we use the trees, sand, and rocks for building. We have the ability to catalogue and cross-reference information about food using all of our senses. The well-preserved bones of early Iron Age humans reveal that their stomachs "contained the remnants of sixty different species of plants. … Multiply that number through the seasons and across the animal kingdom, and some appreciation for that human's catalogue of sensual clues begins to accrue" (Manning, 2004, p. 20).

In our very existence are sown the seeds of environmental use and possible abuse, which has intensified dramatically over the past 300 years. Humans must manipulate nature in some ways to construct our lives. In a search for successful reproduction, we have altered the Earth's landscape. Obviously, the utilitarian perspective on the human-nature relationship alone will not to lead to a more sustainable existence.

Intellectual and cultural

Human response to the need for resources and vulnerability in the face of natural forces has been largely technological. Yet there is much evidence, starting with the evolution of communication and writing, that cultural ideas and norms are inextricably bound with nature. The chief mechanism for meaning-making is human language, and it had its origins in the natural world. As Abram explains:

> Oral language gusts through us—our sounded phrases borne by the same air that nourishes the cedars and swells the cumulus clouds. … Whether sounded on the tongue, printed on the page, or shimmering on the screen, language's primary gift is not to re-present the world around us, but to call ourselves into the vital presence of that world—and into deep and attentive presence with one another (Abram, 2010, p. 11).

Language has been essential to human creativity and owes its origins to the environment. As human communities moved toward writing, they moved away from the natural world that had served as the crucible of their communication. With writing, language came to be seen as a human creation, independent of the earthly context.

Humans are storytelling creatures. Jerry Hoeg demonstrates that narrative evolved by natural selection to regulate "two interrelated social arrangements: the relations between individuals within a given society, the intrasocial; and the relations between society and its natural environment, the extrasocial." Children from the age of six on typically have this narrative capacity. The stories that societies tell regulate resource usage within the carrying capacity of the environment (Hoeg, 2009, pp. 1–2).

Humans use all kinds of living organisms as sources of metaphor, myth, and modeling. Some of the ways societies achieve a balance with other living organisms include taboos against eating certain animals or rituals involved in hunting. East Africans have oral traditions about elephants as protectors that signal rain. Elephants provide a cultural template for human families in these communities because in their stories the animals have grandparents with long memories and the capacity to weep and mourn.

Landscape is not just something to be regulated. It can regulate us. Anthropologist Keith Basso describes the culture of the Western Apache, where human beings needed the longer-term histories associated with previous peoples' experiences on the landscape to help guide their personal growth and maintain the society. "[P]lace-making is a universal tool of the historical imagination. And in some societies at least, if not in the great majority, it is surely among the most basic tools of all" (Basso, 1996, p. 5).

The Apache remember history and reinforce morality through the landscape. Basso recounts brief encounters between a distraught member of the community and elder members. Elders use place names to help the younger person to recover emotionally and socially from her problem, often evoking a string of place names that conjure associated stories and morals. A single utterance can perform multiple tasks: heal a wounded spirit, display tactful attention to a particular behavior, and affirm the value of traditional values, among many others. Basso observes that while "grandmothers and uncles must perish … the landscape endures, and for this the Apache people are grateful" (Basso, 1996, p. 61).

The Luo of Western Kenya along Lake Victoria strive for a life of indebtedness—even debts that they will never repay in their lifetimes. Anthropologist Parker Shipton has explained in the first of his trilogy, "A life in which all debts were settled would be a frozen life of atomized individuals—no life at all." This is not overspending a credit card and then seeking bankruptcy through a legal process. Instead, it is cultivation of relationships of give and take that ensure connectedness for a lifetime and beyond—so that one's welfare is literally tied up in that of another's. Shipton describes this kind of relationship: "Loans are the elastic in economic life, stretching labor and capital over land, stretching food over the season, stretching income over a lifetime." He calls these entrustments. "They are also about defining who we are, and about connecting to something bigger than ourselves" (Shipton, 2007, pp. 208–209).

In Western history, the land mortgage became increasingly common after the 16th century. Such loans imply that land is bounded and separate from the people on it. In most of rural Africa, land is bound to people and more than one person can claim interest in any given piece of land for reasons of social security. This is in keeping with a broad, long-standing strategy of spreading out risk, authority, and ownership. Commoditizing land is insanely risky for farmers in areas with unreliable rains and uncertain markets. Mortgaging might make sense in an industrial economy with sufficient wage employment. But Kenya has neither. Despite more than sixty years of exposure to land titling and mortgaging, most Luo are reluctant to mortgage their land. They see it as unnatural and unfair. Land belongs to both ancestors and future family members. Lineages lay claim to land for both the dead and the unborn. Burial sites are important spiritual resources. In the Luo approach to land, all three biophilic attributes are demonstrated—material, cultural and spiritual. People are bound to the land.

Conclusion

The news is often depressing and debilitating, whether it is political, economic or ecological. Often this is so because it is so narrowly-conceived and delivered. Acting and living from our biophilia, our interdependence—or, as Aubrey Streit Krug has written in this volume, our reciprocal healing relationship with the Earth—is broad and real. Such an approach has provided me with some capacity to resist poisonous dominant ways of being and, thus, find meaning. Collectively, it could promote optimal welfare of people and planet.

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Economic transformations for an ecological civilization

Fred Iutzi

The first recorded use of the word "ecology" is typically dated as 1866 by German biologist Ernst Haeckel. It is derived from the Greek *oikos*, which means home or dwelling place, and the Greek *logos* and *legein*, meaning to gather, recount, or say. Of course, *logos* has also come to imply directed inquiry or science. We can play with literal interpretations of the word ecology to layer on meaning: "talking about home," "the science of dwelling in a place," or "the story of where we live."

Closely related to ecology but much older is "economy" or "economics." It starts with the same *oikos* for home, and then takes on *nomos* and *nemein*, to distribute. For the ancient Greeks, *oikonomia* meant household management or stewardship—literally, the distributions and allocations needed to manage a household, or metaphorically, doing the same in a community or a nation. Either way, the connotation was wise, competent, and thrifty management by the *economos*—the individual who acts as steward.

A connotation-free definition of economics today is something like, "the production, distribution, and consumption of goods and services." But economist Lionel Robbins gave a definition perhaps more intelligible to ancients and moderns alike: "the science which studies human behavior as a relationship between ends and scarce means which have alternative uses" (Robbins, 1932, p. 16).

The way we manage our household—economics—is by marshalling means and ends, ideally with prudence. But if we take stock of the story of where we live—ecology—we find that, more often than not, the household is coming apart at the seams. We find that, more often than not, we have lost sight of the ends we seek, and we make our choice of means with little regard for the unwanted ends that may be produced. We strive for food and get soil erosion and polluted water. We strive for a feeling of safety and produce oppression. We strive for convenience and get a warming planet.

The truth is, we don't know what we're doing in this civilization of ours. We've unmoored ourselves from past technological and energetic limits, but we haven't learned to swim the waters we now find ourselves in. Our decision making has become abstract, isolated, deranged. We need to reintegrate the story of where we live into our culture and our society. We need a truly ecological civilization, and getting there will require a profound reordering of means and ends along with the institutions that mediate them. Getting there will require economic transformations at every level of society: how we grow, make, trade, shop, own, and govern. How on earth will we do all that? Here's a place to start, from the old Paul Bunyan story[1]:

> We put over a hundred million feet of logs in the river. It came off one 40 of timber that grew and peaked like an Egyptian pyramid. We didn't know the country, but Bunyan was sure we'd hit one mill or another downstream, and didn't give a hoot which one, since logs were the same price everywhere. After running that drive for four weeks, we passed another camp that had cut a steep hill 40. After another month we hit another deserted hill 40, and Bunyan began to swear, because he saw all this lumbering sink the price of logs. But after four more weeks and another hill 40, we realized it was Round River.

Here I'll let Aldo Leopold take over, from his essay "The Round River: A Parable of Conservation":

> We of the genus *Homo* ride the logs which float down the Round River, and by a little judicious "burling" [logrolling] we have learned to guide their direction and speed. This feat

[1] I have read a number of different versions of this story, synthesized in my rendition here. One example is the retelling by Schlosser (2020).

> entitles us to the specific appellation sapiens. The technique of burling is called economics, the remembering of old routes is called history, the selection of new ones is called statesmanship, the conversation about oncoming riffles and rapids is called politics. Some of the crew aspire to burl not only their own logs, but the whole flotilla as well (Leopold, 2013, p. 458).

From this wry commentary about our Paul Bunyan economy, Leopold offers his main point about ecological processes. "Wisconsin not only had a round river," he wrote, "Wisconsin is one. The current is the stream of energy which flows out of the soil into plants thence into animals, thence back into the soil in a never-ending circuit of life" (Leopold, 2013, p. 458). Leopold highlights energy, but of course we could talk about cycles of nutrients, carbon, genetic diversity, and so on. All of these exemplify how ecosystems and the ecosphere are beautifully circular—in the sense of "unbroken circle," "perfect circle," or "virtuous circle."

Our economic systems, in contrast, tend to be perversely circular—think "circular logic," "circular firing squad," or "vicious circle." This is reflected in the fuzziness of the economic ends we seek. Like Paul Bunyan's crew fruitlessly driving logs in a circle, the process takes over. The objective of agriculture is for people to be fed, but the abstract concept of wealth creation in a laissez-faire economy has become the product, and so the interests of farmers and eaters fall by the wayside. The reason to produce things like houses and clothing is for people to be sheltered from the elements, but instead we get a consumer products arms race. And we continue to burn daylight—fossil daylight, the solar energy stored in coal, oil, and gas—while the planet warms. The perverse circularity of the economy ignores or subverts the beautiful circularity of the ecosphere.

The confluence of these two confusions—about ends and about means—is exemplified by the use of Gross Domestic Product as our key economic indicator. GDP is the final market value of the goods and services produced within a country. The author of this metric, Simon Kuznets, was famously on record cautioning against misuse, pointing out that the statistic ignores economic activity outside the marketplace, wealth inequalities, and the experiences of the actual human beings involved. "[T]he welfare of a nation can, therefore, scarcely be inferred from a measurement of national income" (Kuznets, 1934, p. 7).

Measured in isolation, national income is a flow with no attention paid to the accompanying stocks of natural resources—with no accounting for the ecological wealth from which income is extracted, or for consequences of that extraction. I'll tell you what I call a flow imposed with no regard to the stock on either end: a wound.

U.K. economist Kate Raworth (2012) has offered a "Safe and Just Space" framework for thinking about how we are called to live on the planet. A "safe" existence is one that avoids violating any critical planetary boundaries: atmospheric

CO_2 concentrations, nitrogen and phosphorus cycling, nonrenewable resource extraction, and the like. A "just" existence is one where the vast majority of people on the planet attain certain minimum standards for such things as nutrition, health status, and energy availability. Raworth plots these safety criteria on a round diagram and the justice criteria on another round diagram, and then overlays the two. Plotting the minimum acceptable level of human well-being and the maximum tolerable impositions on the planet defines the space we can safely and justly operate in as a civilization. The shape of that space supplies Raworth's tagline and the name of her book, *Doughnut Economics* (Raworth, 2017).

Sustainability researchers associated with the University of Leeds in England concluded that humans are far from fitting in the doughnut. For five out of the 11 human well-being indicators they used—including life satisfaction, health, and sanitation—not one country in the world meets the minimum while simultaneously staying in-bounds on the sustainability metrics. For the other six well-being indicators, only a handful of countries are achieving even one of them sustainably (O'Neill et al., 2018).

The strategies in the conventional progressive toolbox for making the economy more sustainable aren't cutting it. Policies and practices designed to reduce the tight coupling of economic activity with planetary extraction include integration of renewables into the current energy economy, replacing gas engines with hybrids, installing water-efficient toilets, and using the lower-energy lightbulbs. When all of these changes are made while accepting a growth economy, all will ultimately prove inadequate, which does not mean ignoble or unnecessary. At The Land Institute, we encourage the adoption of the best possible organic farming methods with annual crops, to help slow the rate of resource loss and degradation, to buy us time to develop the perennial grains we believe are necessary. Likewise, other "bright green" efforts can be regarded as necessary to buy time for deeper economic transformations. Strategies to use less energy and fewer resources in the existing economy, as far as they go, are helpful and necessary and therefore noble. But they are hopelessly insufficient. This is not a situation where we can insert one or two technological fixes and write a new law or two. Our thinking and actions must change profoundly. We need a transition to an ecological civilization.

What have we typically meant by the term "civilization"? Most often it is associated with progress. Boy and girl meet an annual grass, domesticate that grass into a grain crop (such as wheat or rice), and then settle down, urbanize, and socially stratify, as arts and letters blossom, a people-nature dualism flourishes, and they all live happily ever after—or at least until the resources run out. What, in contrast, is an ecological civilization? I propose two criteria. One is that economic actions by individuals, households, and society be deeply ecologically informed, to respect planetary boundaries and the well-being of fellow dwellers on it. In other words, live in the doughnut. The other is that the impulse for

economic actions to be good, ecologically informed, and compassionate should be woven into the very fabric of culture, and not dependent on maintaining an extremely high rate of good decision making by individuals over a long time. In other words, make it doable for people who aren't geniuses and aren't saints.

So, what does this require of us? First, we need an end to global economic growth. All that we know of history, all that we know of biology, and all that we know of earth system science tells us that economic activity can never be decisively and thoroughly decoupled from impacts on the ecosphere. That is enough to tell us that infinite growth is a nonsense concept. But at this point, merely ending growth will not be enough—we will need to tackle economic *degrowth* (D'Alisa, Demaria, & Kallis, 2014; Kallis, 2018).

Back to those measures of human well-being. On most of those indicators, only a handful of countries achieved the minima while simultaneously not overdrawing from the ecosphere. If we were to cobble together a hypothetical sustainable, minimally prosperous country out of the lot, we would have the nutrition pathway of Eritrea; a sanitation pathway that hasn't yet been demonstrated, but where Tajikstan is the closest fit; the median income and energy use pathways of Moldova; a health pathway that hasn't been demonstrated, but where Vietnam is the closest to fitting; the secondary education pathway of Sri Lanka; the equality pathway of Ethiopia; the full employment pathway of Rwanda; and pathways to democratic governance and to overall life satisfaction that have not yet been demonstrated by any country. Notice anything about that list? Not much Global North on it. We will need degrowth as a planetary civilization overall, and we will especially need degrowth here in the rich countries to make it possible for our neighbors in the Global South to climb out of the trench dug by centuries of colonialism and ongoing economic imperialism. The good news is that our southern neighbors may be able to teach us a thing or two to aid our transition.

Second, as we contemplate degrowth, we need to develop a sense of sufficiency. As Wes Jackson points out, we've evolved to like our num-nums—easy carbon. And the drive to satiate our big brains' complex and abstract desires hasn't faced much selection pressure against it—yet. Rather than a consumer arms race and the proverbial battle to keep up with the Joneses, we need to cultivate that sense of sufficiency—learning to take pleasure in modest amounts of energy intensive goods and services, and an overflowing abundance of fulfilling relationships with one another and with the ecosphere.

Third, we need to embed good economic behavior into culture. The main way to do that is ethics. A very familiar passage from Aldo Leopold's classic essay "The Land Ethic" applies here: "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise" (Leopold, 1949, pp. 224–225). But we can go back considerably further for that idea. Historian Dotan Leshem writes: "Both ancient Greek *oikonomia* and contemporary economics study human behavior as a relationship between

ends and means," but while modern economics is largely neutral about ends, "in ancient economic theory, an action is considered economically rational only when taken toward a praiseworthy end" (Leshem, 2016, pp. 225–226).

Praiseworthy ends included careful stewardship of the family, household, and farm; contributions to public institutions; support for friends and neighbors of more limited means; and creation of leisure time for good governance, arts, and letters. Unpraiseworthy ends included self-aggrandizement, excessive luxury, and poor stewardship. Perhaps economics should only refer to careful stewardship of practical matters, and we should pay heed to Aristotle, who argued that a separate and less virtuous term, "chrematistics," for the art of acquiring wealth. Indiscriminately plowing your wealth back into creating more wealth for yourself fell in the province of chrematistics, not economics. So, one might say Aristotle advocated a no-till economics.

Fourth, we need to be prepared to make cooperation the fundamental building block of our economic activity and reasoning. We have developed a cult of *Homo economicus* that does not represent the actual behavior of actual human beings very well at all. We are neither coldly rational nor exclusively self-centered. Millions of years of evolutionary history have prepared us to relate to one another affectionately and collaboratively. In many chapters of history this cooperative spirit at the levels of family and society has been a norm, and today we still see it break through when the chips are down. An economy more explicitly founded on cooperation will include better recognition of the labor that's performed outside of the legible economy. It will include forming business entities as cooperatives—enterprises that are jointly owned by the people who benefit directly, and that are governed on a strictly equitable basis. As David Bollier (2014) suggests, it will include holding various kinds of property in the commons.

Fifth, we have to figure out who makes decisions and how. Democracy, as we currently conceive it, is clearly better than the authoritarian alternatives that are frequently counterposed to it. But is it good enough? Is it the best we can do? We are challenged by writers such as Loka Ashwood (2018) and James Scott (1998), who ask whether majority-rule democracy is capable of truly respecting minority rights and point out that we have not done well orchestrating big, fancy interventions from afar.

This brings us to localism. There are efficiencies in resource use available to local economies, and opportunities for local decision making to cultivate and draw on local wisdom and a local culture. Re-localizing our economies will be critical for getting back into the doughnut. But local is not a panacea. Shorter transportation distances are usually less energy intensive than longer ones, but occasionally they're not. Local, participatory decision making theoretically has large advantages over governance from afar, but sometimes local decision makers simply replicate the same biases that were already being projected from the far-off

capital. While we continue developing critical local foods and local economies, we must learn how to make those approaches truly work, and to see when they don't.

How do we make the transition from the economic sensibilities and systems we have, to the economic sensibilities and systems we need? This is a daunting task. A small handful of problems are solvable using the existing levers of political process at the national level, and so political advocacy is constructive. Organizing locally will help us solve another handful of problems now, but more importantly it will better equip us to envision the future we want when all else fails. Likewise, organizing locally will help us better advocate politically now, but more importantly it will better equip us to implement what we want when all else fails.

Let's connect this transition with the two opening circularities, the virtuous and the vicious, with a metaphor. Traveling spacecraft often take an elliptical orbit. When the destination nears, a rocket thruster is fired to circularize the orbit, to take an orbit that no longer swings wildly around but keeps close by the home neighborhood. That so-called "circularization burn" consumes a large amount of scarce fuel, but positions the craft so that physical forces will maintain its relative position for free. Kate Raworth (2017, p. 243) writes, "Ours is the first generation to deeply understand the damage we have been doing to our planetary household, and probably the last generation with the chance to do something transformative about it." So, as a civilization we have the opportunity now—maybe our one and only remaining opportunity—to perform a circularization burn. At The Land Institute, we are using technologies made possible by cheap fossil fuels to develop crops that will not be dependent on fossil fuels. The same logic arguably applies to economic thought and experimentation—we should get cracking now while we have the energetic slack to wing ideas freely around the globe.

In conclusion, changes will be necessary:

1. End the growth economy.
2. Develop a sense of sufficiency.
3. Embed good economic behavior in culture via ethics.
4. Cooperate.
5. Make decisions in a just and appropriately scaled manner.

If we can perform this civilizational circularization burn, maybe we can get out of the perverse circularity of our current economics. Maybe we can craft for ourselves an economic circularity that mimics and interlocks with the elegant dynamic circularity of nature, with the "stream of energy which flows out of the soil into plants thence into animals, thence back into the soil in a never-ending circuit of life," to borrow again from Leopold. Maybe at last we can reconcile our ecology and our economics. The story of our life in this place can guide the stewardship of our life in this place.

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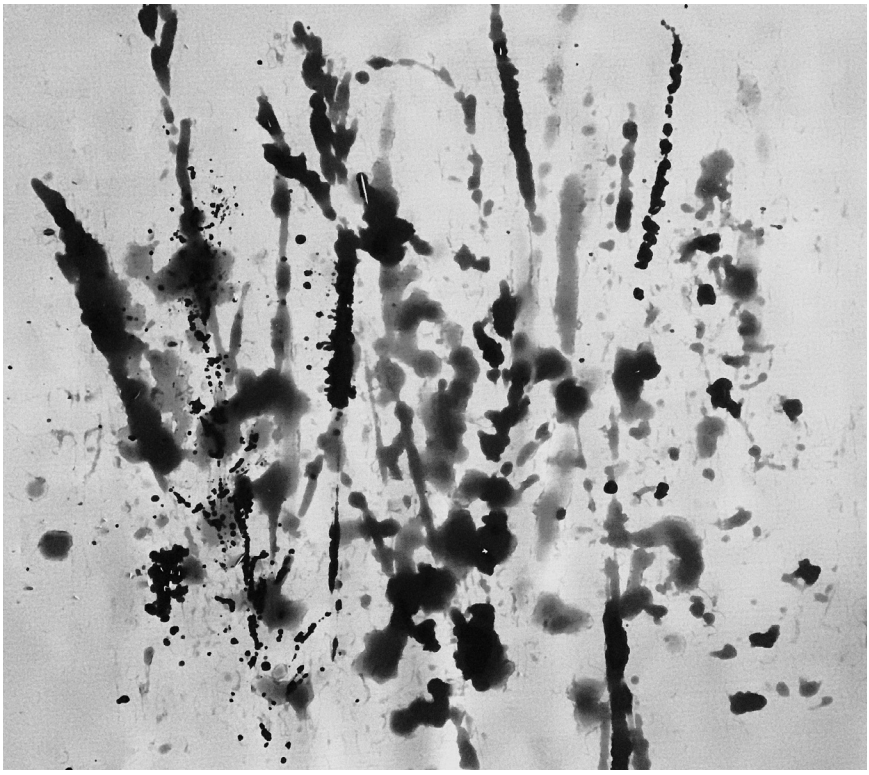

ABOVE: Field 6, 2020. *Nancy Winship Milliken*
OPPOSITE: Field, 2020. *Nancy Winship Milliken*

Cap and adapt: A failsafe policy for the climate emergency

Larry Edwards and Stan Cox

The peril that the United States and all of humanity face from global climate change is readily evident. The extraordinary climate-related catastrophes in recent years have become almost routine. Extreme weather events are becoming more intense and more frequent, with regions sometimes suffering back-to-back or even concurrent disasters. Emergency response capacity is being stretched thin, recoveries are prolonged, and migrations from climate-impacted areas are testing the world, politically and morally.

In July 2019, five months after the Green New Deal bills (H. R. Res. 109/S. Res. 59) were introduced in Congress, additional resolutions to declare a climate emergency were introduced in the Senate by Bernie Sanders and in the House by Representatives Earl Blumenauer and Alexandria Ocasio-Cortez (S. Con. Res. 22/H. R. Con. Res. 52), currently with eight and 103 cosponsors, respectively. The resolution "demands a massive-scale mobilization to halt, reverse, and address [the emergency's] consequences and causes" that requires "a managed phase-out of the use of oil, gas, and coal to keep fossil fuels in the ground." While the resolution addresses the need to control all greenhouse gases, its concept of a managed phase-out of fossil fuels goes directly to the root of the largest U.S. contribution to climate breakdown.

We propose a "Cap and Adapt" policy to accomplish the resolution's proposed managed phase-out of fossil fuels at a speed matching the last-minutes-to-midnight urgency of our climate plight. It is, by design, inherently failsafe, both for meeting any target date for the phase-out and for meeting the needs of individuals, families, communities, and the national economy.

The term "failsafe" emerged in the 1950s to describe systems designed to anticipate potential problems and succeed even in the face of individual failures. A failsafe system does not depend on everything working without interruption but instead builds in effective responses to a breakdown. In everyday language, it typically means a system that is surefire or can't miss: "unlikely or unable to fail" (Oxford dictionary); "designed so that if one part of it does not work, the whole thing does not become dangerous" (Cambridge dictionary); and which "inherently responds in a way that will cause no or minimal harm … to the environment or people" (Wikipedia).

Writing during the COVID-19 pandemic reminds us of how quickly conditions can change. But it's important to recognize that when the public-health crisis abates, the nation will face countless more climate-aggravated blizzards, heatwaves, ice storms, wildfires, hurricanes, and floods. Congressional progressives will need to introduce a full-strength draft bill that decisively tackles the fossil fuels problem, with a phase-out schedule of appropriate speed that includes a social and economic safety net. We suggest Cap and Adapt.

Leading the target: A failsafe climate policy for fossil fuels

In principle the Cap and Adapt policy is:

- fast-acting and inherently failsafe for delivering essentially zero fossil fuel emissions (recognizing there will be reasons for continuing to produce those fuels at very low levels), by whatever date will be targeted; while being

- fair, equitable, and inherently failsafe in meeting the needs of the economy, regions, communities, families, and individuals.

The framework has three parts. The first is a cap on fossil fuel extraction and imports, which declines on a fixed schedule prescribed in the legislation. The cap has primacy in the framework, because stabilizing—and then reversing—the climate crisis must have primacy in public policy. The other two parts, which help society and the economy adapt to that declining supply of fossil fuels, are an enhanced Green New Deal to facilitate the just and complete transition of the U.S. economy to 100% renewable energy, along with a standby program to smoothly and fairly ration national fossil fuel supplies in the event of energy shortages during the transition.

How fast can Cap and Adapt go in eliminating fossil fuels? We propose a 10-year end date, attaining essentially zero fossil fuel use in the United States by 2031. The extraction and import of each kind of fossil fuel and the embedded emissions in imported goods decline to near-nil in 10 equal, annual steps. Each

annual step is 10% of the quantity of fuels extracted and of the carbon content of goods imported in 2019, the base year we use. However, Cap and Adapt will work for any target date that is established in legislation or by executive order. Ours is an emergency proposal, in contrast to carbon budget-based target dates in other policy proposals (Intergovernmental Panel on Climate Change, 2018; United Nations Environment Programme, 2019). Those plans are premised on keeping temperature rise below the arbitrary, very unsafe 1.5°C or 2°C levels and they lead to net-zero emissions dates of 2040, 2050, or beyond.

We acknowledge that the Cap and Adapt proposal sets a high bar that is difficult to clear politically. But in the face of the deepening climate emergency, bold policy that leads the target for legislative potential and helps move the goalposts is vital. A weaker policy on fossil fuels or their emissions, if adopted, will fail. Cap and Adapt starts at the top of the fossil fuel supply chain, where regulation is effective, easy to accomplish, and can be failsafe for cutting emissions. Cap and Adapt has three parts: the cap, a mobilization, and standby rationing.

1. The Cap

This top level of the framework implements the congressional emergency resolution's call for "a managed phase-out of the use of oil, gas and coal." It puts a linearly declining cap (an upper limit on the amount of fuel extracted from the ground or imported and on the embedded emissions in imported goods) that will reach essentially zero before a specified date. Each year until then, fossil fuel extractors and importers ("producers") will be issued free, non-tradeable permits for specific quantities of the raw or imported fuels each is allowed to produce. For domestic producers, this applies at the well or mine; for importers, to the imported raw or finished fuel. The end date will be specified in the legislation and should be aggressive. The cap's linear rate of decline is identical for overall production of each kind of raw fossil fuel. The annual decline and the permitted production of oil, gas, and coal will be measured in barrels, cubic feet, and tons, respectively, not in carbon content or dollar value.

By its nature, the declining cap is failsafe for meeting the target date because it directly reduces the production of carbon that would be emitted as CO_2, the fixed-by-law schedule cannot easily be relaxed, and it is enforceable through permits. An aggressive cap will send a strong signal that new fossil fuel-consuming infrastructure should not be built and that existing infrastructure will soon have to be retired, much of it before its normal end of life. Recent research shows that early retirement of that infrastructure is necessary, even for policies less stringent than Cap and Adapt (Tong et al., 2019).

To avoid inflation, the permits will be issued at no cost, other than perhaps a fee to cover the program's administration expenses. A price on permits is unnecessary for controlling emissions because the declining cap accomplishes that. Price controls can be utilized if they are necessary to prevent inflation and profiteering.

Importation of goods is a path for some CO2 emissions to "leak" around the domestic cap on fuels extraction, in the form of emissions made outside our borders during manufacture and transport before products reach the port of entry. Such leakage would disadvantage domestic manufacturers and undercut the nation's emissions reductions. Leakage can be reduced or eliminated with border carbon adjustments, or BCAs (Mehling, Van Asselt, Das, Droege, & Verkuijl, 2019). These must be designed to comply with requirements of international trade treaties, principally the General Agreement on Tariffs and Trade (GATT). Border adjustments can be made either through quantity ceilings on various kinds of imports, or tariffs on them.

2. Mobilization: Adapting to the phase-out

A nationwide mobilization of industry, the economy, and the workforce is a necessary part of the program to eliminate America's fossil fuel emissions, as envisioned in the Green New Deal resolution and the climate emergency resolution. The purpose is to supplant fossil energy through electrification, the construction of a 100% renewable energy supply, and the necessary electricity distribution networks, and by making energy efficiency and conservation improvements. Combining the Green New Deal with the other two parts of the policy framework should eliminate the "rebound effect"—the tendency of improvements in efficiency to lead to more, not less, consumption. With fossil fuel increasingly restricted by the cap, the primary purpose for improving efficiency becomes stretching the utility of fossil fuels and electricity more so than cost savings. Even so, at this systemic level, the cap prevents aggregate cost savings made through energy efficiency from increasing fossil fuel use.

The Green New Deal will need to be enhanced with new mechanisms that allocate the diminishing supplies of fossil fuels and imported goods to the economy's various sectors in a way that meets people's needs. A particularly important sector is the Green New Deal's industrial mobilization, because the energy transition must be completed on schedule. This supply-side allocation mechanism operates without putting a price on carbon or fuels.

While the Green New Deal is not yet a detailed proposal to Congress, we rely here on its spirit as expressed in HR109/SR59 and its call for rapid mobilization. We also foresee the Green New Deal repurposing some economic sectors to meet the needs of the transition, as was done during the World War II industrial mobilization (Rockoff, 1984, pp. 85–126). Importantly, Green New Deal policies will also ensure that no one will be left behind in the transition, and that employment opportunities created by the transition from fossil fuels are open to all, including people from the replaced industries.

3. Standby rationing: Adapting if shortages occur

A ready-to-go rationing program is necessary in the event that renewable energy

capacity (thermal or electric), its supporting infrastructure (e.g., the expanded electric grid), and energy efficiency improvements can't be put in place fast enough to fully substitute for the cap-enforced decline in fossil fuels. This rationing of fossil fuels would be by quantity (volume or weight of the fuel), instead of by price as is the case today.

The standby rationing program serves as a kind of insurance policy. Some technology advocates believe expansion of renewable energy, energy efficiency improvements, and demand reduction can completely displace and substitute for fossil energy in time to prevent climatic disaster (Jacobson, Delucchi, Cameron, & Frew, 2015). If that turns out to be accurate, a Green New Deal would be sufficient and rationing would not be triggered. However, other researchers have concluded that even a rapid buildup of renewable energy could not completely replace the quantity of energy currently being supplied by fossil fuels (Clack et al., 2017; Loftus, Cohen, Long, & Jenkins, 2015). If the non-fossil energy buildup does not keep up with fossil fuel reductions—which we strongly suspect will be the case—rationing would be a vital safety-net for society, national security, and achieving the necessary climate target. If rationing were triggered, it would affect most dramatically those households (generally affluent ones) with large carbon footprints.

The role of rationing, if shortages arise, would be to ensure fair distribution of available fuels and electricity to households and other end users, satisfy the basic personal needs of all, and avoid the chaotic ad hoc rationing-by-queuing seen during the 1970s oil crisis, when frustrated drivers waited in long lines at the gas pumps. This fair-shares rationing system will issue personal allowances for purchases of fuels and major fuel-using transport services, such as air travel.

Rationing is a policy of last resort, but one with popular appeal under dire circumstances, when people are convinced that it is necessary. Rationing would apply to everyone equally; be fairly administered; and be vigorously enforced to ensure violators are few. This acceptance and success has been demonstrated, both historically and in contemporary societies worldwide, most notably in the United Kingdom and United States during World War II (Bentley, 1998, pp. 22–24; Rockoff, 1984, p. 130; Cox, 2013).

Some have called for using fossil fuel rationing as a mechanism to reduce CO_2 emissions. In Cap and Adapt, the cap performs the emissions-reduction role, with rationing's role to be at the ready to ensure the climate-failsafe policy is also socially failsafe. Ending fossil fuel use is required; rationing, if needed, is the last of two mechanisms for adapting the nation to that requirement.

Rationing allowances, like the cap, would be denominated in quantities of fuel, not dollars or relative carbon content. Individuals would have rationing smart-cards, automatically credited with fresh allowances every week and debited when making purchases. Detailed systems for this kind of rationing have been developed but would need to be adjusted for the current situation. For

example, more than a decade ago, the U.K. Parliament considered the concept of transferable energy quotas, or TEQs (Chamberlin, Maxey, & Hurth, 2014). The TEQs approach is based on using market price for industrial allocation and personal trading of carbon quotas, but Cap and Adapt proposes doing this without reliance on price. TEQs were dismissed then as being ahead of their time.

Several kinds of rationing systems are possible, and any could be used in our climate policy framework. Personal allowances could be either tradeable or non-tradeable, and if they were tradeable that could be through personal sales or via an equitable non-price means. Our belief is that a system which precludes the pricing or sale of allowances, but provides for equitable access to a pool of unused allowances, would be fairer and better functioning than by using TEQs.

Institutionalizing the framework's two adaptation features

The successful national mobilization during World War II is a model for today. It supported the U.S. economy and society while pursuing the overwhelming task at hand, made sweeping changes in public institutions and policies, and instituted macro-scale government interventions in the economy. The War Production Board, for example, managed the allocation of resources among the military, industrial, and civilian sectors. The Office of Price Administration oversaw price controls and consumer rationing, with local rationing boards that were attuned to local needs handing the day-to-day mechanics. Pricing was not used to make any of these allocations. The bureaucracy required to administer all this was surprisingly modest in size, employing fewer people than the U.S. Post Office of the time (Rockoff, 1984, p. 175).

Today, the nation's urgent climate obligation requires a rapid, whole-economy transition from the use of harmful energy sources that are deeply embedded in the economy. The Climate Mobilization, a national climate emergency organization, has published a "Victory Plan" (Silk & Bamberger, 2019) describing several agencies that, as in WWII, would be required to ensure sufficiency and fairness for all under our proposed cap. Cap and Adapt uses the same kind of non-price mechanism as then to allocate fossil fuels among the economy's sectors, executed flexibly by a government agency to adapt to changing circumstances during the transition. The objective is to ensure the increasingly scarce fossil fuels are prioritized to the production and direct uses that are most needed by society and for the build-out of the transition to a fossil-fuel-free economy. Issuing fossil fuel allowances among the sectors is a zero-sum game; because of the cap, an increased allocation to one economic sector means a lower allocation for other sectors. Allocation decision-making needs to include public consultation processes at the national, regional, and community levels (including frontline communities, those disadvantaged communities that bear the brunt of impacts from industrialization and pollution) and recognize differing needs among regions and between seasons.

Just as with the cap's free issuance of fossil fuel production permits, the allowances for fossil fuel use allocated to the economic sectors would also be free. This avoids inflation and keeps fuels affordable, until the time their production is eliminated. If price gouging begins to occur, price controls could be applied. Everyone normally expects that lower prices will lead to increased consumption and emissions. But here, the cap on fossil-fuel extraction completely decouples price level from consumption and emissions (although fossil fuel prices should nonetheless be maintained above the prices of renewable energy). So, employing price controls would not impair the rapid elimination of these fuels. Furthermore, there would be no argument for using a carbon tax to reduce fossil-fuel demand, because emissions will be controlled by the declining cap on fossil fuels. Another way Cap and Adapt drives energy consumption away from fossil fuels is the cap's transparent, definite schedule for rapid elimination of fossil fuels in the marketplace. It would provide certainty for consumers, industry, and financiers.

Similar to the allocation of fuels, the permits for importation of emissions that are embedded in goods would be issued at no cost and the allocations to various sectors of the economy would give priority to the needs of society and the energy transition. Here too, the no-cost permits would help avoid inflation, and also help prevent complaints under international trade agreements that the free allocation of domestically extracted fuels is a non-price barrier to trade. Besides contributing to reductions in the nation's carbon footprint, the border carbon adjustment involved in this would serve a leadership function, encouraging exporting nations to shift to carbon-free production, an effect amplified by the fact that the cap declines rapidly to nearly nil.

Comparison to other policy approaches

Cap and Adapt vs. carbon pricing: Pricing strategies such as carbon fee-and-dividend, cap and trade, or polluter-pays taxation (which really means the customer pays) rely on indirect economic linkages, operate through time-wasting gradualism, and offer incomplete emissions reductions. Because prices are a familiar feature of the economy, using them to try to control greenhouse gas emissions and to distribute fossil fuels within the economy seems natural to many people. But that pricing is poison for climate policy, as indicated by the angry reaction of the Yellow Vest movement in France to rising fuel prices (Aronoff, 2018), failures of two State of Washington voter initiatives (Roberts, 2018), and the repeal of Australia's carbon tax (Higham, Reis, & Cohen, 2016). Several studies show that to be effective, the price on carbon would have to rise to hundreds or even thousands of dollars per ton (IPCC, 2018; Nordhaus, 2018). This is inflationary and pits everyone against everyone else, instead of fostering a sense of common purpose.

Another difficulty with pricing is that the ability to pay—the wealthy always have much more ability than others—would influence the allocation of fuels

to different uses (e.g., to jet fuel rather than gasoline) and to different sectors of production (e.g., favoring luxury goods over necessities). That has been acceptable to many in a time of unrestrained energy consumption, but it cannot be tolerated when available energy is limited. The systemic, inherent unfairness and counter-efficiency of pricing mechanisms are seeds for malfunction or self-destruction of a policy. In contrast, a policy focus on phasing out the sources of carbon—directly keeping the devil in the ground—is simpler and more reliable than trying to reduce emissions indirectly by pricing carbon. And history shows that it will spark far less resentment.

Although taxes on carbon or fossil fuels could help fund the energy transition, we are now too late in attacking climate change to rely on such partial, unreliable solutions for reducing emissions. The funds generated by a carbon or fuel tax would decline under an effective climate policy as less fuel is used, with revenue reaching low levels just at the time when the more expensive-to-reach, high-hanging fruit in the mitigation technology tree becomes crucial. Better funding options include taxes on wealth or high incomes, redirecting subsidies presently going to the fossil fuel industry, or using modern monetary theory (Wray, 1998; Kelton, 2020).

Cap and Adapt vs. other "managed decline" proposals: Oil Change International and others have proposed a different approach, which they categorize as a "managed decline" policy (Muttit, 2016). This uses a prohibition on new development of fossil fuel deposits and further exploration, rather than using a hard-and-fast schedule for reduction in the flow of all fuel. This approach is passive; by not regulating sources that are already producing, it sets the fossil fuel end-date to be when existing sources happen to reach depletion. Because of this limitation, managed decline can't achieve the aggressive end-dates that climate activists are increasingly demanding. Furthermore, not addressed is the potential for a gap between this policy's putative decline in fossil fuel extraction and the capability of a Green New Deal to, at all times, adapt to that decline. The proposal isn't failsafe for meeting an emissions target by any specific date, much less an aggressive date, or for protecting people in the event of possible fossil fuel shortages.

Conclusion

The Green New Deal resolution expresses hope, but not certainty, that its massive 10-year national mobilization will get the nation to net-zero emissions. It has no provision for ensuring that performance. The climate emergency resolution before the Congress recognizes that a managed phase-out of all fossil fuels is required. With respect to fossil fuel emissions, Cap and Adapt embodies the intents of both resolutions. And it takes their concepts further, with a coordinated three-part framework designed to be failsafe for accomplishing the fossil fuel phase-out on

an aggressive schedule, and to be failsafe for the needs of the economy and people in the event that shortages develop.

Although a policy might be functionally failsafe due to its nature, no policy can be politically failsafe after it is adopted. Any effective policy will always be open to challenge. The best that can be done is to make the policy inherently fair, which provides some immunity from being repealed or weakened, while still achieving its purpose. Cap and Adapt's adaptive features provide fairness that helps defend against challenges to the cap. This is the best that any climate policy can do politically and still be effective.

Green and Denniss (2018) have called for emissions-cutting climate policy to use "both arms of the scissors," meaning supply-side and demand-side approaches. Cap and Adapt does so, with the primary element being the supply-side cap on fossil fuel production and imports. It then uses two kinds of demand-side policies to adapt society and the economy to the cap, and provide a safety net. We believe Cap and Adapt offers both speed and effectiveness, and is as failsafe as any climate policy can be. If adopted in one major emitting nation, that nation can then inspire its cohorts to follow suit (Manji, 2008).

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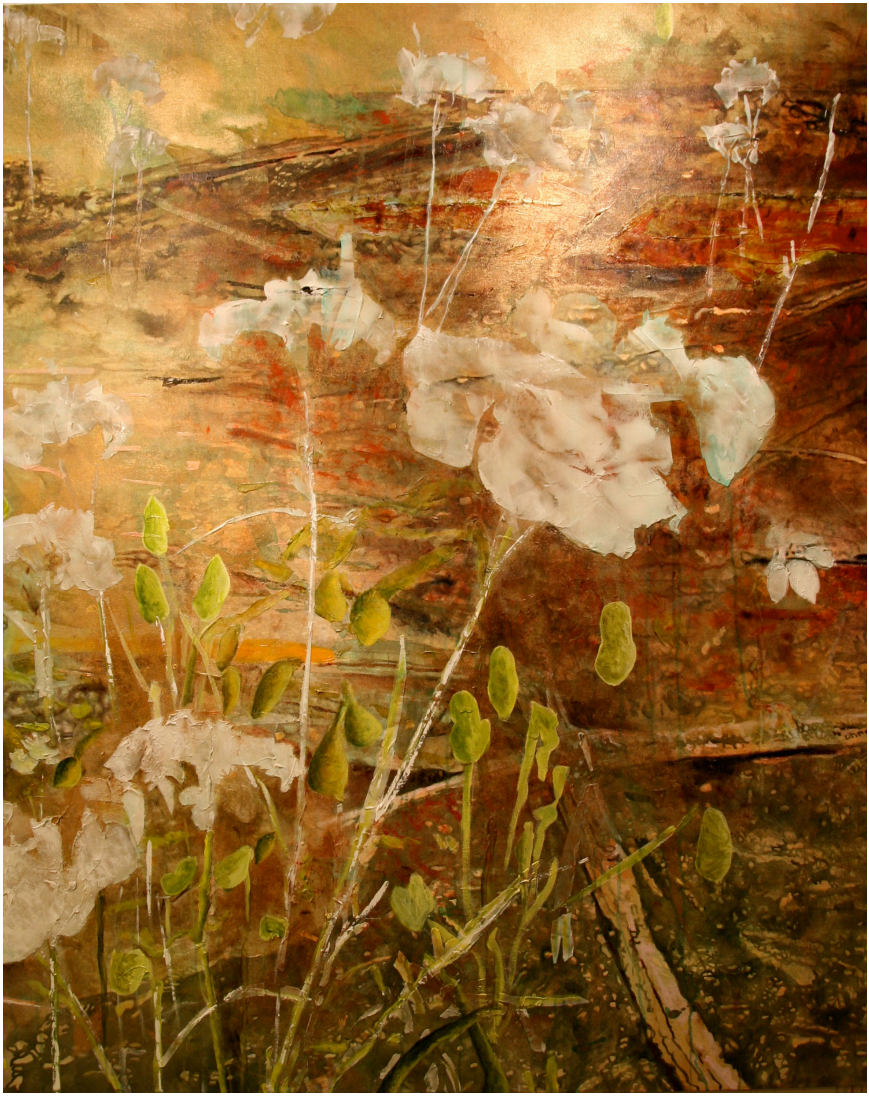

ABOVE: Tar Sands Tonglen (cropped), *Cameron Davis*
OPPOSITE: GRACE, Wood and wax, 2017. *Matthew Burke*

Ecospheric care work

Aubrey Streit Krug

Humans are social beings who need each other. Cooperating and working together are necessary traits for humans to respond adaptively to changes in, and the potential collapse of, social-ecological systems. We know that various hierarchies in our world today, such as patriarchy, mean that not all people share equally or equitably in the work of caring for each other and the world. How will care work be shared in our uncertain future?

In her critical engagement with literary imaginings of a "postwork utopia," Jennifer Mae Hamilton recognizes that:

> recrafting the world and, later, sustaining vulnerable beings across the hardest centuries of planetary crisis and suffering … will likely involve familiar kinds of housework and tasks involved in social reproduction today with some additions: preparing and cooking food, building shelter, telling stories, keeping each other cool and warm and tending the sick combined with caring for soil communities, maintaining energy systems, finding clean water and growing and harvesting crops. How is this work the same as earlier forms of housework? How is it different? (Hamilton, 2019, p. 9).

Hamilton's important questions invite further feminist reflections. In particular, as people contemplate how to make decent human futures through an era of intensifying crisis, care may be more relevant than ever. So, I am heartened that care-related aspects of human life—such as housework, social reproduction,

emotional labor, mutual aid, and community—are increasingly being perceived and investigated in ecologically minded efforts, not only to remember how people might cope and survive, but also to conceive of and work for a just transition. I feel grateful for the many ecofeminist inquiries that frame, inform, and enable such reflections about the relations between women, the Earth, and systems of domination (Plumwood, 1993; Salleh, 1997; Alaimo, 2000; Gaard, 2010).

I feel both relief and grief about how the kinds of care work needed now, at this moment in human and planetary history, may be the same as earlier forms. Relief because undervalued but vital work is being paid attention to; grief because paying attention to such work doesn't mean it will become valued beyond its service to currently dominant social and economic systems.

And I feel intensely curious about the ways that housework and care work more broadly might become different. Oxfam International's "Time to Care" report explains how the vast amount of unpaid and underpaid care work—done primarily by poor and marginalized women and girls—is "crucial to our societies and to the economy" (Coffey et al., 2020). The report points to a coming "care crisis" and calls for implementation of a "4Rs" framework to *recognize*, *reduce*, *redistribute*, and *represent* unpaid care work. I wonder about how to connect this social and economic framework, along with other analyses of care work, with an ecological understanding of humans' places on the planet, including human agricultural pasts and presents.

My question here is: How might the ecosphere, in which humans are embedded, become a recipient of and participant in care? How might ecospheric care work help people learn to come back "down to Earth" during and after the collapse of energy-intensive systems?

Care work

It is first useful to distinguish between "caring about" and "caring for" something. There are plenty of good reasons for why humans should care about each other and the Earth at this moment in time. Lives and ways of life are at stake.

But I question the suggestion that the solution is for people in general to care more about lives and ways of life. For many, the amount we already care about plants, peoples, places, and this planet is a struggle. In emotional terms, people—especially young people—are grappling with concern, fear, anger, despair, and grief due to the harm that is happening and is to come. Reckoning with mortality is one thing, and in fact a very human thing, but reckoning with the accelerated loss and extinction of species and ecosystems at the planetary scale is unprecedented and can feel overwhelming. Even though we may possess skills and methods for coping, such as those discussed by eco-psychologists (Macy & Johnstone, 2012; Pipher, 2013), we are venturing into the unknown.

Of course, some people should care more about other lives and ways of life. The reasons why they do not care matter—for example, because they are caught within the current systems and preoccupied with pursuing such things as money, status, and power. That failure to care enough on the part of some is one of the reasons why other people must take up the additional work of *caring for*.

In many cases, those taking up such necessary care work are themselves survivors of historical trauma and ongoing structural violence, and are now bravely working to heal and flourish. For example, in North America, Indigenous Peoples who have survived catastrophic and genocidal system change, and who have already experienced climate change through forced relocation, are leading ecological advocacy efforts, which depend on practices of care work (Kimmerer, 2013; Whyte, 2016). As Kwagu'ł researcher Sarah Hunt remarked at a conference I attended in late 2019, when it comes to organizing and community events, at the most basic level "there has to be somebody to make the sandwiches."

I would like to foreground that aspect of caring for others: Care is work and requires skill and effort (Folbre, 1995; Meyer, 2000). Caring for others is the necessarily repetitive, incessant work that doesn't get done in any final sense—it has to be done over and over again for daily life to continue.

Care work has been treated in particular ways in the current society and economy. It is understood as necessary but is not very well monetarily rewarded, if at all—at least not in its everyday forms. Care work is often rendered invisible and taken for granted. Though some of it is visible—such as in professions like childcare, nursing, and teaching—much goes unseen, underground, unrecognized, and without status, such as the care work of parenting. As feminist economists have been demonstrating for many years, care work is also unevenly distributed. In the context of the dominant Western patriarchy, care work is often "feminized" or stereotyped as essentially feminine work (Gilligan, 1982; Noddings, 1984). Kate Manne (2017) refers to this as "human giver syndrome," the patriarchal norm that the humanity of some humans (women) is contingent upon them primarily giving their time, bodies, and attention to the moral support and needs of other humans (men).

Giving care is good, but since care is work, it comes at a cost. In a world where giving care is not valued and supported, human givers get burnt out (Nagoski & Nagoski, 2019). That is not an accident but rather the logical outcome of a system in which some people are allowed to exist only to serve the creation of other people's wealth.

For those of us working to build ecologically resilient networks, we should seek to make visible and recognize (the first of the 4Rs identified by Oxfam) who is doing the *caring for* in those collaborative relationships. For example, in a U.S. context, we should ask: In our organizations and communities, is the care work that goes into building partnerships evenly distributed, or is it mostly people of color and women who carry that responsibility? How are care workers and their

work recognized (or not) socially and economically? How could white people and men become more willing and able to do care work and do it well? And who will do the work of teaching people how to care well?

Care work connects physical labor, emotional labor, and the ethical work of justice. As Maria Puig de la Bellacasa (2017) puts it, care has three dimensions: labor/work, affect/affections, and ethics/politics. Care work across these three dimensions acknowledges the tricky realities of what beings (both humans and more-than-humans) need, and calls for those needs to be met in ways that are equitable rather than exploitative.

This concept of just care work grows from ideas of disability justice. Disability, illness, and mortality are realities shared across the human community—though the care work of attending to these realities is not shared evenly. As Leah Lakshmi Piepzna-Samarasinha reflects in her visionary work:

> I wrote this because I believe we stand at the crossroads, between both the gifts and the unexpected, inevitable collapses of our work, and we have the opportunity to dream and keep dreaming ways to build emergent, resilient care webs. I believe that our work in creating the new world depends on it—because all of us will become disabled and sick, because state systems are failing, yet "community" is not a magic unicorn, a one-stop shop that always helps us do the laundry and be held in need (Piepzna-Samarasinha, 2018, p. 35).

All humans depend on the care work of others, and that dependency is only likely to increase in a world with less discretionary energy. While there may be cases where the best form of *caring for* something is non-intervention, generally people do need to care for each other and for the plants, animals, soils, and places of the more-than-human world.

Long-term social justice is inseparably interdependent with the health of the Earth's ecosphere. To build just communities, we need to learn how to care more skillfully, collectively, and ecologically. How to recognize and value the care of others. How to join with them. And how and where to direct our care.

Ecosphere

People might (re)turn to the ecosphere as a recipient of and participant in care work. The ecosphere is the dynamic mantle of life on this sun-fed planet in the Milky Way—the nexus of airs, waters, rocks, and creatures whose interactions together with light make life (Rowe, 2006). The ecosphere includes lithosphere, hydrosphere, atmosphere, and biosphere. Davis (2009) has also postulated the layer of the ethnosphere, the intellectual and spiritual sphere of thoughts, ideas, concepts, stories, cultures, etc. An ecospheric approach prioritizes integration and

process across what has often been divided into these static abstractions. In sum, the ecosphere is a way to name the astonishing realization that there is a dynamic mantle of life on *this* planet at *this* time in *this* galactic place—and here we are, all of us, ecospherically entangled and interdependent in ongoing emergence.

In practical, affective, and ethical terms, care is about people's relationships to each other and people's relationships to the ecosphere. And the term "people" here does not mean a collection of "atomic" individuals—singular, self-made, and self-willed. We exist as people only in the ecospheric community, in those relationships to one another and to the ecosphere as a whole.

Ecosystem processes are the supposedly "background" work of ecosystems, necessary for Earth as ecosphere to sustain human life. These ecosystem processes are vital, yet they are made invisible by our anthropocentric culture: not fully understood or properly valued, and increasingly disturbed, disrupted, and degraded. Similarly, care work is the "background" work of our lives and jobs that is necessary for our communities to sustain human life, but is too often undervalued and degraded.

So, perhaps I could say that care is about doing the background work of the world, and doing it with love. Except there is no background down here on Earth. Since human communities are inextricably embedded in ecosystems and the ecosphere, we humans need both ecosystem processes and care work to continue. We need them to be valued—which is not to say that they should be appropriated, subsumed, and commoditized by the global economic system.

An ecospheric perspective points to the particular relevance of agriculture in addressing our current predicament, as several articles in this volume suggest. For example, The Land Institute's Ecosphere Studies program works to integrate sociocultural research and educational projects with agroecological research. In complement to wide-ranging traditions and ongoing practices of perennial and polycultural agriculture systems around the world (e.g., Indigenous agroforestry), the development of new perennial grain crops in diverse agroecosystems contributes exciting possibilities for landscapes and soil communities (Crews, Carton, & Olsson, 2018). But fundamental questions arise about whether human communities are willing to do the work of ecospheric care, and if so, how they can learn to do such care skillfully, collectively, and with abiding love and respect for humans and non-humans alike.

No human being or community is a blank slate—care work and ways of caring are profoundly shaped by society and economies, often in ways that are deeply unjust. Hence, as the 4Rs framework insists, it is not enough merely to recognize unpaid human care work—people must also seek to reduce, redistribute, and represent that work. Even further, as the diverse feminist inquiries of Hamilton, Puig de la Bellacasa, and Piepzna-Samarasinha indicate, understandings of care must go beyond the human and place people in their ecological, relational context.

To learn new ways of caring for other beings—or remember ways that others have known but we have forgotten—some humans may first need to *un*learn. For instance, members of the dominant society in the United States will need to let go of and dismantle certain things in order to care for the ecosphere. They will need to let go of the denial of crisis and harm, to let go of the domination of fellow non-humans and humans, to dismantle current systems and structures that actively reinforce domination and undermine the potential for equitable care, and to return homelands and make reparations to the Indigenous Peoples of the continent.

Ecospheric care work

It is hard to overstate what is at stake in attempts at ecospheric care work, and it is not possible to know the outcomes of experimental projects based on this approach. What can be known generally are the choices available about social, cultural, and ecological practices and knowledges, such as: what to carry forward, what to leave behind, what to accept, and what to learn for the first time. Even as some options for human communities close down, other options are opening up, such as with the possibility of new perennial grain crops and new ways of feeding ourselves and relating to the more-than-human world.

One way that ecospheric care work may help people learn to come back "down to Earth" (Latour, 2018), during and after the collapse of energy-intensive systems, would be to help build the community capacity needed to support a just transformation to diverse and perennial agriculture economies. Applied projects in perennial agriculture provide opportunities for people to engage in such ecospheric care work: to provide physical, emotional, and ethical labor to build ecological relationships with plants, animals, land, and water.

In 2019, the Ecosphere Studies program collaborated with scientific colleagues at The Land Institute to launch a small civic science pilot community in which participants grow *Silphium integrifolium*, a native perennial North American prairie plant currently being domesticated for perennial oilseeds production (Van Tassel et al., 2017). As a case study in ecospheric care work, the *Silphium* civic science community could be understood as an invitation for people to learn to care for a plant, a future crop, which could someday care for people by feeding them while holding on to soil and supporting biodiversity. Since the prairie ecosystems of this continent have done exactly that—nurturing a richness of lives and lifeways in the long term—this domestication project necessarily involves a reminder of, and ecospheric commitment to, the importance of prairie restoration and care for the land.

More than 40 people in 18 U.S. states accepted our invitation to join the pilot community in 2019. They tend *Silphium* plants by watering, weeding, and observing them in a variety of growing environments. They share their observations with us and respond to monthly surveys. They explain the project

to their families, friends, and neighbors. While the scientific information gathered about how *Silphium* responds is important, so is the social information gathered about how people respond. The civic science project allows participants and researchers to learn together about *Silphium* and perennial agriculture and about how their individual and community care work shapes their motivation and learning. Preliminary results are positive, and we look forward to further analysis and publication.

In its pilot stage, the *Silphium* civic science project has already prompted us to examine the reasons and strategies for pursuing equity and justice by involving a broader representation of people in a domestication process (specific to this project) and ecospheric care work (more broadly). What economic and social incentives and support will help make it possible for people with different lived experiences and motivations to participate? How could this project and other experimental efforts be organized to distribute and share care work more equitably across participants and researchers? What are the best ways to recognize and represent the care work being performed by participants and researchers in this project?

I'm involving my son in this work—I want him to have the chance to learn how to care. But far more importantly, I want to do everything I can to collaboratively create a project and world in which all children have access to and the ability to care for plants who sustainably feed them.

Perennial agriculture is a long-term vision for positive human reconnection with the ecosphere that stretches across generations and geographies. My experience in this particular *Silphium* civic science pilot project has helped me to realize that this long-term vision can be aligned with now-urgent human tasks. I have learned that serving potentially radical and justly transformative long-term solutions is exactly what I need to persist at this moment in time. Through this work of caring for other people as we together in community learn to care for perennial plants, I have started to grasp my personal answer to the question Kathleen Dean Moore and her colleagues pose: "What would you be willing to spend your whole life taking care of?" (Moore, 2016, p. 18).

Care work that is ecospheric involves many of the same tasks but feels different to me from earlier forms of housework; it feels alive with possibility. I can exercise what choice I have to struggle to divest my care from exploitative systems (patriarchy, white supremacy, settler colonialism, nature domination—the list goes on) and to support and join with others in their work to do the same. I can come back over and over again to the humble, imperfect, ancient labor of collaboratively creating communities who care for each other and the land; and I can collaboratively help to make metaphors, experiences, relationships, opportunities, food systems, and cultures that are new. I can slow down long enough to listen to what lasts, to remember what humans have come to know about care through much of the history of our species. And I can also move

with the quick pace of courage, to face up to the consequences and choices now at hand.

I can physically and intellectually labor with books, notebook, and a computer to write an essay that tries to conclude by situating my emotional efforts at self-care and community-care in critical proximity to unsettling ethical questions of privilege and equity, and social and ecological justice. I am one of the few whose care work is not unpaid, and so I have a chance to question it and a responsibility to leverage it. Here is what I imagine and expect: to cope and to transition, many humans will need to practice ecospheric care work both skillfully and collectively.

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The human vocation to cultivate the land and serve the Lord: A religious contribution to the perennial imagination

Elizabeth Groppe

> In the day that the LORD God made the earth and the heavens, when no plant of the field was yet in the earth and no herb of the field had yet sprung up—for the LORD God had not caused it to rain upon the earth, and there was no one to till (ʿābad) the ground; but a stream would rise from the earth, and water the whole face of the ground—then the Lord God formed man from the dust of the ground, and breathed into his nostrils the breath of life; and the man became a living being (Genesis 2:4b-7).[1]

These are the opening lines of the second of two creation narratives that begin the Book of Genesis. What pertinence might they have within a volume of essays on economics, philosophy, sustainability, and perennial thinking? Historically speaking, the Bible is the most influential text in the history of Western civilization, and it is today a sacred text for Jews (in the form of the *TaNaKh*) and Christians (in the form of the Old and New Testaments), who constitute

[1] All biblical citations are from the New Revised Standard Version translation unless otherwise attributed.

respectively 0.2% and 31.3% of the global population. Religious traditions shape the imaginations of their adherents with consequences that may bode well or ill for humanity's relationship to the land.

What do I mean by the shaping of the "imagination"? In *Christ the Form of Beauty*, Francesca Aran Murphy describes the imagination as an aesthetic form that structures our knowledge by enabling the apprehension of reality perceived through the senses within a structured and meaningful whole (Murphy, 1995). The philosopher Charles Taylor writes in *Modern Social Imaginaries* of the "social imaginary" as the way in which "people imagine social existence, how they fit together with others, how things go on between them and their fellows, the expectations that are normally met, and the normative notions and images that underlie these expectations" (Taylor, 2004, p. 23). The imagination in this sense is not fantasy but an aesthetic, cognitive, ethical, and sensorial framework that shapes our interpretation of the world and our way-of-being within it.

In "The Historic Roots of our Ecological Crisis," published in 1967 in the journal *Science* and still discussed 50 years later in courses on religion and ecology, medieval historian Lynn White, Jr. laid primary responsibility for the ecological crisis upon the Christian tradition. Using Taylor's terminology, one could say that it is White's position that Christianity cultivates in its practitioners a social imaginary in which it is appropriate for humans to dominate the earth. White argued that it's no coincidence that the wedding of science and technology, employed in a manner that has been so ecologically destructive, originated in Western Europe within a culture shaped by Christianity. Western science and technology absorbed elements from China, Islamic civilizations, and elsewhere, but the framework of mind that has spawned unprecedented ecological degradation is a "distinctively *Occidental*" phenomenon (White, 1967, p. 1204).

White noted that, in contrast to animistic religions in which every tree, spring, and hill has its own guardian spirit, the Genesis creation narrative presents the human being as the only creature made in the image and likeness of God (Genesis 1:26-27), and humanity's dominance over other creatures is evident in our power to name them (Genesis 2:19–20). Moreover, in Christian interpretations of the Genesis text, Adam foreshadows Christ, the second Adam and the incarnation of the divine Word in *human* flesh. "Christianity," White concluded, "is the most anthropocentric religion the world has seen." Implicit in the tradition is the assumption that "it is God's will that man exploit nature for its proper ends" over the course of time, which is understood in a linear rather than cyclical fashion (White, 1967, p. 1205). White did observe that Saint Francis of Assisi named other creatures his brothers and sisters and cared for them

accordingly. And yet, White maintained, Saint Francis' attempt at a "spiritual revolution" within Christianity was a failure. But it is an attempt, he continued, that should be revisited. "Since the roots of our trouble are so largely religious, the remedy must also be essentially religious, whether we call it that or not" (White, 1967, p. 1207).[2]

White's account of the role of the Christian tradition in enabling ecological degradation has been subject to multiple critiques. Theologian Anne Clifford, for example, argues that the Bible is profoundly *theocentric* rather than anthropocentric. The naming of the animals in Genesis 2 is expressive of human relationship to other creatures, and the command to exercise dominion (*rādā*) over every living thing (Genesis 1:28)—interpreted in the context of Genesis as a whole—is a command not to dominate other creatures but to ensure their survival in the manner of Noah, the righteous and blameless man (Genesis 9:1). Clifford acknowledged that White's "criticism has some validity with respect to the historical record of Western Christian industrial societies." Nonetheless, in her judgment, it "grossly misrepresents the intended meaning of these texts" (Clifford, 1996, p. 24).

Clifford addressed the misconstrual of the divine command to have dominion (*rādā*) (Genesis 1:26–27), but what of the term *'ābad* that also appears in the Genesis narratives? This Hebrew verb is commonly rendered "till" in English translations of Genesis 2:5 and 2:15. The assumption that tilling the soil is a normative dimension of humanity's relationship to the land has become embedded in the Christian imagination, and our current awareness of the destructive consequences of tilling requires a reexamination of this assumption. Wes Jackson's visionary work at The Land Institute and the new perennialism can open our imagination to new ways of reading the creation narration that can contribute to a transformation of humanity's relationship with the land.

Tillage in the Christian imagination

I grew up in a town of 5,000 people in northern Indiana, a region blessed with fertile black loamy soil. My father was a professor of English at Saint Joseph's College, an educational community founded by the sisters, brothers, and priests of the Society of the Precious Blood that in its initial decades produced most of its own food. My family lived in town, but within five minutes on a bicycle, I was

[2] Although White's focus is the Christian tradition, members of every major religious tradition are today engaged in constructive reflection and action in response to the ecological crisis. See, for example, the publications that resulted from a series of conferences published by the Harvard University Center for the Study of World Religions (Tucker & Williams, 1997; Tucker & Berthrong, 1998; Hessel & Ruether, 2000; Tirosh-Samuelson, 2002; and Foltz, Denny, & Baharuddin, 2003).

on country roads that crisscrossed through undulating green oceans of corn and soybean fields. As a teenager, I rose at 5 a.m. in July to walk to the courthouse, the pickup point for youth who worked detasseling corn. We waited for the yellow school buses to take us to corn fields, where we spent the day walking between rows of sheered "female" corn stalks to remove by hand any tassels that the detasseling machines had missed. This would ensure that the rows of "female" corn would be fertilized by pollen from the "male" rows of corn planted in swatches between them, resulting in a hybrid seed. It was hot and tedious work, but it was one of the few summer jobs for teenagers, and it paid relatively well.

In my social imaginary—my assumptions about social existence and "how things fit together"—all of this was perfectly normal. Oceans of green corn fields and large red industrial-scale detasseling machines were simply the way in which humans grow food. I did not notice that the dirt paths on which I walked between rows of sheered corn stalks were hard and compacted, nor that after the stalks were cut down the rain washed across the surface of the exposed soil and carried some of it away. Nor did I see what was *not* there—the hundreds of species of prairie plants, the insects to whom they would have provided habitat, the birds who would have made this habitat their home. Catholicism was foundational to my family's life, but I failed to notice that there was a deep contradiction between the sacrament of communion we celebrated in the Catholic liturgy and the manner in which we grew the food we shared in the fellowship that followed mass in the church basement.

One reason I did not recognize this contradiction was the influence on my imagination of an interpretation of the Christian tradition in which plowing and tilling the soil are normative. According to the commonly used New Revised Standard Version (NRSV) English translation of Genesis, at the inception of the creation of the world "there was no one to till the ground" (Genesis 2:5). The Lord God then created *'ādām* from the dust of the earth (*'ădāmâ*) and "put him in the garden of Eden to till (*'ābad*) it and keep it" (Genesis 2:15). Biblical scholars understand the Pentateuch (the first five books of the Bible) as a compilation of multiple strands of originally oral tradition, and they attribute the creation narrative in Genesis 2:4b-3 (as distinct from the creation narrative in Genesis 1:1–2:4a) to the "Yawhist" source, a tradition so-named because of its distinctive use of the unpronounceable name "YHWH" in reference to God (usually rendered as "the LORD God" in English). Scholars estimate that the Yahwist narrative originated in approximately 950 BCE. It is the oldest layer of tradition in the Bible and it reflects the experience of the Hebrew people who subsisted in the land of Judah by pasturing sheep and goats, cultivating orchards on terraced hillsides, and plowing fields to grow barley and wheat.

The Yawhist narrative expresses the intimate relationship between human beings and the soil. The profound dependence of humanity on the earth that the Hebrew people knew existentially is evident in the original Hebrew text:

"[T]he LORD God formed *'ādām* from the dust of the *'ădāmâ* (soil, earth, ground) and breathed into his nostrils the breath of life, and *'ādām* became a living being" (Genesis 2:7). We are creatures of the soil, *'ādām* made from *'ădāmâ*. Or, in the words with which Catholics begin our observance of the season of Lent, "Remember man (*'ādām*) that you are dust and to dust (*'ădāmâ*) you shall return."

In a story well-known even outside the Jewish and Christian traditions, the creation of *'ādām* is followed by the creation of Eve from Adam's rib, and it is not long before the progenitors of the human race partake of the only tree in the garden of Eden from which God had commanded them to abstain—the tree of the knowledge of good and evil. God then banishes them from the garden, lest creatures with such knowledge eat also from the tree of life and live forever (Genesis 3:22). YHWH compassionately gives them garments to cover the nakedness that had become a source of shame, but God also says to the man:

> Cursed is the ground because of you;
> in toil you shall eat of it all the days of your life;
> thorns and thistles it shall bring forth for you,
> and you shall eat the plants of the field.
> By the sweat of your face you shall eat bread
> until you return to the ground,
> for out of it you were taken;
> you are dust, and to dust you shall return.
> (Genesis 3:17–19)

This narrative, biblical scholars have observed, is an etiology of the toil and hardship that the Israelites experienced as they grew grain. On the one hand, this narrative presents the working of the ground to grow grain for bread as a result of sin. But in standard Christian interpretations of Genesis 2, it is the *sweat* and *toil* in the fields that are the result of human sin, not tilling itself, which is expressly identified as part of our human vocation in common translations of Genesis 2:15. Biblical scholar Theodore Hiebert observes that the word *'ădāmâ* in the verse "then the LORD God formed man (*'ādām*) from the dust of the ground (*'ădāmâ*)" (Genesis 2:7) appears elsewhere in the Pentateuch in a context in which it clearly means not simply "ground" but arable land. The most precise English translation of Genesis 2:7, he writes, is that YHWH created a "farmer" from "farmland." This "understanding of the human vocation as farming," he continues, "is underscored by the task God gives the first human: to till, or cultivate, the garden's soil" (Hiebert, 2000, pp. 139–40).

Indeed, the biblical creation narrative has as its context the practice of agriculture in the ancient Near East. Daniel Hillel's reconstruction of the migration of the Hebrew people out of their enslavement in Egypt posits that they

first settled in the central mountain range of Canaan, because the valleys were already populated (Hillel, 2006). They cleared oaks, pines, and shrubs (Joshua 17) and built retaining walls with stones to construct terraces to prevent the shallow and stony soils from eroding. In these terraced soils, they planted grape vines and trees that bore olives, pomegranates, figs, and almonds. On slopes that could not be terraced, they pastured animals. After their population size and strength had grown, they displaced the Canaanites from the more desirable lands of the valleys, and there they tilled the soil to grow vegetables, wheat, and barley.

I won't attempt a comprehensive survey of the role of agriculture in the economic subsistence and religious imagination of post-biblical Christianity, which spread beyond the land of Israel, across the continent of Europe and eventually around the globe. One example will have to suffice. *Piers Ploughman* (ca. 1370–90) is a moral and theological allegory attributed to William Langland. Considered one of the greatest works of medieval literature in the English language, it features a man named "Will" (a name connoting desire and intention) who has a series of visions while dreaming.

In the second vision, the character Reason preaches to a group gathered in a field who repent of their sins, confess, and in penitence set out on a pilgrimage to Saint Truth. When they get lost along the way, Piers Ploughman appears, offering to assist the wayward penitents if they will help him to plow his half-acre. Some refuse and are punished by Hunger, but others take up the plow and receive pardon of their sins. The character of Piers Ploughman is identified allegorically with the person of Jesus Christ who undergoes the Passion on the cross, descends into hell, arises victorious, and then establishes the church, which is cultivated by Piers with his four oxen (representing the four Evangelists). Evident in *Piers Ploughman* is the physical dependence of 14th century English communities on till agriculture; those who do not plow are punished by Hunger. Also evident is the theological significance of the Ploughman, who is a Christ-figure. As Protestant theologian Paul Tillich explained, religious symbols use a finite reality (in this case, the Ploughman) to direct our attention to an infinite and transcendent reality, and in so doing the finite reality is imbued with religious significance (Tillich, 1951).

In our era, Pope Francis promulgated in 2015 *Laudato Si': On Care for Our Common Home*, the first papal encyclical within the history of the tradition of Catholic Social Teaching (initiated by Pope Leo XIII in 1891) to focus on humanity's relationship with all creation. In the second chapter of the encyclical entitled "The Gospel of Creation," Francis emphasizes that Genesis does not give humans license to dominate earth for our own benefit, as some readings of Genesis 1:28 would have it. Rather, "the biblical texts are to be read in their context, with an appropriate hermeneutic, recognizing that they tell us to 'till and keep' the garden of the world (cf. Genesis 2:15). 'Tilling' refers to cultivating, plowing or working, while 'keeping' means caring, protecting, overseeing and

preserving" (Pope Francis, 2015, par. 67). Tilling with care and the intent to protect is, of course, better than tilling with carelessness, but over the long term one cannot both plow and preserve the soil.

That annual tilling can be destructive I learned from Wes Jackson, co-founder of The Land Institute in Kansas. There he discovered a small remnant of the prairie that once covered over 85% of the land, and he cultivated with affection a "conversation" with a landscape where perennial root systems build soil, sequester carbon, foster resilience, and support more than 250 varieties of plants. This led him to imagine an alternative to grain agriculture based on tilling the soil to grow annuals in monocultures. Perennial grains grown in polycultures—what Jackson calls Natural Systems Agriculture—could check the eroding force of wind and water, while the growth and decomposition of perennial plant and root matter would build up the quality and quantity of humus. Jackson describes till agriculture, in contrast, as a claw tearing at the soil, ripping it away to build civilization (Jackson, 1980, p. 8).

Renewing the Christian imagination

In *Scripture, Culture, and Agriculture*, biblical scholar Ellen Davis explains that the oldest Hebrew term for "prophet" is *chôzeh*, a word that means "seer." A *chôzeh* is not someone who predicts the future but who sees the present moment as God sees it—within the scope and span of God's intentions for creation from its origin through the end of days. Some of the biblical prophets behold calamitous visions: "I have seen," spoke the prophet Jeremiah, "and here, the garden-land is now the wasteland" (Jeremiah 4:23, Davis translation). A prophet may also behold God's hidden wisdom to which the rest of us are blind, to instruct "our weak religious imagination" (Davis, 2009, p. 10).

Davis identifies Jackson as someone who has beheld God's wisdom through his contemplation of the prairie (Davis, 2009, pp. 33–36), and the visionary work of The Land Institute and the new perennialism invite Christians to reexamine our religious imaginations and to question some long-standing assumptions. Does the book of Genesis really say that it is the human vocation to till the soil? This is a common English translation of the Hebrew texts of Genesis 2:5 and 2:15. There is, however, no reference to any actual tilling or plowing in the Garden of Eden. The narrative in Genesis 2 describes a garden abundant with fruit-bearing trees. That is all.

Throughout the books of the Bible written in Hebrew, the root of the verb *ʿ-b-d* that is rendered "till" in the NRSV translation of Genesis 2 occurs in a conjugated form 259 times. In 98 of these instances, the conjugated form of *ʿ-b-d* refers to the service of God through worship, sacrifice, and observance of Torah. In 79 instances, *ʿ-b-d* refers to worship of idols or other gods such as the Canaanite Baal. In 78 texts, *ʿ-b-d* connotes service to a human master of some kind: a king, a person to whom one is enslaved, or a person whom one must serve in bondage for

a period of time. In 16 cases, *ʿ-b-d* means labor of some unspecified character, and in 18 cases *ʿ-b-d* specifically refers to agricultural work of some kind, including the cultivation of grape vines. Given this range of meaning, Hiebert renders Genesis 2:5: "[T]he LORD God had not caused it to rain upon the earth, and there was no one to serve (*ʿābad*) the soil." This "way of speaking of agriculture," he emphasizes, "views the human as the servant, not the master, of the land. It emphasizes human dependence on, rather than dominion over, the earth" (Hiebert, 2000, p. 140).

Davis is appreciative of Hiebert's exegesis of Genesis 2–3 but believes he has gone too far when he writes, "The land is a sovereign to be served" (Davis, 2009, p. 29). In Scripture, the only sovereign to be served is God. The worship of anything or anyone other than YHWH is an idolatrous violation of the covenant.

Here, details about translation are important. Davis explains that "the wider usage of the verb [*ʿ-b-d*] suggests that it is legitimate also to view the human task as *working for* the garden soil, serving its needs" (Davis, 2009, p. 29). She also notes that there are two verb roots used in Genesis 2:15—"And YHWH God took the man and put him in the garden of Eden *lĕʿobědāh ûlĕšoměrāh*" (Genesis 2:15). The human is not only to work [*ʿ-b-d*] but also to *š-m-r* the garden. Frequently, she explains, this "verb [*š-m-r*] translates 'observe,' with a variety of nuances, several of which may be apt here: to acquire wisdom by observation of the working of the world (Psalm 107:43; Isaiah 42:20), to abide by moral guidelines or the dictates of justice (Hosea 12:7; Isaiah 56:1) or even the rhythms of nature (Jeremiah 8:7), and—the sense that applies in the majority of instances of the verb—to observe the ordinances of God: 'Yes, my Sabbaths you shall keep!' (Exodus 31:13, Davis translation). So it may be that the human is charged to 'keep' the garden and at the same time to 'observe' it, to learn from it and respect the limits that pertain to it" (Davis, 2009, p. 30).

The Hebrew texts in Genesis 2:5 and 2:15 allow for a variety of translations other than "to till"; we could say that the human vocation is "to work and to keep" the garden, or "to cultivate and to observe" it. To "cultivate" the soil is not necessarily to put hand to the plow. In Deuteronomy 28:39, a verb formed from the root *ʿ-b-d* is translated "cultivate" (New American Bible) or "dress" (NRSV) in regard to the care of grape vines, a perennial plant. And yet, one may well object, the only form of grain cultivation known to ancient Israelites required annual tillage; must not *ʿābad* be rendered "till" if we are to be true to the historical context of the narrative?

Not necessarily. Genesis 1, the first of the two creation narratives in the book of Genesis, comes from a strand of tradition distinct from the Yahwist: the priestly body of tradition that biblical scholars date to the sixth century BCE. This poetic and liturgical narrative describes a primordial creation repeatedly deemed "good" by God after each of the six days of creation—a created order that differs in some ways from the world that the Israelites actually knew. According

to Genesis 1, both humans and animals are herbivores: "I have given you," God says, "every plant yielding seed that is upon the face of all the earth, and every tree with seed in its fruit; you shall have them for food. And to every beast of the earth, and to every bird of the air, and to everything that creeps on the earth, everything that has the breath of life, I have given every green plant for food" (Genesis 1:29–30).

In this vision of a wholly good creation at its inception, not even the majestic lion kills and eats its prey. The Israelites knew that this is not the case in the world as they actually experienced it; they carefully guarded their flocks of sheep from beasts of prey, and they periodically slaughtered one of their flock for their own consumption. They knew they needed to do so to survive. But they also believed that there was something imperfect and flawed in this reality. According to the book of Genesis, God grants humans permission to eat animal flesh only after the exile from Eden, the spiraling of creation into a crescendo of violence in Genesis 4–6, and the great flood. The permission to eat animal flesh with some restrictions, some Rabbinic commentaries explain, is God's concession to humanity's post-diluvian condition, not an expression of pure divine desire. We also can imagine the human vocation to *'ābad* the land within the Garden of Eden (Genesis 2:15) as a form of cultivation that does no harm to the soil, even though we know that on the other side of the primordial garden, Cain and his progeny did indeed take up the plow (Genesis 4:2).

Such an exegesis of the meaning of *'ābad* in Genesis 2 is consistent not only with Genesis 1 but also with the foundational character of care for the land within Israel's covenantal relation to God. There are in the Torah a number of provisions for this care, including the law of *shmtiah*—the sabbatical year in which crops are not planted to allow the soil to rest from human cultivation and to rejuvenate (Leviticus 25). "Overall, from a biblical perspective," Davis emphasizes, "the sustained fertility and habitability of the earth, or more particularly of the land of Israel, is the best index of the health of the covenant relationship" (Davis, 2009, p. 8). When the people of Israel live in right relationship with the land, they enjoy righteousness and intimacy with God; "truth (or faithfulness,' *ĕmet*) springs up from the earth (*'eretz*) (Psalm 85:12, Davis translation)" (Davis, 2009, p. 8). To serve (*'ābad*) the Lord rightly is to care for the soil.

Simply changing "till" to "cultivate" or "work" in English-language translations of Genesis 2:5 and 2:15 will do little to change a Christian imagination formed to assume that annual tillage is normative. But in homilies, catechesis, art, poetry, and literature, Christians can develop interpretations of Genesis 2 that can contribute to the vision of a created order in which humans produce grains for food without exposing the soil to erosion and compaction. In *Piers Ploughman*, it is the Ploughman who bears an allegorical relation to Jesus Christ, who suffered death on the cross because of the sins of humanity. In Alexandre Hogue's 1939 oil painting "The Crucified Land," the final canvas in his *Erosion* series, the allegory

to Christ is not the Ploughman but the soil. A wooden cross bearing the remains of a scarecrow's clothing teeters in a wheat field on the edge of a deep gash cut through the soil by rain water. It will clearly not be long before the soil on which the cross stands is washed into the gullies that snake through the land. In the background stands an idle plough beneath a stormy western sky (Hogue, 1939).

Conclusion

"All created things are yours, O Lord," Pope Francis writes in *Laudato Si'*, citing Wisdom 11:26. On this basis, he continues, it is the Catholic conviction that "as part of the universe, called into being by one Father, all of us are linked by unseen bonds and together form a kind of universal family, a sublime communion which fills us with a sacred, affectionate and humble respect." He continues, "God has joined us so closely to the world around us that we can feel the desertification of the soil almost as a physical ailment, and the extinction of a species as a painful disfigurement" (Pope Francis, 2015, par. 89). The Christian imagination invites us both to envision the restoration of the created order and to cry in lamentation in the face of its degradation.

When I return home to Indiana to visit family in early spring, I often see gusts of wind blowing the soil from the land that is bare and denuded between croppings of corn and soy. Natural Systems Agriculture and the new perennialism enable us to see that there are alternative ways to produce food, and this wisdom can renew our interpretation of a biblical narrative that calls us to cultivate (*'ābad*) the soil in a manner that serves (*'ābad*) the glory of the Lord.

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Dandelions are divine[1]

Bill Vitek

We are in the midst of an exciting new story being told—and by "new," I mean about 175 years old (Mowe, 2016). It is a story about the way things are and how they come to be, a story in which our much-touted ingenuity plays a bit part and divinities have only supporting roles. Wildness is at the center of this new story, with a perennial imagination: creative, improvisational, partially lawless, alive, and full of surprises. Wildness with desire, agency, and a will to act that is present not just in those agents we call self-conscious, but in all things from quasars to quarks, cells to ecosystems.

Wildness

In the spring of 1851, to what must have been a very confused audience at Concord's Lyceum, Henry Thoreau first said, "In Wildness is the preservation of the world" (Thoreau, 1862).[2] For those in attendance, wildness was the very opposite of preserving the world. It was where demons lived—a dark, forbidding, and dangerous place. At that time, it wasn't enough to avoid such places. It was every good New Englander's sacred duty and secular right to subdue the wild wherever it was found, to drive it out of its dark corners, to transform and improve it into a pastoral landscape of crops and livestock, towns, and villages. Thoreau's talk that evening must have sounded like lunacy and blasphemy, not just against his audience's fundamental religious beliefs, but also against their fundamentalist beliefs in human superiority and the power of technology to remake the world.

[1] This essay began as a guest homily at the Unitarian Universalist Church in Canton, NY.

[2] Thoreau capitalized the "W" throughout the essay.

Surely, we've made some progress since Thoreau. But the evidence is mixed, and in some cases points to matters being far worse now than in previous centuries. And it leads to the dismal conclusion that, even at our most ecologically aware and educated best, we are little better, and maybe worse off, than Thoreau's perplexed listeners.

I recently attended a gathering of environmental studies' faculty and students at a small liberal arts campus in New York State's Capital Region. We were outside on a lovely greenspace eating healthy, local food and talking about the things that environmental studies students and faculty talk about. In this group, a young boy—four or five years old, the son of a professor—was running around with the familiar fluffy white globe containing the seeds of future dandelions.

Weeds

As someone who is both an admirer of Thoreau and who grew up surrounded by the American fondness for lawns, I found myself conflicted. Here was this bit of wild nature, impatient for the wind to scatter its seeds, hitching a ride on a child's urge to play. The common dandelion is the very definition of wildness. It's a perennial plant with tap roots that can grow to ten feet and, if broken, will send up new shoots (Hourdajian, 2006). Its flower head looks like one blossom, but its hundreds of yellow petals are each a complete flower. Bees and birds love dandelions, but their pollination work is unnecessary because dandelions reproduce asexually without the need for fertilization (Bradbury, 2015). They can survive in almost any climate and at elevations ranging from sea level to 12,000 feet. Introduced to America from Eurasia for nutritional and medicinal value, dandelions contain more vitamin A than almost any other fruit or vegetable. The blossoms can be made into wine; the roots, roasted and ground, can be used as a coffee substitute (Zachos, 2019). Beautiful in its own way, the plant also has many medicinal uses (Fletcher, 2019). What a perfect plant! What a wonderful example of wild nature's willful power to preserve itself and to contribute to its surroundings. The plant and child were engaged in an improvisational dance of fertility, a playfulness with purpose for at least one of the dancers.

But there was another side to the argument, one better known and with stronger sentiments in its favor. I was on a college campus mostly free of such dandelions, a campus that surely spends time and money keeping its lawns looking the way they have for generations, even though much of the United States is not hospitable to turf grasses, none of which are native species. But no one in this group was alerting the parents and urging them to better control their son's behavior. Should I? More drastically, should I distract the boy, reprimand or restrain him somehow, this devil child behind the innocence—costing the

college money, spreading a vicious weed, and only weeks before graduation ceremonies when the grounds have to look their best?

The culture seems to be on the side of intervention. Annually lawn care is a $40 billion industry in the United States, where 90 million pounds of fertilizer and 78 million pounds of pesticides are used annually just to keep lawns thriving, bright green, and bug-free. Lawns also consume massive amounts of water—more than U.S. farmers use to grow wheat, or corn, or any other agricultural crop (*The Week* Staff, 2011). In the United States, state and federal tax dollars pay for an annual electronic publication with the title "Federal and State Noxious Weeds" (USDA, n.d.), which includes the dandelion. The boy may as well have been spray-painting graffiti on one of the college buildings. He too was wildness itself and acting in the spirit of Thoreau. But he was on the wrong side of cultural values that run deep, even among the ecologically aware students and faculty in attendance that evening.

The 10,000-year-old problem

Half of all the plants growing in America are classified as weeds, and agriculture is a leading cause of species extinction worldwide (Millennium Ecosystem Assessment, 2005). How did things come to be this way? Here's a very compressed answer. Ancient and indigenous understandings of a wild, creative, and sacred Earth were interrupted, driven underground, and nearly eliminated by the slow development of annual, soil-disturbing grain agriculture that began 10,000 to 12,000 years ago. With its powerful dualisms pitting crop against weed, livestock against predator, that style of agriculture established attitudes that nature was to be subdued or ignored. And it warned in no uncertain terms that any plant, animal, or person interfering with agriculture's need to expand would be evicted, enslaved, or exterminated—because expand it must. The thinking goes something like this: surplus food feeds more people and more people need more surplus food. It's called "growth," and it erodes and exhausts the soil, eventually making it unproductive.

The people who harvested the unprecedented energy bounty from extracting soil carbon to grow annual grain crops created large, complex, energy-intensive cultures beginning around 5,000 years ago. That's what we call "civilization." We study their contributions to theology, philosophy, literature, the arts, and science. We point to their works as hallmarks of human advancement, and their influence can be seen in many cultural, educational and political institutions, including the justification and acceptance of dominion over the human and other-than-human world. When our thinking is binary—either/or—it is an echo of the attitudes that began with agriculture. And it is so entrenched in our intellectual, cultural, and spiritual DNA that it is mostly invisible to us.

This is a good time to re-state that in wildness is the preservation of the world. Why? Wildness is the universe's metabolism of continuous process

and productivity, creating atmospheres, elements, energy-conversion systems like photosynthesis, cells, organs, organisms, ecosystems, social systems, consciousness, and self-consciousness from the simplest of ingredients. Over and over again. It is an unprecedented good not just for humans, but for all beings across the galaxies, big or small, atom, cell, molecule, plant, animal, ecosystem, ecosphere.

Worldview evolution

Thoreau and the Transcendentalists—and the Romantics before them—were onto this. They read ancient scriptures from around the world, which allowed them to see the natural world—to experience it—with fresh eyes and new perspectives. From there we can chart the course of an ongoing movement toward recapturing wildness, not just in poetry or mythology but across the sciences, policy, medicine, manufacturing, and agriculture. It can be described as a Copernican revolution, and like Copernicus' insight to put the Sun, not the Earth, in the center of the solar system, it turns our perspective inside out. With it comes a new age of discovery.

Charles Darwin published *Origin of Species* in 1859, a radical reconfiguration of the origins and processes behind life. America's 19th century wilderness movement helped create national parks in the American West, and back east New York State constitutionally declared a part of itself "forever wild." Evolutionary biology and quantum physics in the first half of the 20th century pointed to a strange world of process, probability, chance, and creativity; and philosophers and theologians scrambled to rework and reinterpret their theories, concepts, and systems.

New voices and ideas emerged in agriculture and ecology: Aldo Leopold, Liberty Hyde Bailey, Sir Albert Howard, J. Russell Smith, Eugene and Howard Odum, J. Stan Rowe, Lynn Margulis, and James Lovelock, to name a few. Twentieth century advances in ecology, evolutionary biology, and agroecology made possible alternatives for an agriculture that mimics nature, not subdues it.

Wes Jackson, a plant geneticist and one of the early participants in the modern environmental movement, focused on the potential of perennial grain crops grown in diverse polycultures, rather than annuals grown in monocultures, to reduce soil erosion and degradation (Jackson, 1980), what The Land Institute calls "Natural Systems Agriculture." Jackson envisions a future when all grain crops are grown in agroecosystems, in mixtures, perennially. It's visible on the horizon: imagine agricultural landscapes not scraped bare every spring and not treated with fertilizers and herbicides. More prairie than plow, it is a truly alternative agriculture in which nature's wild wisdom is mixed with human cleverness and humane understanding; where conservation is a consequence of agricultural production, not something that has to be sacrificed to it.

This approach has found other applications. Janine Benyus (1997) introduced the world to the concept of biomimicry in her book by the same name, and

highlighted its use in energy production, manufacturing, medicine and computing. The Microbiome Project at the Mayo Clinic (n.d.) is just one example of medical researchers studying human microbiomes in order to understand their influence on a host of illnesses including gluten insensitivity and rheumatoid arthritis. It's part of the larger reconceptualization of humans not as individuals but as ecosystems. If that sounds far-fetched, keep in mind that each of us is composed of about 30 trillion cells and we are host to, according to recent research, the same number of bacteria in numerous bacterial communities, not to mention fungal, viral, and archaean communities in, on, and around our bodies (Abbott, 2016). We compete and cooperate with these microbiomes and they with us. That's an ecosystem! And it echoes Paula Gunn Allen's beautiful statement: "snowflakes, leaves, humans, plants, raindrops, stars, molecules, microscopic entities all come in communities. The singular in reality cannot exist" (Allen, 1991, p. 107). Philosopher James Feibleman puts it this way: "The smallest human isolate is a culture, not an individual" (Feibleman, 1951, p. 416). The test for this, he said, is long-term or generational survival. An individual cannot reproduce. A culture, a community, a system can. They can endure. And so our notion of community expands well beyond the human.

Every day there are reports of new discoveries of plant intelligence (Mancuso, 2010) or the ability of plants and trees to communicate utilizing fungi, the Earth's natural internet (Stamets, 2008). Underwater microscopes show coral to be dancing, fighting, and feeding one another (Antonio, 2016). Bacteria communicate with one another (Bassler, 2009). New scientific evidence demonstrates the mental capacities of birds (Jackson, 2016) and the ability of plants to count (Gorman, 2016). Quantum biology and astrobiology are emerging scientific fields. Ecological economics is working on new concepts and systems that have the potential to understand the value of a bee's or a worm's work to the ecosphere, and to create human prosperity without consuming and poisoning the planet. Technical and awkward-sounding terms like *downward causation* (Doyle, n.d.), *ontic openness* (Nielsen & Ulanowicz, 2011), *pre-adaptations* (Ardila, 2016), and *self-organizing criticality* (Watkins, Pruessner, Chapman, Crosby, & Jensen, 2016) are used to make scientific sense of it all.

One of the leading thinkers in this movement, the scientist Stuart Kauffman, has dared to try to bridge the gap between science and religion by giving the relentless creativity of the universe a simple name: God (Kauffman, 2008, p. xi). The theologian Gordon D. Kaufman (2004) came to a similar conclusion, linking God and creativity in the creation of the universe, the cosmic evolutionary process and the emergence of life, and human symbolic creativity. Ecospheric thinking even shows up in Pope Francis' Encyclical Letter *Laudato Si'* (2015), a document that, at least to my old Catholic eyes, seems often on the edge of doctrinal heresy within conventional theology. But 165 years after Thoreau, this way of thinking has a lot of support and evidence. It is a perspective with the

power to shift paradigms, to overturn the status quo and present us with clear choices for the future.

The perennial imagination

After a 10,000-year interlude of excessive and unsustainable extraction, we can once again place the wild, perennial work of the ecosphere back in its proper place as the sole source of creativity in all things. There is still much to do, and we wish we could speed things along. But when such a transition arrives in its full expression, changes will come quickly, like a wooden floor giving way after years of hidden decay and rot. This re-centering of the ecosphere has the potential to heal the ecological and social wounds begun by agriculture and that continue unabated in modern global capitalism; to make us less dependent on destructive extraction; to help us establish standards of morality and justice that protect human dignity *and* our fellow, other-than-human earthlings; and to inspire us to find grace, beauty, love and even divinity in a living, unpredictable—and yes, wild—universe. A dandelion in the hand of a young child. Thoreau was right about the preservation of the world.

I'll give the last words to Daniel Martin of Martin's Family Farmstand, located just outside of Potsdam, New York, describing his technique for growing strawberries:

> I grow these berries without any chemicals. One of the things that I do to minimize insect problems is to not mow the adjacent areas more than I need to while the berries are forming and sizing. Wild plants grow in these areas and they give habitat for a diverse community of beneficials and also work as trap crops. Even if it is not nicely manicured I think this wildness is lovely in its own way and produces good berries (Martin, personal communication, February 12, 2018).

It's hard to argue with that.

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Rena Detrixhe, 2012

Annuality and perenniality in wild plants: Developing malleable concepts

Craig Holdrege

Thinking and seeing

When I study nature, all my looking is informed by concepts—the fruits of past experience. But concepts are a two-edged sword. On the one hand, they give me an orientation and focus for my study. On the other hand, they can narrow my view, so that I may tend to fit what I find into pre-existing categories. In his journals, Henry David Thoreau expressed in characteristically radical and fresh manner the tension that arises when a person wakefully attends to how ideas inform sensing:

> It is only when we forget all our learning that we begin to know. I do not get nearer by a hair's breadth to any natural object so long as I presume that I have an introduction to it from some learned man. To conceive of it with a total apprehension I must for the thousandth time approach it as something totally strange. If you would make acquaintance with the ferns you must forget your botany. (October 4, 1859, Journal XII: 371; in Walls, 1999, p. 91)

In this sense, it is only when I try to leave behind what I already know that I become truly open to what is new in sense experience. This is a prerequisite for

learning. But at the same time, Thoreau knew out of his own experience how important previous knowledge is:

> The scarlet oak must, in a sense, be in your eye when you go forth. We cannot see anything until we are possessed with the idea of it, and then we can hardly see anything else. In my botanical rambles I find that first the idea, or image, of a plant occupies my thoughts, though it may at first seem very foreign to this locality, and for some weeks or months I go thinking of it and expecting it unconsciously, and at length I surely see it, and it is henceforth an actual neighbor of mine. This is the history of my finding a score or more rare plants which I could name. (November 4, 1858, Journal XI: 285; in Walls, 1999, p. 84)

The art of knowing involves finding ways to let ideas (concepts) continually grow through new experience. If I subsume new experiences under already existing notions, then I am boxing those experiences in. If, by contrast, new experiences allow my idea of ferns or scarlet oaks to expand and deepen, I am in a living dialogue with nature. My perception is then imbued with an attitude of mind that is open to surprises and to the unexpected, while being rooted in a rich field of past experience.

I say this here as prelude to a consideration of what I will call annuality and perenniality. I begin with a study of annual and perennial plants, as these categories have been used by botanists to express different life histories and life forms that plants can have. An annual plant develops from a seed and in one growing season develops new seeds, while the rest of the plant dies away. Biennial plants live for two seasons, usually growing vegetatively in the first year and flowering and going to seed in the second. Perennial plants live through more than two or more growing seasons. In herbaceous perennials, leaves and aboveground stems die away, but roots, bulbs or underground stems continue to live. In woody perennials—shrubs and trees—the above-ground trunk and branches grow from year to year. Some perennials live only a few years, while a few live for thousands of years.

In the course of my inquiry, I experienced how the concepts began to grow and become more fluid. I became more intrigued with annuality and perenniality in a broader sense, even though my focus remained with plants.

Day and year

If there are two rhythms that are most decisive for life on Earth, they are the day and the year. On the equator each day—every day of the year—alternates

between twelve hours of daylight and twelve hours of night. In the tropics there is relatively little seasonal variation, especially in those areas that have ample rainfall throughout the year. A tropical tree can form buds; sprout leaves; lose leaves; and develop flowers, fruits, and seeds all at the same time.

The further we move from the tropics, the more there are variations in the year that become essential for life in that region. In subtropical regions there are often distinct dry and wet seasons, while in temperate zones the annual pendulum swing between short days of cold winter and long days of warm summer is decisive. The further you move toward the poles, the more radical the difference between winter and summer. On the poles themselves the day has essentially disappeared, since the sun is above the horizon for six months and below the horizon for six months. Sunrise with dawn and sunset with dusk are month-long events.

Every plant is a creature of the light. By exposing its green tissues to the power of light, and taking in carbon dioxide, water, and a small amount of minerals, the plant is able to build up its own organic substance. This is the miraculous process we call photosynthesis. Being children of Sun and Earth, it is no wonder that plants are so deeply entwined with the solar rhythms of day and year, and with their place on the planet. In the course of evolution, myriad plant forms have developed around the globe, each in its own way living in relation to the terrestrial, biotic, and cosmic conditions of its region. The consideration of annual and perennial plants provides one entryway into the manifold life forms of plants.

Annual plants

Annual plants have a short life cycle. When the seed of an annual finds adequate conditions, it germinates, sends down roots, develops a stem and leaves, and progresses rapidly into flowering, fruiting, and the development of new seeds. While the seeds are maturing, the mother plant dies away. The annual plant lives in a continuous movement of transformation—bringing forth new members as old ones die off. Some annuals can develop from germination to seed production in less than two weeks.

From a physiological perspective, annuals have the capacity to interact with light and carbon dioxide from the air in a way that allows them to carry out photosynthesis at a high rate, so that they grow quickly. They do not form lasting organic substance in their roots and stems. Rather, they put proportionately more substance than perennials into seed formation (Bazzaz & Morse, 1991).

The seed is the most lasting phase of an annual's life and only the seed carries the species into the next growing season. It may germinate soon after being shed or it may lie dormant for weeks or even years. The seed is a unique stage in the life cycle of any plant. While the whole plant from which the seed develops is rooted in one spot in the earth, the seed becomes an independent entity. It can move—via

FIGURE 1: Development of the Field Poppy (Papaver rhoeas), an annual plant. This plant developed from seed to seed formation over the course of 13 weeks. There is a two-week interval between each stage depicted. (From Holdrege, 2013)

wind, water, and animals—from place to place. Since many annuals are prolific seed producers, their seeds can spread out into the wider world. Most of them will not germinate, but some will find conditions that allow them to develop through a whole new life cycle. With seed germination and subsequent growth, the plant embeds itself into—and also brings to expression—the conditions of a particular place.

Only about 10% of all flowering plant species are annuals. They are most prevalent in sunny environments and in places where other vegetation is sparse. In dry habitats such as deserts, seeds of annuals may lie dormant for many years until adequate rain falls, and then burst into rapid growth; the desert blooms with annual wildflowers.

Most of the "weeds" in gardens or crop fields are annuals. ("Weed" is an anthropocentric designation of wild plants that grow where we want only our domesticated plants to grow.) Through tilling we open up the soil, free it from plants, and in this way provide ideal conditions for wild annuals to thrive. Common groundsel, for example, is one such "weed" that can flower through a good part of the year, and its seeds float off in the wind like those of dandelions. I know groundsel mainly from Europe, generally finding it where the soil has been

disturbed and opened up in yards and gardens. Taking hikes that led me far from such gardens into woodlands and through pastures, nowhere did I see groundsel. Then I would come upon a place where foresters had burned tree limbs in the previous year. Virtually without fail many groundsel plants would be just there, growing out of the charcoal-covered soil. Their seeds are everywhere, but they only germinate and take root in specific microenvironments.

This example can give you an impression of the way annuals exists. They have a rapid life cycle, developing from seed to seed within a few weeks to a few months, depending on species and conditions. The seeds spread and most of them will never germinate. But some find conditions, such as a patch of open soil, that allow them to develop through their whole life cycle. They bring plant life to areas that are otherwise open, and suffuse that environment with new growth. In this way they fill out gaps in the mantle of plant growth in a variety of environments. When they die, decomposers break them down, which provides new conditions for other plants to grow. Annuals are often pioneer species in ecological successions.

Where vegetation is dense, such as in a prairie or pasture, or very shady as in the understory of forests, you find very few annuals. If a spot opens up, such as through an animal digging a burrow in a pasture, seeds of annuals may germinate and the plants can develop, but with time perennial grasses or wildflowers that dominate the plant community will replace them. So we can see annuals as plants that "come and go," creating plant cover to barren areas for a short time until a plant community develops that mainly consists of perennials.

In the larger story of plant life on Earth, annuals, on the one hand, re-vegetize disturbed areas, initiating an ecological succession of plant species, and on the other hand, in dry and desert climates they enliven the earth for a short period of time when periodic rains come.

So that we don't get caught in rigid categories, I want to mention that some plant species have populations that develop as annuals, biennials, or perennials. For example, annual bluegrass, *Poa annua*, is a widespread "weed" that is usually an annual. But populations of species exist in which individual plants are biennials or perennials (Gibeault, 1971; Law et al., 1977). The perennials can live for a few years by producing new side stems (tillers) that take root and persist. Interestingly, in some instances, the perennial types grow in more dense pasture-like groups, while the annual types grow in places where vegetation is sparser. Another weedy annual, wild rice (*Oryza rufipogon*), also has perennial forms, and these tend to grow in deep swamps, while the annuals are usually found in swamps that periodically dry out and where the soil can be parched for part of the year (Morishima et al., 1984). As the preceding examples demonstrate, plasticity within a species allows it to vary and establish new life histories, often in relation to different environmental conditions.

Perennials

Except for equatorial plants, most plants on the globe are embedded in a yearly cycle since they have a period during a year when they form flowers, fruits, and seeds. By maintaining roots, stems, and sometimes leaves beyond one growing season, perennial plants become more independent from the annual solar rhythm that is so determinative in the life of annuals. New shoots and leaves in the current season develop out of the buds and germinal tissue that the plant formed in the previous year. In this way herbaceous perennials—most wildflowers and grasses—can live for a few to many years, while woody perennials—vines, shrubs, and trees—live for decades to many hundreds of years. The oldest known individual plants are bristlecone pines of western United States, which can live to be well over 4,000 years old. Between the short-lived annuals and long-lived trees

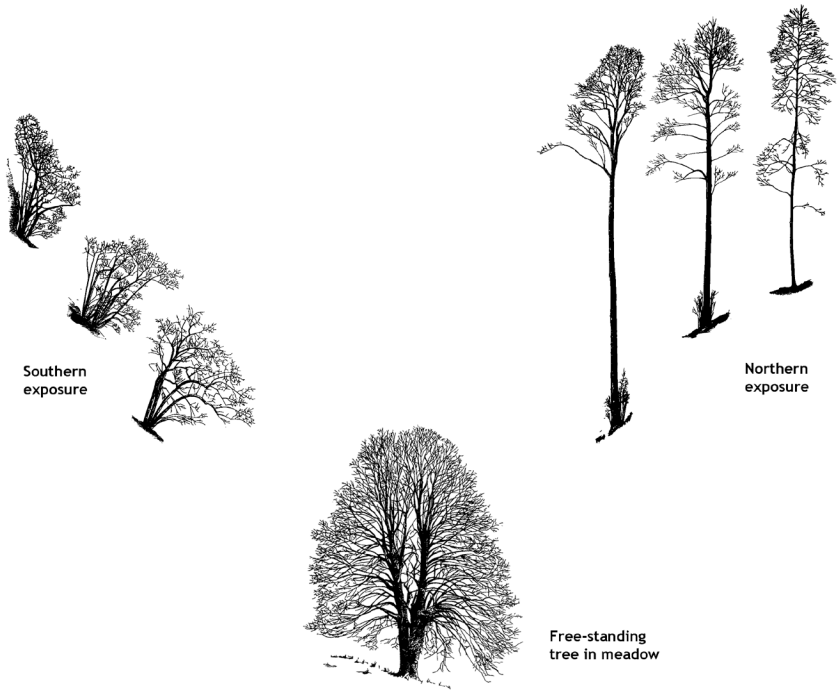

FIGURE 2: European linden (Tilia platyphyllos) with three different growth habits related to where they grow. The bush-like trees on the left grew on the slope of a mixed deciduous forest with a southern exposure in Switzerland. The tall and narrow-crowned trees on the right grew on the opposite, northerly exposed slope of the same valley, also in a mixed deciduous forest. A few kilometers away the free-standing tree grew in a meadow, spreading its large crown in all directions. (Drawings by Mathias Buess; in Bockemühl, 1992)

there are countless types of plants that range in lifespan of the individual plant from two seasons (biennials) to a few years, to many years. Perennial plants—especially trees—become long-term inhabitants of a specific place on earth, strongly influencing their environment and being influenced by it (see Figure 2).

Generally speaking, perennials grow more slowly than annuals, and most perennial wildflowers only begin to flower and produce seeds after a few years. Woody plants develop even more slowly. You can find trees in a temperate forest that are 10 years old and not even three feet high. Moreover, oaks, ashes, maples, and many other trees will often not form flowers and seeds until they are 20 or 30 years old. While slowing down growth and reproductive maturation, trees form the hard and relative lasting substance of wood. They develop enduring form and substance that becomes the basis for more growth each year. Every year trees expand in girth by adding a ring of wood to trunk and limbs, and grow in length through extending and branching limbs.

In a mature tree, the tips of the twigs form buds during the growing season that will open the next year. These buds contain a germinal stem, leaves, flowers, or leaves and flowers. Each year the thousands of buds on a tree unfold and develop a twig with leaves and flowers. In this way the tree, like an annual plant, is embedded in a yearly rhythm. But stems of the "plantlets" that have grown out of the buds do not die away; they become woody and remain rooted in the tree. Year by year the tree thickens its trunk and limbs, laying down new rings of wood, and extends the tips of the branches. Through this growth and branching the tree forms a living foundation for annual growth raised far from the ground—and deep into the soil.

Taking root

While the whole annual plant dies back at the end of the growing season, in herbaceous perennials, the underground stems and roots can continue to grow year to year. In woody perennials both aboveground stems and the roots below ground continue to grow year to year. In this way perennials develop larger and deeper rooting bodies than annuals. How expansive and deep the roots of a plant grow depend significantly on the soil environment. Figure 3 shows the roots of three Siberian elm trees that are approximately the same age. The root profiles differ starkly from one another. While there is no way to tease out all that influences root growth, it is clear, at least in this case, that the below-ground surface of the water table marks a boundary for the growth of the roots into the depths.

While most of the roots of plants are in the upper meter of soil, roots can grow very deep. Trees and shrubs have the deepest roots, followed by herbaceous perennials (Canadell et al., 1996; Fan, Miguez-Macho, Jobbágy, Jackson, & Otero-Casal, 2017; Stone & Kalisz, 1991). In exceptional cases, roots of trees and shrubs can grow over 20 meters (65 feet) deep and radiate sideways over 20 meters

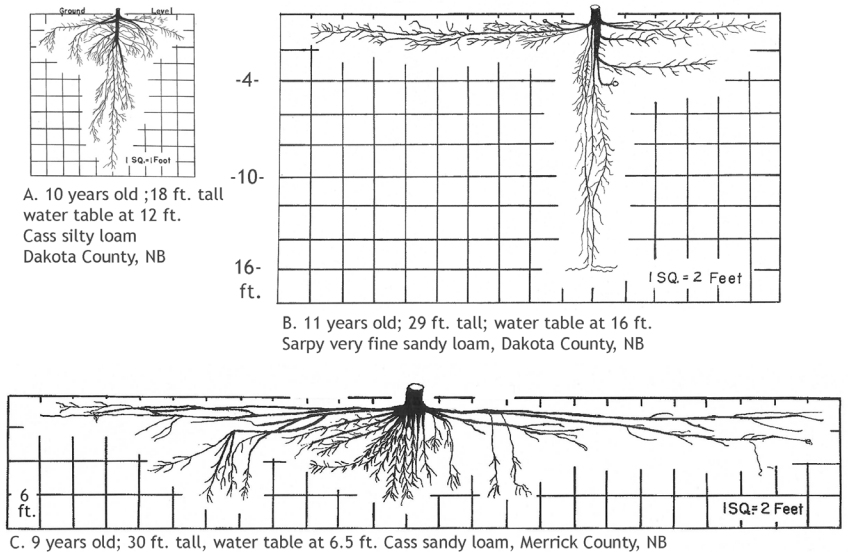

FIGURE 3: Root systems of three Siberian elm (Ulmus pumila) trees of similar ages, but growing in different contexts in Nebraska. (Modified after Sprackling & Read, 1979)

from the trunk. The longest roots have been discovered in bore holes or mines, reaching down more than 60 meters (197 feet) (Jennings, 1974; Phillips, 1963).

Roots are in an ongoing process of growth and decay. Ecologist John Weaver, who with students and colleagues studied prairie plants thoroughly in the first half of the 20th century, investigated root growth in different species of perennial prairie and range grasses (Weaver & Zink, 1946). They observed the development of the roots grown from seedlings over three growing seasons. In one species most of the roots (81%) that had formed in the first year were still present at the end of the third growing season. In four others, between only 10% and 45% were still present after the third season, so these plants had lost a majority of their first-year roots. But each year they had developed many new roots, so that after three seasons they had grown hundreds to many hundreds of roots. Perennial plants connect more strongly each year with the earth through decay of older roots and formation of new ones. As Goethe put it, "Life is [nature's] most beautiful invention and death her art of creating much life" (Goethe, 2002, p. 46; translation by author).

Expanding ideas—Clonal plants

The concept of annual and perennial plants refers at first to individual plants. We consider this particular wildflower or that particular tree. But it is not necessarily

a simple matter to say, "this is an individual plant." Take common milkweed (*Asclepias syriaca*), which grows in stands with long vertical stems that terminate in clusters of flowers (Holdrege, 2010). If you dig down into the soil a few inches, you find that the different stems are connected via underground shoots called rhizomes. The stand that you first think consists of individual plants is actually one branching plant that is connected underground. It is like a shrub that would do all its branching underground and only send the flowering shoots up into light and air. Each year the aboveground shoots die away, but the underground plant develops buds out of which new horizontal and vertical shoots grow. Through underground branching each year, the plant can grow quite large.

Aspen trees tend to grow underground root suckers out of which new trunks grow. In this way large groves of trees develop that, similarly to milkweed, are also individual plants. One of these groves in Utah, called "Pando," spreads over about 43 hectares (about 107 acres) (DeWoody, Rowe, Hipkins, & Mock, 2008). This makes it a very large organism and one that is likely very old. There is no simple way to determine the age of such mega-organisms, which may be many thousands of years old (Ally, Ritland, & Otto, 2008; de Witte & Stöcklin, 2010).

Botanists speak of plants that reproduce vegetatively in the way of milkweed or aspen trees as clonal plants. We generally think of plants reproducing via seeds, with the seeds having been formed through pollination. Clonal plants don't need seeds to form new plants, even though virtually all of them can also produce seeds. Clonal plants represent a different form of perenniality. Their existence also demands that we expand our idea of plant individuality and plant size, and they also present a quandary for determining the age of plants.

Since the connections between underground branches can dissolve or be broken, a clone can separate into plants no longer joined with each other. These separate plants can grow and form their own branching stands. Because they are no longer physically connected, are they now two plants or still one, since they derived from the same mother plant? This is an interesting conundrum.

FIGURE 4: Mother of Thousands (Kalanchoe sp.). Plantlets grow out of the leaf margins, then drop from the mother plant and can immediately take root in the soil.

Physically we can consider them as separated entities but biologically they are connected, since they are of one origin.

To take a more extreme example, a number of species in the plant genus *Kalanchoe* have leaves that grow complete little plants at their margins (see Figure 4). These plantlets fall off the leaves and take root. Each plantlet, in turn, can grow into a plant that creates many more plantlets. In this way, over time, countless plants can derive from one plant. For this reason, one common name for them is "mother of thousands." We grow these plants in pots at The Nature Institute, and often visitors and course participants will take some plantlets with them and grow them at home. When their plants produce plantlets, they may pass them on to others. When children or grandchildren continue to grow mother of thousands, how old are those plants? When does a clonal plant die? As some researchers have remarked, clonal plants are potentially immortal—there is no natural death.

There are even annual and perennial plant species, to which our common dandelion belongs, that can form seeds without pollination (Hojsgaard & Hörandl, 2019; Noyes, 2007). There is no mixing via pollen with another plant, or even with the pollen of the same plant. The seeds develop vegetatively. The seeds are extensions of the mother plant, so all of the mother plant's progeny form a clone—one widely spread organism. Such a species might be an annual from the perspective of its life history—since the mother plant dies away at the end of one growing season—but when the plant lives on through its vegetatively produced seeds, it is in this sense also a perennial.

To summarize: In plants that can reproduce vegetatively, what appears as an individual plant is a snapshot of an unbroken stream of life that connects all the offspring that have arisen from it. The categories of annual and perennial traditionally consider the continuity of life within an individual plant that is rooted in one place. The annual, as an individual, is short-lived; the tree is long-lived. These concepts become more fluid and nuanced when we consider vegetative reproduction, which is widespread in flowering plants. From this perspective, some annuals can also be considered perennials, and some perennial clonal herbaceous plants (wildflowers and grasses) may be hundreds of years old.

Plants in community

Plant communities are generally long-lived, perennial entities. While a forest can exist for centuries, the individual plants come and go, and the composition of the forest can evolve with changing environmental conditions. Trees, of course, are the dominant life form in forests, but the forest can also be inhabited by vines, shrubs, herbaceous perennials, and annuals. Many of the spring wildflowers that I observe each year in a local bottomland forest are perennials that mainly spread through rhizomes. There are only a few annual species, but they appear year after year and are integral members of the forest community.

In temperate mixed deciduous forests such as those in middle Europe or eastern North America, the annual cycle of the seasons is determinative for how the life of the community and its organisms unfolds—dormancy in the winter, rapid growth and flowering in the spring to summer, retraction of life processes and leaf loss in the fall. In this way the perennial community is embedded in the annual solar cycle. The interweaving of annuality and perenniality gives life to the community.

Grasslands, which cover wide expanses of continents around the world, consist mainly of perennial grasses and wildflowers. The prairies that once covered a large portion of the central United States up through the 19th century developed after the last ice age and existed for 10,000 years. The individual perennial grass and wildflower plants that make up the prairie usually live only a few years to occasionally 40 years (Anderson, 2006; Laurenroth & Adler, 2008).

Desert plant communities are ones often characterized by annuals. For example, the deserts of Palestine consist of about 60% annuals (Bazazz & Morse, 1991). Because flourishing plant life in the desert is so dependent on rainfall, in long rainless periods very little of the plant community appears aboveground. But the seeds are widely spread. Seeds consist of only 10% to 15% water (fresh wood, by contrast, can have a water content of 50%). Seeds are dry like the desert. But they are also life in a dormant state, sometimes existing for many years until rain falls and they germinate. A desert plant community is one of the most variable of plant communities, and owes its existence in part to the capacity of annuals to remain in a quiescent state as seeds for extended periods of time. Annuals contribute in this way to the perenniality of the desert community.

Numerous interactions between plants and other plants, animals, fungi, microorganisms, soil, light, warmth, air, and water create the dynamic weaving that is the life of a given plant community. Fungi connect plants via their roots through so-called mycorrhizal networks (see reviews in Gorzelak, Asay, Pickles, & Simard, 2015; Tedersoo et al., 2020). Most plants are part of such networks. Through them substances are exchanged between the plants and fungi and, through the fungi, between different plants. For example, in western North America young Douglas fir seedlings receive via mycorrhizae nutrients and water from older Douglas fir trees, allowing the seedlings to grow better. Different species of plants also exchange substances through mycorrhizal networks (Philip et al., 2010; Simard et al., 1997).

Another form of interaction between plants is through volatile chemicals that they release into the air, such as when they have been damaged by predators (see, for example, Karban et al., 2014; Karban, Yang, & Edwards, 2014). These chemicals can reach plants in the immediate vicinity and, at least in a good number of those investigated, their neighbors are stimulated to produce protective substances and experience less insect damage.

Plants—especially trees—can have a significant effect on their surroundings by bringing up water from moist deep soil through their roots and releasing it into dryer soil closer to the surface. This happens mainly at night, and during the next day this additional water in the soil is available not only to that plant but also to others of the same or different species in the vicinity (Caldwell et al., 1998; Neumann & Cardon, 2012). The reverse can also happen in arid environments: plant roots can bring the moisture they take in near the surface of the soil and move it into deeper dry soil. This increased moisture allows roots to grow deeper.

So while a plant may be an individual specimen from one perspective, as a living being it is activity that weaves together with the life of many others and the larger environment. Every species has its own identity, but this identity is not static. It is thoroughly dynamic, in the sense that the form and substance of a plant are being continually built up, transformed, and broken down, and all this by virtue of the way the plant's activity is embedded in the activities of its environment. Life courses through each plant, but it also courses through a plant community, a biome, and, in the end, the whole Earth.

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Let's get creaturely: A new worldview can help us face ecological crises

Wes Jackson and Robert Jensen

No farmer has ever gone out to the barn to start the day and discovered that a baby tractor had been born overnight. For farmers who work with horses, the birth of a foal would not be surprising.

That observation may seem silly, but it highlights an important contrast: Machines cannot reproduce or maintain themselves. Creatures can.

The tractor comes out of the industrial mind, while the horse is creaturely. The tractor is the product of an energy-intensive human-designed system, while the horse is the product of an information-intensive biological process that emerges from earth and sun. The implications of this difference are rarely acknowledged in the dominant culture, but we believe they are crucial to explore, now more than ever.

In the short term, humanity needs to devise policies that respond in meaningful ways to today's multiple, cascading ecological crises (including, but not limited to, rapid climate disruption), which present risks now greatly accelerated and intensified well beyond previous predictions. If that seems alarmist, we recommend "World Scientists' Warning to Humanity: A Second Notice" (Ripple et al., 2017) for details.

To put uncomfortable realities bluntly: In ecological terms, things are bad, getting worse faster than anticipated, leaving humanity with increasingly limited options. Everyone agrees that there are no quick and easy fixes, but we want to push further: Do not expect any truly sustainable fixes to emerge from the industrial mind.

That's why we believe it's crucial to discuss not only policy but the need for a new worldview, one that can expand our imaginations. The distressing realities

of our moment in history need not be the end of our story, if humanity can transcend the *industrial* and get *creaturely*.

Creatures—humans, other animals, plants, and microbes—are all products of a rich, integrated evolutionary history. Unfortunately, something in our big brains has too often led us to see ourselves as set apart from the rest of the larger living world—to think of "human" as so different from "nature" that we believe ourselves to be separable from the ecosystems on which our lives depend. The Industrial Worldview, deeply rooted in this delusion, defines much of our day-to-day existence and suffocates our imaginations.

What if we embraced a Creaturely Worldview as a corrective? This would challenge not only the dominant culture but also some in the environmental movement who are committed to industrial thinking and its accompanying technological fundamentalism (defined as the belief that the increasing use of evermore sophisticated high-energy, advanced technology is always a good thing and that any problems caused by the unintended consequences of such technology eventually can be remedied by more technology). The current debates about sustainability and justice, most notably around proposals for a Green New Deal, might be more productive if everyone started by considering this question: Which provides a better standard for our choices, the Creaturely World or the Industrial World?

(Before proceeding, a footnote: We are not the first to ask this question, of course. In some sense, indigenous and traditional people who resisted the Industrial World have long advocated for a Creaturely Worldview. The Amish rejection of some of the products of the Industrial World reflects a faith in the Creaturely. The agrarian writer Wendell Berry, one of our touchstones in this enterprise, has spoken of the costs to people and land in the countryside with the "change from a creaturely life to a mechanical life" that accelerated after World War II (Corrigan, 2011). With that acknowledgement of our roots, back to the argument.)

First, remember that the Creaturely World had a considerable head start. Creatures have been here some three-and-a-half billion years. The Industrial World has existed for only 250 years, about 14 million times shorter. By linear comparison, that's roughly the difference between an inch and 220 miles.

Why creaturely?

We argue for the Creaturely based not just on time but more importantly on the greater creativity and efficiency of nature's ecosystems, compared with the limited vision and mixed record of human cleverness. The Creaturely World features self-organizing renewability (remember the horse and foal) emerging from the integrated structure of ecosystems—what we might call the "natural

integrities." A tall-grass prairie ecosystem, for example, is not a random collection of species but the result of natural selection that produces species interacting with each other and with the abiotic world in ways that efficiently utilize the available resources. The Industrial World erodes those integrities, requires human attention to maintain, and is non-renewable. For the Industrial World to work, dismemberment of integrated nature is required.

The Creaturely World is *information-rich*; the genetic code of organisms stores enormous amounts of information. People routinely speak of living today in an information age made possible by digital technologies, but this human-generated breed of information is only a tiny fraction of what is found in the DNA of the Creaturely World. The fact that human inventions are relatively information-poor is typically obscured by our use of highly dense energy to compensate.

A perfect example is the widespread use of anhydrous ammonia as a source of nitrogen fertilizer for modern agriculture, the product of what energy scholar Vaclav Smil (2000) has called the most important invention of the 20th century, the Haber-Bosch process. Natural gas is the feedstock most often used to turn tight-bonded atmospheric nitrogen into ammonia. This industrial process "solved" the problem of soil nitrogen fertility and declining supplies of natural fertilizers such as guano. Unfortunately, after being spread over millions of acres of grain-producing fields, the surplus industrial nitrogen finds its way down the slopes and into the waterways until it meets the ocean waters, where it creates huge dead zones. On the way downriver, cities spend millions of dollars to get it out of drinking water, in some places failing so dramatically that people have to drink bottled water.

Haber-Bosch does its assigned job of increasing crop yields, but with a climate-changing cost: It uses fossil energy to generate the 200 to 400 atmospheres of pressure and temperatures of 750 to 1,200 degrees Fahrenheit required to produce ammonia from that natural gas feedstock. In contrast, the biological process of nitrogen fixation in various plants operates at four-fifths of one atmosphere of pressure and at ambient temperature, relying on 21 enzymes that are the product of the DNA code—drawing on the natural integrities of the Creaturely World. The Industrial World's nitrogen production substitutes fossil-energy for information, disrupting ecosystems' integrities with a non-renewable process that contributes to ecological degradation, from the mining of the fuel to the acceleration of global warming (Smil, 2011).

This is an example of a larger rule: Ecosystems are far more creative than human systems. Consider a modern city, the product of the human-generated information used to build the housing, businesses, infrastructure, and transportation networks that allow millions to live in close quarters, often with exciting results (both constructive and destructive). All that excitement leads us to ignore the fact that these cities of the industrial age are made possible only through massive expenditures of fossil energy and other resources, some of

which come from the other side of the planet. Meanwhile, natural ecosystems are home to a much more expansive variety of creatures living in far more complex relationships, requiring none of that fossil energy to maintain. Natural ecosystems can maintain themselves for countless millennia using only solar flows, while cities draw down millions of years of concentrated energy in a relative blink of an eye. Which model provides a standard for our future?

Here is an idea that is counterintuitive in the modern world: *Highly dense energy limits the human imagination*. Yes, all that fossil energy has subsidized a tremendous amount of science and art, expanding dramatically what we know about the world and building an expansive trove of stories about it. But rather than imagining how we might use that energy to build a sustainable future, we have rushed to use it in ways that enriched some quickly, impoverished others slowly, and left us facing a future that is speculative, not guaranteed. As we come to the end of the fossil-fuel epoch, as a species we seem to lack the collective imagination to break free.

Another challenge to the conventional wisdom: The Industrial World acts as if public policy is made by humans and those policies determine how we use energy, but in fact that highly dense carbon, once unleashed, sets policy and drags us along. We did not build the contemporary world by making choices about how to use energy; highly dense energy dictated the shape of the contemporary world, in which we make choices that have been constrained by the industrial mind. The choices we do make within the Industrial Worldview matter very much—we can opt for more or less destructive paths—but in the long run, it is the worldview that has to change.

Facing problems honestly

Let's pause to answer a reasonable concern: Are the two of us zealots? Do we want to give up on everything humans have ever built? Are we calling for a mystical return to the Paleolithic tomorrow? No to all those questions. Are we proposing to "let nature take its course," and stand by while billions of people die in such a transition? Certainly not. Advocating for a shift in worldview is a plea for new ways of thinking, not a celebration of misanthropy. Rather than throwing up our hands in despair because imaginations have been so limited in the Industrial Era, we suggest that the dominant culture start identifying and attempting to follow the patterns of the Creaturely World—not an atavistic return to any particular moment in the past but rather attention to the lessons of evolutionary history.

An example is The Land Institute (TLI) in Salina, Kansas, where both of us have worked since 2015 with the Ecosphere Studies program. The term "creaturely" doesn't appear in the organization's mission statement, but the Creaturely Worldview informs its work.

For more than 40 years, TLI researchers and teachers have advocated for nature as the standard for grain farming, as they work to develop an information-

rich agriculture that mimics the vegetative structure of an information-rich native prairie (an approach known as Natural Systems Agriculture). As part of a larger agroecological movement (Food and Agriculture Organization, n.d.), this project is developing perennial grain polycultures (grain crops that need not be planted every year, grown in diverse mixtures), a more creaturely approach to agriculture than the annual monocultures in industrial fields. In addition to reducing soil erosion, those perennial grains would sequester more carbon, and adding legumes to the mix sponsors biological nitrogen fixation, removing the need for the Haber-Bosch process and its accompanying emissions.

In this work, TLI staffers recognize that every day they use the products of human cleverness and industrial society—booting up computers, carrying tools to the research fields in pickup trucks, transferring pollen in three natural gas-heated greenhouses, and burning fossil fuel to warm labs and offices—all in the hopes of developing crops that can endure without all the trappings of the Industrial World and make possible a transition to truly sustainable agriculture.

The big test that's coming: Once we have these new species and varieties, will growing them at the scale necessary to feed people require maintaining the industrial infrastructure that brought them into existence? We believe the answer is no, that their creatureliness will persist without a need for human intervention. These species could be grown by people who never touched a computer, and could be maintained without the artifacts of the Bronze and Iron ages. The Industrial World can't say that of many, if any, of its achievements.

We realize that we cannot get to perennial polyculture agriculture without some of the tools of the Industrial World. We continue to use fossil fuels, though over time we hope we can supply more of the power for this transition period with solar and wind technology. But we cannot be naïve about "renewable" energy, and the Creaturely Worldview can help us understand why.

First, the easy part: No combination of renewable energy sources can power the existing Industrial World (Cox, 2017). Rational planning must include not only replacing fossil fuels with renewables but also dramatically reducing our consumption (Heinberg & Fridley, 2016). If we are using renewable energy to try to produce enough electric cars to continue our current transportation system, for example, we are only digging the hole deeper, not finding ways out. An enforceable cap on carbon at the mines, the wellheads, ports of entry, and forests seems necessary (Cox, 2020), which means we'll also need a fair rationing system (Cox, 2013).

Second, the hard part: There are limits to renewable energy technologies' ability to replicate themselves. At the risk of unnecessary repetition: The Industrial World is not self-renewing. Working against, instead of with, the efficiencies inherent in natural integrities means that a considerable amount of energy that so-called renewable technologies produce must go into mining and manufacturing the non-renewable materials required for that infrastructure.

That's a losing game. Wind turbines and solar collectors built with fossil-fuel infrastructure will not be easy to maintain or reproduce when that fossil energy is gone.

What does that Creaturely Worldview have to offer here? We can begin by scrutinizing proposals under the Green New Deal umbrella, most of which embrace "green-energy cornucopia" thinking (Cox & Cox, 2017) that keeps us entranced by the industrial mind's illusion that we can sustain unsustainable living arrangements. As even many of its supporters understand, the problem is not that the Green New Deal is too ambitious but that it is not ambitious enough. Virtually all politicians, and even many who identify as environmental activists (Asafu-Adjaye, et al., 2015) embrace a growth economy and techno-optimism. As difficult as it is in mainstream political circles, we must challenge those dogmas and imagine a transition to a more Creaturely Economy.

A Creaturely Worldview requires dramatic changes in social and political arrangements. One obvious shift would be reducing the size of farms and increasing the farm population (Bradford, 2019), recognizing that we can better feed ourselves by relying on a sufficiency of people rather than on capital and dense energy. Repopulating the countryside would require something like a new Homestead Act, creating an opportunity to correct the extermination and exploitation of both peoples and ecosystems that was woven into the first version in 1862.

There is a clear need for short-term industrial productivity as the transition unfolds, and that there may be a place for the Industrial World in our future—but only if it is clearly subordinated to the Creaturely World. Wind and solar energy are a good example of that: We'll need them in the transition period, but our reliance on them should shrink (unless, by magic, wind turbines and solar collectors start having babies) as we get closer to the creaturely goals.

Obviously, a Creaturely Worldview doesn't have all the answers to all problems. A worldview doesn't solve problems but rather shapes the way we understand questions, and guides our search for answers. While articulating a vision for the future we draw upon our imaginations, which cannot be divorced from our evolutionary history. The way we describe the future is always partly new and partly rooted in that history. With that in mind, we might think of the Creaturely World as a kind of New Paleolithic, the next step forward after the ephemeral fossil-fuel epoch has run its course.

In such a Creaturely World, there will be less of many material things that many of us (including the authors of this article) have grown accustomed to, but potentially more of the one thing the Industrial World could never produce: a sense of being at home and cherishing our origins in a universe that is not just a place but also a story.

We are but one part of that story, and our place in it should feature earth as our creator, our defender, and—with proper restoration of the Creaturely—our redeemer.

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ABOVE: Made by Taiwan Series/Roadside: North-Facing Retaining Wall #1, 2009. *Karen McCoy*

OPPOSITE: Made by Taiwan Series/Tunnel: Water, Heat, Moisture, Plant Growth, 2009. *Karen McCoy*

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Wes Jackson, President Emeritus of The Land Institute, is the author of the 2021 book *Hogs Are Up: Stories of the Land, with Digressions* from the University Press of Kansas. He has written and edited numerous books, including the *Nature as Measure: The Selected Essays of Wes Jackson* and *Consulting the Genius of the Place: An Ecological Approach to a New Agriculture*. Born and raised on a Kansas farm, Jackson earned his PhD in genetics at North Carolina State University and taught at Kansas Wesleyan University and California State University, Sacramento before co-founding The Land Institute in 1976.

Robert Jensen, Emeritus Professor in the School of Journalism at the University of Texas at Austin, collaborates with the Ecosphere Studies program at The Land Institute. Jensen is the author of the 2021 book *The Restless and Relentless Mind of Wes Jackson: Searching for Sustainability* from the University Press of Kansas. Among his previous books are T*he End of Patriarchy: Radical Feminism for Men* and *Plain Radical: Living, Loving, and Learning to Leave the Planet Gracefully.*

Lisi Krall is a Professor of Economics at the State University of New York, Cortland. Her current research focuses on the emergence of agriculture and the configuration of human economic order into an economic superorganism. Her essays and articles on political economy, human ecology, and the evolution of economic systems appear in such diverse journals as the *Cambridge Journal of Economics*, *Behavioral and Brain Sciences*, and *The Ecological Citizen*. Her 2010 book, *Proving Up: Domesticating Land in U.S. History*, explored the connections of economy, culture, and land in U.S. history. She has been a Fulbright Scholar, a SUNY Senior Scholar, and a recipient of the SUNY Chancellor's Award for Research.

Karen McCoy makes sculpture, walking art, drawings, photos, and video. She received her MFA from the School of the Art Institute of Chicago and taught in Sculpture and Social Practice at the Kansas City Art Institute, where she is Professor Emeritus. McCoy has also taught at Williams and Colby Colleges and at the University of Minnesota, Morris. Her art work has been shown across the United States, Europe, and Asia, and recent awards and exhibitions include a Charlotte Street Foundation Fellowship in 2017–18 and the accompanying exhibition at the Nerman Museum for Contemporary Art.

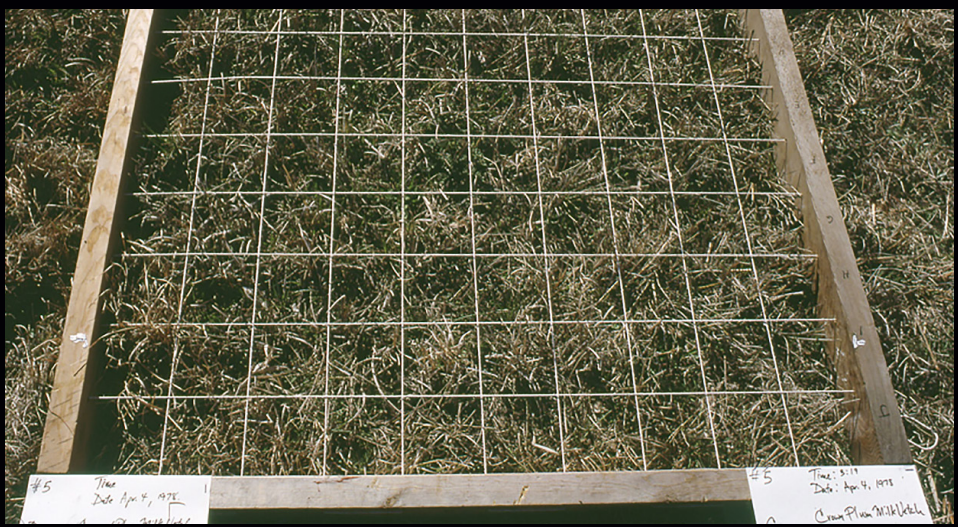
Nancy Winship Milliken creates sculpture, installations, prints, and photographic enactments about the health of the land and surrounding communities, reflecting a desire for change in the socio-environmental course of our society. Defining her sculpture as "contemporary pastoralism," Milliken works to keep materials close to their original state. Much of the work is made in collaboration with farmers, artisans, poets, and environmental studies interns from universities all over the nation.

Kathleen R. Smythe teaches, writes, gardens, rides, walks, and cultivates a local lifestyle in Cincinnati, Ohio. She has been a faculty member in the History Department at Xavier University for more than 20 years. Smythe deeply appreciates the history and values of Jesuit education, as well as the vibrant local food scene in the region. She is the mother of two, mostly out in the world on their own now. Cora and Colin provide inspiration and consolation.

Aubrey Streit Krug is a writer and teacher who studies stories of relationships between humans and plants. She directs the Ecosphere Studies program at The Land Institute in Salina, Kansas, where she lives with her husband and son. She grew up in a small town in Kansas, where her parents farm wheat and raise cattle, and she loves limestone soils and rocky prairie hillsides. Streit Krug holds a PhD in English and Great Plains Studies from the University of Nebraska-Lincoln and is a co-author of the collaborative textbook *The Omaha Language and the Omaha Way*.

Bill Vitek is a philosopher, educator, author, and musician. He is a Scholar in Residence at Middlebury College and Professor Emeritus at Clarkson University, where he taught for 32 years. Vitek directs the New Perennials Project for Rockefeller Family Fund.

This anthology is the first project in the New Perennials Publishing venture. Our goal is to provide thoughtful analyses on crucial social/ecological questions, all at no cost to readers. Our hope is that students and teachers—both in high schools and universities—will find these essays challenging and useful in their work. Beyond the classroom, we believe readers who are concerned about the state of the world will find the anthology compelling.



The frame laid down at Nick and Joyce Fent's 80-acre virgin prairie just north of Salina, Kansas, where Wes Jackson took plant inventories with his students to determine which native plants lived close to each other. This is where and when his Natural Systems Agriculture research started, in March 1978. Photo by Terry Evans.

ABOUT THE EDITOR

Bill Vitek teaches, thinks, and writes with a broad audience in mind, and with a simple, if urgent message: the philosophical imagination can and must do useful work in the world. He taught at Clarkson University for 32 years, and is currently a Scholar in Residence at Middlebury College where he directs the New Perennials Project. His collaborations with Wes Jackson and The Land Institute stretch across three decades.

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