Meeting the Agricultural Challenges of the 21st Century
With a Little Help from Liberty Hyde Bailey[1]

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. . . a land ethic changes the role of Homo sapiens from conqueror of the land-community to plain member and citizen of it.
---Aldo Leopold

Basking in the apparent glow of the industrial revolution it is easy for us to assume that the way we live our lives, entertain ourselves, provide for our shelter, and produce and distribute our food, is sustainable. We have, after all, been incredibly successful in overcoming most of the challenges that humans have faced in their long history of acquiring enough food on a sustainable basis to feed a rapidly growing human population. There are no longer any doubts that we are now producing enough food to feed the entire human population of over 6 billion people currently living on the planet. While more than 800 million continue to be severely malnourished, it is clear that this deficiency in food availability is *not* due to any lack of production.

While some may doubt whether the expected 10 billion people in the decades ahead will have enough food, others seem confident that we can meet the production challenge. The industrial paradigm, based on the principles of specialization, simplification and consolidation, has led us to develop a modern food system nothing short of miraculous. One hundred years ago no one dreamed of 200 bushel per acre corn or 100 bushel per acre wheat. And many expect the miracle to continue, fueled by new technologies. We assume that economic growth and increased production are our birthright and can continue indefinitely.

But in the midst of this euphoria difficult challenges lie ahead.

Challenges Facing Modern Agriculture

In addition to the rich ecological capital that industrial agriculture inherited (rich genetic and biological diversity, abundant top soil, etc.), the principal reason industrial agriculture has been so successful during the past century is that it has been blessed with cheap energy, abundant water, and relatively stable climates. But that rosy landscape seems poised to undergo rapid and significant change.

Cheap energy appears to be a thing of the past. While global demand for petroleum is increasing exponentially, the global production capacity of oil and natural gas either seems to have peaked or will do so soon.[2] And while "alternative energy" is being developed, none will provide the kind of energy-efficiency ratios that we have become

[1] This paper was presented at the Ag History Society Conference, June 23, 2007, Ames, Iowa
[2] R. Heinberg, 2003. *The Party's Over: Oil, War and the Fate of Industrial Societies*. Gabriola Island, BC, Canada: New Society Publishers. P. Roberts, 2004. *The End of Oil*. Boston: Houghton Mifflin Company.

accustomed to with concentrated, stored energy such as old growth forests, coal, oil and natural gas. And so far as anyone knows, there are no other undiscovered forms of concentrated, stored energy on the planet.

The transition from concentrated, stored energy, to current energy will be particularly difficult for our food and agriculture system. Oil and natural gas have provided almost *all* of the energy used in our modern food and agriculture system. On-farm inputs---fertilizers, pesticides, farm equipment, irrigation water, and diesel fuel---are derived almost entirely from petroleum-based technologies. And, beyond the farm gate, almost all of our food processing and distribution systems likewise are based on a petroleum platform. Even without any additional challenges, our diminishing energy future will make it extremely difficult to maintain business as usual on the farm.

And this is one of many changes on the horizon that will produce equally difficult challenges for our industrial food and agriculture system.

Ecological degradation, much of it *caused* by industrial agricultural practices, threatens future agricultural productivity. Groundwater resources are being depleted rapidly on much of the planet. Climate change likely will produce more unstable weather, and the loss of both genetic diversity and biological diversity has simultaneously reduced the planet's capacity for self-renewal and self-regulation. All of these factors that threaten the sustainability of our modern food system are symptoms of the deteriorating ecosystems that serve as the foundation of all food production.

This ongoing deterioration was described with exceptional clarity in the United Nations' Millennium Ecosystem Assessment (MEA) Synthesis Report.[3] Produced by more than 1300 scientists from 95 countries, the 2005 UN MEA report outlined disturbing conclusions regarding the global resources on which agriculture depends. During the last half-century, humans have so polluted and over-exploited earth's ecological systems that unprecedented and abrupt ecological collapses are expected. A principal cause of this degradation, according to the report, stems from the changes made to meet our rising demand for ecosystem services, especially the growing demand for food, water, timber, fiber and fuel. In other words, the same industrial economy that generated such a successful industrial agriculture now threatens to undermine our capacity to *maintain* productivity.

Climate change is another 21st century phenomenon that seems poised to disrupt our production miracle. Scientists are now in virtual agreement that---due to excessive greenhouse gas emissions---the climate could change dramatically in the decades ahead. Ironically, some of those troublesome greenhouse gases are produced by the same industrial agriculture that has given us our production miracle. And the impact that climate change may have on our capacity to maintain productivity could be significant.

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[3] United Nations. 2005. Millennium Ecosystem Assessment Synthesis Report. March. http://www.millenniumassessment.org/en/index.aspx.

But climate change likely will be in our future whether or not greenhouse gas emissions initiate it. Scientists have warned us for some time that the unusual, comparably stable climate we have experienced in the last century is simply not normal. The National Academy of Sciences Panel on Climactic Variation reported in 1975 that "our *present* climate is in fact highly *abnormal,*" that "the earth's climates have always been changing, and the magnitude of . . . the changes can be catastrophic." The report then went on to say that "the *global patterns of food production and population* that have evolved are implicitly *dependent on the climate of the present century*." (emphasis mine). In other words, the dramatic increase in yield that we have seen since the 1930s is due as much to unusually favorable climate as it is to modern production technologies.

The NAS panel went on to acknowledge that this "normal" climate change could be *further exacerbated* by the fact that "we may be producing climatic changes as a result of our *own activities*." It is this *combination* of "normal" climate variation *plus* the changes springing from our industrial economies that will almost certainly have a significant impact on future agricultural productivity.[4] And the impact is likely to be especially volatile for our industrial farming systems. Every farmer knows that highly specialized production systems require relatively stable climates to perform well. When just two crops---corn and soybeans---occupy 92 percent of Iowa's cultivated land, Iowa farmers need a climate that is consistently favorable to these commodities to maximize productivity.

Of course, as Cynthia Rosenzweig and Daniel Hillel have pointed out, it is impossible to foretell exactly how climate change will affect our production capacity.[5] The impacts on any given ecosystem will be determined by a complex set of factors such as the severity of temperature changes, precipitation patterns, and enriched carbon dioxide in the atmosphere. These factors and our inability to predict how complex natural systems will evolve under new circumstances make it impossible to offer precise predictions. Nevertheless, as Rosenzweig and her colleagues advise us, we need to understand what is at stake and "prepare for change wisely."[6]

Despite these uncertainties, we can reasonably anticipate some of the short- and long-term challenges that climate change poses for agriculture. In the **short term** (2020-2080) we can anticipate greater climate fluctuations, "extremes of precipitation, both droughts and floods."[7] Such fluctuations can be especially devastating for the highly specialized, genetically uniform, mono-cropping systems that dominate the agricultural landscape.

The **long-term** (2080 and beyond) consequences of climate change could be grim. Jim Hansen's review of four prominent climate change studies published in the July 13, 2006

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[4] Report of the Panel on Climate Variations, 1975. *Understanding Climate Change.* National Academy of Sciences. Washington DC.
[5] C. Rosenzweig and D. Hillel, 1995. "Potential Impacts of Climate Change on Agriculture and Food Supply," *Consequences*. Vol 1 (2). Summer.
[6] C. Rosenzweig, A. Iglesias, X.B. Yang, P.R. Epstein, and E. Chivian, 2001. "Climate Change and Extreme Weather Events: Implications for Food Production, Plant Diseases and Pests," *Global Change and Human Health*. Vol. 2 (2). December. 90.
[7] Rosenzweig, Op. Cit. 2001. 100-101.

New York Review of Books provides context for anticipating potential future impacts of climate change on agriculture. Hansen anticipates that "If human beings follow a business-as-usual course . . . the eventual effects on climate and life may be comparable to those at the time of mass extinctions." How does agriculture remain productive in a world with significantly reduced biodiversity? Will we still have pollinators? The recent unexplained Colony Collapse Disorder affecting honey bees on multiple continents may be only a glimpse of future capacity for disruption.

The potential for increased droughts due to climate change may be exacerbated by the fact that we also have been drawing down our groundwater at an unsustainable rate in recent decades. Lester Brown points out that while we each drink four liters of water a day, modern industrial production systems now use 2,000 liters to produce each of our daily food requirements. Agricultural irrigation alone uses 70 percent of all fresh water on the planet. Today, we use twice the water for agricultural irrigation as we did in the 1960s and consequently we have been drawing down our fresh water resources at an unsustainable rate. In other words, excessive water use is another key ingredient in our destructive industrial paradigm.

Water depletion is especially troublesome in China where 80 percent of grain production is dependent on irrigation, and in India where 60 percent requires irrigation. In some parts of China aquifers are dropping 10 feet per year and in India by 20 feet. In China some farmers are already pumping water from 1,000 feet deep and in India from 3,000 feet.[8] China and India are the most populous nations in the world and significantly reduced crop production there, due to water depletion, would have major global food supply consequences.

Water tables in the Ogallala Aquifer, which supplies much of the irrigation water for the central United States, where 20 percent of grain production is dependent on irrigation, have dropped as much as 100 feet in some places and according to some reports this fossil water bank is now half depleted. A few farmers already have had to abandon irrigation due to water depletion. Reduced snow packs in mountainous regions due to climate change have decreased the spring run off, which is a primary source of irrigation water in many parts of the world, and may further reduce our food production capacity.

Of course water, climate and energy are all tightly coupled in the real world and responses to alleviate one problem can further exacerbate the others. For example, one response to the impending energy crisis has been the development of corn-based ethanol as an alternative fuel. But, ethanol processing requires significant amounts of water which will likely further deplete the supplies in the Ogallala. Furthermore, longer and more frequent droughts, likely outcomes of climate change, will force more farmers to install center-pivot irrigation systems. This may be especially true in the Corn Belt, since land rent and other costs have increased dramatically due to higher corn prices, spurred by increased demand for corn to supply ethanol plants. Farmers cannot afford drought-related crop failures when they incur such high production costs. And by some estimates, rent will be much higher in the next year or two, at least in Corn Belt states such as Iowa

[8] L.R. Brown, 2006. *Plan B 2.0*. New York: W.W. Norton and Company. 42-44.

and Illinois. Farmers can hardly be blamed for installing more irrigation systems as a hedge against drought under those economic conditions.

The potential ripple effects associated with devoting a significant percentage of our land to producing energy instead of food, feed and fiber may be equally significant. Increased corn demand may tempt farmers to switch to more continuous corn production, planting fence row to fence row, and maximizing nitrogen inputs to insure high yields. Higher energy costs and land rent will leave them little choice. The outcome may be even greater ecological degradation. Furthermore, as global populations grow and water resources diminish, competition for land to produce food versus land to produce fuel could create unprecedented moral dilemmas.

A Few Lessons from History

As we anticipate this difficult journey into the future it may be helpful to view agriculture within its historical context. Using that perspective, we can explore some alternative ecological, philosophical and social options that may help us to develop a new agriculture based on a new paradigm.

Ernest Schusky's comprehensive anthropological research on this topic seems particularly relevant.[9] Schusky believes that energy has always played a key role in our acquisition of food. For most of our tenure on the planet we have been gatherers. We hunted animals and collected plants for food. From an energy efficiency perspective this was a very effective way to feed ourselves. No energy was required for production or transportation. We simply gathered food, prepared it and ate it.

The invention of agriculture, approximately 10,000 years ago, ushered in the Neolithic Revolution. During this era, we domesticated plants and animals and used human and animal energy to produce our food. While such agricultural practices were much less energy efficient than gathering, they presumably offered other advantages.

Schusky suspects that the shift from gathering food to producing it through agricultural practices took place over a period of time. Gathering, he speculates, was not without impact on the environment. Gatherers likely altered the genetic composition of the environment by choosing some plants and animals over others. This selectivity likely had an effect on local ecologies similar to that of any pest.

Schusky points out that we chose domestication of plants and animals despite the fact that it was less labor efficient than gathering. While domestication "greatly concentrated solar energy, it appears their care may have required more labor in food production than did food collecting."[10] Eventually it must have occurred to our ancestors that there may be a benefit to domesticating their preferred plants and animals in order to insure an

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[9] E.L. Schusky, 1989. *Culture and Agriculture: An Ecological Introduction to Traditional and Modern Farming Systems*, New York: Bergin & Garvey Publishers.
[10] *Ibid*, xii.

adequate supply of their favorite foods, despite the fact that it required more labor energy to produce.

But a more significant shift in our food system came much later. Around 1930 we embarked on a new era of agriculture. Schusky calls this latest period the "neocaloric era" because it is based almost entirely on "old calories," namely fossil fuels. The defining characteristic of our modern food system is that it replaces energy produced by human and animal labor with fossil fuel energy. But from an energy efficiency standpoint it is the least effective food system we have ever had. Industrial agriculture, for the first time, *consumed* more energy than it *produced*! Schusky cites one egregious example---it takes "about 2200 calories of fossil energy in order to produce a one-calorie can of diet soda" which he suggests is "downright embarrassing to human intelligence."[11]

But our industrial food system provides other benefits that we apparently valued more than energy efficiency or sustainability. The qualities we admired appear to be short-term return and maximum volume. The preference for short-term returns and maximum volume over long-term sustainability and resilience may be linked to several historical events.

One was the birth of modern scientific consciousness. This new way of thinking, spearheaded by Rene Descartes and Francis Bacon, was formulated to free us from the religious paradigm of the 17th century with its "speculative philosophy." It was to provide us with a more "practical" philosophy that could help us to understand "the nature and behavior of fire, water, air, stars, the heavens, and all the other bodies which surround us" so that we could "employ these entities for all the purposes for which they are suited, and so make ourselves masters and possessors of nature."[12]

This new paradigm had a profound effect on how we view ourselves vis-à-vis the rest of nature. For most of human history, we saw ourselves as *part* of nature. But this turning point, four hundred years ago, destroyed that continuity and led us to view nature as a collection of raw materials that we could, and should, modify into more useful objects that better serve our interests.

This new consciousness gave free reign to the industrial revolution, and, by the 1930s, to industrial agriculture. Agriculturalists adopted fundamental industrial principles and applied them to the way we farmed. We began acting *upon* nature with little thought to the potential impact our activities may have on the land's resilience and capacity for self-renewal. We lost all sense of the connection between our own wellbeing and the health of the rest of the biotic community. As a result, we are now perilously close to modifying the very functioning of the planet itself. This modification greatly complicates the task of feeding our expanding human population.

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[11] *Ibid*, xii-xiii.

[12] Rene Descartes, translated by Laaurence J. Lafleur, 1950. *Discourse on Method*. Indianapolis: The Liberal Arts Press. (Original French edition, 1637.) 10.

A second event that contributed to our tendency to value short-term returns over long-term sustainability was the evolution of a new economic culture. Adam Smith is generally credited with the free market economic philosophy. Smith contended that there were comparative advantages to be gained by guiding a marketplace through free trade and by proposing that individuals, each seeking only their own benefit, would automatically serve the common good. Laissez-faire economics helped spawn our hyper-individualism and convinced us that expansion of wealth, generated by unbridled economic growth, was the sole path to well-being---despite much evidence to the contrary.[13]

A third event that helped launch our modern food system was the 1798 publication of Thomas Malthus' *Essay on the Principles of Population*, which, for the first time, called attention to the "problem" of unchecked human population growth. Malthus argued that since human population would increase geometrically while the food supply could only increase arithmetically, food famines would, at some point, become inevitable. This awareness helped to spawn a culture of production focused entirely on yield. Increasing yield to "feed the world" became a rarely questioned value among food producers in the industrial world. Almost any production practice that promised increased yield was accepted without question.

These events, together with the technologies they spawned, dramatically transformed our food and farming systems. In the gatherer tribes as well as in the Neolithic communities, food was a *community* adventure. As Schusky points out, "The Neolithic food producers, like their food-collecting ancestors, were independent. Communities in the same regions were essentially alike in what they produced. There was no need for trade, and the only specialization of labor followed age and sex lines."[14] In other words, food and food production were community activities, rooted in community tradition, and produced solely for the benefit of the community.

In our industrial culture, food is a *commodity* to be produced at the cheapest possible price and sold to individual food customers through a highly concentrated food processing and distribution system. Producing as much food "stuff" as possible, in the least amount of space/time possible has become the sole metric by which efficiency is calculated. Farmers are simply raw materials suppliers, and are recognized and praised almost exclusively for having produced the highest yields. They are rarely recognized as caretakers and seldom rewarded for insuring long-term sustainability. Food is marketed to consumers purely as an individual good, exclusive of any community benefit.

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[13] Bill McKibben, 2007. *Deep Economy: The Wealth of Communities and the Durable Future*. New York: Henry Holt and Company. 95-128. Amartya Sen 1987, *On Ethics and Economics*, Cambridge, USA: Blackwell, 18f. Sen argues that there is no empirical verification to support the theory that self-interest serves the common good.

[14] Schusky, *Op. Cit*., 3.

Underlying this commodity culture is an "implicit and poorly articulated" utilitarian ethic that has become integrated into the agricultural "sciences," which in turn justifies the current food system claim that it "leads to lower food costs for consumers."[15]

Of course, environmental events occasionally serve to mitigate this unbridled drive toward short-term productivity at the expense of sustainability. The great Dust Bowl of the 1930s led to the creation of the U.S. Soil Conservation Service which promoted an interest in greater land care. Even so, the drive to produce as much as possible clearly remained the principal good. The slogan to describe this new food system and proudly promoted in our industrial culture is "fast, convenient and cheap," signaling that short-term returns are valued above all else. As Paul Thompson put it, farmers are now required to operate out of a single ethic, "produce as much as possible regardless of the cost."[16]

But, as we enter the 21st century, the values of short-term returns and maximizing production to the exclusion of all other values may no longer serve us well. We now know, at least since Darwin, that nature is an interdependent community of subjects, not a collection of raw materials available for our indiscriminate exploitation. We also know now that our exploitive activities have caused irreparable harm to this interdependent community and that the damage now jeopardizes future food production potential.

Furthermore, as Schusky has pointed out, the neocaloric era is of necessity a very short epoch because the calories which sustain it are "old" calories. Fossil fuels are concentrated, stored energy. They have accumulated in the earth over many millennia, and once they are gone there is no further stored energy, so far as we know, to replace them. At the rate we are extracting them we are likely to reach our new energy constraint sooner rather than later. So the compelling question now facing us is, what will the next era of food production look like and what kind of food culture can we develop to envision and sustain it?

A New Ethic for a New Agriculture

Vulnerabilities inherent within the industrial agriculture system were recognized by a few ecologists and agriculturalists throughout the 20th century. Among them were Liberty Hyde Bailey, Aldo Leopold and Wendell Berry.

In his essay, "The Outlook for Farm Wildlife" published in 1945, Aldo Leopold wrote:

> It was inevitable and no doubt desirable that the tremendous momentum of industrialization should have spread to farm life. It is clear to me, however, that it has overshot the mark . . . it is generating new insecurities, economic and ecological, in place of those it was meant to abolish. In its extreme form, it is humanly desolate and economically unstable. These extremes will some day die of their own too-much, not because they are bad for wildlife, but because they are

[15] Paul Thompson, 2006. "Introduction" in Robert L. Zimdahl, *Agriculture's Ethical Horizon*, Amsterdam: Elsevier Book Aid International. xiv.
[16] Paul Thompson, 1995. *The Spirit of the Soil: Agriculture and Environmental Ethics*. London: Routledge.

bad for the farmer.[17]

In that prescient observation, Leopold captured much of what is vulnerable, yet attractive about industrial agriculture. He also recognized early on that we could not correct the misadventures of industrial economies either through regulation or economic self-interest. As he observed in *A Sand County Almanac*, any system of proper land care that is "based solely on economic self interest . . . tends to ignore, and thus eventually eliminate, many elements in the land community that lack commercial value, but that are (so far as we know) essential to its healthy functioning." Consequently, Leopold knew that our hope lay in fostering an "ecological conscience." Such a conscience, he mused, "reflects a conviction of individual responsibility for the health of the land" and, when correctly understood, "Health is the capacity of the land for self-renewal." And from that perspective, he proposed that "conservation is our effort to understand and preserve this capacity."[18]

That insight is critical for understanding the relationship between conservation and agriculture. Conservation, in Leopold's view, is not about "preservation" or keeping nature in its "natural" state. Nature is dynamic and constantly evolving and there is no way that we can "preserve" it. Consequently, any notion of conservation which assumes that we can preserve "parts" of nature while exploiting other parts is deeply flawed. What we can do, and must do, is learn how to enhance nature's capacity for self-renewal and self-regulation. That can be done only by living in an ecological neighborhood long enough and intimately enough to learn how to manage it in an ecologically sound manner that enhances its capacity for self-renewal. Agriculture must be adapted to that task if there is to be any hope of achieving sustainability.

Aldo Leopold was, of course, deeply influenced by Liberty Hyde Bailey and shared Bailey's conviction that the only way to achieve a "permanent" agriculture was by means of a new land ethic grounded in such ecological principles. Bailey, in particular, made a significant contribution to our efforts to craft a new era for agriculture based in ecological rather than industrial thinking. He sought to "articulate principles of a new worldview, and to both develop and institutionalize support for an interwoven agricultural, educational and political philosophy needed to facilitate a worldview shift."[19]

These insights help us to understand one of the limitations implicit in many current sustainable and organic agriculture practices. We have essentially reduced sustainability to the practice of implementing technical alternatives without any fundamental change in philosophy or system design. As Peter Rosset and Miguel Altieri correctly observed, today's sustainable agriculture is beset with a "persistent contradiction . . . that of input substitution versus agroecologically informed transformation of farming systems."[20]

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[17] J. Baird Callicott and Eric Freyfogle (eds) 1999. *Aldo Leopold: For the Health of the Land.* Washington, DC: Island Press. 218.
[18] Aldo Leopold, 1949. *A Sand County Almanac*. New York: Oxford University Press. 214, 221.
[19] Paul A. Morgan and Scott J. Peters, 2006. "The Foundations of Planetary Agrarianism. Thomas Berry and Liberty Hyde Bailey" *Journal of Agricultural and Environmental Ethics*. Vol. 19, No 5. 444.
[20] Peter M. Rosset and Miguel A. Altieri, 1997. "Agroecology versus Input Substitution: A Fundamental Contradiction of Sustainable Agriculture," *Society and Natural Resources*, 10. 283.

A paltry version of sustainable agriculture, featuring input substitution, cannot begin to address the challenges we now face. Simply substituting "natural" for "synthetic" inputs---Chilean nitrate for anhydrous ammonia, for example---is not likely to reduce our energy consumption or our water use, or enable us to maintain productivity in the face of climate change. What we need is the kind of "new hold" that Bailey proposed which fundamentally changes the way we see ourselves in relation to the rest of nature and, therefore, the way we produce our food.

In the early 1900s Bailey already recognized that the "collecting" and "mining" approaches to acquiring our food in the past were not sustainable. The collector "sweeps the earth to see what he may gather" and the miner exploits what nature has accumulated without regard for the health of the land. "In both these stages the elements of waste and disregard have been heavy." Now we need to move into a third way, a "productive stage, whereby we secure supplies by controlling the conditions under which they grow, wasting little, harming not."[21]

The "new hold," the worldview which Bailey proposed, necessitates a new relationship with the rest of nature, one in which we see ourselves as an integral part of the health of the whole. It requires that we "have contact with the earth" and that farming *not* be reduced to "a business."

But Bailey was quick to point out that this new "contact with nature" was not merely some "back to the farm movement," nor

> thinking merely of instructing the young in the names and habits of birds and flowers and other pleasant knowledge . . . nor of any movement merely to have gardens or to own farms . . . nor of rhapsodies on the beauties of nature. Nor . . . of any new plan or any novel kind of institution or any new agency; rather shall we do better to escape some of the excessive institutionalism and organization. We are so accustomed to think in terms of organized politics and education and religion and philanthropies that when we detach ourselves we are said to lack definiteness. It is the personal satisfaction in the earth to which we are born, and the quickened responsibility, the whole relation, broadly developed, of man and of all men,---it is *this attitude* that we are to discuss."[22] (Emphasis mine)

Bailey was not calling for us to become naturalists, but to transition from one worldview to another---from a worldview which assumed that we were the "possessors and masters of nature" to one that recognized that we are but "plain members and citizens."

Bailey recognized that ecological thinking involved more than a shift in the way we use technology. It didn't just involve re-inventing our farms. It involved a new way of being in the world. As Rolling and Jiggins point out, "Ecologically sound agriculture requires change, not only at the farm level, but also at higher agro-ecosystem levels, such as

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[21] Liberty Hyde Bailey, 1980. *The Holy Earth*, New York: New York State College of Agriculture and Life Sciences. Reprint of the 1915 edition published by Scribner, New York. 18.
[22] Bailey, *Op. Cit*. 19-23.

watersheds, biotopes and landscapes . . . not only at the level of the farm household, but also at the level of the institutions in which it is embedded."[23]

Many have expressed pessimism about the potential for achieving such a sweeping paradigm transformation. After all Bailey proposed this transition almost a hundred years ago. Leopold picked up the mantle more than 50 years ago. Wendell Berry has expended enormous energy and brain power giving us compelling poetry, novels and essays in our own time, appealing for a similar transformation. Yet, more than ever we seem wedded to the industrial ethic. So, perhaps we can be forgiven if we remain a bit pessimistic.

But worldview transformations seldom come through articulation of new visions. They come as a result of a convergence of events which increasingly render the old world view untenable and in those moments we are given what Thomas Berry calls "moments of grace." They are moments when events occur that provide us with the opportunity to initiate significant changes due to the breakdown of the old order. And when those moments of grace arrive, it is imperative that the new vision be available to guide us in our transition. Such a moment, I suspect, is near at hand.

Indeed Thomas Berry argues that we stand on the threshold of a *unique* moment of grace as we enter the 21st century.

> So now in this transition period into the twenty-first century, we are experiencing a moment of grace, but a moment in its significance that is different from any pervious moment. For the first time the planet is being disturbed by humans in its geological structure and its biological functioning in a manner like the great cosmic forces that alter the geological and biological structures of the planet or like the glaciations.
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> It is tragic to see all these entrancing forms of life expressions imperiled so wantonly, forms that came into being during the past 65 million years, the lyric moment of Earth development. Yet as so often in the past, the *catastrophic* moments are also creative moments. We come to appreciate the gifts that the Earth has given.[24] (Emphasis mine)

The reason it is important to place our modern food story into the context of history and to hear the voices of Liberty Hyde Bailey, Aldo Leopold, Wendell Berry, Thomas Berry, and others is *not* to change the world. We cannot make their voices more compelling in the 21st century than they were in the 20th. But the context of our lives is about to change dramatically. We will have to learn to live with current instead of stored energy. We will have to live within the limits imposed on us by a generous earth community. We will have to cooperate with the cycles of life rather than declaring war on them. And we will need to adapt *to*, rather than attempt to exercise control *over*, evolutionary processes.

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[23] N. Rolling and J. Jiggins, 1998. "The Ecological Knowledge System" in N. Rolling and M.A.E. Wagemakers (eds) *Facilitating Sustainable Agriculture: Participatory Learning and Adaptive Management in Times of Environmental Uncertainty*. Cambridge, UK: Cambridge University Press. 283-311.

[24] Thomas Berry, 1999. *The Great Work: Our Way to the Future.* New York: Bell Tower. 198-199.

We may indeed experience some painful moments in the decades ahead, as we learn these fundamental planetary lessons. We may well decide to go into denial, to pretend that we can sustain the industrial fantasy world we created and inhabited for the past 200 years. But we also are presented with the opportunity to awaken from our *dream* world and prepare to live in our *real* world.

Once we opt to live in our real, ecological world and abandon the fictitious industrial world we have created for ourselves, the gift that Bailey, Leopold, Berry and others have given us will help us find our way. And the transition to the "new hold" begins with a spiritual journey. As Wendell Berry suggested, our "ecological crisis" is, in fact "a crisis of character."[25] Hence, it is ultimately our *character*, the way we relate to ourselves and the rest of the earth community, that will determine the outcome of this human experiment, an experiment that our mother earth has been conducting for the last long while, starting with mammals about 200 million years ago.

The core lesson we now must learn is that we are *not* "conquerors" of the land-community, but "plain members and citizens of it." "Man the consummate egotist"[26] must give way to man the fellow traveler. The fundamental transformation that must take place if we are to have a home on our beloved planet, let alone manage some kind of sustainable "permanent" agriculture with which to feed ourselves, is to revise our view of ourselves and our place within the earth community. It is our only hope.

Lynn Margulis and Dorion Sagan probably described the foundation of that "new hold" most poignantly.

> Human beings are not particularly special, apart, or alone. A biological extension of the Copernican view that we are not at the center of the universe deprives us also of our place as the dominant form of life on the planet. It may be a blow to our collective ego, but we are not masters of life perched on the final rung of an evolutionary ladder. Ours is a permutation of the wisdom of the biosphere. . . . The much vaunted accomplishments of technology, from writing in southwestern Asia over 10,000 years ago to the modern microchip, are not *our* property. They came from the biosphere---from the interconnected environment of *all* life . . . . We have done well separating ourselves from and exploiting other organisms, but it seems unlikely such a situation can last. The reality and recurrence of symbiosis in evolution suggests that we are still in an invasive, "parasitic" stage and that we must slow down, share, and reunite ourselves with other beings if we are to achieve evolutionary longevity.[27]

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[25] Wendell Berry, 1997. *The Unsettling of America*. San Francisco: Sierra Club Books (First published in 1986.) 17.

[26] Lynn Margulis and Dorion Sagaan, 1997. Microcosmos: Four Billion Years of Microbial Evolution. Berkeley: University of California Press. 193.

[27] Margulis and Sagan, *Op. Cit*. 195-196

I suspect that anyone who has studied our evolutionary history would have to agree with Margulis and Sagan. Redesigning agriculture for the next era would appear to be a practical necessity. The neocaloric era is clearly designed to control nature rather than adapt to nature. And it cannot last.

Yet, I also suspect that we are so emboldened by our current culture of production that many of us doubt that we could ever produce sufficient food to meet the requirements of our current, let alone our future, human family without the powerful control technologies we have invented in the last 50 years..

To address that concern it is important to recognize, at the outset, that the principal question we face regarding the human population explosion is that reducing our *ecological footprint*[28] may be a more pressing agenda than producing enough food. Failure to reduce our ecological footprint may soon cause the kind of ecological collapses which will dramatically reduce our food producing capacity and render all of our technologies superfluous.

Ironically, it may be that taking the steps to reduce our ecological footprint can go hand in hand with designing the new food system for the next era of agriculture and, in the process, actually *improve* our quality of life. In his new book, *Deep Economy: The Wealth of Communities and the Durable Future*, Bill McKibben suggests some practical ways in which communities can become much more food self sufficient while reducing their ecological impact, reinvigorating their local economies *and* living more satisfying lives than we currently do.

McKibben's examples may strike some as impractical. Despite the fact that he cites actual enterprises which appear to be successful, his examples mainly feature local production and direct marketing. Some may argue that local food initiatives cannot feed major population centers like New York City. The Cuban example may not be relevant since their climate allows them to produce food year round which would not be possible in many parts of the world. Yet, the food future that McKibben envisions can certainly be part of our new agricultural era.

But small farmer's markets are not the only examples available to us. Farmers in various parts of the world have already transitioned their farms to a new paradigm that meets many of the challenges we face. And they appear to be quite productive. I have made the case elsewhere for exploring these new systems as a way of designing a new agriculture for the future.[29] Suffice it to say here, that when Joel Salatin of Polyface Farms near Swoope, Virginia can annually produce 30,000 eggs, 10,000 to 12,000 broilers, 100 beef animals, 250 hogs, 800 turkeys and 600 rabbits on 140 acres, using a rotational grazing system that requires very little fossil fuel, then we *cannot* dismiss these new ecological models of farming as insufficiently productive out of hand. How much more could we do

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[28] William E Rees, Mathis Wackernagel and Phil Testenale.1996. *Our Ecological Footprint*. Gabriola Island, BC, Canada: New Society Publishers.

[29] Frederick L. Kirschenmann, 2007. "Potential for a New Generation of Biodiversity in Agroecosystems of the Future," *Agronomy Journal*, American Society of Agronomy. 99:373-376.

if we devoted at least 30 percent of our public research dollars to exploring various adaptations of such agroecological approaches?

In this regard perhaps Wendell Berry said it best. "If the people in our state and national governments undertook to evaluate economic enterprises by the standards of long-term economics, they would have to employ their minds in actual thinking. For many of them, this would be a shattering experience, something altogether new, but it would also cause them to learn things and do things that would improve the lives of their constituents."[30]

But as Bailey acknowledged, in the short term we may need to "escape some of the excessive institutionalism and organization" to allow ourselves to be captured by the "new hold." Beyond that we may need to be nudged toward the "new hold" by the convergence of events which will shortly begin to awaken us from our industrial dream-world and invite us to live in our real ecological world.

[30] Wendell Berry, 2003. *Citizenship Papers.* Washington, DC: Shoemaker & Hoard. 129