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A Coevolutionary Interpretation of Ecological Civilization

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The discourse on "ecological civilization" initiated in China is now spreading to the West. Ecological civilization both critiques industrial civilization and envisions a new ecological future. With this paper I am pleased to join in this critique and envisioning discourse through a coevolutionary explanation of the failings of industrial civilization and a coevolutionary interpretation of the possibilities for an ecological civilization.

I introduce the concept of coevolutionary development in Section I. I explain the short reign and most important characteristics of industrial civilization from a coevolutionary perspective in Section II. In Section III, I elaborate on the nature and importance of economism, the collection of beliefs that are sufficiently widely shared to keep the industrial order working and that must be overcome for an ecological civilization to emerge. In Section IV, I draw on the coevolutionary framework to suggest important properties of viably interacting ecological societies. I conclude in Section V with a discussion of the difficulties of directing the coevolutionary process toward ecological civilization. While this essay attempts to join the Chinese-led discourse on ecological civilization, it is situated largely in Western history and ways of arguing.

I. A Coevolutionary Framework of Development

Evolution is typically explained in terms of a species becoming increasingly better fit to live within a particular physical environment. Tortoises, for example, evolved to better and better fit arid environments as arid environments selected for individuals in the population who were better able to reproduce and survive aridity. In such evolutionary narratives, there is a clear analogy with progress for the tortoise is getting better and better at doing something. This has led to a conflation of the concepts of evolution and progress. In nature, however, the environment of a species also consists of other species: many species are predators and prey while perhaps also having symbiotic relationships with other species. Thus traits of each of the species select on the traits of the other species and all coevolve with each other. Now, with species all evolving in relation to each other, there is no longer a fixed goal like fitting dry environments. Understanding the coevolutionary process helps us see that evolution is not necessarily progress. Nature just goes on changing. Indeed, evolution is not a story of progress, and Steven Jay Gould (1989) has argued that earlier times in the history of life have been as wondrous as the one in which we live.

While shifting to an understanding of evolution as a coevolutionary process between species separates the processes of evolution and progress, understanding the coevolution-

ary process gives us a more valuable insight. Since species are coevolving with each other, we now have an explanation of the process of change as well as an explanation of how ecosystems become tightly interconnected systems where the nature of each component reflects the nature of other components. The process of change results in tightly interacting species reflecting each other qualities, like a lock and key. Change and "interlockedness" are not usually thought of as fitting together. Indeed, change is frequently understood as a process of earlier things breaking down and new things fitting together rather than existing things fitting more tightly together.

In an earlier work (Norgaard, 1994), I argued that development could be understood as a coevolutionary process. Consider a system, shown in Figure 1, consisting of five subsystems: values, knowledge, organization, technology, and the environment. It is important to first see these five subsystems as interacting with each other directly much like individuals in populations of different species interact with each other in an ecosystem. These "ecological" interactions in some cases can be described in mechanistic ways such as the impact of a plow on soil or an insecticide on insect pests as well as beneficial insects in agriculture. In other cases, interactions might best be understood as behavioral given different perceptions and levels of information. Coevolution occurs in a system, and systems have their own dynamics apart from the selective processes of evolution.

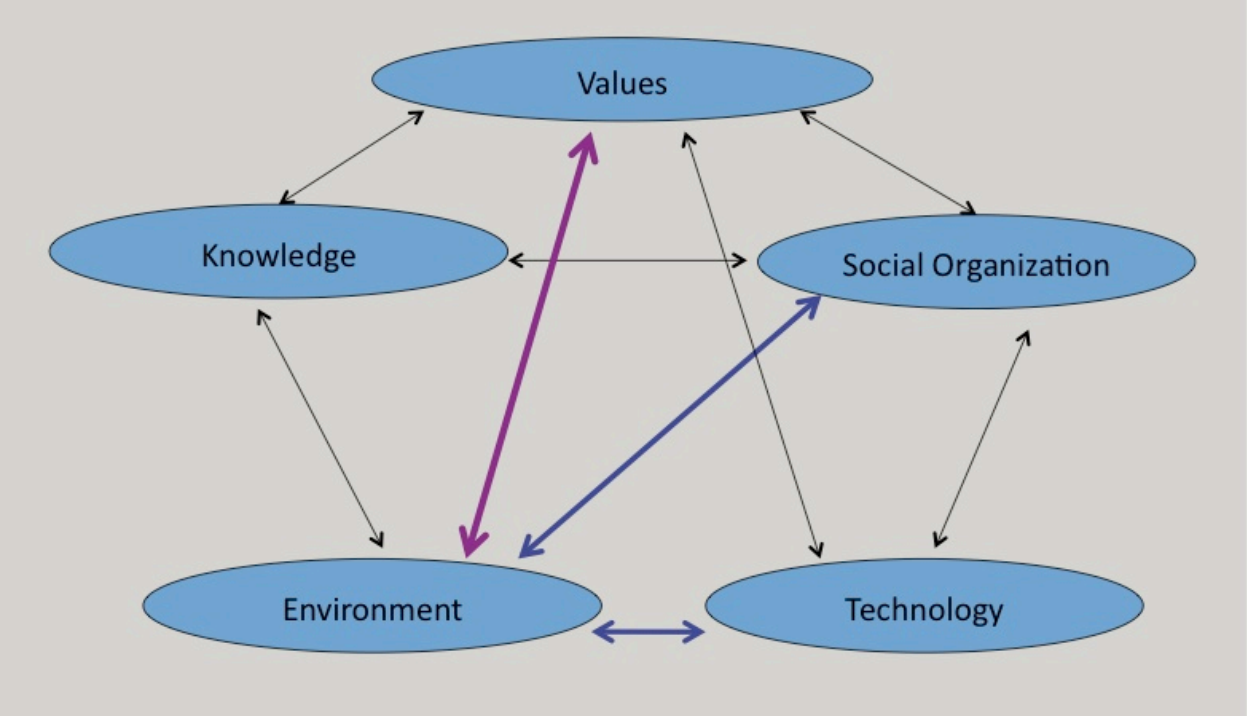

Figure 1. A Coevolutionary Development Framework (Norgaard, 1994)

With respect to the coevolutionary process, each of the subsystems has different types of traits, or culturgens, a basic unit of culture (Lumsden and Wilson, 1981) analogous to a gene. Under "organization" for example, the traits could include structural characteristics of families, markets, governments, and corporations. Some structural traits couple with other traits, for example, the bureaucratic hierarchies of governmental agencies and cor-

porations are coupled with relatively authoritarian decision-making while collectives are coupled with relatively democratic decision-making. These different traits or culturgens can be more or less important in different societies, i.e. there are distributions of characteristics, or traits, in each subsystem, as well as changing in their relative importance over time. More dominant traits provide stronger selective pressures while less dominant traits can still contribute to potential niches for new traits in each of the subsystems. New traits arise through accidents or mistakes, deliberate experiments, or "invasions" or deliberate transfers from other societies. This general framework provides a way of explaining both change and why things fit together with each other so tightly, or interlockedness.

The traits within the five subsystems would narrow and equilibrate over time except that "mutations" through replication errors and experiments as well as introductions (invasions) from other areas keep disturbing the system, challenging fitness as it had worked, and sending the system in new directions. Industrial society has been energized by fossil hydrocarbons. People have not coevolved with the environment for the past 150 years. Rather, fossil hydrocarbons drove a wedge between people and nature, and people coevolved around fossil energy. This new relationship with fossil carbon meant the earlier connections between human and natural processes were severed and human activities could, in the short run, deplete nature. Now with the dominance of modern ways of thinking and valuing in a globalizing economy, there are fewer and fewer possibilities for replication error and fewer and fewer areas beyond industrial society from which invasions might occur. The globalization of the coevolutionary process has narrowed the potential for on-going coevolution such that humanity risks coevolving to extinction. This paper elaborates on this theme, explores the possibilities for helping direct coevolution toward an ecological society, and uses the framework to further elaborate on the possible characteristics of a sustainable ecological society. Let me start with industrial society.

II. The Short Reign of Industrial Civilization

Economism and the industrial order have coevolved. Economism is the changing mix of knowledge beliefs and values related to, reinforced by, and essential to the short run operation of the industrial order. The industrial order is the changing interplay between technology and social organization made possible by the combustion of fossil fuels.

The age of agriculture lasted some 15 millennia and still dominates in particular spots around the globe today. During the 20th century, industrial civilization largely displaced agricultural civilization. The transition started in Europe during the 19th century and got underway in the United States by the end of that century, but for the most people the 19th century was firmly in the agricultural age. By moving toward industrial processes and organization and industrially supported agriculture, human population increased more than four times, from some 1.6 billion to about 6.7 billion during the 20th century. Over that century the global market economy increased by about a factor of 25, from less than 2 trillion to about 50 trillion US dollars per year (in 2000 US dollars). Industrial processes and their organizational forms supported the population surge and economic growth. Industrial society, however, will likely only have the 20th century to call its own, for the way in which industrial civilization uses energy and materials is not sustainable.

The social consequences of industrial order entailed specialization, or fragmentation, in both science and in the workplace. The fragmentation, or distancing, broke down what

had been communities of shared values and understanding (Giddens, 1990). In the age of agriculture, the vast majority of people had a direct sense of how nature worked and how to work with nature through working the land. Into the 19th century, there were philosophers who had read much of what had been written, both on natural and the moral philosophy, in their cultural tradition and some of what had been written in others. Now, ecologists understand ecology, mechanics how to fix cars, lawyers the law, with few being broadly and deeply educated or broadly and deeply skilled. While we all listen to the same news broadcasts, they are simplified down to the level of the high school educations we hold in common. This makes it extremely difficult for the public to understand complex problems and take action.

Modern science and technology made industrial society possible, but science and technology were only part of the story. The process of industrialization coevolved with the combustion of fossil hydrocarbons. Technologies, social organization, knowledge, and values were all able to feed of this new energy source rather than interact with nature. In this transition, society no longer coevolved with the environment. On the contrary, nature's services were degraded. Modern science understood nature in fragments. Both progressive governance and property rights organized our interaction with nature in piecewise fashion around reductionist knowledge. The availability of fossil hydrocarbons as a source of energy meant society no longer had to coevolve with nature. Yet at the same time, everything that people did still had a subsequent impact on nature. In effect, fossil hydrocarbons drove a wedge into the coevolutionary process, separating social coevolution from coevolving with the environment (Figure 2).

The rise of corporate and governmental central planning built the industrial and military infrastructure to assure energy and materials flowed across historic boundaries. The move from rural villages and towns to industrial and financial mega cities also restructured how people relied on and interacted with nature and each other to maintain their material well-being. And the new structure made people dependent on industrial goods and industrial agriculture for their very existence. The 20th century was marked by the application of science to war, the targeting of industrial infrastructure, two World Wars, the Great Depression, the Cold War and mutually assured destruction, and the race to steer un-industrialized nations along capitalist or socialist paths. Given the tremendous waste of war, economic instability, and doctrinaire emphases on one form of an economy or another, it is amazing that there was still a surplus leaving at least the top third of global society materially better off going into the 3rd millennium.

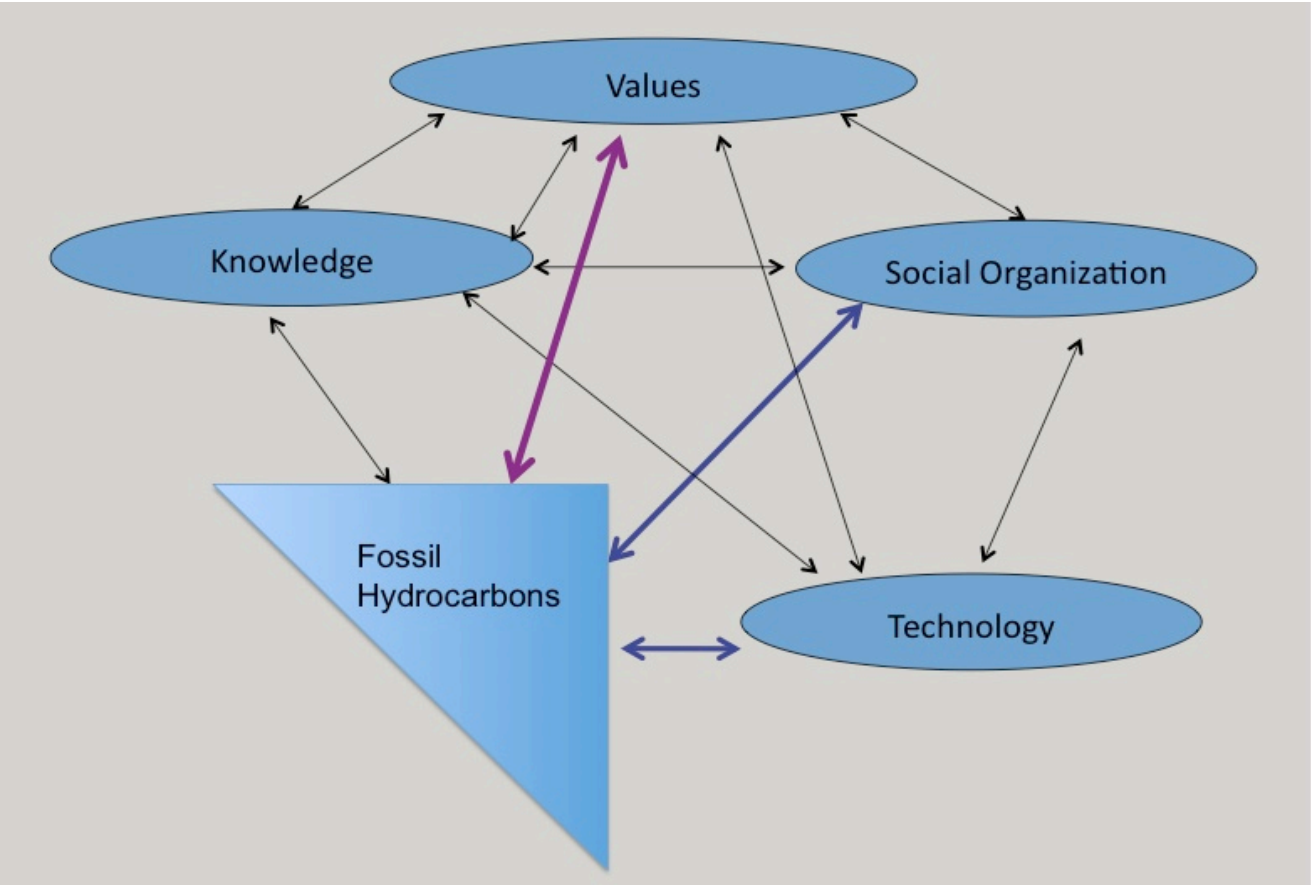

Figure 2. Fossil hydrocarbons have driven a wedge between the coevolution of society and the environment.

John Stuart Mill argued in the 19th century that people would choose free, creative, social, intimate, and playful time over long work hours for ever more material consumption. Industrial economies would naturally reach a steady-state as material desires became sated. Furthermore, the decline of the economy in our lives would be a welcome outcome for surely the producing and hawking of wares is not the purpose of life. Massive advertising, however, created new desires, sustained the demand for products, and life's purpose became tied to material accumulation. Equally importantly, the development and flow of information, already fragmented through specialization, became tied to advertising and advertisers' interests. This eventually reduced news to infotainment and complexity to exaggerations of the tails of highly distributed knowledge and values. The reduction in information, supposedly in an information age, compounded the problems of specialization and collective understanding, leading to less and less shared understanding and less and less social control over the industrial economic system. The breakdown of rational, informed governance hastened the pace at which industrial society destroyed its environmental and social basis.

The new industrial order is short-reigned because fossil hydrocarbons are being depleted and their combustion is transforming the climate. Industrial civilization must change, but first it is important to understand what holds it together and keeps it on its course even as this course is understood by more and more people to be self-destructive.

III. Economism

While the industrial social order has been marked by the disparities between what different people know, people in industrial civilization have acted together in an ever so coordinated manner. Economism has helped keep individual members of industrial civilization working together. Economism has become the residual basis of understanding behind the minimal governance that exists. Economism drives the development discourse. In short, economism presents the greatest challenge to ecological civilization. This phenomenon needs to be elaborated and teased apart, for its reign too must be short.

The economy became our cosmos. The stars still shine, but descendants of Abrahamic religious traditions are no longer shepherds pasturing sheep at night under a starry sky. On the contrary, half the world's population seldom sees stars through the artificially lit nights of the mega cities of industrial civilization. City children may see sheep in a children's zoo, for most of us have lived most of our lives in a world of buildings, vehicles, processed foods, and electronic gadgetry. Markets have long existed, but in industrial civilization markets and prices dominate our lives, signaling where we should work and what to consume. The linked chain of markets from agriculture, forestry, and mining to final products have become so long that the connections of products to nature and to people close to the land can hardly be imagined. Thus, while rice remains central in the Chinese diet, China is no longer a rice culture. Under these circumstances, the cosmologies embedded in the narratives of traditional religious and other belief systems have had less and less intrinsic meaning. Furthermore, since moral behavior is inseparable from the system in which we make behavioral choices, new mores necessarily arose around industrial civilization and, in particular, around markets.

Agricultural civilization, with the vast majority of people tied to the land, meant that most people had a shared understanding of their civilization, their place in civilization, and their civilization's relation to nature. Human knowledge is much more divided and differentiated in industrial society due to specialization in formal training and experiential knowledge. Each of person sees different aspects of reality more clearly, other aspects less clearly. Each has different interests due to specialization in education and through different roles in the industrial economy. Of course, there have long been differences between rich and poor, those with land or capital and those with neither, but now there are differences marked by who holds which particular fragments of understanding and by narrow conceptions of interest around multiple positions in industrial civilization. This makes it difficult to "see" the whole system of industrial society or be in a position to develop a sense of care for all.

Nevertheless, people have functioned together in industrial society in amazing synchrony. Industrial civilization has held together through a combination of myths about the industrial system. So there is a "we" formed through our common acceptance of beliefs that allow us to interact together, indeed to be absolutely dependent on the actions of others, in a complex economic system. Thus we are one through the centrality of the economy in our daily lives and in our concern, or not, for the future. Economism syncretically has smoothed over incongruities between fragmented disciplinary and experiential knowledge and the incongruities between earlier religious and modern market moral systems. This is equally true in the so-called "developing world" as the developed (Escobar, 1995). This commonality of shared myths that makes us a "we" is central to our difficulties in perceiving and responding to the environmental problems of industrial civilization.

Let me, for the moment, artificially distinguish between an economy that is "out there" and the complex of myths, or economism, we have developed to aid us in living within the economy. This distinction is exactly parallel to nature as a reality of its own and the complex of myths traditional peoples hold about nature and their relation to nature. Just as traditional myths provide explanations for natural phenomena, facilitate individual and collective decisions, and give meaning and coherence to life, so do modern beliefs about economics and the economy make coordinated life in industrial society possible. I refer to this complex of myths as economism. Of course, as noted in the introduction, the economy, *i.e.* the industrial technologies and social organization, that is "out there" and economism, *i.e.* the values and knowledge we believe to be true, have been coevolving, hence the distinction between economism and industrial society, except when viewed in a snapshot, is moot. Similarly, the environment has coevolved with both our environmental myths and our environmental science, both good and bad. And our economy and environment have coevolved. Nothing is separate at all. Hence the importance of deconstructing the economism we have and replacing it with more appropriate short cuts to understanding and living within the economy, an economism that will facilitate ecological civilization.

Economism is to the formal models of the discipline of economics as environmentalism is to ecology and environmental science more generally. Just as environmental science helps inform and justify environmentalism, the academic discipline of economics helps inform and rationalize economism. And just as environmentalism influences funding for environmental science and how environmental scientists choose between frameworks, the ways in which they interpret their results, and how they speak to the public, so economism affects academic economics. While distinctions between environmentalism and environmental science are commonly recognized, the term economism is relatively unknown. Yet economism is so pervasive in how we think and communicate that it is like water to fish. And while we can make fairly clear distinctions between environmentalism as a political movement and ecology and environmental science as a scholarly effort, the academic discipline of economics is so tightly bound with and infused by economism that distinctions are difficult. Indeed, it is best to understand economics as advocacy science.

This brew of popular, political, and academic philosophy and practical beliefs has an unusual property. Economism both keeps industrial civilization glued together while it greases the skids for particular types of change. Let me elaborate why economism is not only a good word to describe the role of economics in our lives but also provides a better way to think about the academic discipline of economics.

Economism consists of multiple interactive realms. First, there is academic economism, the beliefs that guide the careful selection of equations, data, methods, and words that appear in academic articles and the disciplinary discursive dynamics that lead to a few articles and the economists who write them being important while most are not. Second, there is the acculturation of students, from the lessons about markets in grade school on to the training of those who graduate with doctoral degrees in economics. Acculturation also includes the general interest material about the economy appearing in the popular press and in books. Third, there is how economists work, interacting with those who need their services, in governmental policy and implementation processes, as well as in the corporate sector. Fourth, there is the popular political economic discourse on ends and means. And, fifth, there is people's everyday sense of reality that comes through living in specialized

niches within a nearly global economy rather than, for example, on a nearly subsistence farm within a community of farmers.

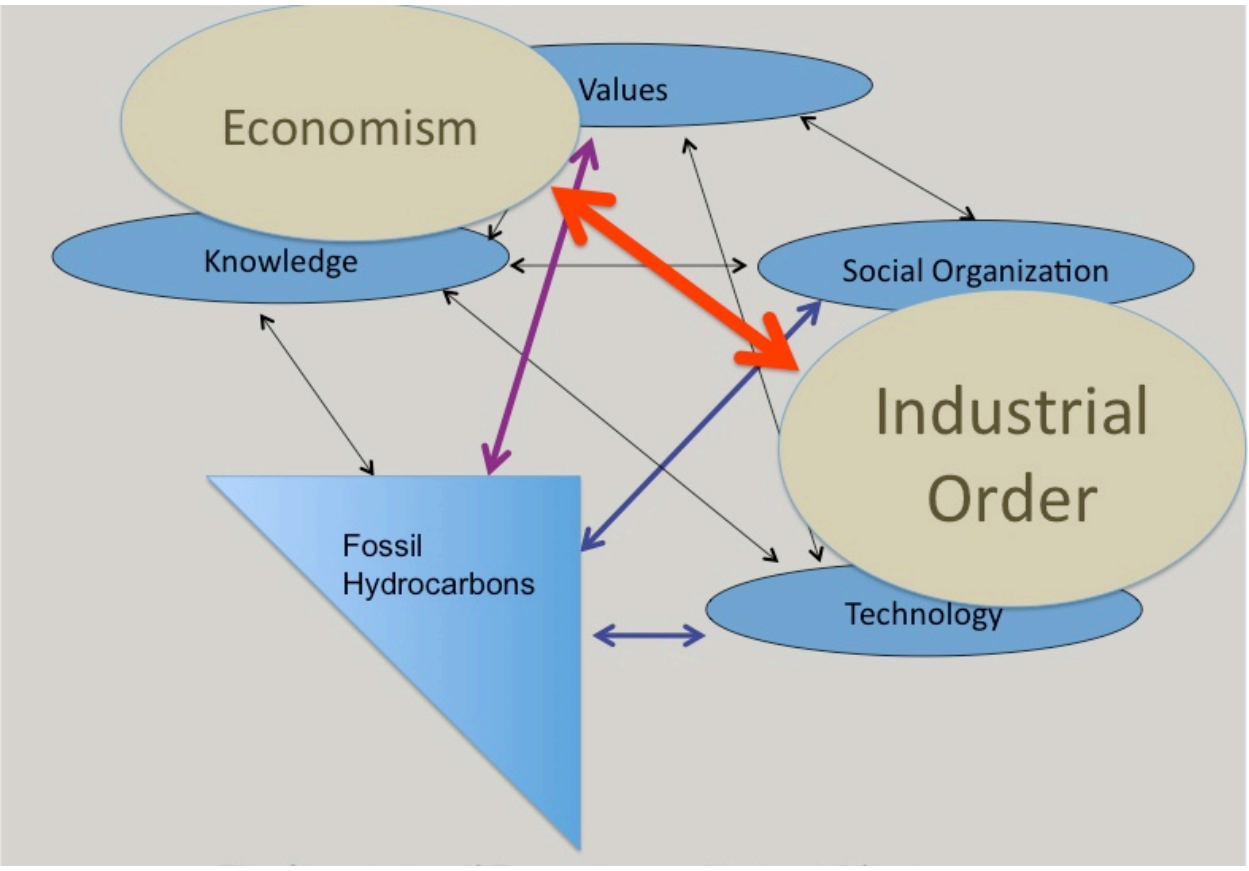

Figure 3. We now see a coevolution between the industrial order and economism

To some extent there are separate realms in which economism operates and evolves. What is taught as basic economics bears little relationship to the diversity of the historical explorations of theoretical economists. The texts say little or nothing about the small proportion of innovative economists, many at the best universities, who are opening up new paths (Colander, Holt, and Rosser, 2004). The ethereal abstractions of economic theory bear little relation to the common-sense understanding of laborers working in a globalized economy. And yet there are strong feedbacks between these different realms as well as selective processes affecting the evolution of each over time. The theory of exchange of goods – incorrectly used by capitalists, politicians, and academic economists to justify expanding capital mobility – has transformed everyday economic life. The variety and price of goods as well as wages and employment opportunities in developing economies as well as profits, wages, and employment security in developed economies have all been transformed by late 20th century developments in economism. Thus the academic, professional, and popular realms of economism, though they to some extent have their own dynamics, are highly interactive and not easily disentangled.

The importance of academic economics to economism and hence the ways it became integral to our lives is especially critical. Industrial society has been a symbiosis of economic reasoning, albeit using highly selected and sometimes incorrect selections of academic economic reasoning, with the power of economic interests. A great many individual decisions, some with deep moral implications, have been determined by income and prices. We have perceived and understood "reality" from our particular positions in the economy and through the economy to the positions of others and a world of resources and ecosystem services. Our hopes for the future have been largely economic portrayals of material progress. Our reliance on markets to solve all problems has become obsessive. Economism has been our secular religion within which we have engaged in political discourse about values and through which we have described our relations to each other and our overall position in the economic cosmos. In short, economism has played a very similar role to that of religion through much of human history, and, as a religion, economism has become decidedly fundamentalist over the last three decades.

Let me elaborate on this with a particular example around which my broader argument will build. Over the past two decades, with the rise in concern with environmental sustainability, natural scientists, especially conservation biologists, have become increasingly engaged in debates over the course of development and the implementation of new development strategies. Within these debates, they found monetary valuation strategically very attractive. Describing the value of nature in monetary terms did not necessarily fit their personal values and relation to nature. Rather, they were driven to address biodiversity loss and ecosystem integrity through what they thought was economics. Identifying the contradictions of this particular new interest in economic valuation provides a way of identifying why we cannot use purportedly objective economic techniques to get us out of the predicaments of industrial civilization that economism has been central to getting us into.

Conservation biologists share the objective of conserving biological diversity, and this objective defines their academic and professional careers. While they personally valued biodiversity because they hold life sacred in some way or another, they also came to believe that most people would never appreciate the richness of life as they did. Nature films vastly increased the public's awareness, but many conservation biologists concluded that to get through media barriers and engage in the rough and tumble of real politics, money talked louder than people's attraction to the cute and fuzzy or people's public sense of the complex, delicate dynamics of nature. Thus much as engineers in America a half century ago in the era of large water projects were drawn to learn economics and contribute to the practice of cost-benefit analysis, biologists were drawn into learning some economics and contributing to its application in the discourse on the value of ecosystem services.

Economics textbooks have long presented the shortcomings of industrial society as largely a problem of imperfect markets. We have misused the environment because there have not been markets for ecosystem services such as pollution absorption capacity, pollination by beneficial insects, and nitrogen provided by soil microbes. As a consequence, the prices generated in imperfect markets led people to make choices about interacting with the environment that were not in the public interest. Market prices should have been corrected by including all of nature's services. Cost-benefit analyses used in public decisions also needed to include values that are not currently reflected in markets. So, to a large

extent, the problem has been portrayed as one of getting the prices right so that the right decisions were made. And getting the prices right has been portrayed as a technical difficulty to be overcome by doing economics well. Hence conservation biologists were busily learning textbook economic theory,

In fact, however, conservation biologists have been simply learning economism. Economic theory is much more complicated and raises many more interesting questions than it answers, especially with respect to questions of values. Economism and most introductory economics texts have paid little attention to the history of economic thought, and in particular to the fact that economists have long known that the invisible hand of the market needs to be told where to go by a larger understanding of value outside of economics (Howarth and Norgaard, 1992). Economism does not include the history of the steps taken by economists to rationalize away the need (Harberger, 1971) for values beyond economics to make distributional decisions. The system of prices confirms Gödel's Proof that every system must rely on things outside of it to define what is inside of it (Hofstadter, 1979). And in the process of trying to match ecological thinking to market thinking, ecologists have also ignored the richness of their own understandings of ecology (Norgaard, 2010). The following quote, or some variation of it, is oft attributed to Albert Einstein:

We cannot solve our problems with the same thinking we used when we created them.

This suggests we need a new pattern of thinking, something clearly different from academic economics and economism, to get us out of the crises of industrial civilization. Markets will surely still be useful in ecological civilization, some new form of economism will surely arise. But ecological civilization requires a new paradigm, perhaps not a dominant paradigm but rather a plurality of new ways of thinking, but regardless we cannot get to an ecological civilization by coevolving within the dominant way of thinking of industrial civilization.

IV. A Coevolutionary Vision of Ecological Society

The coevolutionary framework provides a way of understanding the past. It also helps us envision an ecological society. The rates of energy and material use in industrial civilization are not sustainable. The evidence is becoming stronger that climate change will drive ecosystem change for centuries even if humanity becomes carbon neutral quickly. While industrial civilization is toying with the idea of bringing ecosystem services into the market system, environmental governance is at its limits (Norgaard, 2010). Thus a system driven by fossil hydrocarbons is not sustainable. This is the first thing that needs to be changed, and the quicker the better so that we can coevolve with natural processes as an ecological civilization. Thus, in the vision I am putting forward here, ecological civilization is a society interacting and coevolving with ecological systems in a sustainable manner within our limits of knowing and governing ourselves and our relations with nature.

The coevolutionary framework, as an evolutionary framework, inherently values and favors diversity. Diversity is essential to on-going evolution. Western individualist philosophy pleads for respect of individual diversity, for without diversity individualism has little meaning. Evolution complements moral pleas for respect with scientific rationales.

While the diversity-stability debate among ecologists has never been fully resolved, ecologists retain a strong sense that reducing the diversity of a system reduces the likelihood of the system recovering from a disturbance. Regardless of this debate over the mechanics of ecosystems, diversity clearly favors on-going evolution while the lack of diversity can lead to stagnation and the inability to evolve new forms in response to new conditions.

Diversity can be enhanced by accidents, deliberate experiments, and by introductions from other ecosystems, or in the coevolutionary development of civilization model, other cultures. For the latter to occur, other cultures are needed, and thus globalization is undesirable. Introductions from other places need to be possible, but if they are occurring everywhere all the time, if cultural boundaries are totally ineffective, than the different cultures soon become one. Thus coevolutionary thinking favors a patchwork quilt of coevolving cultures, as shown in Figure 4. In ecology, some ecosystems in a patchwork quilt of diverse ecosystems will likely prove resilient to a range of unexpected perturbances and facilitate the recovery of all. The same can be true for coevolving societies. The increasing dominance of a few patterns of thinking, valuing, organizing, and relating through technology is an important weakness of industrial civilization. Globalizing the economy further threatened what diversity was left. Also, with little diversity between cultures, experiments in knowledge, values, organization, and technology are narrowed and the conditions for experiments to succeed are limited. With little social diversity, ecosystem diversity is reduced. This line of reasoning suggests that decoupling is in order.

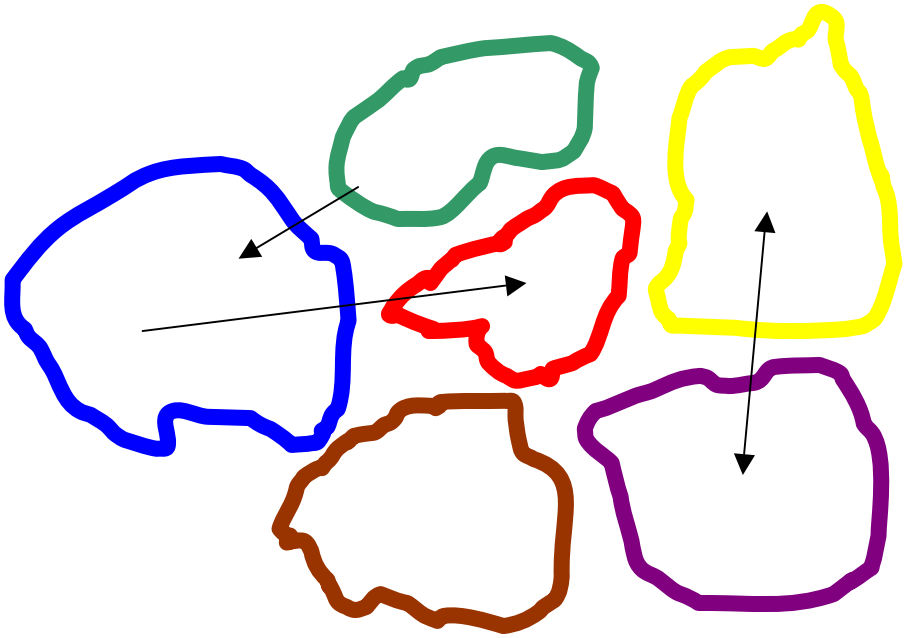

Figure 4. Ecological Civilization as a Patchwork Quilt of Coevolving Ecological Societies

Imagine a patchwork quilt of coevolving ecological societies (Figure 4). They support each other through the differences between them and thereby together make up ecological civilization. Within each patch, values, knowledge, organization, and technology are coevol-

ving with nature. The patches are "lightly coupled" in the sense that transfers of traits, or culturgens can occur between cultures but do not occur so frequently that the cultures lose their distinctiveness achieved through their separate histories. For the maintenance of diversity, there are appropriate and inappropriate levels of connectivity, and there is little question that the connectivity of globalized industrial civilization is reducing diversity and experimentation in ways of valuing, understanding, organizing, and relating to the environment. Industrial civilization and its globalization have all been rooted in the rationale of efficiency, a logical rationale to follow when a Newtonian mechanical understanding of systems dominates the knowledge system. A coevolutionary ecological civilization would place much more emphasis on understandings of systems stemming from Darwin.

The next most important difference between industrial and ecological society will be with respect to the nature of collective understanding and its interplay with values. As I argued in Section III, it is economism, not modern science and religious and other value systems operating in some sort of rich synchrony that keeps the industrial order operating. The separation of religion and science that emerged around the time of Galileo is still very much supported by the vast majority of scientists (see, for example, the arguments presented by Gould, 1999). The split between objective science as an uncontroversial public way of understanding and religion as a personal matter runs deep, it is difficult to imagine alternative configurations, and yet economism deftly fuses facts and values and it is exactly for this reason that it is so powerful. At the same time, the artificial separation between facts and values in the myth of objectivity has also had devastating impacts on both religion and science.

Sociologist of religion Robert Bellah (2001) provides an excellent overview of Christianity's awkward and limited response to the rise of economics and industrial civilization (though he and others to follow do not use this particular term). Thomas Berry and others have sought to update the cosmology of Christianity to bring it in line with modern natural science, how this feeds back on the nature of morality in industrial civilization, and the need for a whole new direction (Berry, 2006; Swimme, 1996; Tucker, 2003). Berry has also raised key questions concerning the mismatch between religion and economic beliefs (Berry, 1999). John Cobb and Herman Daly have been especially effective at providing a Christian critique of economic beliefs while constructively contributing to our understanding of sustainability (Daly and Cobb, 1989). While these authors are working from a Christian framework, the issues they raise with respect to values, science, and industrial civilization are broadly applicable to other religions and secular moral philosophy. Indeed, the implications of the findings of climate science for intergenerational ethics and rich-poor social justice have given birth to a whole new literature within secular moral and political philosophy (Brown, 2002; Northcott, 2007; Sachs and Santarius, 2007; Schlosberg, 2007; Garvey, 2008; Vanderheiden, 2008; Gosseries and Meyer, 2009).

Much of the literature on how the mythical separation of valuing and knowing has affected science falls in the realm of postmodern sociological critiques of how science really works within society (Nowotny, Scott, and Gibbons, 2001). Much of the problem is associated with the fact that different frameworks for understanding complex systems, or different assumptions used in the application of frameworks, emphasize different things and thereby prioritize, or value some things at the expense of others, with whole communities of scientists defined by their frameworks of thinking and disciplinarily-accepted assumptions (Norgaard, 2008). The integrated assessments of complex problems such as the work

of the Intergovernmental Panel on Climate Change, and interdisciplinary scholarship in general, bring out the contradictions of "divergent disciplinary objectivities" (Norgaard, 2008; Norgaard and Baer, 2005a and b). Renowned climate scientist Stephen Schneider documents the contradictions in his autobiographical account of the history of climate science (Schneider, 2009). Indeed, the interactions of climate science and industrial society are so mutually malignant as to portend a grisly death for each (van Storch *et al*, forthcoming).

And so what will play the role in place of the role played by economism in industrial civilization? What will smooth change while holding ecological civilization together? How can we retain the best of our heritage of values and the insights into reality through science, encourage the coevolution of valuing and knowing again, and make them functional together?

I find hope in discursive democracy, a transition away from vote counting toward shared learning. I have argued that scientific assessments of complex issues such as climate change and ecosystem transformation entail deliberation, learning, and the development of trust between scientists from different disciplines with different values (Norgaard and Baer, 2005 a and b; Norgaard, 2007 and 2008). The assessment process certainly does not always go smoothly (Schneider, 2009), but it works better than any other approach to date toward inclusively expanding understanding and engaging with values. The experiences of some in the scientific community with the integrated assessment process of deliberative learning complement the arguments for deliberative, or discursive, democracy as a way of rebuilding political society being explored by key political theorists (Dryzek, 1990 and 2000; Gutman and Thompson, 2004; Ober, 2008; Sunstein, 2009). Just how deliberative democracy as a way of working with science and values will connect to implementation is by no means clear. The typical breakdown of governmental agencies as defined by disciplines and bounded problems are rooted in the myth of objective science and tightly bound to reductionist approaches of thinking. Some new form of adaptive organization will need to arise, but thinking in this direction is still quite preliminary (Brunner, et al, 2005; Adger and Jordan, 2009).

V. The Possibilities for Coevolving Toward Ecological Society

The coevolutionary framework gives little support, indeed goes against, traditional sources of hope for the future. Coevolutionary change may be good or bad. In coevolutionary thinking, there is no inevitable march of history or presumption of progress as found in so much of modern social argumentation from Marx's historical materialism to Rostow's "Stages of Economic Growth" and on to the "environmental Kuznets curve wherein the problems of growth are overcome through more growth. Plowing forward, let alone plowing faster, will not get us to ecological civilization, at least from the coevolutionary perspective. Georges Sorel (1908) argued a century ago that both capitalists and Marxists were holding out the promise of progress, encouraging workers to trudge onward faster, and that the promise was in fact simply an entre to further exploitation. With respect to ecological civilization, the promise of an inevitably better future by pushing through industrial civilization is simply a way to continue environmental exploitation.

Neither, however, is coevolutionary thinking supportive of narratives in the Abrahamic tradition of an earlier Edenic time followed by damnation and the possibilities of

redemption by following a path of righteousness. Fossil hydrocarbon consumption by industrial civilization is not analogous to the forbidden fruit bitten into by Adam and Eve. The coevolutionary narrative is neither one of ascendance nor damnation.

The coevolutionary framework also leaves us with the sense that whatever controls we thought we had over the future, the controls presumed to be there in more mechanistic, deterministic ways of knowing, have been disabled. Thinking through a model where the past unfolds into the future through experiments and random introductions rather than through human design is humbling. It helps us see how industrial civilizations, their technologies and social organization as well as our knowledge and value systems, have interacted and coevolved around fossil hydrocarbons. The coevolutionary framework helps us understand the relationship between economism and industrial civilization. But this new framework neither helps us see how industrial civilization could have been avoided nor helps us see how we can help ecological civilization emerge. Indeed, because our knowledge, values, organization, and technology have coevolved around fossil hydrocarbon energy, rather than nature, we see that the transition to a new path of coevolving with ecological systems will not be easy. Quite the contrary, the current qualities and interlockedness of knowledge, values, social organization, and technology favor coevolution to human extinction or some "survival" outcomes we probably would not choose. Let me be a little more specific.

An important strain of modern consciousness, especially among scientists since Francis Bacon, has posited a world of progress through increasing control over nature. In this form, people, with scientists in the lead, transcend nature, becoming more God-like as they free themselves from worldly constraints. A combination of God-like fantasies and beliefs in historical inevitability seem to drive promoters of creating super people through the new genetic technologies (see, for example, Silver, 1997 and my review of the literature, Norgaard, 2004). Ray Kurzweil (2005) has written a best selling futurist book on how humans are at the threshold of transcending biological destiny through a combination of genetic, nano, and robotic technologies. One reason the scientific community has not solidly endorsed the science of climate change is because many non-climate scientists are firmly convinced that we can, will, and should evolve beyond the temporary problems of climate change, rising above the problems of a warming earth to some new world in which people are super human and not in need of nature. Of course, the new super people will not simply be super-intelligent, they will all be beautiful and athletic too. Meanwhile those procreating naturally would become increasingly less useful and desirable. The promoters of these brave new worlds acknowledge that many will be left behind, procreating naturally without access to the super genes of those who will control the future. Following this scenario, something will have to be done about natural people to keep them from being a drag on progress, and it will not be pretty. And with no use for natural environments, nature too will likely suffer, not from overuse, but simply because it will get in the way.

Thus I am just as concerned with what some "optimistic" futurists present as an ascent of humanity as I am concert with what many pessimistic environmentalists present as humanity's demise. Both seem possible, with the two being in somewhat of a competing race, though a combination of the two also may be possible.

Nevertheless, I still have hope. The coevolutionary way of thinking does not deny the possibilities of guiding the future in desirable directions. Human consciousness evolves and can be changed consciously also. Evolutionary thinking does not deny the possibilities of

"free will" (Dennett, 2004). By exposing the defects in economism, by providing alternative ways of thinking about the future, and by deliberately engaging in experiments in social organization, we can help establish the conditions that could lead to an ecological civilization as envisioned through the coevolutionary framework.

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