Connecting the Dots: Hayek, Darwin, and Ecology

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Abstract: Social institutions viewed from a Hayekian perspective closely match evolutionary and ecological perspectives in biology. All rely on the same systemic relationships of variation, selection, and inheritance. What Hayek called spontaneous orders are variations of a larger range of related phenomena. Concepts developed in one such field can enrich our understanding of analogous phenomena in others. Among the most important concepts explored here are individuals, organisms, species, and ecosystems. This integration carries important implications for how human societies can exist sustainably on the earth.

Keywords: Aldo Leopold, biology, Darwin, ecology, ecosystem, emergent order, evolution, Geerat Vermeij, Hayek, individuality, invisible hand, meme, organism, organization, spontaneous order

> …modern ecology is…the creation of two groups… The one studies the human community almost as if it were a separate entity, and calls its findings sociology, economics, and history. The other studies the plant and animal communities…The inevitable fusion of these two lines of thought will, perhaps, constitute the outstanding advance of the present century.
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> Aldo Leopold, *A Sand County Almanac*

This essay integrates the study of social institutions from a broadly Hayekian perspective with evolutionary and ecological perspectives in biology, arguing all rely on the same systemic relationships of variation, selection, and inheritance, albeit in very different contexts. Hayek's "spontaneous orders" are important examples of this much larger range of related phenomena. Consequently, we may learn more about any of them by exploring research of analogous processes in another.

Evolutionary theory rests on three insights that, in different words, are often applied to the social sciences of complex phenomena: variation, selection, and inheritance. When variations appear in organisms within a particular environment, some survive better than others, with the most successful leaving more descendants. As they do they pass their advantageous traits on through their offspring. This is the evolutionary process. Ecological theory utilizes these same insights from a different perspective, emphasizing relations between different species within a given network rather than the change from one species to another along a given trajectory. Although these basic principles have been greatly refined and developed since 1859, no subsequent scientific work has challenged Darwin's core insights.

Earlier observers thought they saw similarities between the economy of nature and the economy of a household, and assumed a higher authority was responsible for both. Recognizing these same similarities, today many natural and some social scientists suggest they arise from social and natural invisible hand phenomena. Variation, selection, and inheritance are common to all, but the nature of the variation, the principle of selection, and how inheritance is passed on, are specific to the order we are examining. So how far can we go in exploring these systemic similarities?

Biologist Geerat Vermeij argues we can go quite a ways, writing "Perhaps evolutionary theory and the long record of life on earth might reveal insights that political scientists, psychologists, and historians . . . have missed" (Vermeij 2010, p. 60). I believe Vermeij is right, and this paper will seek to build on his argument from a social scientific direction.

DISCOVERY PROCESSES

Hayek described competition as a discovery process, and explored this way of looking at it from a market and a scientific perspective (1978). His insight applies to both biological and social invisible hand phenomena. Be they innovative

products, scientific hunches, political proposals, or new species; variations on ways of existing within such systems are kinds of hypotheses that are then subjected to evaluation by the systemic contexts on which they depend. There has to be a successful fit between the "hypothesis" and the systemic constraints within which it is evaluated. Successful hypotheses acquire systemically defined resources of money, acceptance by scientists, votes, or offspring, and so flourish (diZerega 2010). Within any of these processes, at any point new hypotheses can arise to be tested in turn and possibly replace one that had long been dominant.

Successful hypotheses fall along a continuum between marginal changes and something truly new. In economic theory one end of such a continuum can be described as Kirznerian arbitrage entrepreneurship: alertness to opportunities for successful market transactions (Kirzner 1973). The other end is pure Schumpeterian pioneering entrepreneurship, the process of "creative destruction" (Schumpeter 1961). Most actual entrepreneurial projects fall somewhere along a continuum between these models, disrupting some plans while having an arbitrage dimension as well.

The same observation applies in science, where, Thomas Kuhn distinguished between "revolutionary" (Schumpterian) and "normal" (Kirznerian) science (Kuhn 1996). Scientific knowledge usually increases at its edges as the implications of existing theories are applied to explore ever more questions. Sometimes, however, a major discovery transforms how scientists think about what had once seemed settled knowledge, as happened in physics with the discovery of relativity and quantum mechanics, and previously, with Darwin and evolution. Other discoveries can fall somewhere in the middle, transforming a particular discipline while not challenging the larger scientific consensus within which it exists. The theory of continental drift is an example. Again we are observing a continuum of more or less rather than two distinct categories of change. I have made the same distinction regarding policy innovation within democracies (diZerega 1988, pp. 454-7).

The same patterns appear in biology. Vermeij quotes Wolfgang Steerer arguing "An organism represents a hypothesis of its environment, continually tested by selection for its predictive value and modified by adaptation for a better fit" (Vermeij 2004, p. 26). Over time new developments arise based on those that have previously succeeded. Vermeij explains, "Adaptation in general is the formation, and continual testing, of hypotheses about the environment" (Vermeij 2004, p. 26).

As in social systems, successful adaptations are usually marginal, such as a species gradually developing greater speed or resistance to a pathogen. However, sometimes these changes will be deeply transformative, as when the evolution of grasses made the rise of tropical savannah ecosystems possible at the expense of forests (Stromberg 2011). Perhaps the most profound change is when some species develop new ways of organizing themselves, such as the social insects who individually are small and vulnerable and whose ancestors were largely solitary. Most individual social bees and all ants are less viable than their solitary ancestors, however as societies they are now among the most successful life forms to have ever evolved (Wilson 2012). We human beings are the most extreme earthly case of ecological transformation caused by this process.

NATURAL AND SOCIAL NETWORK EFFECTS

Because they are networks, when acting within ecologies Garret Hardin emphasized we cannot do only one thing (Hardin 1986). As with social invisible hand phenomena, everything is linked with everything else in networks of relationships. Some of these links are weak but others are strong, and we often have little idea what the stronger ones are until we have disrupted them. For example, no Japanese forester imagined cutting coastal forests would significantly harm ocean fisheries, or even harm them at all. When a marine chemist then discovered decomposing leaves from forests significantly fertilized plankton, trees were replanted in coastal places. Where this was done, fish and oyster harvests increased (Robbins 2002). These kinds of networked relationships go every which way. Scientists studying Pacific Northwest forests discovered returning salmon's bodies were an important source of nitrogen, enhancing forest growth, which in turn enhanced the region's suitability for sustaining salmon (Helfield 2001).

The same observation applies in society. When the city of Berkeley adopted rent control, neither critics nor advocates imagined one of its impacts would be to make Berkeley a center for "California cuisine." The long-term influence of rent control was to reduce student populations, replacing them with young professionals with more money to spend and more interest in eating out. The result was a burgeoning of creative restaurants while the population rent control was intended to assist declined (diZerega 2000. pp. 311-14).

While many organisms' presence or absence has little impact on the ecosystem they inhabit, if an organism's influence is strong enough its presence can transform one

ecosystem into a different one, as happened with the evolution of grasses mentioned above. Their physical size is not important. Grasses are smaller than trees. But the networks they influence are very important. Being grazed often kills small trees, but because they grow from the bottom up, grasses are little damaged, and many even thrive on it. In ecological studies, species whose presence or absence changes the broader ecological patterns are called "keystone species." For example, salmon are a keystone species in Pacific Northwest forests, even though they are rarely present (Grames 2012).

We see the same patterns of networks and stronger or weaker links in society. Cities are social ecologies constituted by intricate networks of relationships. Jane Jacobs famously argued the nature of city blocks had a large impact on a neighborhood's safety and social and economic vitality. Small diverse blocks encourage varied pedestrian use because they are more pleasant places to walk. Pedestrians add to the attractiveness of a neighborhood, and provide constant observations of what happens on the streets, increasing public safety. They promote a diversity of social networks. Short blocks are more than simply an 'inefficient' street layout for car transportation. Increasing the speed of traffic flow by widening streets and creating longer blocks discourages these other positive urban features, degrading a city's social and economic health (Jacobs 1961, pp. 112-40). Imposing these requirements from above is like converting a natural forest to a plantation, where a complex network is subjected to a hierarchy of priorities, in this case facilitating traffic flow above other values.

Vancouver, British Columbia, is usually described as one of the most livable cities in North America, if not the world. Vancouver's urban policies generally reflect Jacobs' and others' insights about vital neighborhoods being more important for urban well-being than encouraging rapid transportation. They cultivate a vital urban ecology. The wisdom of these insights has been confirmed for many decades (diZerega and Hardwick 2011).

Short blocks are not the only factor encouraging urban vitality. Jacobs argued dense mixed use neighborhoods populated by people of varied incomes had a similar impact, again by increasing the variety of interactions. High-rise apartments surrounded by open space, no matter how park-like, inhibited the growth of social networks, reducing a region's ability to support and nourish rich human relationships and increased crime. As in natural ecologies, complex network effects existed at every level (Scott 1998). However, due to the networks of relationships they encourage short diverse blocks could be described as a keystone feature of vital urban ecologies (Schiller 2016).

BLURRING BOUNDARIES

Most of the time we describe biological ecosystems as if they possessed clear boundaries, as I just did when describing the Pacific Coast forest ecosystem. But in fact, all ecosystems are integrated into the larger biosphere, the total ecology of life on earth. Boundaries between the ocean and land, forest and savannah, or a lake and its surroundings are porous, sometimes very much so, as those Japanese scientists discovered. But for most purposes the "ecology of life" is too complex to comprehend, and so scientists look at smaller sub-systems, such as coastal rain forest or arctic tundra, as reasonably unique in themselves and hope to discover patterns that might also exist elsewhere, or perhaps encounter something new to science.

Ecosystems' boundaries are determined by the questions we ask. The Pacific salmon ecosystem overlaps with that of Pacific Northwest rain forests but raises different questions for research. When studying the Amazon rainforest, usually an ecologist does not need to pay attention to wind-blown dust from parts of Africa, but for other questions this more inclusive frame is important because the dust is a major source of phosphorus for earth's largest tropical forest (Yu 2015, p. 42).

Again, the same pattern exists in the social world. The market order is the network of products and production that incorporates all that is bought and sold. Science grows in complexity as new discoveries open up additional fields for exploration. Neither the market nor science are coterminous with the social world. We can select out subsets of social ecosystems such as markets or science for study, but in reality, as with natural ecosystems, they interpenetrate. The boundaries we perceive arise from our questions. Markets, science, and other spontaneous orders in Hayek's sense combine and interpenetrate in the larger social world we call civil society (diZerega 2014).

INDIVIDUALS IN BIOLOGY

The same kind of relativizing and blurring of what were once considered reasonably distinct ecosystem boundaries is also being discovered in the organisms *within* these systems. To focus initially on nature, over time the ecology of life tends to become increasingly complex (Vermeij 2004, pp. 252-4). Growing differentiation creates possibilities for

new kinds of biological integration. For example, two very different species of tree, paper birch and Douglas fir, live cooperatively, aided by yet another species, a mycorrhizal fungus, that links them at their roots. Each sends carbon to the other during stressful periods. During the summer, young firs suffer if they are in the shade, and receive aid from birches. In the winter the birch have no leaves to produce energy, and receive nutrients from firs (Frazer 2015). The result is what *Nature* called the "wood wide web" (Helgason 1998). There are many similar examples. We have even discovered varieties of bacteria within our guts can make good health possible, and influence our minds for the better (Schmidt 2015).

Sometimes a species will have existed so intimately with another for so long its members can no longer live independently, as with some fungi ants cultivate and the corn we cultivate. This dependency can even embrace both organisms, as with yucca moths and yuccas, each of whom needs the other to reproduce.

This blurring of once taken for granted boundaries goes still further. What we have long considered individual organisms are not individuals in the way we thought. In some cases, distinct organisms become so dependent on one another they become a separate individual in their own right, as with the partnership of algae and fungi we call a lichen. In recent years, these relationships have been discovered to be far more common than once imagined. Even the eukaryotic cells making up our bodies and the bodies of all other multicellular organisms are composed of what were once at least two distinct organisms (Margulis 1999).

Bacteria are a different kind of individual entirely. Individual 'species' of bacteria can trade DNA back and forth allowing resistance to antibiotics to rapidly spread through a population. The borders between individual bacteria are more open than they are in eukaryotic cells. Individuality in any strong sense does not exist.

In all these cases boundaries between organisms remain, but, depending on the issue at hand, they can be porous and sometimes only contextual. In terms of our own biology, increasingly scientists call us "ecosystems" (McFall-Ngai 2013) or "super organisms" (Milius 2014, p. 15). Our individuality is certainly real, but emerges from a node of intersecting relationships rather than existing as some kind of psychological or biological billiard ball separate from other similar balls.

This revision of biological individuality helps deepen our understanding of it in the social world.

INDIVIDUALS IN SOCIETY

Human beings are biological individuals *and* social individuals. In nature most biological individuals are not social in our sense of having a culture and division of labor and knowledge. They are two different kinds of individuality. I want to suggest in turn that *not all social individuals are biological individuals*. Each kind of ecosystem develops its own kinds of individuals and species, and individuals in the social world include more than what we think of as individual human beings. We are its only biological component, but not its only social component.

Species are collections of individuals with common traits that, on the whole, maintain their distinctiveness from other species. As we have seen, the boundaries between biological species are not rigid, but they are strong enough for the species distinction to be important (Stamos, 2013). Is there a social-ecosystemic equivalent to biological species?

Geerat Vermeij helps us here, arguing in economic systems an 'occupation' is like a 'species.'

> The key to the analogy between species and occupations lies in the roles that these entities play in the systems in which they live. The conditions of life create a regime of selection that yields adapted individuals whose phenotype [its observable features] reflects not just ancestry and the means by which some species can be told apart from one another, but also the ways of life the members are able to lead thanks to heritable adaptations. Similarly in human society, occupations have phenotypes that allow us to identify and classify individuals economically. Like species. (Vermeij, 2004, p. 45)

Building on Vermeij's insight about occupations, organizations are like complex organisms where different species of professions symbiotically combine to accomplish what they could not achieve by themselves (diZerega, 2015). There are many biological equivalents to this kind of relationship, such as lichens, slime molds, and corals. The key to this insight is to focus on the relationships (occupations) rather than the biological individuals (human beings).

From a human point of view many organizations resemble slime molds. Most of the time slime molds exist as individual amoebae living separately on the floor of a forest. However, should conditions deteriorate, they combine together into a larger "slug" able to accomplish what they

cannot individually. In their new collective relationship individuals act differently than when they were separate from one another, including self-sacrificing behavior in service to the larger entity. Yet in many slime molds their individual cellular boundaries remain, and if conditions improve the larger 'slug' dissolves again into individual amoebae (Cellular Slime Molds). The relationships between slime mold amoebae shifts between one kind of individual to another. Is the amoeba an individual organism? Is the 'slug'? Are they both?

Applying this perspective to society, occupations come together to form organizations to accomplish what they could not achieve singly. Individual human beings are expendable so long as the occupations they practice are performed by another.

Should the organization cease to exist, many occupations can still survive on their own. As with a slime mold, human beings will behave differently on their own than they otherwise might when part of a strong organization, a phenomenon behind some of our most heroic acts, and also many of our most despicable (diZerega, 2015). But what makes them a part of the organization is not their individuality but their performing essential occupational functions. Thus, the organization is an organism composed of occupational relationships shaped by the context within which they exist together.

Like occupations, organizations seek their goals in a larger selective environment that imposes constraints as well as offering opportunities to flourish. As with successful occupations, successful organizations adapt to handle their environmental constraints as well as exploiting their opportunities. Like an organism they can evolve and adapt. Organizations are complex non-biological organisms existing within the social ecology.

Civil society as ecology

The model I am developing sees civil society as an ecology. On the one hand, because we are biological beings, civil society is a part of the ecology of biological life. But it is also a network of voluntary cooperation, shaped by and in turn shaping human ends. Their strongest strands are the invisible hand phenomena of markets, science, democracy, and other spontaneous orders. Now we are seeing another dimension to this network: organizations and occupations comprise species that to some significant degree can be separated from their biological identity as human beings. Of course, they work through human beings, but they can in turn actively shape the human beings who comprise them. Far from needing expression by biological organisms, increasingly many occupations are being performed by robots, and organizations increasingly prefer the latter.

Civil society contains many different kinds of organizations: sole proprietorships, partnerships, family owned concerns, cooperatives, research teams, churches, charities, sports teams, universities, political parties, and corporations. Each kind of organization brings different strengths and weaknesses to its task. Some are specialized to flourish in science, some in the market, some are profit oriented and some are philanthropic. Some members within an organization are tightly linked, as in a sports team, and some are loosely linked, as in a university. Because it best facilitates individuals coming together to cooperate for common ends, civil society is the richest and most diverse social ecosystem for organizational species.

If organizations in a social ecology are like organisms in a biological one, we will gain in understanding by viewing them as subject to similar evolutionary pressures leading to differentiation and adaptation. Organizations seek to succeed within an environment shared with other organizations, each shaping that environment to some degree and in turn shaped by it. There are producers who seek systemic resources and are then subject to predation and parasitism as well as scavengers who reconstitute organizational resources into more viable forms. There will also be keystone organizations as well as others that play a far less important role in shaping a social ecosystem. Like a life form, each can be understood teleologically

Distinguishing occupations and organizations from the human beings who embody them sets the stage for a final step in grasping how civil society can be understood as the most complex ecosystem ever to have arisen on this planet. Institutions, be they organizations, occupations, or other patterns of relationship we engage in are cultural, not biological, phenomena. And cultural phenomena are maintained or changed by how we think about them.

The extended nature of the human mind

We evolved in a chain of descent probably going back at least 3.8 billion years (Rosen, 2015). We express this heritage in at least our metabolism, our senses, and our physical needs. Today scientists are learning this deep earthly rootedness even shapes our psychological well-being and the conditions for maintaining physical health (Maller, 2006, p. 45-54; Williams, 2017). We are more intimately connected to this planet than the abstractions of 'economic man' and 'rational action.' can ever grasp.

Yet all of us are aware we also differ from the rest of nature. There is no region of the earth where life has not been significantly affected by human action other than perhaps bacteria or archaea living deep underground, in undersea vents, or deep in thermal pools. Our era is increasingly called the anthropocene because in important ways we are increasingly influencing global ecosystems and even the world's geology. Even more distinctly, we *know* we are doing so.

Rather smugly, we attribute our disproportionate influence over other life forms to our intelligence. But as we usually think about our intelligence, we are wrong. We are cleverer, but not in the way most of us like to imagine.

Human intelligence comes with few instincts able to orient us in the world. If necessary, a newborn fawn can soon run. Absent that necessity it knows to lie quietly to avoid predators. A human baby will normally take a year to walk, two to run and many more to run fast. If infants needed to be quiet to survive, we would be extinct. *Individual* intelligence is real enough, but is primarily useful on the margins, benefiting from and occasionally modifying achievements of a greater intelligence located in relationships *outside* our physical bodies rather than inside our heads.

Our minds consist of much more than what our individual intelligence can discover or create. They also include our cultural inheritance. As Hayek put it, "Mind is as much a product of the social environment in which it has grown up and which it has not made as something that has in turn acted upon and altered these institutions."(Hayek, 1973, p. 17). Hayek elaborated " [M]ind can exist only as part of another independently existing distinct structure or order, although that order persists and can develop only because millions of minds constantly absorb and modify parts of it (Hayek, 1979, p. 157).

Based on work with an unusually isolated Amazonian tribe, linguist Daniel Everett's newest work demonstrates how, rather than having an innate instinct for language, as has long been thought, language evolved along with culture. It is not an artefact of biological evolution, but rather of cultural evolution, promoted by the need to communicate effectively and quickly. Like Hayek, Everett argues culture and language are the foundations for human reason and understanding (Everett, 2017; 2012).

Tom Wolfe writes of Everett's conclusions "language had not evolved from . . . anything. It was an artifact. Just as man had taken natural materials, namely, wood and metal, and combined them to create the axe, he had taken natural sounds and put them together in the form of codes representing objects, actions, and, ultimately, thoughts and calculations and called the codes words" (Wolfe, 2016).

Mind in this more inclusive cultural sense constitutes an emergent order of its own with its own variation, selection, and inheritance, one in important respects distinct from the orders in the biological world. For example, language enables the rapid inheritance of acquired characteristics, and that inheritance can come from any person who is able to pass on or be imitated by another, regardless of biological connections. If sex speeded up evolution and adaptability by mixing two genomes, language does so by mixing the insights of countless individual minds. The world of ideas operates in important respects in different ways than other ecological processes, but with the same abstract principles underlying them.

Memes and institutions

Richard Dawkins' term "meme" describes an idea that enters into culture and can then shape as well as be shaped by it. As such memes have a kind of 'objective' existence in the sense Peter Berger and Thomas Luckmann used the term for culture as both a human creation and an objective reality (Berger, 1967 p. 61). They exist independently of any particular subjective mind, and need those minds to replicate. Successful memes influence behavior, sometimes powerfully.

Dawkins famously compared memes to genes, arguing like genes they adapt, flourish, and die, in their case through our success or failure in incorporating them into our lives (Dawkins, 1989). I think equating memes with genes is a most useful heuristic, and perhaps considerably more than that. As memes, ideas in the broad sense adapt, spread, die or mutate through their interaction in a social ecosystem.

From this perspective ideas are like organisms requiring mental rather than physical energy from people to flourish. Ideas compete for this mental support because we have limited attention to give them, and the most successful often form symbiotic relations with others. Without support, an idea "dies," or perhaps goes dormant awaiting a more supportive environment.

Ideas manifest in the material world by influencing our behavior. As elements within a culture, ideas influence the world through the medium of the people guided by them, shaped by the institutional framework within which they act.

Institutions are not quite like ideas. They are patterned ways of doing things that also shape our perception of what

to do and how to do them. Institutions 'tell' us how to do things but not what things to do, even if their own values influence our actions somewhat independently from our intentions. They shape and coordinate our dealings with others, and so usually magnify our power to act in the world while also channeling and shaping that power. They can be supported by memes, but are not themselves ideas.

In civil society, language, science, markets, democracy, a variety of organizations and many other elements of our lives such as what constitute a family and what it means to make a contract are institutions. Some arise in an evolutionary way, the product of our actions but not our design, others are deliberately created and found useful enough to persist until they take on a reality independent of their creators. These institutions shape and coordinate our dealings with others, to some degree independently of our intentions, and as such magnify our power to act in the world while also channeling and shaping that power.

In Berger and Luckmann's terms, like institutions, memes take on an "objective" independent existence. (Berger, 61) Initially we encounter them as a part of our taken for granted world, where what it is to be a parent is as uncritically accepted as true in the context of an institution as what it is to be a rock in the context of its hardness. Some institutions are spontaneous orders and some are the organizations acting within those orders (diZerega, 2015).

An institution is not necessarily a meme. If an institution is questioned this questioning becomes a part of the ideational ecology but need not impact how the institution operates. The market, for example, existed long before economic theory and those who support it through their action need not have any conception of it at all. Alternatively, the influence of the market as a meme need have little impact on how it functions, which is independently of individual intent or even awareness. Ideas exist separately from institutions, but each shapes the other (diZerega, 2015).

In its immediate impact on us the ideational meme-network dwarfs biological ecologies and evolution and is at least as powerful as the institutional ecologies of language, markets, science, democracies, and civil society which shape how it manifests. If institutions shape how we go about acting and cooperating, this ideational ecology provides the environment wherein we decide what it is we will do. Institutions are not creative.

Two examples help clarify my meaning. As an institution, what we often call the "scientific method" can be applied in similar ways over long periods but what counts as scientific knowledge verified by that institution changes all the time. The rules of the market and of market oriented organizations can apply to either relatively uncreative activities, such as supplying a market niche with a product that does not change, or to innovative and inventive companies. For example, markets can coordinate building buggies, cars, and rocket ships but the ideas for what to build must come from the outside.

I distinguish between institutional and ideational ecosystems because how ideas manifest is powerfully shaped by the institutions in which they act, just as these institutions can be shaped by them. While ideas and institutions mutually influence one another, for some purposes we can treat them as different. *The human relation with the rest of nature is one of them.*

We can learn from many people, reconfigure what we learned, and adapt at a speed making it possible within a single generation's lifetime to change from a society where horses were still common and cars a rarity, to one where we watched a live broadcast of the first man to walk on the moon. But when that walk occurred no one imagined the interconnected world of today with its smart phones, internet and computers at everyone's beck and call. The institutions shaping all this changed, but not nearly as much as the ideas manifesting within them.

The big disconnect: institutions and ideas as cultural accelerators

In the biological world one close analogy to developing social institutions would be the evolution of eusocial collective societies by organisms that were once solitary, such as ants or bees. While rooted in biological rather than social evolution, their evolved way of life completely changed the roles these organisms play in the world. Many who study them argue an ant colony in particular should now be considered a super organism, an organism distinct from the individual ants who make it up, or perhaps a physical extension of the queen, as if our fingers could take leave from our hands but still be subject to our intentions (Wilson, 2012). Eusocial insects can be said to have genetically determined institutions but so far as we know they have no memes, which is perhaps why they are relatively unchanging. We are obviously far more able to learn and change our institutions than are ants, but in the modern world an individual could be said with little exaggeration to know as much about the collective mind of its society as an ant does about its.

Human beings have developed two conceptually distinct and, in practice, deeply interrelated dimensions of non-biological invisible hand phenomena we combine together into

what we broadly term "culture." Both institutions and the ecology of ideas are unique to human society and so differentiate it from the biological world that ultimately supports it. They are different dimensions of the larger "mind" which makes possible and empowers what we consider our individual minds. Because they are not biological, there is a basic disconnect between the cultural world in which human beings most immediately live and the biological world that ultimately supports them.

Biologically we inherit genes and to some degree the impact of previous experiences from our parents and even great grandparents (Interlandi, 2013). Institutionally we inherit systems of cooperation and coordination, systems rewarding some kinds of cooperation and penalizing those that do not fit their values. We take most of this institutional framework for granted, sometimes seeking to change some from within the perspective of the others. But for the most part institutions and memes exist independently of individual human beings.

In terms of the language I am developing here, social institutions are subject to processes of change and adaptation, but much more quickly than most such processes in biological systems. The other dimension of mind is the realm of ideas, and here the problem is even more severe. Culturally we have developed and maintain an *ideational* ecosystem of beliefs from what "everybody knows," shading to more specialized beliefs. All of these meanings are rooted in their relationships with other such concepts. We have created an ecological field of meaning within which we orient ourselves. This system adapts even faster than does the institutional ecosystem. Biological evolution proceeds at the speed of successful reproduction. With some bacterial exceptions, institutional evolution is considerably faster. Ideational evolution proceeds at the speed of thought.

In both its institutional and ideational dimensions, culture creates a deep disconnect between human life and the biological world that ultimately supports it. Rapidly reproducing life forms able to exist as generalists can successfully adapt to us, but more specialized or more slowly reproducing ones are at a disadvantage. Rats and mice, flies, bacteria, and dandelions do pretty well in the modern world. Elephants, lions, whooping cranes, whales, redwoods, and increasingly, song birds, not so well. These beings need special protection or consideration if we are to continue benefitting from their presence.

The natural ecosystems that support us are more like redwoods and elephants than dandelions and mice. The long-term viability of ecosystems around the world on which we depend is being threatened by anthropogenic global warming. But global warming is only the most extreme instance of culturally based power disconnected from natural processes. Topsoil normally takes many years to form and can be wiped out in days. Coral reefs and kelp forests support important nurseries and shelter for the fish on which so many of us depend. They can be easily destroyed and recover far more slowly. Given their power over natural processes in the short run and dependence on their health in the long, cultures run the risk of destroying the natural processes that support them.

Some societies succeeded in living sustainably and others failed, but all societies face this challenge (Diamond, 2005). Viking settlements died out in Greenland whereas the Inuit succeeded. The fertile crescent is one of agriculture's points of origin, but today land that long sustained earlier civilizations has little agricultural value. North Africa became Rome's breadbasket after the Romans impoverished their own soil, but today North African soil is also much degraded (Montgomery, 2007, pp. 64-7). Egypt was saved from this problem because annual floods by the Nile enriched the soil, a matter more of luck than wisdom. Today due to the Aswan Dam the Nile no longer renews the soil and Egyptian farmers face the same problems less fortunately located farming civilizations had to face. Over the past 40 years the world as a whole has lost perhaps one third of its arable land, and we hope to be around for thousands of years to come (Milman, 2015).

Human culture's disconnection from nature is amplified by our unequalled capacity to shift from one resource to another, eliminating any short-term reason for conserving the first, while avoiding the natural checks that keep other species from completely consuming their resource base. The earth's life forms, the ecosystems that sustain them, and its minerals all constitute our resource base. When one resource is exhausted or made extinct, we find substitutes. In doing so we impact natural relationships so deeply as to transform one ecosystem into another, usually a far more impoverished one, Alternatively, we generate short term abundance at the risk of long term failure, as with the depletion of underground aquifers. Like a factory that never reinvests any of its profits in upkeep, natural operating 'capital,' such as soil and water, is exhausted.

Our capacity to substitute one plant or animal for another weakens any purely instrumental incentive to conserve them. But as we substitute one organism for another we usually do so based only on their utility as resources in the narrowly human world and ignore any role they play

in their ecosystems. *We act linearly in a nonlinear environment*.

The problem of ignorance

The more powerful a culture's impact on its environment the more foolish this approach becomes. Its implications duplicate arguments against market interventions such as price controls: each intervention generates unexpected problems inviting another external intervention until its ability to coordinate plans becomes seriously crippled.

The Scottish Enlightenment's thinkers criticized people thinking they could rationally reconstruct society. Within the same tradition, Hayek criticized imposing a hierarchy of goals on the market's invisible hand phenomena, arguing efforts to override the price system's coordinating abilities with direct interventions such as price controls over some or all market phenomena would backfire. Maintaining a market order required *not* making short run interventions to achieve particular goals if doing so interfered with the market's feedback processes. The short-term advantages would be clear and the future damages would *always* be unclear and so in terms of costs and benefits, *always* be under estimated. Were the results known, the interventions would usually have never have been made.

Wes Jackson made the same point with respect to ecologies: "Given that we have far more ignorance than knowledge about the workings within, the ecosystem becomes the best conceptual tool to help us understand how to get along in this world" (Jackson, 2008. p. 27). Neither Jackson nor Hayek believed nothing could be done to serve human goals better if market or ecological processes interfered with our well-being. However, they emphasized whatever we do should harmonize with the underlying dynamics of a complex social or biological system rather than imposing an external goal on it. To use an agricultural metaphor, in both societies and nature, the technique for creating positive changes should be to encourage and cultivate rather than construct and command.

Ignorance in action

Many economists have tried to integrate environmental theory into economics. If my argument is sound, they are getting it backwards. By ignoring the problem of ignorance and applying linear reasoning rooted in market based rationality to nonlinear issues, they end up with flawed analyses and mistaken perspectives. Consider two examples from *Free Market Environmentalism,* by Terry Anderson and Donald Leal. One deals with forests, the other with oceanic fisheries.

Michigan's Kingston Plains once contained a large old growth white pine forest. After the forest was clear-cut and the land burned over, the forest did not regrow. Between the kind of logging performed and subsequent fires the soil is now too poor for the trees to regenerate. Nor is the land useful today for agriculture or recreation. To most people the way the Kingston Plains was logged would appear to be a bad use of the land.

Anderson and Leal argue otherwise:

> When the trees were cut, good timber stands in the Great Lakes area were selling for around $20 per acre. In order to determine whether it would have made more sense to invest in trees by forgoing the harvest, we must consider the return on other investments. Had the income from selling these trees been invested in bonds or some other form of savings at the time, it would now be worth approximately $110,000 per acre, or $2.8 billion for the forty square miles. . . . Because the land in this area is not worth anything close to this, we must infer that harvesting the trees was the correct choice. (Anderson and Leal, 2001, p. 43)

Years before Anderson and Leal wrote their book, Garret Hardin observed "*At high rates of interest the present value of the distant future effectively vanishes*" (Hardin, 1986, p. 74). The old growth redwoods we treasure today are not 500 years old, the minimum standard for old growth trees of that species. They are at least 1500 years old. As Hardin observed, "He who finds ecstasy in the wonder of today's mature redwood forest benefits from a preservation a pre-Christian economist could not have justified" (Hardin, 1986, p. 75).

The forest that once stood on the Kingston Plains were considerably younger, but according to economic reasoning still far too old to justify investing in its maintenance. Better to cut it all down, even if it never re-grows.

Kingston Plans, Michigan. Loren Berndt

Anderson and Leal describe the core market logic for using resources: "the long-run prevailing interest rate serves as a guide for determining the rate at which… resources should be harvested." (41). While their book depicts some innovative and successful ways, particularly in which local fishing communities have managed to develop sustainable practices, they are able to do so because either the relevant ecosystem is able to be encompassed by traditional property rights owned by individuals and communities rather than corporations, or they exist within a larger network of regulations.

A traditional economist might argue that I am describing only a aesthetic preference for forests over fields. While I think this argument is incorrect, addressing it would take us far afield. Happily, (or from another perspective unhappily), a concrete example goes well beyond aesthetics…

In Northwestern forests Anderson and Leal's market logic was applied to the Pacific Yew. Because Pacific yews were not valuable lumber trees, most that grew in logged areas were burned in slash-disposal fires (Egan, 1992; Leary 1992). By the time scientists discovered it produced taxol, the yew had become much less abundant. However, taxol is effective in treating ovarian, breast, cervical, pancreatic, and some kinds of lung cancer, as well as Kaposi's sarcoma, and is now on the World Health organization's list of essential medicines. Powerful struggles emerged over whether to harvest it for its medical value, even if unsustainably from seriously depleted populations, or allow less of the medicine to be available in order to preserve the tree. At the time there was no other source of taxol (Kolata, 1991). Fortunately for people and yew alike, synthetic varieties of taxol have now been developed, but one can legitimately wonder whether the drug would have ever been discovered, if market logic alone had governed forestry in the Pacific Northwest.

The problem of a disconnection between power and importance applies to more than forests. In many of the world's oceans overall catches have begun to decline, in some cases catastrophically so. This decline happened in a matter of decades, as world fish stocks were healthy after WWII.

To justify their expense, modern capital intensive fishing trawlers are virtually forced to take every fish they can locate. Often they do not even use many of the fish they catch, because they are the wrong size or species. In 1994 a record 751 million pounds of dying edible fish were dumped back into Alaska waters alone, up from 740 million pounds in 1993 and 500 million pounds in 1992. David Germain reports 17 million pounds of halibut, 4 million pounds of herring, around 200,000 salmon, 360,000 king crabs, and 15 million tanner crabs were discarded, the equivalent of 50 million meals. Because many of these fish and crustaceans are caught deep in the sea, where they were adapted to the high pressures of the depths, raising them to the surface normally kills them (Germain, 1995, p. A-16). This practice is economically "efficient" in exactly the way Anderson and Leal described with respect to cutting and abandoning smaller trees to get at the more valuable larger ones (Anderson and Leal, 2001, pp. 39-40).

The results, if the logic is allowed to work itself out unchecked, is catastrophic. In 2008 the United Nations Environment Program reported as much as 80 percent of the world's main fish catch species have now been "exploited beyond or close to their harvest capacity". If fishing rates continue unabated by 2048 all of the species currently fished for food will have disappeared (Oliver, 2008).

I have explained how all societies are challenged by the deep disconnect between biological and cultural ecosystems, with the latter being dominant in the short run but the former dominant in the long run. More than one society has failed to bridge this disconnect well enough to survive. The enormous increase in market power is making a challenge once met or failed by particular cultures in particular places a world-wide problem. Market logic simply cannot think long term unless enormous profits are promised for doing so, as Anderson and Leal emphasize.

This disconnection is the fundamental tension between economic and ecological processes. It is why, if our world is to last as a prosperous and good place for us to live, economics *must* be subordinated to natural processes.

When the social sciences are divorced from the biological ones, and the commonality and interweaving of different emergent systems becomes confused or invisible, the results will be misunderstanding of vital issues and destructive policy conclusions.

THE IMPORTANCE OF ETHICS

Given that people often urge interventions as soon as the advantages they seek appear to outweigh immediate disadvantages while the future is 'purely theoretical,' there is an inherent tendency to make long term mistakes. With respect to the market, Hayek considered ethical principles the only reliable check to off-set the apparent advantages of short term interventions into complex market processes at the cost of long-term sustainability (Hayek, 1973, pp. 55-71). On this important issue Hayek was one with the ecologist Aldo Leopold who also emphasized ethics as a restraint on power (Leopold, 1970, pp. 237-64). In the absence of ethical relationships the short-term advantages of intervening into complex systems will always outweigh the somewhat hypothetical long term disadvantages. As such, an appropriate ethics is a essential tool for dealing with ignorance when our power is greater than our knowledge. Perhaps the subject of environmental ethics is as important for maintaining a sustainable society as is the ethics men like Hayek long argued are foundational for maintaining a free society (diZerega, 1996).

That, however, is beyond the scope of this paper.[1]

NOTES

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