THE UNSUSTAINABILITY AND ORIGINS OF SOCIOECONOMIC INCREASE

BY

MARK S. MERITT

A master's thesis submitted to the Graduate Faculty in Liberal Studies in partial fulfillment of the requirements for the degree of Master of Arts, The City University of New York

2001

This manuscript has been read and accepted for the Graduate Faculty in Liberal Studies in satisfaction of the requirement for the degree of Master of Arts.

Thesis Adviser **Date**

Approved

Executive Officer **Date**

THE CITY UNIVERSITY OF NEW YORK

ACKNOWLEDGMENTS

It would have been impossible for me to write this paper, and the expanded work to which it will hopefully lead, without the contributions of the following people:

Daniel Quinn, who has influenced my thinking and given me more knowledge, wisdom and inspiration than any other individual. His work crystallizes the ideas and findings of so many others even as it breaks ground and points to a new path for generations to come. I hope my work here proves a worthwhile contribution to the body of thought and action that is his legacy.

Allan and Doris Meritt, my parents, who supported all my choices in higher education, from my decision to move into the very unpractical undergraduate major of Theatre Arts to my graduate work at the intersection of the hard and soft sciences. What these contrasting pursuits have in common is that I was interested in them for their own sake, not because they were guaranteed to provide a career path. I can only hope that more parents will come to act as they have, empowering their children to create their own priorities rather than adopt those of others.

Jennifer Norris, my wife, who has been nothing but understanding and encouraging while I spent so much time on my graduate work that could have otherwise been spent with her. I hope I will have the opportunity to return the favor as she discovers new pursuits for herself.

Rachel Brownstein and Katherine Koutsis, executive officer and executive assistant respectively of the Master of Arts in Liberal Studies program at the City University of New York Graduate Center, who help realize the interdisciplinary pursuits of people like me, even when we stop living in New York City.

Joseph Dauben, Rosamond Rhodes, Gregory Johnson, Sharon Zukin, Robert Rockwell, John Oppenheimer, Timothy Alborn, Marshall Berman, Michael Blim and William Kornblum, professors of the various courses that made up my Liberal Studies curriculum, whose varied insights and guidance all helped shape my work. Thanks especially to Professors Johnson, Rockwell, Alborn, Blim and Kornblum, all of whom fostered work that led directly to this paper.

Added thanks to William Kornblum, who agreed to serve as thesis adviser for a project that he felt was ambitious but feasible and valuable. His excitement, input and steering have been beneficial so far, and I hope they will continue to be as I elaborate this work.

Mark S. Meritt
Red Hook, NY
January, 2001

TABLE OF CONTENTS

INTRODUCTION: A PARADIGM IN SEARCH OF A SHIFT

The Bubble Burst

In December 1919, with capital of just $150, Charles Ponzi opened the Security Exchange Company in Boston, Massachusetts. Through this venture, he hoped to capitalize on the international trade of postal reply coupons. Several countries accepted these coupons, issued by the International Postal Union, in exchange for postage stamps, allowing people to spare a correspondent the cost of return postage. Ponzi figured he could purchase the coupons cheaply from countries with weak economies and redeem them in the United States for a profit. Unfortunately for Ponzi, his “Great Idea,” essentially a form of speculation in currency markets, lost steam — making any substantial profit would require the redemption of huge quantities of coupons. His profit would be eaten up between red tape among postal organizations and his own expenses in hiring people to handle the material (Knutson, 1996; Walsh, 1998: 2). Whenever he mentioned his plan to others, though, they became very interested and eager to participate. With potential investors lining up at his door, “he stopped buying international postal coupons and dealing with endless bureaucracy — and focused instead on bringing in investors” (Walsh, 1998: 2).

Ponzi issued negotiable notes of various denominations, promising a 50% return on investment after 90 days had lapsed. To make good, Ponzi used the money brought in by later investors to pay off earlier ones. As he paid off the matured notes, word quickly spread about the fantastic profits being earned. More and more investors came in, and he even decreased the pay-off period to 45 days. With so many transactions to handle, the bureaucracy he wanted to avoid returned, and he had to strike up a relationship with a bank. Even with the administrative hassles, in less than a year Ponzi had collected $9,500,000 from over 10,000 investors (Knutson, 1996; Walsh, 1998: 3).

As it had to, the venture came to an end. Funds simply switched hands from one contributor to another, with no actual investment being made to achieve profits. Money paid out, described as income, was actually distribution of capital. Though this was by no means the first such swindle in history, and though his arrest did not stop Charles Ponzi from continuing to pursue a life of financial crime, the Security Exchange Company left a legacy, with such scams coming to be known as Ponzi schemes (Knutson, 1996; Walsh, 1998: 7).

A close cousin of the Ponzi scheme is the pyramid scheme. In the Ponzi scheme, money is handed over to a central organizer to be invested, but the organizer simply uses new funds to pay old debts. In pyramid schemes, with or without an administrator, money is handed over for a right to do something, usually to open some sort of franchise or to solicit members. Each new member is placed in a hierarchy and pays those above them, expecting to eventually collect money from a far greater number of people who join later and are thus placed below. After a certain number of levels below have completed their commitments to the higher-up, his or her membership comes to a close (Walsh, 1998: 8; Blaylock, 2000). With the promise of great profits, members must enroll others underneath them to keep the plan going. While it may be awful enough to fraudulently profit from strangers, doing so through friends and family makes the pyramid scheme potentially more insidious than a mere Ponzi scheme.

Pyramid and Ponzi schemes share several key features. First and foremost is the misidentification of fresh capital as income. Also obvious is the exploitation — intended or not, direct or not — of newer members by older ones. In the case of pyramid schemes, this also takes the form of lower members exploited by higher ones. Either way, no new wealth is ever created. Instead, wealth gained by one participant is wealth lost by another. As the schemes' communities grow, the divergence between the wealthiest and the poorest increases. The rich get richer, but the poor have an ever more difficult time succeeding because there is a limited number of possible participants right from the start. The more join, the more difficult it is to find another to join.

When the sources of new recruits dry up, the structure collapses. In a truly systematic way, these schemes can only work well for a few participants and must fail the vast majority. Once known as bubbles (Knutson, 1996), these kinds of schemes have an inherent flaw which makes them destined to burst. Aside from any moral issues, they simply can't work. This is the main reason why they have been outlawed in all fifty states and in most countries, and their blatant unfeasibility makes the law enforcement profession look upon them as victimless crimes: Those who are bilked have usually participated willingly (Walsh, 1998: 8) and should have known better.

The lesson of the bubble is a lesson in sustainability. According to the World Bank's millennial development report (WB2K), "A development path is sustainable only if it ensures that the stock of overall capital assets remains constant or increases over time" (World Bank, 2000: 28). While other definitions may be given, this appears as good as any, literally suggesting the *sustaining* of one's *ability* to achieve success beyond the present into the indefinite future. Anything that reduces long-term ability, though it may provide temporary successes, cannot be said to sustain, and anything that cannot sustain must die. The World Bank may mean something different by development than a Business Improvement District or Economic Development Corporation, but the core notion of sustainability remains the same across the board. Bubbles are merely unsustainable development paths in microcosm and, as such, are something to avoid. When a society operates unsustainably in macrocosm, it is also destined to burst. Whatever causes its unsustainability, despite immediate benefits, cannot last forever. For a society, understanding unsustainability is a life or death matter.

Sustainability, Paradigm and Vision

As Thomas S. Kuhn described it in The Structure of Scientific Revolutions, science is always practiced within a paradigm, a set of "universally recognized scientific achievements that for a time provide model problems and solutions to a community of practitioners" (Kuhn, 1996: x).

He refers to the science done within a current paradigm as normal science. As is in the nature of the scientific method, though, scientific knowledge may always be imperfect and can be questioned. When a new theory comes along and explains more or more neatly, science itself can be altered. The achievement of such a theory, involving the practice of revolutionary science, can only happen by stepping outside the existing paradigm. One of the hallmarks of revolutionary science is that it is "sufficiently unprecedented to attract an enduring group of adherents away from competing modes of scientific activity. Simultaneously, it [is] sufficiently open-ended to leave all sorts of problems for the redefined group of practitioners to solve" (Kuhn, 1996: 10). As the revolutionary science gains acceptance, it *becomes* normal science, a process exemplified by physicist Max Planck's statement that "a new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it" (cited in Kuhn, 1996: 151). The resulting paradigm shift is what Kuhn says comprises a scientific revolution (Kuhn, 1996: 90).

Joseph Schumpeter described the important and related concept of preanalytic vision. Since analysis must start with something to analyze, the something is given by a preanalytic cognitive act Schumpeter called vision. Whatever is omitted from this cannot be recaptured by subsequent analysis (Daly, 1996: 46). Kuhn himself suggests much the same thing, saying that "something like a paradigm is a prerequisite for perception itself" (Kuhn, 1996: 113). Revolutionary science occurs when someone looks at something in a new way and finds greater explanatory success than was achieved using a previous approach. Many alternative visions may lead to a dead end, but the right one can cause a paradigm shift — and a shift cannot happen without a new vision.

Revolutionary science allows its practitioners to do something that normal science does not. When the something it can allow its practitioners to do is *survive*, and if survival is desired, a paradigm shift is absolutely necessary. It is the purpose of this paper to show that our society is operating unsustainably as a result of a complex socioeconomic paradigm. The paradigm is itself inextricably bound to a vision of humanity's relationships with the rest of nature that leaves out key facts, preventing us from being able to fully understand our situation.

The Ecological Perspective

In 1868, German biologist Ernst Haeckel coined the term and founded the discipline of ecology, the study of the relationships between a species and its inorganic and organic environment. Eventually, the discovery of whole ecosystems yielded an expansion of the ecological perspective to the mutual dependence and balance among all inhabitants of an ecosystem (Enzensberger, 1974/1996: 17). As ecological science has developed, humanity has gained a much greater knowledge of how living systems work. Only within the last few decades, though, with the publication of Rachel Carson's Silent Spring and the beginning of environmental movements, did the discipline begin to capture the public's imagination, bringing to the forefront the position of humans within ecosystems.

But ecology was also effectively an invention of Charles Darwin's, who indeed can be seen as the most important figure in its history (Worster, 1994: 402). Darwin's theory of natural selection says that some of the variations found in individuals of a given species may confer an advantage to their possessor. This advantage can mean the difference between survival or not, or at least it can increase the possessor's chances of successfully reproducing, passing on the advantageous traits and leading to their increased presence in the population. Making an analogy to the active selection of traits in artificial breeding, Darwin suggested that nature, in effect, selects for the advantageous traits, though the selection is actually passive — more elimination than selection. Through this process, a species can change over time, evolving from one species into another, accounting for the evolution of countless species from simple beginnings. Through Gregor Mendel's work with snow peas, and the discovery of genes and their random mutations, the mechanisms of inheritance and variation became known. The ideas were combined, forming the neo-Darwinian synthesis, and natural selection gained wide acceptance.

Underlying the entirety, though, was the notion that selection only occurs within circumstances local in both space and time — whether or not a trait would provide an advantage is only ever determined with respect to an individual's environment at a given moment. Hence, the very evolution of life and ecosystems had at its root the process of natural selection, which itself necessarily involved relationships within living systems. Evelyn Hutchison attempted to capture this dynamic in the title of her 1965 book of essays, The Ecological Theater and the Evolutionary Play (Worster, 1994: 403). Since any number of plays can be performed in a theatre, though, perhaps it would be more appropriate to say that ecology is a snapshot of evolution or that evolution is ecology over time. In the end, they are merely two sides of the same coin, the dynamic workings of the community of life.

Since the burgeoning of environmentalism, several important ecological and demographic studies have been published, including Paul Ehrlich's The Population Bomb, The *Ecologist*'s "A Blueprint for Survival," and the Club of Rome's Limits to Growth. Aside from whatever controversies or contradictions may have arisen in their analyses or proscriptions, there is a growing consensus on the validity of their claims that our present global society is operating unsustainably, that it will bring about its own end if certain practices are not changed. Further, true to ecology's focus on the relationships among factors within a system, there is an increasing sense that many of our worst social ills and inequalities find their root in the same unsustainable processes that cause ecosystem degradation.

Adopting the ecological perspective involves using the science of ecology as a framework to study subjects which it may or may not traditionally cover. Sometimes "ecological thinking" is used to model human production processes after ecosystemic processes. The study of "human ecology" can mean anything from an analysis of human action within ecosystems, or even a set of policies to govern that action (Worster, 1994: 368), to the study of how human behavior changes in different public or group situations. More broadly, ecology's focus on systems and the relationships among their components can be used as a general methodological approach, a model for how to analyze a subject, regardless of the relevance of any particular knowledge from within the field of ecology.

In Biomimicry: Innovation Inspired by Nature, Janice M. Benyus works mostly with the first form of the ecological perspective noted above. She attempts to glean lessons on how we can improve the way we live by mimicking the non-human world, yielding potentially groundbreaking improvements in everything from agriculture and medicine to material science and computing. Benyus outlines "a canon of nature's laws, strategies, and principles that resonates in every chapter" of her book:

Nature runs on sunlight.
Nature uses only the energy it needs.
Nature fits form to function.
Nature recycles everything.
Nature rewards cooperation.
Nature banks on diversity.
Nature demands local expertise.
Nature curbs excesses from within.
Nature taps the power of limits. (Benyus, 1997: 7)

An important idea that flows from the third form of the ecological perspective, that of systems analysis, is that even small alterations within a system can have system-wide consequences. This was most eloquently and famously described by Edward Lorenz as the butterfly effect, in which the flapping of a butterfly's wings could potentially result in a storm on the other side of the world (Worster, 1994: 407). An action intended to have one effect yields one or more additional effects due to often unknown relationships to other components within a system. Corollary to this is the concept of unintended consequences, expounded by Edward Tenner in Why Things Bite Back: Technology and the Revenge of Unintended Consequences. When these unintended effects are undesired and perhaps even ironically cancel out the benefits of the initial action, Tenner calls them revenge effects (Tenner, 1996: 6). These often involve the replacement of acute problems with chronic ones that may not be open to solution but which, instead, demand constant maintenance, leaving us exerting more effort than if we had never acted against the problem in the first place (Tenner, 1996: xi). For example, baldness caused by a cancer therapy would be a mere side effect, but if that therapy induces another equally lethal cancer, it has produced a revenge effect (Tenner, 1996: 7).

Given the complexity of our global society and the diversity of its social problems, it seems entirely reasonable that we can shed light on our plight by employing the ecological perspective in terms of the form of ecology (i.e., its focus on systems and relationships). At the same time, the ever-increasing ecological degradation our society generates indicates that the content of ecology must also play a key role in understanding our circumstances. This two-fold applicability of ecology is no coincidence. Indeed, bearing in mind both Benyus' canon of nature's tenets and Tenner's doctrine of unintended consequences, an ecological analysis of the broadest socioeconomic traits of our global society confirms the notion stated earlier. We are, in fact, operating unsustainably, and this is the very cause of the most significant social and ecological problems we face. It is precisely this integration that makes both the form and content of ecology crucial.

The science of ecology and the ecological perspective are uniquely capable of analyzing this situation, and their historically recent development explains why it is only now that we can embark on a full assessment. But ecology can do much more than simply uncover our prevailing unsustainable paradigm and its associated preanalytic vision. Taking the evolutionary angle, in terms of the different but equally important forms of biological and cultural evolution, we can discern just how we came to adopt unsustainable practices and understand why they are so difficult to let go. Finally, though a complete exploration of the subject is beyond the scope of this paper, ecology and evolution can also point the way toward sustainability, helping us generate a sustainable paradigm which includes not only insight on what to change but new perspectives on *how* to achieve social change itself.

Thesis

Our prevailing economic paradigm is one of growth. It relies on a faulty preanalytic vision of the human economy as a system that is closed and independent of its own physical basis. By adopting a more appropriate vision, that of the human economy as a subsystem of the Earth, economic growth can be shown to be thermodynamically unsustainable because it hinges upon increasing resource use which, in a finite world and in direct contrast to the definition of sustainability, ensures that the stock of overall capital assets decreases over time. Further and more significantly, growth is ecologically unsustainable because it disrupts ecosystems upon which humans depend, long before resources ever approach depletion. Thus, while growth may provide short-term benefits, sustainable economic growth is a genuine contradiction in terms and therefore cannot provide a long-term basis for economic improvement.

Basic population ecology models will show that population growth is simply an epiphenomenon of a particular kind of economic growth, the increase of our food supply. Ecologically speaking, population growth is thus not a sustainability problem in and of itself but only inasmuch as it is caused by, and exacerbates, increasing resource use. Theories of organization and state formation, however, show that a growing population generates hierarchy within a social structure. Population growth can therefore systematically generate inequality by increasing the complexity of social structure, perpetuating poverty, material and otherwise, even in conditions of abundance. Further, the complication process itself is systematically unsustainable in its own way. Robert M. Carneiro’s circumscription theory, the most generally accepted theory of state formation, will be critiqued and used as a starting point for the discussion of structural complexity. In the end, economic growth is, in more than a metaphoric sense, the largest pyramid scheme possible. It mistakes assets for income, inherently generates positive results for a minority of its participants and must systematically come to end.

Given its negative consequences and long-term unfeasibility, it is crucial to understand the origin of our unsustainable attachment to growth and whether or not it is inevitable in a human economy. A critical look at some additional concepts from population ecology suggests that, while exponential population growth may be a valid strategy for some species, it is highly unlikely that this holds for humans. Instead, the practices of economic growth must find their root in cultural causes, explaining their relatively recent rise and affirming that they can be changed.

Since structural complication occurs parallel to population growth, it seems that this too should have a cultural cause. On one hand, this is obvious since human social structure is itself an aspect of human culture. More significantly, though, in contrast to unilineal models of cultural evolution, the roots of growth and civilization have *merely* cultural causes, neither part of the biological evolution of *Homo sapiens* nor cultural universals, present in all human cultures at all times. An analysis of cultural evolution and its integration with biological evolution, including further critique of circumscription theory, will both show this to be the case and explain how maladaptive cultural traits can persist for long periods, contrasting with maladaptive genetic traits which are selected against much more quickly.

Analyzing the unsustainability of our global economic strategy and revealing how such a strategy arose involves looking at aspects of “increase culture” which it, in effect, does not want seen. The final step in comprehending its rise involves understanding the nature of the filters it puts before us. The primary way these filters polarize is through the issue of nature and culture, which we’ve come to think about through the twin dichotomies of heredity versus environment and nature versus man. Upon inspection, the issue is revealed to be a single, multifaceted unity. Edward O. Wilson’s hotly contested theory of sociobiology is the starting point for the discussion of the nature/culture debate.

With a genuinely ecological understanding of how humanity fits in with the rest of nature, the filters through which we see our increase culture can finally be removed. The result is the uncovering of a complex of cultural traits, including total reliance on agriculture, the ultracompetitive interspecies practices that surround that reliance and the institutionalized ownership of food as a means to keep people from abandoning civilization. This complex arose along with increase culture itself and serves to perpetuate it. An additional and most significant result is the expansion of our prevailing paradigm to include not just physical growth and structural complication but a *preference* for those very traits. Thus, we cling to these traits rather than being able to give them up when their costs outweigh their benefits. This preference has insidiously prevented us from being able to even recognize our paradigm as a paradigm. Instead, we came to conceive our civilized way of life as the one right and possible way to live, incapable of contemplating a shift and, in any case, undesirous of one.

Through this ecological analysis of unsustainability, we can also gain a greater understanding of other aspects of our culture not obviously related to increase. Of highest importance, though, is the fact that this perspective can help us find a way out of increase into a sustainable paradigm. To conclude, I will provide a brief outline of some hallmarks of a sustainable culture, revealing sustainability to be something that can be achieved through optimistic, fulfilling and empowering means.

THE UNSUSTAINABILITY OF GROWTH

A Matter of Vision, A Vision of Matter

In many ways, economic growth is desirable, yielding incredible improvements for many populations, from necessities like health-related infrastructures and food to conveniences and luxuries. Along with these benefits, its historical feasibility has made it appear to be simply a matter of common sense that growth should be the hallmark of a healthy economy. However, the success of growth has blinded us to the fact of its unsustainability. This is not a claim about growth being immoral or wrong, but simply one that parallels the key criticism of the pyramid scheme. Declaring growth unsustainable simply says that, in the long run, it does not work and another option should be pursued. It is only within the last two centuries that the science relevant to this analysis was developed. Further, it is only during the 20th century that the analysis itself arose and that we have begun to witness the broad proliferation of most of the negative unintended consequences of growth (Dubos, 1968: 25).

The foundation of this analysis involves understanding exactly what the human economy is. In Beyond Growth: The Economics of Sustainable Development, economist Herman E. Daly suggests that our understanding of the economy is limited by a faulty preanalytic vision of it as an isolated, closed system in which there is a circular flow of goods and services from firms to households and of factors of production from households back to firms (Daly, 1996: 47). Such a vision ignores the physical dimension of that which flows within the circle, allowing for the possibility, even desirability, of unlimited growth. However, only abstract exchange value flows in the closed circle. Completely ignored is that to which value is added (Daly, 1996: 62). At its root, “to produce is to metabolize natural physical energy into energy useful to man” (Deléage, 1989/1994: 43). Without a resource base, there would be nothing with which to do anything within the circle: “Adding value is more like multiplication than addition — we multiply the value of ‘stuff’ by labor and capital. But multiplying a zero always gives zero” (Daly, 1996: 64).

We can easily understand the problem by taking a brief look at some critiques of the Gross National Product, the standard measure of national accounts and modern society’s key indicator of the health of a nation’s economy. Of its many problems, the biggest is that GNP conflates three incongruous factors, adding services (a benefit), throughput (a cost) and net accumulation (simply a change in capital stock and funds) (Daly, 1996: 112). The use of any non-renewable resources is the liquidation of wealth (Ashworth, 1995: 197; Daly, 1996: 82), yet such use is *added* to the GNP as a good. Further, costs such as those for environmental cleanup, rather than being counted negatively as a cost of poor economic practices, are simply added to the GNP as products and services purchased (Ashworth, 1995: 197; Daly, 1996: 112), another good. Deducting for depreciation of capital in order to keep productive capacity intact is an accepted principle in accounting income (Daly, 1996: 16) yet is completely ignored when calculating GNP. The flaw that is at the heart of the pyramid scheme repeats itself precisely in the GNP: Capital is counted as income, and we find ourselves living off principal instead of interest (Ashworth, 1995: 180; Daly, 1996: 40). Even the most traditional economist knows that costs must be compared, not added, to benefits and that you cannot live off your principal without depleting it.

To account for physical material, one needs a different preanalytic vision, one that sees the economy as an open subsystem within the larger system that is the Earth. Since the Earth is finite, the human economy can grow, at most, only up to the size of the Earth itself (Daly, 1996: 47-49). The human economy is thus, as with any species, simply our share of the biosphere, the sum total of the Earth’s resources used by humanity. Indeed, as the science of ecology has developed, it is this view that appears more and more to represent common sense. Further, it is only from this perspective that the idea of sustainable development makes any sense, for if the economy was not limited by a larger system, it would not need to worry about what activities could not be sustained (Daly, 1996: 7).

Arguments about the ephemeral nature of finance, services and information may be made in an attempt to circumvent the idea of material limits to our economy. However, it should be abundantly clear that even these rely on material resources. Without material, not only would there be nothing with which to create currency or store information but there would be nothing to purchase, nothing to live on. Indeed, there would be no people to provide or purchase services or products. In the end, no matter how an economy is measured or what innovations may arise, it must have a material base (Altvater, 1989/1994: 78; Dryzek, 1992/1994: 178; Ashworth, 1995: 25; Daly, 1996: 28, 42, 64).

Thermodynamic Irreversibility

The Earth is technically an open system. It receives energy from the sun (and, to a much lesser extent, other cosmic sources) and emits heat back into space. Of course, the Earth is extremely dynamic within, making any number of uses of the energy it receives from space before emitting an equal value back out. However, since the flow of energy into the Earth is non-growing and energetic equilibrium with respect to the rest of the universe is maintained (Hardin, 1993: 76), the Earth is effectively a closed system. Eventually, as the sun burns out, even this equilibrium will be lost. Per the ecological preanalytic vision, the human economy is one of many open systems within the closed system of the Earth. In principle, its size can increase to no larger than that of the supersystem itself. The subsystem relies on the supersystem as both tap and sink, a source of material inputs and a disposal area for waste outputs.

Thermodynamics and entropy therefore become crucial. The first law of thermodynamics is that the conversion of energy into work is never efficient, with some energy always being lost in the process. From this is derived the law of the conservation of energy, denying the possibility of perpetual motion. The second law of thermodynamics is that energy always flows downhill, from high-energy objects to low-energy ones. Entropy is the amount of disorderliness in a system, and higher temperatures are said to introduce disorder. Thus, high-energy sources are said to have low entropy, since, when they are put to use, they will give off heat, resulting in less energy available for future work and thus higher entropy in the system (Barnes-Svarney, 1995: 283-4). Thus, the second law of thermodynamics also states that entropy increases in an isolated system.

While the model of the circular flow of value added is consistent with the first law of thermodynamics, involving only transformations of matter, it completely ignores the second law of thermodynamics (Daly, 1996: 65). The Earth is both the supplier of high-energy, low-entropy raw materials and the recipient of low-energy, high-entropy wastes (Daly, 1996: 33). The sun is the only significant source of energy for the Earth and thus, except for the energy generated by the planetary core, the very foundation for the creation of all low-entropy resources on the Earth. If energy on Earth is used at a rate higher than that at which the sun replenishes it, the Earth's entropy increases irreversibly, making it ever more difficult to find energy to accomplish work: "By definition, the overall increase of entropy associated with any process of production is always greater than the local decrease in entropy corresponding to this process" (Deléage, 1989/1994: 42). In a closed system, it is only a matter of time before it becomes clear that there is simply no such thing as a small growth rate (Gotelli, 1998: 8).

Such a view of resource use was developed right along with thermodynamics itself, the 19th century thermodynamicists viewing nature not as boundless but always threatened with exhaustion (M. O'Connor, 1994: 3). That economics has not yet come around to incorporating this knowledge makes it no less true. To study our economy without acknowledging its environment is like studying physiology in terms of the circulatory system without ever mentioning the digestive tract:

> An animal with an isolated circulatory system and no digestive tract would be a perpetual motion machine. Unlike this imaginary circular-flow animal, real animals have digestive tracts that connect them to their environment at both ends. They continuously take in low-entropy matter/energy and give back high-entropy matter/energy. An organism cannot recycle its own waste products. (Daly, 1996: 193)

An economy acts in the very same way.

Just as growth traditionally seemed to provide only benefits, the possibility of continued growth was not unreasonable when environmental taps and sinks were much larger in comparison with the human economy (Daly, 1996: 34). Indeed, the growth of the human economy is not the only example of apparently unlimited growth: Outbreaks of pest species, from insects to plants and beyond, occur in precisely the same way (i.e., when their available resource base is sufficiently large in comparison to their population) (Gotelli, 1998: 11). As an economy grows, however, it becomes ever clearer that what once seemed unlimited is not after all. Sustainable growth is a thermodynamic contradiction in terms. To ignore an economy's exchange with its environment is to treat it as if it were a perpetual motion machine (Daly, 1996: 34). Yet just as pyramid schemes have been outlawed because they simply can't work, the U.S. Patent Office no longer accepts applications for perpetual motion machines (Hardin, 1993: 40). If our growth economy were subject to patenting, it would be rejected.

Tap, Sink and Biodiversity

Human exceptionalism, the belief that humans are not subject to certain natural laws, cannot keep us from the effects of thermodynamics. But what if it could? Would unlimited growth then be possible? An understanding of the workings of ecosystems shows that the answer would still be no.

As living systems, ecosystems are marked by an extraordinary internal complexity, with countless relationships, interdependencies and subsystems. One hallmark of ecology is thus the existence of cycles, in which by-products from one process become the raw materials for another. An important concern for any production process, then, whether photosynthesis or microchip manufacture, is the way in which it attaches to the larger ecosystem. It receives its inputs from taps of resources which must be regenerated, and it places its outputs, including wastes, in sinks which must be able to absorb them (Daly, 1996: 3).

Organic resources tend to be renewable, because they are part of systems in which they spontaneously regenerate, while inorganic resources tend to be non-renewable. Renewables, though, can be exploited to extinction, while non-renewables may regenerate over extremely long periods of time (Daly, 1996: 80). The key is simply that any resource used at a rate greater than its rate of regeneration will be depleted. Further, ecosystems have particular assimilative capacities, amounts of wastes they can absorb while maintaining normal function (Ashworth, 1995: 126). The more our production processes create by-products which are not easily assimilated back into ecological cycles, the more we tend to exceed ecosystemic absorptive capacities, reducing regeneration rates and putting further stresses on the material inputs themselves.

Another important issue is that we make efforts to *alter* our taps, most obviously and significantly in our pursuit of agriculture, silviculture and the breeding of animal food sources. By attempting to harvest as much as possible, our processes tend toward the use of heavy machinery and chemicals, whose own production is ecologically stressful (Dubos, 1968: 187). Simultaneously, the cultivation endeavors themselves encourage monoculture and genetic uniformity, increasing crop vulnerability to pests, disease and other shocks (Altvater, 1989: 83; Deléage, 1989/1994: 41; Gore, 1993: 70; Scott, 1998: 11-22, 264-270). All of this contributes to ecosystem destabilization. Indeed, figures for the United States and Europe in the 1960s and 1970s show between six and nine calories worth of fossil fuel being expended to produce just one calorie of food (Deléage, 1989/1994: 40). Such a ratio appears almost foolish in comparison with the slash and burn techniques of New Guinea islanders described by Roy Rappaport, in which 21 calories of food are generated by just one calorie of effort (G.A. Johnson, personal communication, February 23, 1999; Rappaport, 2000).

Beyond stresses on tap and sink is the biodiversity factor. Crucial to regeneration and maintenance of ecosystems as a whole is the ability of its varied constituent parts, its many species, to be able to reproduce and maintain themselves to play their roles within complex ecological relationships. Insufficiencies in parts of the system can weaken the whole and even lead to collapse. When the authors of WB2K note that the estimated marginal value of some species' existence may be as low as $44 (World Bank, 2000: 103), it is clear that they fail to understand the real threat of accelerated extinction. Given the complex interdependencies within ecosystems, those seemingly worthless species' stability may be crucial to the existence of other species presently given a much higher value (Odum, 1975: 49). As evolutionary biologist Niles Eldredge notes in Dominion, "... the one kind of tree that produces absolutely no edible nuts or fruits, whose leaves and bark yield no useful medicines, nonetheless anchors the soil, shades the understory, and perhaps intermittently shelters other species on which we do depend" (Eldredge, 1995: 94). To truly understand the importance of biodiversity, one must literally see the forest for the trees, looking beyond particular species and their immediate value in the human economy to see the big picture.

Some light on biodiversity may be shed by the field of island biogeography, which attempts to account for the number of species within a given discrete area, a real or conceptual island. In the 1960s, Robert H. MacArthur and Edward O. Wilson developed the equilibrium model of island biogeography, which holds that the number of species that can stably coexist on an island of a given size and a given distance from other species sources represents a balance between immigration of new species and recurrent extinction of resident species (Gotelli, 1998: 159). One can scale this model up to analyze the Earth as a whole, in which there would be an optimum number of species capable of coexisting worldwide. Extinction rate remains in the equation, but immigration would be replaced with species generation through evolution, while the number of species in the source pool becomes the total number of species on the Earth at a given time. This application of the model actually has a hidden benefit in that the standard model must ignore evolution (Gotelli, 1998: 166), while the global version explicitly incorporates it.

It is easy to imagine, indeed borne out by fact, that, for the largest part of global history, the evolutionary generation rate was greater than the extinction rate, yielding increasing global biodiversity. The MacArthur-Wilson model predicts that the Earth would eventually contain a quantity of species whose diversity was optimal for its size. There would continue to be a turnover between new and old species, but the equilibrium level of overall biodiversity would be maintained. In general, the larger the island the lower its extinction rate, and the more isolated the island the lower its immigration rate (Gotelli, 1998: 164-165). Applied to the global model, in which the Earth is the largest and most isolated island possible, equilibrium should yield relatively low rates of both generation and extinction, indicating a high degree of stability. In the end, biodiversity should only ever increase or be maintained at an optimum level; only extenuating circumstances should lead to a decreasing trend.

An important phenomenon that can occur in population ecology is the paradox of enrichment, in which a predator with a low death rate and a high conversion efficiency (i.e., the efficiency with which it consumes prey species and converts them into more predators) ends up overexploiting its prey, drives them to extinction, then starves (Gotelli, 1998: 140). It is a very bad predator, indeed, that eliminates its prey (Benyus, 1997: 269). Even the World Bank notes that even the lower estimates of the global extinction rate are approximately 1,000 times the natural background rate (World Bank, 2000: 102). If persistent economic growth exploits non-human species, directly or indirectly, so as to yield a paradox of enrichment, it must at some point increase the global extinction rate to outweigh evolutionary generation, yielding the very biodiversity crisis we now see (Eldredge, 1995: 128). Whether or not the Earth had yet reached its optimal biodiversity when persistent human economic growth began — and it certainly may not have — it seems clear that such an increase in the extinction rate would drag diversity down further and further away from the optimum. This would continue until the paradox kicked in, extinguishing the source of overexploitation. Note that the situation worsens when one considers that the extinction of non-prey species, ignored by the paradox, also reduces biodiversity and destabilizes ecosystems.

A species that grows ceaselessly thus not only extinguishes many other species in the process of growth but also creates the conditions for its own extinction. Indeed, with the possible exception of a few microorganisms, the odds are that a species that pursued this strategy would not be remotely the last to go extinct. After such a species disappeared, global biodiversity would increase again, eventually reaching its optimal level. Damaging as we may be, then, the world is in no danger of ceasing to exist as a habitat for life in general since whatever destruction we may cause would hardly be able to destroy all life, a conclusion supported by James Lovelock's Gaia theory (Worster, 1994: 379, 386). A balloon that takes in too much air will pop, but it can hardly take in *all* the air that exists, and, once burst, the air that was inside the balloon returns to the atmosphere. The notion of "saving the world" ends up meaning simply saving the world as a human habitat (Quinn, 1999: 6). If we are to accomplish this goal, its success lies in ceasing our systematic reduction of biodiversity, thus in reducing our impact on the global extinction rate. If adamant economic growth is a cultural trait, its extinction need not coincide with the extinction of *Homo sapiens* (Eldredge, 1995: 132).

In theory, the human economy can grow to no more than the size of its supersystem, the Earth. In practice, a species constantly expanding its niche would stress its taps and sinks, as well as the pervading biodiversity, to such an extent that it would degrade the ecosystems on which it depends long before it ever came close to the size of the supersystem. As Benyus says, "our problem is not a shortage of raw materials (though that will come), it's that we've run smack against the limits of the Earth's resilience" (Benyus, 1997: 246). Even if it was thermodynamically sustainable (which it isn't), growth is thus not ecologically sustainable. Understanding the complete workings of all ecosystems, even if possible (which it isn't), would not provide a path out of this situation, since any attempt to work within ecosystemic requirements (e.g., management to maximize the existence of species and other resources on which humans depend) would place limits on growth.

The only possible way out might be alchemy, the knowledge of how to convert the worthless into the valuable. Instead of lead into gold, ecological alchemy would convert wastes, pollution and degraded sources into viable raw materials. In other words, alchemy would be the ultimate form of recycling. Clearly, the more we can do this the better off we will be, but even this is problematic. First, these attempts would bypass ecosystemic processes that recycle automatically and with less effort. More importantly, entropy prevents complete recycling (Daly, 1996: 33). Atoms may be recycled indefinitely, but energy in a closed system cannot, leading ecologist Eugene P. Odum to suggest two fundamental and contrasting principles of ecology, themselves reflecting the laws of thermodynamics: circulation of materials and one-way energy flow (Odum, 1975: 60-1). Not only would alchemy only take us so far, but the heat lost during the never completely efficient recycling processes must go somewhere. It would merely become yet another anthropogenic cause of global temperature increase (Dryzek, 1992/1994: 178), one of the key destabilizers of the biosphere. Recycling, while crucial, can thus never be the sole savior of an unsustainable economy.

Population: A Very Special Case of Economic Growth

One important facet of economic growth is population growth. Indeed, when non-human species are modeled, population size is most often used as the indicator of the size of their economy. The human population size is not necessarily the best index for the size of our global economy, since food and non-food resource use per capita varies widely in subpopulations around the world. However, though there may be much disagreement about how to analyze the situation, more attention has been given historically to our growing population than to most any other aspect of our expansion. Often posed as a great problem in and of itself, with solutions ranging from the controversial to the more controversial, it is crucial to understand the ecological dynamics behind our population size, especially since population growth is simply assumed to be an inherent characteristic of our species, its cause seldom sought. Basic population ecology concepts can shed light on this as well, most notably the models of competition and predation developed in the 1920s and 1930s by Alfred J. Lotka and Vito Volterra.

To understand these models, we need to grasp the notion of a species' carrying capacity. Rather than simply being tree-hugger rhetoric, this concept has a concrete mathematical basis, calculated from a species' birth rate, death rate and constants for each of these rates representing their degree of density dependence (i.e., the extent to which these factors are affected as the population size itself changes). Resources are depleted more and more as crowding increases so that the birth rate gradually decreases in comparison with the death rate. Eventually, a population reaches a level at which birth and death rates are equal, and the population is maintained at the maximum level at which it can achieve sustainability (Gotelli, 1998: 26-28).

The carrying capacity, however, is *not* a constant for any given species, as revealed by the Lotka-Volterra models of competition and predation. The competition models give competition coefficients to each species, indicating the effect that each species has on the growth of the other (Gotelli, 1998: 102). Similarly, the predation models incorporate the conversion efficiencies mentioned earlier (Gotelli, 1998: 128). The carrying capacity is shown to be a variable, determined only in relation to the carrying capacities of other species (Ashworth, 1995: 127; Gotelli, 1998: 102-103), expressing the importance of relationships within ecosystems. Thus, environmentalists who demand that we respect carrying capacity and pro-natalists and growth advocates who claim it to be meaningless share an incorrect idea of just what carrying capacity even is. The Lotka-Volterra models reveal that a species can increase its carrying capacity at the expense of other species. Competition and predation are, at their base, a channeling of carrying capacity, of population potential, from one species to another.

Economic growth appears to be the very definition of increasing carrying capacity. Engaged in this pursuit on a global scale, we do not simply prove ourselves more successful than other species. Instead, we enter into the most extreme possible form of interference competition (i.e., behavior that reduces the exploitation efficiency of other populations) (Gotelli, 1998: 100), consciously commandeering global resources under the auspices of species self-improvement, natural right, etc. Combining our high conversion efficiency and growth rate with a low death rate, various conclusions arise from the models' formulas. Solving for equilibrium predator population, we find that high conversion efficiency means that fewer people are needed to control other species' populations (Gotelli, 1998: 129). Our large and growing numbers must then overcontrol our victims, contributing to a reduction in biodiversity. Conversely, increasing prey population (i.e., food production) as an attempt to fend off starvation simply ends up requiring greater numbers of predators (i.e., people) to control the prey populations (Gotelli, 1998: 129). Basic population ecology thus shows that, as Peter Farb said in Humankind, "Intensification of production to feed an increased population leads to a still greater increase in population" (cited in Quinn, 1992: 133). Constantly increasing food production, the great technofix for the hunger faced by an ever-growing number of people, is the engine that itself drives population growth, "the very heart of the problem for which we need a real fix" (Eldredge, 1995: 155). It may alleviate acute hunger, but it causes its chronic and ever-worsening counterpart. It is rather like someone throwing wood on a fire to put it out, assuming that anything of a lower temperature than fire will cool it off but ignorant that wood fuels the very fire to be put out.

These conclusions are supported by the paradox of enrichment. Victims may find refuges from predation, helping alleviate their overexploitation (Gotelli, 1998: 142-3), but we programmatically seek and destroy such refuges. An extra bird in the hand now, though, means none in the bush later, per the paradox. All of the above conclusions come from continuous time models of competition and predation, where coexistence is inherently difficult to achieve. Discreet time models generally give coexistence over a large range of population size pairings, but even here coexistence can be lost when one species is an ultracompetitor (R.F. Rockwell, personal communication, November 30, 1999), which is precisely what growth economics makes us.

In his *Essay on the Principle of Population*, Thomas Malthus claimed that food production increases arithmetically (i.e., 1-2-3-4-5), while population increases exponentially (i.e., 1-2-4-8-16), yielding the pessimistic notion that food production can never match population growth. With advances in technology, food production has been able to increase more than arithmetically and Malthus' ratio was proved wrong. However, his basic claim of a link between food and population holds — indeed, there is a causal relationship which he did not expect, and, despite that causal relationship, thermodynamic and ecological limits suggest that population growth can eventually outrun food production.

Ecologist Garrett Hardin gleans what he refers to as a demostat, which he describes in Living Within Limits: Ecology, Economics and Population Taboos, from Malthus' description of the dynamic between food and population. Representing essentially the same phenomenon as the cycle rate in the Lotka-Volterra predation model, the demostat is a simple negative feedback loop which acts on population in much the same way that a thermostat acts on the temperature of a room. Abundant food resources allow a population to increase. Through the density-dependent effects of that very increase, the food resources become depleted, driving the birth rate down and the death rate up — a situation equivalent to Malthus' description of social "misery." The population eventually reaches a point at which increase can no longer be sustained, and the increase trend then inflects and becomes a decrease trend. Population reduction then begins to relieve pressure on its food sources, allowing them to regenerate. At some point, those same density-dependent variables allow the decrease trend to turn back into an increase, generating a new phase of "felicity," and the cycle restarts. The predator and prey populations, charted over time, become, in the most simple model of this phenomenon, sine waves, one shifted with respect to the other. This sort of trend was most famously demonstrated in the 1942 study published by ecologist Charles Elton who, upon analyzing a century of fur-trapping records from the Hudson's Bay Company in Canada, found long-term cycling between the populations of the Canada lynx and the snowshoe hare. Population is maintained in dynamic equilibrium around an average population which is, in fact, the carrying capacity, just as temperature is maintained around the set point of a room's thermostat (Hardin, 1993: 104-6; Gotelli, 1998: 132-3, 147). This view is extremely consistent with the above analysis in that a population's set point, just as with a thermostat, can be changed. Hardin and anthropologist Marvin Harris separately identified a set of what Hardin calls demographic revolutions, in which technological innovations such as tool making, agriculture and the development of modern science and industry each contributed to the increasing of humanity's global carrying capacity (Hardin, 1993: 112-114; Eldredge, 1995: 8-9).

Contrast this analysis with the most common discussions of human population growth, such as the one published by the *New York Times* anticipating the occasion of the birth of the six-billionth person (Crossette, 1999). Charts show that our population will level off at just under 10 billion around the year 2200 (Crossette, 1999: 5). This kind of prediction employs the logistic model of population growth, assuming that there is simply some inherent growth rate and some inherent carrying capacity toward which we will grow and then level off (Gotelli, 1998: 26-30). A sidebar derides Malthus' claim that population growth will outpace food production as "more than plain wrong... an enduring source of error and self-bamboozlement," since technological improvements "sidestep limits" (Wade, 1999: 5).

Both the forecast and the refutation of Malthus are completely oblivious to the true cause of population growth and thus the true nature of carrying capacity as a relative variable. Again, Malthus was wrong about the rates of change but not about the food/population connection itself. Limits are not sidestepped — they are literally increased. Further, the logistic model has been misapplied. A smooth leveling off of population, known as monotonic damping, is not the only end predicted by this model. A key variable that affects the outcome is the lag between the increase in a population and the time at which density-dependence evokes a response, proportional to time between generations. This time lag combines with the growth rate to indicate just how the logistic model plays itself out. For a species with a high growth rate and a large time lag, such as humans, the population will greatly overshoot maximum stable carrying capacity, after which food sources would crash and, consequently, the population. Ecologist Nicholas J. Gotelli also relates this to a thermostat, suggesting that, in this situation, the thermostat is faulty, constantly overheating then overcooling, failing to reach the set point temperature (Gotelli, 1998: 32-4). Whether we have already exceeded our carrying capacity or not is highly complicated by the fact that we are constantly increasing that variable along with food production.

Of course, food production, like all resource usage, cannot grow without end, due to the earlier mentioned thermodynamic and, most significantly due to the possibility of extinction, ecological limits to growth. Even WB2K acknowledges that further increases to the food supply will be difficult, especially if they are to be sustainable (World Bank, 2000: 28). But as long as we continue to produce more food, we will continue to produce more people. As Daniel Quinn puts it, posing the escalation of a "food race" to parallel the nuclear arms race, every win on the food side is answered by a win on the population side (Quinn, 1999: 113). The level at which we stop being able to continue increasing food production is unlikely to be sustainable and would thus emphatically *not* be a stable carrying capacity. At that point, food production would take a sudden drop, and along with it would go our carrying capacity and our population, having overshot our optimum as predicted. This would not necessarily bring about our extinction but could nevertheless be the worst social disaster in the history of our species. Indeed, given that social and ecological ills grow along with our population, it is hard to believe that anything above our current numbers could represent some "natural," stable equilibrium population size for our species.

In a materially finite world, the refutation of Jeremy Bentham and John Stuart Mill's notion of the greatest good for the greatest number should be obvious. While one can be maximized or both can be optimized, it is logically impossible to maximize both (Hardin, 1993: 264; Daly, 1996: 220). As the population increases, the amount of resources available per capita must be reduced. This is made all the more dramatic by the fact that a significant portion of the Earth's resources are actually used in *creating* the larger population, with the biomass of the planet gradually being turned into human mass (Hawken, 1993: 34; Eldredge, 1995: 5; Quinn, 1999: 113).

Strictly speaking, though, a growing population is not harmful in and of itself. It is only a problem because of the increased strain on natural resources. There are, of course, many species with populations far greater than six billion that nevertheless do not face our resource problems because their rate of resource use is much smaller than ours and is not ceaselessly growing. In a very real sense, there is no population crisis per se. Population growth is simply a side effect of economic growth, of the commandeering of ever greater quantities of resources. Everything boils down to a consumption crisis, in which the total amount of resources we use reduces the survivability of other species, many of which we depend on, degrading ecosystems, many of which we depend on. All of this brings us closer and closer to extirpating ourselves long before all the resources on the planet run out due to thermodynamic irreversibility.

Increasing food production may channel some extra food to people currently starving, but it also drives population growth, assuring that there will be more hungry mouths later, a revenge effect that thus provides no real solution to hunger. Likewise, other forms of economic growth provide no final solution to quality of life in the so-called developing countries. Economic development may provide amenities now and may contribute to a reduction of population growth (though even this is debatable), but the huge increases in per capita consumption of a smaller, developed population can actually do more ecological damage than lower consumption in a larger, undeveloped population.

The idea of the demographic transition is used to justify development. Undeveloped populations with high birth rates and death rates are thought to initially lower their death rates when development begins, resulting in an increasing population. Eventually, the fruits of development are supposed to help them curb their birth rates, eventually stabilizing the population at a higher level. This scheme, which in any case was only ever a descriptive model and not a deterministic process (Hardin, 1993: 182), holds no benefit in the quest for sustainability given the increased ecological impact of a larger population consuming resources at a higher rate.

Per person, industrialized nations consume resources up to 27 times as quickly as less developed countries, so that the *effective* size of an industrialized population is 27 times its actual head count (Eldredge, 1995: 14). Applying this ratio to 1998 population figures, this means that even Canada, the smallest of the G7 nations at 30.6 million, yields the impact of equivalent of 826.2 million in an undeveloped nation, putting it right in striking distance of the world's most populated countries, India and China. Taken as a whole, the G7 nations' 684.5 million have the impact of nearly 18.5 billion, or about three-and-a-half times the population of the rest of the world (World Bank, 2000: 234-5). Beyond this, per capita energy consumption is itself rising at a faster rate than population (Odum, 1975: 20). Pursuing economic growth, we are caught between the Scylla of population growth and the Charybdis of increased per capita resource use, for these two factors multiply to yield the total size of our unsustainably growing economy.

Growth and Complexity

Perpetual motion doesn't work because of thermodynamics. Alchemy doesn't work because of both ecological instability and thermodynamics. Food production drives population growth. But we can ask one more "what if" question: What if humanity really was exempt from these biophysical laws of nature? Would everything work out? Unfortunately, the answer is still no. Even if we could consume as much as we wanted and create as many people as we wanted, one key factor remains in our analysis of our situation. There is a way in which there is a population crisis beyond the issue of limited resources, more significant to our day-to-day social situations than even the ecological issues so far discussed. To understand this, we need to look at theories of organization and state formation.

The study of state formation attempts to understand how simple, egalitarian social structures like tribes evolved into the complex, hierarchical, inegalitarian structures that pervade the world today. State in this sense refers not to a government alone but to nation-state or city-state, forms of social organization that include all the members of its population. Inasmuch as these organizations are managed as single entities, governments follow, with only a few of the state's members wielding power at the top of its political hierarchy and the government coming to be referred to as the state itself.

Many theories of cultural evolution and state formation propose a unilineal path, an inexorable movement from "primitive" tribes, increasing in complexity to eventually form states and civilization. The term civilization is also meant here, and throughout this paper, in the structural sense. Used in any other sense, as in referring to arts, politics, theology or philosophy, the word becomes problematic, since cultures with simpler social structures also engage in these endeavors. One might just as easily use the word cultured in these cases, equally problematic and subjective since people who are not thought of as cultured lack only a particular kind of culture and not, of course, the phenomenon of culture. In structural terms, though, we can refer to civilization as unequivocally entailing statehood, urbanization, market integration, etc. Theories of state formation support the idea that the complication of social structure that leads to civilization, as globally widespread as it is today, has specific causes and is, in fact, a truly rare phenomenon. As anthropologist Robert L. Carneiro said (referring to a world population figure that was correct at the time of the statement), "At the start of the Neolithic, the world contained roughly eight million people but several hundred thousand small, autonomous societies... Today, more than five billion people crowd the planet, but only about 160 sovereign societies (i.e., nation-states) survive, most of which are large, complex, and powerful" (cited in Langton, 1988: 493).

Though it has evoked many criticisms, one of the most widely accepted theories of state formation is Carneiro's circumscription theory, which Robert M. Schacht sums up in one sentence: "In areas of circumscribed agricultural land, population pressure led to warfare that resulted in the evolution of the state" (Schacht, 1988: 439). Carneiro himself, though, suggests that it should be possible for states to arise in uncircumscribed areas, where overcrowding may occur if population growth is fast enough (Carneiro, 1988a: 499; Schacht, 1988: 439). That Carneiro is willing to concede this has made some of his critics suggest that the environmental factor of circumscribed arable land should not be considered essential to the theory at all. In response, Carneiro claims that "The thesis advanced here is not that societies become more complex *only* by growing larger, or that as they grow larger they *invariably* become more complex. Rather, the contention is that if a society does increase significantly in size, and if at the same time it remains unified and integrated, it must elaborate its organization" (Carneiro, 1967: 360).

For Carneiro, though, the cause of population growth is unimportant, yielding probably the most vehement criticisms of his theory. He uses the exponential model for unconstrained population growth, explicitly rejecting models involving equilibria or limits (Schacht, 1988: 440). The exponential model is useful as a starting point in understanding population dynamics, a building block toward more accurate models, but is utterly rejected by population ecologists as unrepresentative of reality. Carneiro's attachment to this model is especially surprising given that the nature of circumscription theory is to show how various constraining factors affect cultural change. Anthropologist George L. Cowgill has been particularly vocal on this issue, saying that "Population growth is not an automatic tendency of either ancient or contemporary agrarian societies. It is not an automatic 'prime mover' which accounts for development episodes" (Cowgill, 1974: 505), and that "We can never simply assume that stress or the threat of stress will automatically or even typically generate social or cultural development" (Cowgill, 1974: 507). To this, Carneiro claims that it is not up to his theory to explain the rate of population increase, but "simply takes this increase as *given,* and uses it as one element in accounting for state formation" (Carneiro, 1988a: 503). Though not obliged, he is generous enough to offer a suggestion for the high growth rate, posing that sedentism made possible by agriculture permitted a reduction in the practice of infanticide and other forms of population limitation (Carneiro, 1988a: 504). In effect, "with the coming of agriculture, the cork was out of the bottle" (Carneiro, 1988a: 505).

Cowgill, though, poses an opposite consequence of population pressure: "If there is serious stress due to resource shortages that can only be overcome by intense conflict with other groups, the response will be to halt population growth *unless* something other than inelastic fertility is stimulating that growth" (Cowgill, 1974: 517). Indeed, Malcolm C. Webb's sentiment is extremely pertinent here: "It is doubtful that so significant a cultural evolutionary step as the birth of civilization was the consequence of a final struggle of desperate, impoverished, teeming masses" (Webb, 1988: 451). Such notions are perfectly consistent with population ecology and the Malthusian demostat. Carneiro, though, defies the notion of self-constraint, logical as it may seem: "In theory, they might have done so; in practice, they did not. Examine any major area of the world where states arose and you will find [population growth]" (Carneiro, 1988a: 504).

Of course, Carneiro commits a logical flaw here, putting the cart before the horse by suggesting that, because all states arose from (among other things) population growth, population growth (among other things) leads to the state. However, we can resolve this dispute with our knowledge of population ecology. Though Carneiro does not feel the need to explain the cause of population growth, he is right in suggesting that agriculture uncorked the bottle, increasing humanity's carrying capacity as suggested by Hardin's demographic revolutions. Thus, while Cowgill is perfectly correct that population growth cannot be, and indeed is not, a given for all human populations since no species actually grows according to the exponential model, human population growth has, since the agricultural revolution, approximated this model, growing parallel to our increases in food production. The upshot of this is that, while Carneiro is practically justified in granting exponential growth, population ecology models neutralize his theory. As Cowgill suggests, populations do not grow when food production is constrained, they stabilize. Having failed to grow, such populations would be *invisible* to Carneiro's analysis. Only those that found a way to circumvent their constraints would be able to grow. It is food production itself which has enabled the exponential-like growth of humans over the last 10,000 years.

The organizational factor pointed out by Carneiro then becomes most crucial in understanding state formation. A society, *if it is to remain unified and integrated*, must elaborate its organization to accommodate population growth. This conclusion is not unique to circumscription theory, supported as it is by many others such as archaeologist Gregory A. Johnson, whose work more broadly confirms that organizations generally become more complex as they grow in size due to scalar stress (i.e., structural stress due to increasing size) (Johnson, 1982: 389-396). Any entity that grows and wishes to keep intact without fissioning must make its organizational structure more complex and hierarchical, and hierarchy brings, by definition, inequality. Hierarchy arises not just among people within an organization but among organizations in supraorganizational entities as well. The most obvious way in which this is played out is in political organization, the very subject of theories of state formation. The governments of nation-states are tiered, with national laws trumping the laws of successively smaller regional breakdowns until one reaches local municipalities whose laws are permitted to cover only their own small jurisdiction. Individuals in any level of government have more power than those outside government, while the amount of power wielded increases as one moves to "higher" levels of government (i.e., those levels subsuming a wider territory). To paraphrase George Orwell, some hierarchies may be more equal than others, as republic may be compared to oligarchy or dictatorship, but the fundamental society-wide inequality never disappears.

The patterns of hierarchy emerge not just within a nation-state but internationally as well. The United States sits atop a politicoeconomic hierarchy of nations. The remaining G7 nations form the next layer, below which are various levels down to the poorest countries. The once-upon-a-time taxonomy of First, Second and Third Worlds brought this international hierarchy into clear focus. Indeed, the process which creates this particular hierarchy among nations, described by Robert McNamara as “a blood transfusion from the sick to the healthy” (cited in Gore, 1993: 55), is directly parallel to the channeling of carrying capacity from one species to another (Hawken, 1993: 25-6). The developed world claims resources from the developing, reducing developing world’s wealth just as a predator species feeds on its prey. In economics, though, the process is enhanced when the developing world becomes a market for the developed world’s products and even more wealth is syphoned away, widening the gulfs between levels in the hierarchy.

In purely economic terms, commercial enterprises which dominate an industry are thought of as the tops of market hierarchies. Just as nations are tiered within even as they rank above other nations as a whole, commercial enterprises are also internally layered, broken down with executives over various levels of management, themselves above the mass of workers at the lowest levels. Departments are not only organized hierarchically but also themselves form a hierarchy within the company, just like companies within an industry. On the broadest economic level, even industries within an entire economy can be hierarchicalized in terms of importance. Hierarchicalization runs rampant throughout the rest of civilization’s institutions as well: “The monastery, the barracks, the factory floor, and the administrative bureaucracy (private or public) exercise many state-like functions and often mimic its information structure as well” (Scott, 1998: 79). It manifests itself in everything from the gravity of organized religions to the superfluity of a beauty pageant circuit. What is common to all of these incarnations of hierarchy is the disparity in resources — wealth, power, status, etc. — that is endemic to the management of large systems. The poverty of the lower class compared to the upper and the powerlessness of the local compared to the national are both as assured as the inferiority of the Third World compared to the First.

Not only is increasing inequality inherent in such a system, but increasing complexity is, in a way distinct from yet related to that of economic growth, unsustainable. Increasing social complexity, like economic growth, faces limits of its own in a closed system like the Earth. The growth which causes complexity would first reach a physical circumference past which it could not expand. At this point, complexity could continue to increase within the system but there is likely to be a limit here as well, caused possibly by limits of information processing capacity.

Long ago, the initial effect of increased complexity would have been to increase the carrying capacity of an area and so reduce absolute population pressure, an advantageous development which is consistent with Carneiro's circumscription theory. However, Webb says it would only do so "at the cost of increasing the *fragility* of subsistence thus *increasing the necessity of staying in place and maintaining the social and economic status quo*" (Webb, 1988: 455). Anthropologist Roy Rappaport and sociologist Charles Perrow believe that complex systems are profoundly maladaptive since, instead of maintaining flexible responses to stress, their many interconnections mean that change in one component is likely to have a ripple effect, changing the whole system: Diversity and flexibility diminish, and a failure in one element must spread (Yoffee, 1988: 5; Tenner, 1996: 15-16). Thus, while at first the state is strong, successful and seemingly adaptive, like economic growth, its uniformity makes it vulnerable in the long run (Scott, 1998: 7). Complication pushes toward two limits: The breach of one yields explosion, the other implosion. Fissioning, an option long ago left behind, becomes the only choice left to evade collapse.

Bruce H. Mayhew points out that the "seeds of their own destruction" attitude toward certain social systems is usually marked by the grave defect that it is most often discussed as a purely internal flaw, something inherently wrong with the structure itself or with an ideology involved, as with Marx's critique of capitalism. But he acknowledges that population systems nevertheless can generate the conditions of their own demise, arising from an environmental relation, not an internal one (Mayhew, 1982: 137-8). Looking at a few of Mayhew's propositions on how population systems work, we can see more specifically why complication thrives at first and then brings about its own end.

System proposition 4 says that "The higher the rate of change in information and/or energy transactions (resulting in an increase toward the system's upper processing limit) the greater the probability that the structural change in the system will be destruction of the system" (Mayhew, 1982: 140). Thus, with complication, the rate of change not only increases but accelerates, so there is a geometric approach to the always-possible moment when further change is likely to destroy the system. That moment, though, is made less possible by propositions 7 through 9, which state that the upper limit on information and energy capacity will increase along with a social system's population size, functional differentiation and complexity of material technology (Mayhew, 1982: 140). In other words, "The larger a system becomes, the greater the environmental change required to destroy it" (Mayhew, 1982: 148). Hence complication truly does succeed at first, but only at first because even success is bound to catch up with the system, due to propositions 10 through 12. These suggest that the lower limit will also increase, meaning that more and more information and energy are required at minimum to continue the system's operation (Mayhew, 1982: 141): "Functional and technical complexity thus place powerful constraints on operation, requiring even more stringent schedules of activity and systematic coordination" (Mayhew, 1982: 153). In other words, the larger something grows, the greater its maintenance costs (Daly, 1996: 68). The eventual failure becomes just as likely as the initial success, for there must come a time when complexity accelerates faster than the ability of the system's managers to remain in control — and the ability of the Earth to provide energy inputs. The system must simplify or collapse.

This sort of limit need not only occur after state formation. Discussing the Melanesian Big-Man phenomenon, Joseph A. Tainter says, "... as resources are allocated to expanding a faction, those available to retain previous loyalties must decline. As a Big-Man attempts to expand his sphere of influence, he is likely to lose the springboard that makes this possible. Big-Man systems contain thus a built-in, structural limitation on their scope, extent, and durability" (Tainter, 1988: 25). Paul B. Roscoe concurs, elaborating on Big-Man politics with more universal implications:

> Since agricultural populations are committed to stored resources and to a relatively heavy investment in sowed fields, relocation will have its costs, and this fact will tend to promote the hegemony of big-men and chiefs. If subsistence is also dependent on irrigation systems, then... the population will be 'tied down' yet further... elite power can rise to greater levels under intensive than under extensive subsistence regimes... For, if labor- and capital-intensive agriculture makes relocation unappealing, then environmental circumscription, social circumscription, and resource concentration render it more so. (Roscoe, 1988: 480)

Indeed, the phenomenon is universal. Webb suggests that warfare occurred in Egypt "not because of overpopulation or... land shortage, but simply because their dependence on irrigation and exchange networks forced them to stay in place and deal with the conflicts that, for a variety of reasons, inevitably rose among them" (Webb, 1988: 455). Fissioning and dispersal ceased to be a viable, or at least acceptable, course of action.

While we have already seen that circumscription theory is flawed, Roscoe suggests that adding a new layer may improve it: "A gradual continentwide growth in technology..., by stimulating population growth and necessitating continuous attachment to more complex — and demanding — economic networks, eventually would create a condition that one might characterize as *technoeconomic* circumscription" (Roscoe, 1988: 457). Yet another level of circumscription is proposed by D. Bruce Dickson, who suggests that the thesis "be amended to include changing patterns of 'artificial' circumscription brought about by anthropogenic environmental destruction" (Dickson, 1987: 709). In this light, the circumscription process itself can be seen as "a complex dialectical one — in which social units, competing with each other... created ever more constricting and circumscribed agricultural environments for themselves" (Dickson, 1987: 715).

It is clear how economic growth, population growth and social complexity relate to problems of ecological degradation and unsustainability. Just as a socioeconomic system like ours creates, in effect, massive inequities between humans and the rest of nature, inequities among humans and groups are created within, a Doppelganger relationship suggested by social ecologists (Bookchin, 1982: 1), ecological Marxists (J. O'Connor, 1994: vii) and less overtly political sorts such Eldredge (Eldredge, 1995: 15), microbiologist and pathologist René Dubos (Dubos, 1968: 7, 16) and others. Similarly, just as we as a civilization find growth difficult to give up, those in the upper levels of social hierarchies have a great interest in keeping their power and resources and thus in maintaining the system. All of this ensures that the situation will worsen. Ecological degradation certainly has direct impact on human societies through feedback mechanisms, but this analysis of social structure provides direct support for the idea that economic growth and the domination of nature are destructive not only of ecosystems but of the purely social aspects of humanity as well (M. O'Connor, 1994: 5).

In theory, continued integration would inevitably result in the formation of a single world state, the ultimate level of earthbound social complexity (Langton, 1988: 495). Since economic growth could very well reach the limits of sustainability sooner than complication, bringing a premature end to the complication process, we may never see that world state. Additionally, nationalism and the free market ideology may prevent such a final unification. Of course, there is a variation, an alternative to a single integrated world state as such. As John Langton suggests, after having described how the United States allows for organization at a federal level while maintaining a certain degree of freedom at lower levels, "the transformation of the American state also suggests that some form of federalism, combined with a system of governmental checks and balances, might serve as the political structure of a world state capable of solving humanity's common problems without despotism or the destruction of cultural diversity" (Langton, 1988: 495). Supranational entities such as the United Nations, the World Bank, the International Monetary Fund and the World Trade Organization suggest just this sort of development. While this might happen in theory, though, the fact that the United States has not succeeded in solving its own problems after more than two centuries of federalism could be held as just cause for pessimism in applying the system on a global level.

Our hierarchical civilization (technically a redundancy) proves maladaptive through the vulnerability of maximum complexity and minimum variety: There are more parts that can go wrong and fewer unique features to respond to problems. Indeed, the diversity issue is perhaps the more important one. Ecosystems are also complex, but they evolve over long periods of time, generating diverse elements which tend toward equilibrium and symbiosis. In contrast, growth pushes civilizational structures toward pervasive hierarchy, forcing them to change in a single direction at an accelerating pace, never giving them the opportunity to settle into stability. John S. Dryzek echoes this, suggesting that large, highly hierarchical administrative mechanisms cannot cope with truly complex, multifaceted problems, because division of labor tends toward disaggregation of problems into components which become artificially separated from each other (Dryzek, 1992/1994: 181). Indeed, this approach, inherent in “the specialization of modern science and technology that emphasizes the detailed study of smaller and smaller units on the theory that this is the only way to deal with complex matters,” is a manifestation of looking at trees instead of the forest, an idea antithetical both to ecology and to the very resolution of those complex matters (Odum, 1975: 5). The problems of a system like ours, whose analysis requires the integration of knowledge from so many fields, are precisely the kinds of problems such systems are least able to solve.

In the end, economic growth yields population growth, which in turns generates social complication and hierarchicalization, whose many forms include governmental expansion and centralization, urbanization and market globalization. Through a reduction in structural diversity, these conspire not only toward ecological destruction but systematic inequality and organizational implosion — the “diseases of civilization” (Dubos, 1968: 150) inevitably become fatal. This intricate, multifaceted process is the flip side of the growth coin, and only by understanding it can we finally resolve the paradox Dubos claimed about our age of affluence, technological marvels and medical miracles simultaneously being one of chronic ailments, anxiety and despair (Dubos, 1968: 14). It is absolutely no coincidence that, as Secretary of the Interior Stewart L. Udall said in a speech entitled “Can America Outgrow Its Growth Myth,” the United States has “the most automobiles of any country in the world — and the worst junkyards. We’re the most mobile people on earth — and we endure the most congestion. We produce the most energy, and we have the foulest air” (cited in Dubos, 1968: 192). These opposing characteristics are not contradictory but fundamentally integrated, the result of a powerful set of equal and opposite reactions in the interplay between our culture and the ecosystems of which it is a part.

We find ourselves in a modern-day Tower of Babel, built through single-minded increase just as the original was said to have been enabled by its builders speaking the same language. And just as God is said to have stopped its builders’ quest to reach Heaven by making them speak in different tongues, our present lack of diversity also ensures that, aside from whatever morality judgments one might wish to place on it, our own unsustainable tower will topple before we can ever make good on our conquest of the Earth.

THE EVOLUTION OF UNSUSTAINABILITY

Human Expansion and the Theory of *r*-*K* Selection

It is now clear that persistent growth, along with the desire to remain integrated in large social structures, has led us to not only the present extent of global ecosystemic degradation but also to widespread inequality on multiple levels, the inherent side effect of a growing and complicating social system. The question that must now be asked is, given the negative consequences — wide and deep; past, present and future — how did we come to follow such a strategy? Did humans evolve as expansionists?

In the community of life, a wide variety of survival strategies can be found. With respect to population ecology, the theory of *r*-*K* selection suggests that evolution can select for different population characteristics under different circumstances. The theory takes its name from the two constants of the logistic growth equation: *K* stands for carrying capacity, while *r* represents population growth rate (Gotelli, 1998: 70). Through natural selection, the two species archetypes that result are *r*-strategists and *K*-strategists. An *r*-strategist maximizes population growth, producing large or even vast numbers of offspring at a time and at short intervals. Insects, mice and certain plants pursue this strategy, ensuring that large numbers, in the face of low survivorship, will yield a next generation to carry on the species. In contrast, *K*-strategists are species for which achieving a stable equilibrium size represents a successful strategy. Large mammals often fit this category, investing more resources into rearing fewer, "high-quality" offspring at long intervals, expecting that most will survive (Tudge, 1996: 305; Gotelli, 1998: 70).

The theory of *r*-*K* selection is problematic for several reasons. Its predictions were never derived from a population model with age structure (i.e., in which individuals are classified into appropriate age groups to account for varying survivability and reproductive habits). Further, its predictions were never confirmed experimentally, and population density is not the only force driving evolutionary selection. Perhaps most importantly, many species do not fall neatly into one category (Gotelli, 1998: 70). For the purposes of better understanding whether or not humans are inherent expansionists, though, it is useful to contrast humans with the standard profiles. To do so, though, requires that we be more specific about just what humans we mean. From the standpoint of *r*-*K* selection theory, civilized people look very different from peoples such as those in an aboriginal, tribal culture. Some of the key differences between the two strategies are outlined below (Odum, 1975: 156, 159; Gotelli, 1998: 70; J.R. Oppenheimer, personal communication, October 5, 1999):

Characteristic	*r*-strategists	*K*-strategists
Body size	Small	Large
Life style	Annual	Perennial
*Resource availability	High	Low
*Energy use	High	Low
*Rate of resource use	Rapid	Slow
*Energy optimization	Productivity	Metabolic efficiency
*Allocation of resources	Reproduction	Individual growth
Frequency of reproduction	Once/generation	Multiple/generation
*Fecundity & fertility	High	Low
*Survivorship	Poor	Good
Rate of development	Rapid	Slow
Life span	Under one year	Over one year
Mortality	High	Low
*Mortality type	Density dependent	Density independent
*Age of highest mortality	Juvenile	Old age
*Population growth rate	High	Low
*Population growth model	Exponential	Logistic
*Population size over time	Variable	At equilibrium
Level of social behavior	Solitary	Social
Symbiosis	Low	High/mutualistic
Parental care	None	Well developed
Information volume	Low	High
*Dispersal ability	Excellent	Poor
*Species geographic range	Large	Small
*Mobility	Active	Sedentary
*Gene flow between subpopulations	High	Low
*Adaptations	Generalist	Specialist
*Multidimensional niche breadth	Wide	Narrow
Competitive ability	Poor	Excellent
Defense mechanisms	Poor	Excellent
*Autotoxicity	Yes	No
Habitat type	Unstable	Stable

At the risk of making generalizations, the tribal culture will pretty closely resemble the standard *K*-strategist profile, expected since people are large mammals like the other animals typically employing this strategy . However, the civilized culture, in terms of both individuals and populations as a whole, diverges from this profile, taking on several key *r*-strategist characteristics, asterisked above. Some asterisked factors apply more to poorer than richer subpopulations within a civilized cultural system, but the overall effects are unmistakable and can all be attributed, directly or indirectly, to cultural practices. Growth economics spurs the level and rate of energy/resource use, agriculture contributes to the population factors, while various technologies support all asterisked factors. Finally, we have seen how all three of these components contribute in many ways to habitat instability.

It seems clear, then, that, rather than representing some inherent long-term trend for the human species, our high rate of growth and its consequences are cultural. Though they may be hard or impossible to measure, cultural factors can most certainly influence equations for population size. Not only can we point to specific cultural factors that can move people toward the *r*-strategist profile, but the alternative, that we biologically evolved as exponential growers, is simply improbable. First, people in civilized and indigenous cultures are biologically the same. Second, dramatic increases in human population correspond closely with Hardin's demographic revolutions, each a cultural event. Finally, such growth may be an evolutionarily stable strategy for the typical *r*-strategists, whose numbers boom and bust annually as efficient predators or harsh seasons kill off most of a year's progeny. Were humans pursuing this strategy, though, our boom-bust cycle would be hundreds of thousands of years long, a period related to no natural cycle for any species. More importantly, given that our continuously growing population increases social problems and ecosystemic degradation, it would be all the more difficult to defend this as a stable strategy for humans. With a cultural explanation for expansionism indicated, though, the issue becomes whether or not growth is a necessary result of cultural evolution.

A Biased Path to Civilization

Throughout the history of anthropology, there has been great interest in explaining how societies increase in complexity and eventually form civilizations. Beginning in the 19th century with Lewis Henry Morgan's categories of Savagery, Barbarism and Civilization (Feinman & Neitzel, 1984: 40), and Herbert Spencer's simple, compound, doubly compound and trebly compound (Spencer, 1967: 48), one way in which researchers have attempted to deal with the issue is through the creation of taxonomies, often proposing a unilineal evolutionary path, as noted earlier. The work of others such as Elman R. Service has led to the now common four-step system of Band, Tribe, Chiefdom, State (Carneiro, 1987b: 759). Dissatisfaction with this scheme has led to others, such as Joan Townsend's minor variation of Band, Autonomous Village, Intermittent (or Recurring Alliances), Chiefdoms, States (Carneiro, 1987b: 760-1); and Estellie Smith's radical departure to Commonwealth, Confederation, Dominion, Bureaucracy, Technocracy, Transitional (Carneiro, 1987b: 759).

According to Gary Feinman and Jill Neitzel, though, "Despite the continued emphasis on the construction of typologies in both general and area-specific studies, relatively little consensus has been achieved concerning the nature of middle-range societies" (i.e., those societies between the simplest levels and the civilized state) (Feinman & Neitzel, 1984: 42). In addition to quibbles over definitions and boundaries, a general dissatisfaction has arisen regarding the systems' unilineality, with the very idea of a single cultural evolutionary pathway brought into question.

Beyond the classification schemes are proposals for the actual mechanisms of formation for states and civilizations, such as Carneiro's circumscription theory. Such theories pose a deterministic process and, though they have their supporters, often receive criticism for doing so. Indeed, both the determinism and the criticism thereof perfectly complement the unilineal taxonomies noted above. Carneiro, for example, claims that one theory should fit all cases (Carneiro, 1988a: 497), and there are many, both supporters and detractors, who agree with him. But others argue that circumscription is "an essentially monocausal account of political evolution, and thus, at best, provides only partial insight into the panoply of factors shaping that complex process" (Langton, 1988: 485). They claim various economic, ideological, technological and social factors must be incorporated into an explanation of state formation (Cowgill, 1974: 513; Kirsch, 1988: 425; Webb, 1988: 450). Indeed, any theory would be subject to the criticism that it focuses on certain factors at the expense of others. Some critics go so far as to suggest that there are so many factors involved that the search for causal variables of any kind is pointless (Cowgill, 1974: 513), most notably in Service's declaration, "*Down with prime-movers!*" (Service, 1968: 406).

A general thread that runs through Carneiro's defenses against various criticisms has to do with the very intention his theory, concerned with what exactly is required in an explanation. Carneiro appropriately identifies the theory for what it is, one of state formation. It does not intend to explain all cultural evolution, only the rise of states. It does not suggest that all cultures must develop into states, only those that find themselves in certain specific conditions. Accept these limits and, while there is still much to debate, Carneiro does a serviceable job in defending himself and, more important, an admirable thing by stressing the limits of his own theory.

However, beyond admitting varying interpretations of data and the limits of the theory's acceptability, as he makes his case Carneiro exposes a flaw both in the theory and in his presentation of it. The question that circumscription theory is designed to answer is if all cases of state formation share the same cause. The answer he suggests is that the conditions posed in circumscription theory always lead to the state. However, his arguments all suggest that if there is a state there was circumscription, and we have seen how this is the classic logical flaw of attempting to prove a statement by proving its converse. Carneiro must either prove the claim itself or its contrapositive: If a state has not been formed, then there was no circumscription. The contrapositive premise, however, is clearly not true. Joseph A. Tainter provides a case:

> Due to drought and disruption by national boundaries of the traditional cycle of movement, the

> Ik live in such a food- and water-scarce environment that there is absolutely no advantage to reciprocity and social sharing. The Ik, in consequence, display almost nothing of what could be considered societal organization. They are so highly fragmented that most activities, especially subsistence, are pursued individually... Although little is known about how the Ik got to their present situation, there are some indications of former organizational patterns... It appears that a former level of organization has simply been abandoned by the Ik as unprofitable and unsuitable in their present distress. (Tainter, 1988: 17-18)

Carneiro would not deny that complexity can collapse (as he puts it, devolve), but here is a case of the very factors he poses in circumscription theory leading not to war and the state but to a society so simple that it is hardly more than a smattering of individuals. He would deny that an individual exception disproves the rule. However, only one exception is required to disprove a scientific theory, and, in any case, various examples set forth by Tainter and others tell stories of collapse under similar circumstances. While circumscription may often apply in state formation and may be a better general explanation than most, it is not universally true. Indeed, it is likely that there have been countless cases of circumscription of some kind which did not give rise to increased complexity, as the earlier analysis of population ecology and social complexity suggests.

The innocence of faulty logic, though, is not the least way in which Carneiro betrays his defense. While he may argue very appropriately about the limits of his theory's applicability in response to opponents who he feels have misunderstood him, his own general attitude toward complexity is partly responsible for the very misunderstandings he attempts to correct. In his first full proposal of circumscription theory, Carneiro claimed that theories of state formation based on the race, the "genius" of the people or "historical accident" have been discredited (Carneiro, 1970: 733). Yet pages later he says that the step from village autonomy to supravillage integration was "difficult, for it took 2 million years to achieve. But, once it was achieved, once village autonomy was transcended, only two or three millennia were required for the rise of great empires and the flourishing of complex civilizations" (Carneiro, 1970: 736). While the words "transcend," "great" and "flourishing" can technically be read in this context without a value judgment, the tone of the sentence as a whole suggests that culture was struggling toward some destiny and finally passed its most difficult test to reap the rewards of a quantum leap in complexity, as if the genius of the people was in fact at work. The same article ends with the statement that circumscription "helps to elucidate what was undoubtedly the most important single step ever taken in the political evolution of mankind" (Carneiro, 1970: 738).

When defending circumscription theory 18 years later in a special issue of *American Behavioral Scientist* devoted to the subject, he has expanded his pride in the development of complexity, calling it "the single most important step ever taken in human history" (Carneiro, 1988a: 510), political or otherwise. Perhaps his most blatant display in favor of complexity came during a lecture given in June 2000 on the possibility of a science of history, in which he once again touted circumscription and posed the inevitability of an eventual world state. When asked whether political developments such as the secession of the Confederacy from the United States, independence struggles such as those of Ireland, Kosovo, Taiwan, Timor and Myanmar, and even the recurring motion for Quebec to secede from Canada detract from his theory's predictions, Carneiro responded by simply suggesting that nobody said that integration would be easy (R.L. Carneiro, personal communication, June 7, 2000). Scientific theories are supposed to describe how things happen; they cannot dictate what difficult challenges we must struggle through to *make* certain things happen.

For Carneiro, the rise of the state is clearly not just an interesting development worthy of objective study. It is important, to be valued and prized, even our destiny. This kind of talk reinforces a prejudice of complex societies over simpler ones, one which numerous researchers agree has no place in objective social science (Hallpike, 1986: 11; Tainter, 1988: 41). More importantly for his theory, Carneiro foils his defense against those who criticize the theory for its slant toward inevitability.

Perhaps Carneiro's admiration for Herbert Spencer has gotten the best of him. Not only has Carneiro edited a book of Spencer's thoughts on the evolution of societies (Spencer, 1967), but among these thoughts are precursors of circumscription theory. There might be no problem with this, except for the fact that Spencer was one of the key early proponents of social Darwinism, a complex of political ideas which have been discredited for their misapplication of Darwinian evolutionary theory, regardless of what one may think of their moral considerations.

In his introduction to the Spencer book, Carneiro outlines three different forms of social Darwinism. The first is the elimination of the unfit to benefit society biologically, posing that the state should do nothing to relieve the poor, who are less fit to survive. The second suggests that an economy will run properly only when individuals are allowed to pursue private interests unhampered by regulation. Carneiro argues, successfully, that these are both political statements which do not follow from evolutionary theory and should therefore not reflect poorly on Spencer's sociology, supporting the notion of the naturalistic fallacy (i.e., the move from material fact to normative proscription, from "is" to "ought"). A third form of social Darwinism, however, is that of war being won by the larger and more complex society, and hence leading to increased complexity over time.

Thirty years after writing the introduction to this book, Carneiro wrote a letter to the editor of *Natural History* magazine. The letter (Carneiro, 1997/1998), headed by the title "Unpalatable Truth," responded to Stephen Jay Gould, his colleague at the American Museum of Natural History. Gould had devoted a column to explaining how Darwinism has been misunderstood and misused in the political arena, with Spencerian social Darwinism standing as a "a grossly overextended application of biological evolution to human history" (Gould, 1997: 20). In the letter, Carneiro appeared to agree with the criticism of the first two kinds of social Darwinism, but suggests that the third is a scientific fact, essentially defending his circumscription theory. Is circumscription Darwinist because two entities compete (i.e., go to war) and one comes out victorious? Did the more fit entity survive? Whether or not this is true, the matter is complicated (no pun intended) by Carneiro's campaigning for complexity elsewhere.

Gould, though, is not one to shy away from an unpalatable truth. Our most accepted understanding of biological evolutionary theory is that the hallmark of evolution is not complexity but variation. In Full House, Gould uses an ingenious approach toward looking at trends in biological evolution to demonstrate precisely why this is the case. He hopes his argument will help humanity complete the Darwinian revolution, bringing us to a time

> when we smash the pedestal of arrogance and own the plain implications of evolution for life's nonpredictable nondirectionality — and when we take Darwinian topology seriously, recognizing that *Homo sapiens*, to recite the revised litany one more time, is a tiny twig, born just yesterday on an enormously arborescent tree of life that would never produce the same set of branches if regrown from seed. (Gould, 1996: 29)

Yet Gould himself points out that biology and culture, while both being systems of inheritance that may evolve, operate differently and that culture may in fact have a drive toward complexity.

The conflict is set in two seemingly paradoxical stances, taken by members of the same famous research institution. On one hand, Carneiro is willing to admit a hard truth about the contribution, indeed necessity, of war and coercion in the development of cultural complexity and simultaneously holds this war-derived complexity as a dear and destined quality. On the other hand, Gould comes as close to anybody to proving that variation, not complexity, is the hallmark of biological evolution, but he simultaneously concedes that cultural evolution may indeed have mechanisms which drive toward complexity. If culture is shown to be bound to increase in complexity, Carneiro may end up justified in his stance. Yet in our world of increasing social complication, the verdict in favor of cultural complexity might appear to be a death sentence, a concession that humans are perhaps innately flawed.

The matter, though, is not as black and white as it seems. A closer look at the concept of evolution in both biology and culture may lead toward a resolution in the gray area. If the two sides may each be thought to hold a paradox, then, bringing them together, each may contribute to the resolution of the other's apparent contradiction, revealing both logic and compatibility overall, as well as a clearer explanation for the rise of our civilization.

Biology, Culture and Evolution

As C.R. Hallpike points out, "since Huxley's paper of 1956, comparing cultural and biological evolution... there has been an increasing number of publications from biologists and biologically minded anthropologists, trying in one way or another to apply Darwinism to social evolution," noting in particular the rise of sociobiology (Hallpike, 1986: 14). Inasmuch as biology and culture are both systems of inheritance which evolve, it is not unreasonable to attempt to seek what they hold in common. Indeed, they may both hold some things in common with inorganic evolution, which Spencer has pointed out in great detail (Hallpike, 1986: 31). Nevertheless, few would claim that the mechanisms of inorganic evolution "could be even remotely comparable to those of biological and cultural evolution" (Hallpike, 1986: 31), and thus even the application of biology to culture is called into question.

Gould says, "Natural selection may be one of the most powerful ideas ever developed in science, but only certain kinds of systems can be regulated by such a process... driven by differential survival and reproductive success of some individuals in a variable population" (Gould, 1997: 22). Hallpike continues the thought:

> While there are good empirical reasons for treating organisms as efficient, functional, self-regulating systems, there is very much less reason for regarding societies in the same light because they are composed of separate, conscious individuals who are linked by information exchanges and not by bonds of an essentially physical nature. They are thus inherently less stable than organisms, for which metamorphosis beyond certain rigid limits results only in death. (Hallpike, 1986: 25)

Hallpike outlines various ways in which societies resemble organisms, differ from organisms, and resemble species rather than organisms (Hallpike, 1986: 33-4). In the end, though, he concludes that, while biological systems have two separate development processes, phylogeny, the development of an individual, and ontogeny, the evolutionary development of a species, "in social systems these are one and the same" (Hallpike, 1986: 35).

In addition to suggesting that too little time has passed for us to invoke natural selection as the controlling cause of cultural change since the dawn of agriculture (Gould, 1997: 22), Gould provides a concrete, two-part explanation for why Darwinian biological evolution cannot apply to culture. First, the topology of biological evolution involves "continuous division of species into independent lineages that must remain forever separated on the branching tree of life," while culture operates in the opposite manner through borrowing and amalgamation. Second, he says the mechanism of inheritance for culture is Lamarckian. Though abandoned in biology, Jean Baptiste Lamarck's idea of inheritance of acquired characteristics explains very well how anything useful can be passed on by direct education, allowing evolution to be much more rapid in culture than in biology, which requires Mendelian inheritance based on small-scale undirected variation over large periods of time (Gould, 1996: 221; Gould, 1997: 22). In the end, culture may possibly have a drive toward increasing complexity.

But how can we be sure that biology does not, in fact, have a drive toward complexity, especially when the paleontological record so clearly shows that increasingly complex lifeforms have evolved over time? Gould explains that "Our strong desire to identify trends often leads us to detect a directionality that doesn't exist, or to infer causes that cannot be sustained" (Gould, 1996: 30). In statistics, we tend to depict populations either as average values or as extreme examples, when neither is appropriate. When looking at the trend of biological evolution over time, correcting this mistake reveals that progress does not define the history of life, that there may not even be a trend at all. Full House is devoted to the exploration of this subject, but a summary of his argument, based on limit phenomena, will suffice here.

In short, life necessarily began at its simplest level of complexity, a wall before which life could not arise and cannot exist. Variation, therefore, necessarily formed an increasingly skewed distribution, with the level of the most complex lifeform moving farther away from the wall of minimal simplicity because this was the only direction available for movement. Despite this increasing maximum level of complexity, the greatest number of species, by far and ever-increasing, continues to the present day to exist near the wall of minimal simplicity. The spread of variation has its cause in the wall of minimal simplicity, and thus the extremes of maximum complexity can only ever be considered a consequence of the wall and not of any driven trend toward complexity. In the last analysis, it is myopic to characterize the full distribution of life's variation by an extreme value at the end of the distribution where the fewest number of species exists.

Through this analysis, we can understand that, as more complex lifeforms arose, both the maximum and mean measurements of complexity increased. But, rather than indicating a directional trend toward complexity, these are merely side effects of the presence of the wall of minimal simplicity. It would therefore be entirely unrepresentative of the system to generalize based on the maximum or mean measurements. The mode stands as the most appropriate indicator of what is typical for the system, and the mode of life on earth remains situated in the realm of the bacteria. Claims for progress can only be based on the idea of an entity on the move, but an average value is not an entity, only an abstraction based on the underlying reality of variation. As Gould says, "We cannot confuse a dribble at one end with the richness of an entirety — much as we may cherish this end by virtue of our own peculiar residence" (Gould, 1996: 149).

Ian Hacking suggests that our concept of the "average person" is a relatively recent one, rooted in the very same kind of statistical error. The Normal or Gaussian distribution, familiarly thought of as a bell curve, had originally been discovered through two separate routes, first through trials of coin-tossing to determine the probability of getting heads, next through astronomers' observations of celestial positions. Coin-tossing would not always yield a 50% chance, and astronomers would each have some degree of error, but by plotting enough trials together each would cluster around a point, representing respectively the heads probability and the celestial object's actual location, each a real quantity. Adolphe Quetelet began to plot the distributions of certain biological and cultural phenomena in 19th century France, such as the incidences of crime and suicide and measurements of people's heights and weights, all cases in which mean values represent no real quantity. In conceiving of the *homme type*, the average man, Quetelet created real quantities where there was none, leaving us a legacy of measuring and giving credence to abstract properties of a population often in the place of anything concrete (Hacking, 1990: 106-108), and very possibly contributing to the very misunderstanding many have about how biological evolution generates complexity.

Since evolution can only allow individuals to adapt to local circumstances, simplicity might just as easily as complexity be an adaptation, depending on a given environment (Gould, 1996: 139). Indeed, that evolution can produce a parasite for each entity which increases in complexity exemplifies this fact (Gould, 1996: 145). Thus, what seemed to be a paradox in Darwinism, that natural selection offered no statement or mechanism for general "progress" and yet complexity nevertheless appears to increase as time passes, is resolved easily by an appropriate analysis of the trend of variation. Biological complexity is a passive trend, an epiphenomenon of variation, rather than a driven trend in its own right.

Despite all this, many still demand that increasing complexity is, in fact, the hallmark of biological evolution, including Carneiro (Carneiro, 1987a: 126), who claims that "Through this increase in the complexity of organic forms, larger, more varied, and more successful kinds of life evolved and spread over the earth" (Carneiro, 1987a: 112), and even "That greater complexity is a major means of producing adaptation is proved by the fact that so many complex organisms exist" (Carneiro, 1987a: 113). This is, in fact, not at all what happened. Variation drove evolution, and it therefore cannot necessarily be said that later kinds of life, whether more complex or not, are more successful than earlier ones. They are simply later in origin. More importantly, it cannot be said that a complex lifeform is more successful than a contemporaneous simple lifeform. Both are fit survivors of natural selection. Indeed, Carneiro commits his favorite logical flaw once more, claiming the presence of complexity to be proof of its nature as an active, adaptive trend.

Spencer's theory is similar to Darwin's "in so far as both regarded competition as the driving force of an evolutionary process leading to optimal adaptive efficiency" (Hallpike, 1986: 84), but Spencer's was a directional process and Darwin's was not. Confusion remains to this day, and no small part of it owes to the fact that the very term evolution was propelled into biology by Spencer's advocacy, despite Darwin's preference for the more descriptive and accurate descent with modification (Gould, 1996: 137; Gould, 1997: 29). To propose determinism is no sin and, indeed, any theory may be considered determinist in the loosest sense. However, directionality is not automatically involved in every process. In biological evolution, descent with modification occurs based on random variation, which allows individual adaptation only to local environments. If what is adaptive in one environment may be maladaptive in another, complexity cannot be taken as absolutely superior.

To what extent can Gould's analysis of limit phenomena be applied to cultural evolution, even as Gould himself cautions about different evolutionary systems? Driven as it is by Lamarckian inheritance, "human cultural change is an entirely distinct process operating under radically different principles that do allow for the strong possibility of a driven trend to what we may legitimately call 'progress' (at least in a technological sense, whether or not the changes ultimately do us any good in a practical or moral way)" (Gould, 1996: 19). However, unlike previous attempts to apply biology to the study of cultural, Gould's approach simply seeks to understand the nature of trends in general by applying a proper analysis, just as he came to this approach only after realizing that the lamented disappearance of .400 batting in major league baseball actually indicated an increase, rather than the long-believed decrease, in athletic performance. If the approach can bear fruit in such disparate applications as baseball and biology, surely we may be able to glean something from it in the cultural realm.

As anthropologist William H. Durham suggests, "there will obviously arise many analogies, especially imperfect and partial ones, between organic and cultural evolutionary theory. But these analogies will come to light because there is bona fide evolutionary change in both realms, not because evolutionary biology can be successfully applied to both of them" (Durham, 1990: 193). Where Gould claims that Darwinism does not apply to culture, others consider the issue in different terms. Upholding the differences Gould points out between biology and culture, some such as Susan Blackmore nevertheless suggest that any system in which there is heredity, variation and selection expresses a Universal Darwinism and will evolve, though the specific mechanisms will vary (Blackmore, 1999: 10). In other words, culture is not analogous to biology, but instead both are instances of a more general model of evolutionary change, a principle Durham refers to as Campbell's Rule after Donald Campbell, a psychologist who first expressed this notion (Blackmore, 1999: 17). In the end, the issue is a semantic one: Gould sees Darwinism as referring only to passive selection in biological evolution while others reject Gould's criticism, considering Darwinism to be a more general phenomenon of which biological evolution is but one example (Blackmore, 1999: 18).

With all this in mind, the concept of cultural evolution can be clarified. Parallel to his misunderstanding of the process of biological evolution and in the manner of Spencer (Spencer, 1967; Carneiro, 1987a: 111), Carneiro defines evolution in general as "an orderly progression moving in a certain direction" (Carneiro, 1987b: 769), namely that of complexity, with devolution as the corollary term for decreases in complexity and no special name granted to change that does not involve complexity. He likewise refers to development as "an increase in structure" (Carneiro, 1967: 361). He supports this by saying, "To be fully and fairly defined, social evolution must be thought of as qualitative change *in the direction of increased complexity*," further claiming that a fatal dilemma would arise from, for example, looking at the undeniable qualitative change undergone by the Roman Empire during its decline and fall: "Who would want to call the collapse of Rome 'evolution'?" (Carneiro, 1987b: 757) Exemplifying his complexity bias, this claim is anything but fair, and looking at decline as evolution can only be fatal to the pride of someone who loves complexity, not to a theory of evolution.

Admittedly, Carneiro and Spencer are not the only ones who share this view. Hallpike agrees that “The idea of evolution is much more specific than that of mere change. Evolution implies change in a certain direction,” although this is tempered: “... while the social scientist might be readier [than the neo-Darwinist biologist] to accept the directionality of social evolution, he would certainly distinguish this from historical inevitability” (Hallpike, 1986: 15). Likewise, Gould is not the only one to include the entire spectrum of change as evolution, with Henri J.M. Claessen and Pieter van de Velde suggesting that “Both development and decline are intrinsic parts of the evolution of human culture — unless we want to cut evolution into a large number of disconnected shreds and patches” (Claessen & van de Velde, 1988: 782).

Even Carneiro admits that “what one chooses to call evolution is, of course, a matter of choice” (Carneiro, 1988b: 783). But while any terminology is simply a convention and cannot be inherently wrong, we ought to strive for consistency in general. The term evolution may have been borrowed from the social sciences in which it implied progress, but, as is clear from this debate, there is not yet widespread agreement on how cultural evolution works, much less how it should be modeled. On the other hand, there is a great consensus about biological evolution and its mechanisms. Given the strong connection of evolution to biology, not to mention the strength of biological evolutionary theory itself, it makes sense that we adopt a parallel definition for culture, with the term evolution itself having evolved from an end-driven process to a means-driven process. In effect, it seems appropriate to adopt Universal Darwinism, saying not that cultural change works in the same way as biological change but that, where we use the term evolution, we should discuss change involving whatever variation is inherent to a given system. For clarity, we should also refrain from the term development as increasing complexity, given its own ambiguity. Where changes in complexity occur, we should refer to them distinctly and appropriately as just that — complication.

Cultural Evolution and the Evitability of Complexity

Hallpike suggests:

> ... if one regards societies as nothing but jumbles of bits and pieces brought together by the contingencies of history and cultural diffusions, theories of social evolution are indeed a complete waste of time... The simple answer to claims that societies are nothing but amorphous heaps of bits and pieces, or enormously variable, or governed by the unpredictable free wills of individuals, is that if these were true there would be none of those regularities in social change of the kind that we describe as evolutionary. But since such regularities do exist, it is therefore likely that some general principles of social evolution exist, whether or not we call them "laws." (Hallpike, 1986: 7)

The study of cultural evolution received a big boost when Richard Dawkins coined the term meme to refer to the replicating unit of cultural transmission, the cultural corollary of the gene in biology (Dawkins, 1989: 192). The identity of the meme has fluctuated from ideas to behaviors to any piece of information that can be stored in a brain. Whatever their specifics, though, memes parallel genes in several ways. First, each has a strong source of variation (i.e., the human brain for memes, random chemical mutation for genes). Most notably, though, both "selfishly" seek to replicate themselves, doing so without regard for their own long-term prospects, whether biological or cultural. Interestingly, it is this very parallel — that each has its own inheritance system — that reveals memes to be truly unique, neither fundamentally related to nor subservient to genes (Dawkins, 1989: 193-4, 200). Others have followed suit in this analysis, such as Eldredge (Eldredge, 1995: 38), philosopher Daniel Dennett and anthropologists Peter J. Richerson and Robert Boyd (Blackmore, 1999: 34-5).

In line with cultural evolution as an incarnation of Universal Darwinism, based on its own production of varied traits, Durham poses an evolutionary culture theory (ECT) which would seek to explain the descent with modification of human cultures (Durham, 1990: 189) without being exclusively concerned with complexity:

> It is not... a body of theory about stages of societal progression, integration, or complexity... Surely, the emergence of increased social stratification in a population, to take one example, can and does have profound influence on the evolution of its religious beliefs, legal precepts, kinship and inheritance conventions, and so on. And surely there is much to be learned about the dynamics of cultural authorship from these effects. But just as surely, culture and social structure are not the same thing...; temporal changes in social relations — as important as they

> are — should not be construed as cultural evolution... stagelike sequences are not intrinsic to evolution as the term is defined here. (They are, however, intrinsic to a Spencerian conception of evolution which, to my mind, is archaic and prejudiced.) (Durham, 1990: 192)

A look at different types of similarity, as outlined by Durham for his ECT, provides a good example of how analysis of biology and culture can play into each other without forcing any dependencies or inappropriate comparisons. He suggests that there are four types of similarity among cultures: coincidence (similarity by accident or chance), analogy (similarity by convergence or independent invention), homology (similarity by descent) and synology (similarity by diffusion) (Durham, 1990: 191). The first three occur in both biological and cultural evolution, while the last is unique to culture, indicative of its Lamarckian brand of inheritance. Thus, while Gould's caution that culture must not be looked at in the same manner as biology must be heeded, it should simply be rephrased: Culture must not be looked at *exclusively* in the same manner as biology. That which makes it different is unique to it, but other aspects of cultural change share, at least in principle if not in actual mechanism, a great bond with biological change. In this light, just as complexity is neither destiny nor absolutely more adaptive in biology, the same may hold true for culture.

As Carneiro himself said, "It is in the nature of things that simplicity precedes complexity. Or, if that sounds too metaphysical, we can at least say that in the history of the universe, complexity has developed out of simplicity" (Carneiro, 1987a: 111). This indeed applies as equally to culture as biology, as noted earlier in the evolution of 160 nation-states from countless smaller societies. Durham provides an additional detail: More than 4,000 distinct cultures are known to anthropology (Durham, 1990: 194), underscoring the importance of cultural variation.

It is clear that there is less cultural diversity and more complexity than there used to be, but can generalizations be made based on this? Indeed, Margaret Mead, after Franz Boas, notes that "the application of evolutionary concepts to the temporal sequences of a few centuries is misleading, since change can go in any direction — toward simplification or toward complexity"

(Mead, 1964: 7). Circular logic may lead one simply to look at events that occurred and to generalize inevitability from them (Mead, 1964: 151), as Carneiro and others have at times done. In the long-term, for example, populations may fluctuate, but if one looks only at a portion of the data one may generalize increase, decrease or even a plateau as the normal state of affairs, losing sight of the fluctuating forest for the trees. More importantly, even if all that has ever occurred is steady increase, what proof is this that we are not simply witnessing the first, steady part of an overall trend of change which has simply not yet entered its next phase? Indeed, this is exactly what is implied in suggesting that our presently increasing population is heading to a level of stability. It is as if someone watched a ball thrown into the air and concluded that it is in the nature of balls to go up, not waiting around to find out that, in fact, the upward trend peaks and the ball falls back down.

Carneiro himself estimates that only the last fifth of a percent of human history displays any marked increase in complexity compared to what preceded (Tainter, 1988: 24). It should be clear that this is not enough of a basis upon which to generalize trends for increasing population or social complexity as fundamental to humanity. Whether one looks before civilizations arose when simpler societies thrived or after states dominated politically over simpler groups, the only generalization that can be made is that the mode for types of societal complexity must be placed somewhere toward the lowest end of the scale. Lest suggestions like this result in an accusation of a bias *against* complexity, parallel to and just as inappropriate as a pro-complexity bias, it should be noted that an objective conclusion that something may not be typical or sustainable is entirely different from a subjective statement about morality and superiority or lack thereof.

If this is the case, then we can say with certainty that, long before the first states arose, whatever the process and despite the possible presence of increasing complexity in certain small ways or scattered locations, the hallmark of cultural evolution was not complexity but variation. Indeed, many anthropologists point to the need for an increased focus on societal variation and change (Feinman & Neitzel, 1984: 43; Trigger, 1991: 554). Circumscription theory is also specifically criticized for not taking this into account (Langton, 1988: 485).

On the rise of states, Webb says,

> It was rather the developmentally late appearance of certain critical shifts in the extent and significance of conflict and coercion among a small number — and only a small number — of high chiefdoms that in fact finally led to the rise of the state... For the majority of chiefdoms in their varied settings, the relatively low intensity of [resource concentration and social circumscription] was a kind of evolutionary dead end. (Webb, 1988: 453)

It appears to Ronald Cohen that "states capable of countering political fissioning only arise when people living in such areas manage through some 'historical accident' to discover integrative institutions" (cited in Langton, 1988: 486). This historical accident, however, does not have to be considered an accident at all, any more than a biological trait would be. In discussing collapse, Herbert Kaufman declares that "... when events are governed by chance, probability theory is often the means to understanding, which is quite different from the incorrect inference that chance is beyond understanding" (Kaufman, 1988: 235).

Thus, even as Gould is right that complexity can be a driver in cultural change, it does not have to be and, indeed, was not always. Nevertheless, in the midst of variation, cultures must have displayed differences in complexity. At some point, we can safely conclude that increases in complexity, under certain circumstances, proved to be overtly adaptive for, rather than neutrally present in, a given culture or cultures. What was successful became prized and was maintained, passed on through Lamarckian inheritance and even amplified. Where, up to this point, cultural evolution, including the appearance of increased complexity, was due to mechanisms underlying all four of the types of cultural similarity pointed out by Durham, this new development was exclusively one of synology. Change in complexity became directional, and complication itself became a successful meme and a second driver of cultural change in addition to variation. As Service says, "The impersonal determinants of evolution are overcome by the freedom of human beings to change the system — if they have the right theory" (Service, 1968: 405), or, rather, the right meme.

Perhaps this occurred in certain societies at the chiefdom level, which Carneiro declared to be a "*qualitative* step. Everything that followed, including the rise of states and empires, was, in a sense, merely *quantitative*" (Carneiro, 1981: 38). Indeed, the very fact that certain societies tend to oscillate between chiefdoms and simpler organizational forms (Tainter, 1988: 26) may be directly indicative of variation as the hallmark of evolution, with only the occasional development of driven complexity propelling a culture beyond chiefdom. As Webb suggests, "It is not so much that the state makes civilization as that, under the rather rare conditions of very 'sharp' circumscription, civilization... makes the state" (Webb, 1988: 454). It would only be at this point, the point when a driven form of complexity arises, that J.B.S. Haldane's statement that "social evolution is largely the struggle to increase *structure* in proportion to *size*" (Carneiro, 1987a: 115) becomes true, echoing Spencer's discussion of "limitation to primitive size" (Spencer, 1967: 10). Given what has already been uncovered about the relationship between population growth and social complication, the rise and prizing of agriculture, the very thing which uncorked the bottle and permitted an increase in size limits, seems inextricably bound to the development of driven complexity.

With complexity put into this new light, the study of cultural evolution can now be taken on from a few different perspectives. On the macro level, inherent in Universal Darwinism, there is evolution as variation, through memetics or otherwise. On the micro level, one can look at other axes, such as changing complexity — increases, plateaus and decreases. Then there is a bridge between the two levels, where the development of driven complexity on the micro level can actually end up having a great impact on the macro level, putting yet a different spin on the ideas of potential plateaus and collapses. State formation and the rise of civilization become segments of this puzzle, as does the study of collapse, the mirror image complement of the study of rise.

Rather than separate rise and collapse, as Carneiro would under the assumption that the distinction is important and therefore worthy of highlighting rather than blurring (Carneiro, 1988b: 783), anthropologist Norman Yoffee suggests that collapse studies may yield fresh perspectives with which to evaluate conditions of rise — they are inseparably related to each other, different parts in the same cycle (Yoffee, 1988: 2). Underscoring the relevance and relationship of collapse to rise and to social change in general is Cowgill's statement that "it is surprising that states have come into existence at all, and the problem of how and why they fail is an aspect of the problem of how and why they ever exist" (Cowgill, 1988: 254). While traditional views of collapse will remain important, such as that "societies in trouble may often reveal more about what is really vital for their operation than societies in reasonably good shape" (Yoffee & Cowgill, 1988: viii) or that "Nothing defines the role of an element in a system as clearly as what happens when it stops functioning" (Kaufman, 1988: 221), an understanding of sustainability suggests that civilizational collapse may be a cultural adaptation, indeed a way to avoid biological extinction.

Coevolution and the Temporary Success of Maladaptive Memes

We now understand that cultural complexity was bound to develop, not because it was preordained by the machinery that created culture in the first place but only out of normal variation from a lower limit of cultural simplicity. What is certain, though, is that the form of social organization which currently dominates human culture is indeed driven toward complexity and wrapped up with economic growth. Because they are unsustainable, an attachment to these memes is thus maladaptive.

Here lies perhaps the key difference between biological and cultural evolution. Cultural traits arise as adaptive for a given environment, just as biological ones do, but environments change. A maladaptive biological trait may eliminate itself even before the individual carrying it is born, while in culture maladaptive traits may, in fact, thrive for some time (Barkow, 1980/1982: 67). In discussing collapse, Kaufman claims that "... the very symbols and doctrines that at one stage integrated the polities became, in many instances, instruments helping to shatter their unity" (Kaufman, 1988: 226).

This phenomenon, though, also occurs at smaller levels within cultures. Richerson and Boyd point out, as does Durham, that the cultural transmission process can be culturally biased. In biology, bias can only be toward fitness. Cultural fitness, on the other hand, can mean either biological fitness or unfitness, as in the choice to use physically harmful drugs (Durham, 1979/1982: 79, 91; Richerson & Boyd, 1989: 123), which may not be fit on the scale of a nation that passes laws against drugs, but may certainly allow for a degree of acceptance in a smaller group. Ironically, one manifestation of this acceptance could be sexual opportunities even as certain drugs themselves may have the negative biological effect of decreased fecundity. Thus, it is possible that a population may see the rise of a runaway trait, one that increases both its own frequency and the frequency of preference for the trait, despite a selective penalty of fewer offspring at some point, until the degree of the trait eventually becomes a substantial selective disadvantage (Richerson & Boyd, 1989: 129). While the trait will seem to become indefinitely more frequent, "this cannot be literally true; nothing can really grow or shrink without bound. Some process not accounted for in the model will eventually restrain the evolution of the population" (Mayhew, 1982: 128).

Whether drug use, trendy clothing fashions or a form of social organization, the runaway trait may enjoy a great deal of initial success only to be selected against later on, biologically and/or culturally. Harris, says "that the ultimate test of any innovation is the crunch of competing systems and differential survival and reproduction. But that crunch may sometimes be delayed for hundreds of years" (cited in Hallpike, 1986: 39). The delay will vary from trait to trait, and there is no reason to think that it could not take several thousand years before it becomes maladaptive (Eldredge, 1995: 99).

It is this time delay that makes certain runaway traits all the more problematic. A runaway trait may operate on a vast time scale, but its carriers (i.e., people) are no more equipped to deal with such a perspective than any other organism that has ever evolved (Benyus, 1997: 244). The matter is easily explained by behavioral psychology's notion of reinforcement. Good or bad, the closer in time a stimulus and its response the more the connection between them is established, or reinforced. Where some animals require near immediate reinforcement to learn a connection, the more complex human brain may overcome longer delays of months or even years, allowing late reinforcement to take effect (Gleitman, 1987: 86-7). However, psychologist Henry Gleitman provides an example, directly paralleling Richerson and Boyd's explanation of drug use as a runaway trait, which casts doubt on our ability to achieve delayed reinforcement:

> The fact that people sometimes overcome long delays of reinforcement should not blind us to the fact that they often do not. Many of our actions are dictated by immediate reward, regardless of long-term outcome. To give only one example, consider cigarette smoking. By now, most smokers are probably convinced of the ultimate dangers they are courting. In fact, they may experience some discomfort... Yet, despite all this, they continue to smoke. The problem is that the *immediate* reinforcement of the act is positive while discomfort or worse comes later. Transcending the gradient of reward is no easy task. (Gleitman, 1987: 87)

A further analogy can be drawn from biology in the explanation some biologists suggest for the evolution of aging and senescence. Since natural selection determines which individuals' genes will be passed on, it will have the most selective impact up through the phase of life in which an individual reproduces. Those genes which prove relatively disadvantageous through this point will be the ones which take the edge away in competing for a mate. Genes whose negative effects only occur later in life, beyond the reproductive phase, however, will not be as easily eliminated by natural selection. They will be passed onto the next generation before they can adversely affect their bearer. Indeed, a single gene may be neutral or even confer advantages early in life while yielding negative effects later on. In this view, any number of deleterious effects would naturally accumulate in older individuals (Tenner, 1996: 57; Gotelli, 1998: 69; Rose, 1999: 108). Similarly, a cultural trait may prove neutral or even adaptive at first but detrimental later, jibing well with the notion stated earlier that genes and memes can both replicate successfully with no way to account for long-term costs.

Perhaps a new perspective on numbers may benefit here as it did in looking at evolutionary trends. Population size is often used as a measure of biological success. If civilization allows human populations to thrive (i.e., grow) more than other social systems, then they could be said to be more adaptive. Colin Tudge, however, calculates that the current dominant form of social organization is likely, in the long run, to have generated fewer people in total than simpler forms, given that simpler forms, despite possibly sustaining fewer people each year, are likely to thrive for many more years than the most complex forms (Tudge, 1996: 319). Even when looking to maximize population figures, driven complexity can be deemed maladaptive in the long run.

A final way in which driven complexity can be seen as maladaptive is in its implications for biological evolution in general. Aside from the non-human biological disruptions caused by driven complexity, it is possible that it is also responsible for effectively putting an end to humanity's participation in biological evolution (Eldredge, 1995: 138). Durham and social anthropologist Jerome H. Barkow each note that the capacity for culture was itself biologically adaptive (Durham, 1979/1982: 78; Barkow, 1980/1982: 64), but Barkow suggests that, though "Culture and the capacity for culture developed neck-and-neck..., culture won the race... More efficient technology led to greater population size and mobility, thereby increasing gene flow and ending the 'Sewall Wright effect' of genetic drift" (Barkow, 1980/1982: 64). If this is true, then, unlike simpler societies that may reap the adaptive benefits of both biological and cultural systems of evolutionary variation, people living in driven complexity might only expect cultural variation, and the only selection they may be subject to is their own biased cultural selection. All of this adds yet another layer of vulnerability to the system.

Carneiro may be right that "natural selection would not have permitted useless complexity to survive. The complexity that exists today does so because it conferred survival on those organisms which developed it" (Carneiro, 1987a: 113). But simple organisms remain extant because their simplicity conferred survival. He even poses the Amahuaca of eastern Peru as an example of how social simplification may have enabled a society to survive, but immediately discounts this is an exception to the rule (Carneiro, 1987a: 114). Were there truly a rule, though, there would be no exception. Likewise, Spencer may be right that "small aggregates only can hold together while cohesion is feeble; and successively larger aggregates become possible only as the greater strains implied are met by that greater cohesion which results from ... a ... development of social organization" (cited in Carneiro, 1987a: 121). But this is a mere statement of fact, failing to deny the possibility that increasing organization can lead to its own undoing.

If we look at the history of humanity as a whole, the number of instances of pristine state formation pales in comparison to the number of other kinds of societies that have arisen. And given that *Homo sapiens* did not arise in a vacuum, creating its first societal structure from scratch, it would not be at all unreasonable to include the social organizations of at least some other species in our analysis, making states even more of a social-structural exception within the community of life. Finally, as states incorporate each other and grow, they ironically become yet a greater exception in the modal analysis of typical social structures, because there are fewer instances to represent the form. A world state would, despite its potential size, have to be seen as the rarest exception of all, a solitary example of complexity in a history — and, since it would likely end itself, future — marked by variation. Inasmuch as the collapse of states is as relatively recent a phenomenon as their very rise, "Collapse then is not a fall to some primordial chaos, but a return to the normal human condition of lower complexity" (Tainter, 1988: 198).

While cultural collapse should seldom entail biological extinction, the fact remains that it can, and it is this aspect of cultural evolution that is most significant in the study of unsustainability. Cultural evolution, at its memetic base, is a germ theory, an epidemiology of ideas, studying how cultural traits propagate themselves from host to host (Lynch, 1996: 9, 155). This analogy has been suggested by many, from Dawkins' cultural parasites and viruses of the mind (Dawkins, 1989: 192; Blackmore, 1999: 22) to Aaron Lynch's thought contagion (Lynch, 1996: 2), all concepts which, unlike biological disease, are fundamentally neutral. Malcolm Gladwell looks at genuine social epidemics, in which a small idea in the right circumstances quickly finds pervasive success (Gladwell, 2000: 8), also a neutral concept. In all of these cases, a successful trait may be biologically advantageous, disadvantageous or neither. Richerson and Boyd's runaway trait may or may not be a social epidemic, but it has the effect of reducing biological reproductivity at some point down the road. Beyond the runaway trait lies the lethal meme, one which is so maladaptive that it kills its possessor (Quinn, 1999: 25), the biggest possible reproductive penalty for a culture. The memes which cause unsustainability surely are lethal ones.

Biological and cultural evolution may be distinct and unique processes. Genes may not inherently keep memes "on a leash" anymore than memes do genes, but there clearly are cases in which either may do just that to the other (Blackmore, 1999: 35). Driven complexity has the potential to neutralize biological evolution, while the issue of sustainability makes it clear that there are ways in which biological and cultural traits interact and may or may not be compatible. All this leads to the necessary conclusion that biological and cultural evolution affect each other dialectically.

The term coevolution has long been used to describe "reciprocal selection between interdependent species" (Odum, 1975: 167), or how different species can literally evolve together. Coevolution explains, for example, why traditional predator-prey pairs maintain their populations in equilibrium while an introduced species can severely disrupt an ecosystem, having not evolved as an integral part. The process, indeed, can shape not just small sets of species but entire ecosystems (Odum, 1975: 167). Durham applies this concept to evolution itself, suggesting the need for a coevolutionary theory of biology and culture in which they explicitly provide feedback to each other in forming individuals and societies (Durham, 1979/1982: 87-90; Durham, 1991).

Similarly, Richerson and Boyd discuss a Dual Inheritance Model of biology and culture (Blackmore, 1999: 35). Though far from the only place in which coevolution bears fruit in the study of biology and culture, it is this integrated evolutionary perspective that is the most useful, indeed implicit, in considering the rise — and necessary fall — of unsustainable memes.

Deconstructing the False Dichotomy of Nature vs. Culture, Part I: Heredity/Environment

For ages, people have debated the essence of human nature, often posing the issue in the classic form of determinism vs. free will or, as sociology conceived of it, structure and agency, asking whether given circumstances preordain all that we are and do or if we are a clean slate upon which we can write what we choose. With the advent of modern biology and the social sciences, the debate took on a new form, variously described as biological vs. social, genetic vs. cultural, heredity vs. environment. Each side was deemed a concrete scientific factor worthy of study, not just a philosophical concept to be argued. The controversy over nature and nurture raged once more, and the debaters almost invariably took up the torch for the primacy of one side over the other.

Most notable was the volatile debate over sociobiology, Edward O. Wilson's theory of the genetic basis of social behavior. First fully proposed in <u>Sociobiology: The New Synthesis</u> (Wilson, 1975), sociobiology was intended by Wilson to be the synthesis of the biological and the social sciences, a new attempt at a science of humanity. The first 26 chapters of the book dealt relatively uncontroversially with sociobiology in non-humans, but the lone chapter 27 on its application to humans burst the dam. Wilson was accused of methodological problems, unjustified biological determinism and, most significantly, supporting reactionary politics. Critics, most notably the Sociobiology Study Group, whose most illustrious members were Stephan Jay Gould and Richard Lewontin, suggested that evolutionary homology with animals may not be justified when similar phenomena could arise through different methods, genetic for animals and cultural for humans, thus yielding only an analogy (Sociobiology Study Group, 1976/1982: 284). Just as different mechanisms of color mixing are used by light and pigment to produce the same color, one can't directly compare Mendelian biological inheritance to Lamarckian cultural inheritance. In the older terms of the debate, critics were taking the free will side. With nurture acting on a *tabula rasa*, there would be no insurmountable constraints on human potential. In contrast, Wilson was labeled a fatalist.

Through the early 1980s, articles filled both academic and lay periodicals and entire volumes were published on the subject. Yet while the prodigious amount of material seemed to contain all possible arguments from both sides, the issue was never resolved. With the appearance of articles like "E.O. Wilson After Twenty Years: Is Human Sociobiology Possible?" nearly two decades after the Wilson's initial proposal (Flew, 1994), it is clear that the debate continues. And with *Scientific American* including the larger nature/nurture controversy as one of the great questions remaining in science at the end of the millennium (deWaal, 1999), it seems the end is nowhere in sight despite cries for reconciliation.

In reviewing the issue, anthropologist James Silverberg claims that it is important to understand levels of analysis. Biology and culture are different levels, and while analysis at one level cannot contradict analysis at another level, consistency does not imply causation from one level to the next. There is nothing wrong with sociobiology's attempt to synthesize, yet anthropologists do not see reductionism as a form of synthesis (Silverberg, 1980: 37-8). Similarly, Barkow suggests that human social behavior can be explained in terms of evolution, physiology, individual experience and psychology, and cultural organization, and that while all of these factors must be compatible with one another, none are likely to be predictable from another (Barkow, 1980: 181).

Was sociobiology a synthesis or a "sin-thesis" (Silverberg, 1980: 35)? Its status was best summed up by philosopher Mary Midgley. On one hand, she suggested that the burden of proof always lies on the more extreme theory — in this case, the extreme environmentalism that attempts to entirely exclude innate causes of social behavior (Midgley, 1979/1980: 21). Nevertheless, she did not stand with Wilson, claiming that biology cannot be a favored cause simply because it is prior, otherwise "the original big bang would be the only true explanation of everything, and we all ought to be doing astro-physics" (Midgley, 1979/1980: 25). In the end, sociobiology is "neither a heresy to be hunted down, nor a revealed doctrine necessary to academic salvation. It is instead the usual kind of mixed picnic hamper" (Midgley, 1979/1980: 17).

Given that the truth, as is so often the case, should likely reside somewhere in the moderate view, between the two extremes of heredity and environment, it seems that the very opposition of the two factors may be at the heart of the problem. Indeed, at a symposium on sociobiology in 1978, Silverberg suggested that the nature/nurture dichotomy is false but that scientists perpetuate it by favoring biological or cultural explanations, despite that fact that all reasonable scientists say they believe in epigenesis, or interaction between the two systems (Silverberg, 1980: 38-9). This appears to be exactly what happened in the sociobiology debate.

According to Pierre van den Berghe, social scientists in general tend to be plagued with dualistic thinking. Indeed, thinking in terms of binary oppositions may be genetically hardwired in the human mind. Among other things, this has led social scientists to view nature/nurture as an opposition rather than an integrated whole. Modern scientific thinking, on the other hand, is essentially monistic (van den Berghe, 1978/1982: 15). The dichotomy of nature and nurture, when pulled into modern science, became a full-fledged either/or debate, with monistic theories about nature fighting monistic theories about nurture. Under the guise of scientific pursuit, the debate rages on rather than finding resolution. Indeed, if the underlying reality is integrated, with neither on the other's leash, favoring one factor over the other causes the mere spinning of wheels, with monism pointed in the wrong directions and missing the big picture. With nature/nurture dovetailing so greatly between hard science and the inherently dualistic social sciences, the tendency against union is only enhanced.

Philosopher of science Arthur L. Caplan notes that care must be taken in labeling scientific explanations of behavior (e.g., genetic) compared to the set of factors that can act as causes in such an explanation (e.g., hereditary, developmental or environmental). Consistent with arguments on both sides of the heredity/environment, Caplan says that “it is simply wrong to assume that ‘cultural’ explanations of behavior allow no room for biological factors, or that ‘genetic’ explanations exclude any type of environmental factors” (Caplan, 1980: 100). Further, heredity/environment is not the same as sexual transmission/social transmission, yet these concepts have been fused by the problematic shorthand of nature/nurture (Silverberg, 1980: 41).

Progress appeared to have taken place in the debates with the either/or question being replaced by an inquiry into how much of each was relevant in any given circumstance (Livingstone, 1980: 307), but as Gould says, “We cannot factor a complex social situation into so much biology on one side, and so much culture on the other” (Gould, 1984: 32). Elsewhere, he calls the dichotomy non-sensical (Gould, 1976/1982: 343). These statements show him expressing a more moderate attitude than the Group’s original environmental extremism, but they also suggest an impasse that the debate might never solve.

The Marxist approach suggests a reconciliation. Scientist Piotr Fedoseev affirms the Marxist stress on the social but says that “we are also against the oversimplified notion that man is completely separated from nature. Man is a social as well as a biological creature, for he is part of nature” (Fedoseev, 1976/1982: 326). He defends the Marxist thesis that “human nature is a product of history” inasmuch as both biological and cultural evolution are affected by an environment changing over time (Fedoseev, 1976/1982: 328). Social groups can only be understood in social terms, but individuals can be understood from an interaction of social and biological factors (Fedoseev, 1976/1982: 326).

Wilson didn’t mean for sociobiology to be the straw man that the Sociobiology Study

Group made it out to be. He intended it as a fully formed discipline to be accepted. But, political rhetoric aside, it became a straw man simply by virtue of its being the first earnest attempt to deal simultaneously with both nature and nurture, the biological sciences and the social sciences. That it was not the final solution cannot be held against Wilson, who deserves credit for reopening the question of how biology and culture may be related (Lieberman, 1989: 677). An attempt to deal with both, even if it seemed weighted toward one (i.e., genetics), helped point the way toward an acknowledgment of interaction: "It has led to increased communication among biological and social scientists, and the ensuing debate should lead to a more rigorous definition of the issues and surely some advances in our understanding of human behavior" (Livingstone, 1980: 307).

Barkow says that "'Sociobiology' has come to mean not the all-devouring synthesis for which Wilson originally intended it but simply the application of modern evolutionary biology to all species, our self included" (Barkow, 1980/1982: 72). To reject it in this form truly pushes the envelope of monistic cultural reductionism. But to accept it is no solution either. Neither sociobiology nor the hurlyburly surrounding it could truly move the nature/nurture debate forward precisely because, for practical purposes, the debate bought into the opposition of the factors.

Reviewing the debate, sociologists Janice I. Baldwin and John D. Baldwin conclude that "a central criterion for an adequate theory [of human study] is that it not be biased toward either nature or nurture" (Baldwin & Baldwin, 1980/1982: 311). They propose a balanced biosocial theory which recognizes both factors as crucial and complimentary in human development. This brings us back to the coevolutionary synthesis, in which models for the evolution of human social behaviors would "explicitly integrate both the genetic and the cultural inheritance mechanisms" to better deal with behaviors which may stem from either one (Durham, 1979/1982: 88). Indeed, Richerson and Boyd conclude that only a model of coupled cultural and genetic control can explain the results of ethnographic studies (Wilson, 1977/1982: 37), while Durham gives numerous examples of biological and cultural traits which are best explained through an interaction of the evolutionary systems (Durham, 1991). Such an approach avoids false dichotomies simply by acknowledging that there are multiple factors involved and refusing to play an either/or game.

A coevolutionary approach helps clarify how some traits identified as genetic universals may simply be cultural universals — cultural traits that are shared by all human cultures at all times — or, perhaps more importantly, false cultural universals — cultural traits that, over time, pervaded most or even all human cultures but whose contingent history is overlooked. Within this second category lies the Cultural Fallacy, the notion that one's culture was inevitable in the evolutionary process, that one's non-universal memes are, in fact, universal (Quinn, 1999: 47). This is a sort of cultural manifestation of human exceptionalism. Either way, but especially in the second case, there is all the more reason to distinguish the two, and the possibility arises of appeasing both sides of the heredity/environment debate.

Just as Gould eventually drifted toward more moderate views, Wilson himself came on board to some extent with coevolutionism, acknowledging an interaction between biology and culture (Degler, 1991: 310) and agreeing that the nature/nurture dichotomy must be replaced (Wilson, 1980: 302). Though he would continue to tend toward the view that genes keep culture on a leash (Blackmore, 1999: 33), he even pushed his own sociobiology theory toward coevolution, proposing a Gene-Culture Theory of Evolution with physicist and co-author Charles Lumsden (Gould & Gould, 1983: 66). Additional work in the coevolutionary realm has been pursued by practitioners in widely different fields, including biologist René Dubos (Dubos, 1968: 57), archaeologist Bruce G. Trigger (Trigger, 1991: 562-3), anthropologists Alan R. Rogers (Rogers, 1988) and Alexander Alland, Jr., political scientists John Langton, Thomas Landon Thorson and Roger Masters, sociologists Marion Blute and Joseph Lopreato, and economists Richard Nelson and Sidney Winter (Degler, 1991: chap. 13). This interdisciplinarity is perhaps not coincidentally evocative of the very integration coevolution seeks.

Deconstructing the False Dichotomy of Nature vs. Culture, Part II: Man/Nature

In all the discussion about the heredity vs. environment issue of human nature and development, it is almost shocking that nobody seems to have pointed out that one of its tangential issues actually stands alongside it as a twin manifestation of a larger issue, itself volatile and age-old: the relationship between man and nature. Niles Eldredge recognizes that these two issues are related in complex ways (Eldredge, 1995: 18). Heredity/environment, or nature/nurture, is about the dynamic of organismic development — what factors cause an organism to become what it becomes, nature or nurture? Man/nature inquires about humanity's position with respect to nature — are we an integrated part or somehow uniquely separate from the rest? Like its counterpart, the man/nature issue is usually phrased as an opposition with the obligatory "versus" as the link which suggests that there is, in fact, no link. Just as organisms were thought to develop because of either nature or nurture, man is posed as something outside of nature. Nature vs. nurture and man vs. nature are thus the two faces of the all encompassing dichotomy of nature vs. culture.

The nature/nurture debate, of course, occasionally touches explicitly upon man/nature. The controversy over sociobiology brought this out extremely clearly when its detractors were occasionally accused of their own secular form of creationism, as when they were compared to Bishop Wilberforce, who spoke so strongly against Darwin (Midgley, 1979/1980: 34; Caplan, 1980: 100). However, it never seems to be acknowledged how crucial this second version of the debate is to the first. If nurture wins in nature/nurture then man can win in man/nature — man, with his great capacity for culture, can make himself independent of nature, free to evolve his culture outside its constraints. But all other outcomes — nature dominant or integrated — bring humanity back into the fold, equated with all other organisms. Gould, Lewontin, et al, devout evolutionists all, thus end up strange bedfellows with creationism in a fundamental way overlooked by those who point merely to their antagonism toward genetic explanations. This is particularly ironic given how Gould uses the idea of "just-so" stories (Gould, 1980: 258) to equate sociobiology with Biblical literalism. These stories, Rudyard Kipling's term for unprovable hypotheses which have only their plausibility to show for themselves (Gould, 1980: 257), were thought of by Gould and Lewontin as representing the Panglossian paradigm (Gould & Lewontin, 1979), named for Dr. Pangloss, from Voltaire's *Candide*, who felt that we must live in the best possible world by the simple virtue of its existence (Gould, 1978/1980: 284).

Why does nature vs. nurture remain one of the great issues in science when all reasonable scientists espouse their interaction? It seems likely that, despite similar acknowledgments that humanity is likewise integrated with nature, the man/nature opposition is still generally adhered to, in practice if not in principle. This would make it the more fundamental issue, the one whose reconciliation could once and for all dispel the illusion of a nature/nurture debate.

Some such as W.R. Bates emphasize that the prime goal of biology should be to clarify what qualities set humans apart from the rest of creation (Peter & Petryszak, 1980: 45). Again, a parallel appears between scientists and creationists in espousing an anthropocentric view of man's place in nature, the doctrine of human exceptionalism. Indeed, Carl Sagan pointed out that many of the central debates in the history of science are at least in part over whether humans are special, devoting an entire chapter of Pale Blue Dot to "The Great Demotions," the various developments in science which moved humanity away from any favored status in the universe (Sagan, 1994: chap. 3). Sagan points also to the Anthropic Principle as having operated throughout the history of science, first in its weak form in which it is suggested that there would not be humans if the laws of nature were different, but in some cases in its strong form, stating that the laws of nature exist *so that* humans would eventually come to be. Ironically, Sagan also draws a parallel to Dr. Pangloss (Sagan, 1994: 34).

Some important elements of the doctrine of human exceptionalism are noted by sociologists William Catton and Riley Dunlap. Among them are that people are fundamentally different from all other earthly creatures, over which they have dominion, and that people are masters of their destiny (Hardin, 1993: 161-2). This firmly establishes the connection between the two manifestations of the nature/nurture debate — the first is clearly man dominant over nature while the second echos the extreme environmentalist attitude with nurture beating nature. Challenges are increasingly being made to this doctrine because it is proving itself to be "patently unecological" (Hardin, 1993: 162) and also because similarities continue to be found between humans and non-humans, even if they may be the result of different inheritance systems. Looking at a great variety of behaviors and qualities expressed both by human and non-humans, Carl Sagan and Ann Druyan have argued in Shadows of Forgotten Ancestors that there is essentially nothing that is uniquely human (Sagan & Druyan, 1992), and others concur (Eldredge, 1995: 21). If one takes up the view of some critics of sociobiology, that similar behaviors can be the result of genetics in non-humans and culture in humans, one must still show culture to be uniquely human. This idea, though, is not easily defended (Ruse, 1978: 371; Eldredge, 1995: 21), since any learned behavior can be construed as culture.

Even Marxism, which suggested a reconciliation of nature and nurture, will forever be tied to human exceptionalism. The means of production may not belong to individuals, but societal ownership trumps that of the rest of non-human nature (Fedoseev, 1976/1982: 331). Further, Marxist socialism rejected the idea of limited natural resources (Perelman, 1993/1996: 67-8; Vaillancourt, 1993/1996: 52). Biologists James L. Gould and Carol Grant Gould support this notion, saying, "As adamantly as the creationists they ironically despise, Marxists require our species to be unique" (Gould & Gould, 1983: 67). The Marxist claim that humanity is a part of nature ends up bankrupt.

Wilson himself intends for humans to be seen as part of a continuum of nature, evident from the first sentence of the controversial 27th chapter of Sociobiology: "Let us now consider man in the free spirit of natural history, as though we were zoologists from another planet completing a catalog of social species on Earth" (Wilson, 1975: 547). But even in their kindest moments, when his critics suggest that sociobiology may be fruitful when applied to non-humans they must add the caveat that it is problematic for our own species. Biologically deterministic theories are said to have "the enormous potential for *demystifying* human behavior" (van den Berghe, 1978/1982: 17) and can even "demean and belittle humankind" (Caplan, 1980: 98). Sociobiology may be more difficult to apply to humans due to the cultural factor, but it is problematic per se only if one accepts human exceptionalism: "How do we claim that [evolutionary biology] is irrelevant to our own species... without camping out with the antievolutionary Creationists for whom man and beast must forever be separate by the latter's lack of a soul?" (Barkow, 1980/1982: 61)

Beyond even all this, the two false dichotomies are further falsified in that more than two factors are involved in each case. In the development issue of nature/nurture, nature refers to the genes while nurture refers to two things — culture is crucial but only a subset of the larger, complete environment, "as much a part of the total environment as solar radiation, temperature, rainfall, or altitude" (Dubos, 1968: 70). Indeed, non-humans, even those claimed to have no culture, nevertheless evolve with a nature/nurture interplay (Dubos, 1968: 77-8). Man/nature in the positional issue is even more misguided with multiple factors on both sides. Man, of course, deals with people as both genetic and cultural beings, while nature includes both the physical, supracultural environment as well as other individual, non-human organisms, themselves carrying unique genomes and perhaps cultures. Darwinian biological evolution always involved the two factors of heredity and environment, but, in the 20^{th} century debate, both of these factors came to be subsumed in the nature part of the equation simply by virtue of the fact that they are both part of *biological* evolution, with culture becoming the only thing typically referred to as nurture. Indeed, the biology/culture debate is thus subtly yet crucially different from the nature/nurture debate.

On top of everything else is the fact that the entire enterprise — individual development and species evolution — occurs over time. This is integral to understanding the idea of limitations.

Some may argue that cultural progress is inherently unlimited, but, just as a trait's existence at a given moment does not mean it had to have been adaptive in the past, a trait's existence now does not mean it cannot prove itself maladaptive in the future, as noted earlier. Culture evolves quickly and may appear unlimited in the short-term, but long-term circumstances, most notably those related to the physical environment, can limit cultural practices.

In the end, there are at least three key factors influencing an individual organism's evolution — its own genes, the complete non-cultural environment (which itself includes inorganic features plus the genes and cultures of other organisms) and, to the extent that it exists, the cultural environment of learned behaviors — and all operate over time. Interestingly, the cultural factor resembles each of the other two factors: It is both an inheritance system and a set of given circumstances. None of this suggests any need to coin, for example, ecobiocultural evolution or ecosociobiology — indeed, it simply clarifies just what ecology and evolution actually are in their totalities. In doing so, this analysis underscores the importance of recognizing that the nature/culture issue is a deeply flawed concept in two ways. Not only do both manifestations of the conflict actually reconcile to integration and therefore no conflict at all, but both also squeeze at least three domains into two, therefore misrepresenting the entire dynamic.

Man, Nature and Runaway Increase

We saw how economic growth and structural complication are highly integrated. They not only have numerous negative side effects but are also unsustainable and thus maladaptive in the long term. Next, we saw how these practices, so pervasive as to seem like part of human nature, are actually contingent cultural traits, neither present throughout human history nor inevitable in the course of cultural evolution. As Richard Dawkins suggests, just as multiple genes can evolve together and act as a single gene, co-adapted meme complexes may also arise, effectively becoming a single meme (Dawkins, 1989: 197). Our present unsustainability, the result of a complex (no pun intended) of cultural traits which causes increase in both the size and complexity of a human society, thus appears to be due to the possession of a multifaceted increase meme.

Is the increase meme, though, a runaway trait? As Richerson and Boyd defined it, a runaway trait is one that increases not only increases its own frequency but the frequency of preference for the trait. Growth and complexity have arisen in a number of societies and yet, more often than not, collapsed back to material equilibrium and greater structural simplicity long before they ever approached the levels our global civilization currently pursues. Can we account for the very existence of a case as exceptional as ourselves by the presence of a preference which was lacking in other instances of the rise of increase?

The answer can be found in the man/nature issue. It is not simply a twin incarnation of the nature/culture debate along with heredity/environment. Indeed, it is fundamental in understanding the origin of our unsustainable culture through coevolution, the full interaction of heredity and environment, biology and culture. The very implication of posing the nature/culture issues as dichotomies is that one side wins over the other side. Earlier, it was suggested that culture beats biology by virtue of its speedier evolution. This “truth” is a false universal, revealed to be “cortical conceit,” that is, the belief that man is able to ignore his own biological evolution, allowing his behavior to be completely ruled by directives that are culture-inspired and originate from the cerebral cortex (Dubos, 1968: 102). Though cultural evolution may be faster than biological, there is no reason to think them incompatible. Only in a culture attached to the idea of increase can culture appear to make biology universally irrelevant and subservient. Further, since it can do so for only a limited amount of time due to the unsustainability of increase, culture never really beats biology at all, providing a crucial example in support of Dubos’ claim that the cortical conceit causes many of humanity’s biological difficulties (Dubos, 1968: 102). Conceiving of the separation of man and nature could involve the possibility of a stalemate or a win for nature. In an increase culture, though, man is clearly posed to be the winner, separate from and superior to nature.

Returning to the contrasting preanalytic visions of the human economy, the ecological view, that the human economy is a subset of the Earth as a whole, is not merely consistent with the conceptual view that humanity is a part of nature but, in fact, arises from precisely this integrated view, is an explicit expression of it. Indeed, if biology and culture are integrated through coevolution, and if ecology and evolution are mirrors of each other, then ecology *itself* must view culture as under its purview, an integral part of the living systems it studies — and, consequently, economics as a subset of ecology (a notion echoed in Haeckel's original conception of ecology as studying "the economy of nature," though ecology was then seen as a subset of economics). Our traditional economic view, however, that the human economy is an entity independent of resources, is directly comparable with the view of man separate from and superior to nature, of nature being both irrelevant and subservient to culture.

Napoleon A. Chagnon's suggestion that a repugnance of nature as subordinate to culture may have conferred a biological advantage is extremely relevant here (Chagnon, 1979/1982: 122), since increase culture has been extremely successful in perpetuating itself. We have seen, though, how this success can only be temporary. Further, repugnance flows from emotion and opinion, and the fact that conceiving of nature as subordinate may have been adaptive for a time makes it neither true nor permanently adaptive. Nevertheless, if such a view permitted success through increase, then increase and all it brought with it became the evidence, the very manifestation, of man's superiority and separateness (Bookchin, 1982: 343). The belief in man over nature is itself determined by cultural forces (Dubos, 1968: 140) and then serves as the basis for a unique kind of increase culture, one which would have had precisely the justification it needed to continue increase, even beyond the optimum into an era when costs would outweigh benefits, even when continuation could yield only self-destruction.

The earlier notion that a runaway cultural trait parallels aging has an important implication here. In biology, whatever increases longevity also increases the risk of cancer and other "old-age" diseases since those negative traits will have a greater period of time in which to express themselves. Adamantly clinging to a preferred way of life is the cultural equivalent of actively increasing longevity, and doing so in the face of mounting costs merely compounds maladaptation, the cultural equivalent of old-age disease. Just like the victim of a pyramid scheme, wondering why the money hasn't rolled in yet sticking with the "investment," ignorantly retaining faith in a scheme that can't work, our civilization generates ills but we stick to it out of a directly parallel failure of understanding.

It is thus in the false dichotomy of man over nature that the increase meme becomes a runaway trait, yielding, as Quinn describes in Beyond Civilization: Humanity's Next Great Adventure, a preference for civilization so strong that we believe that no other option is even possible (Quinn, 1999: 3). Kuhn supports a similar notion in the abstract, noting that the existing pervasive paradigm that is normal science "often suppresses fundamental novelties because they are necessarily subversive of its basic commitments" and that "No part of the aim of normal science is to call forth new sorts of phenomena; indeed those that will not fit the box are often not seen at all" (Kuhn, 1996: 5, 24). Perhaps it is no coincidence that the word hierarchy comes from a Greek root meaning a keeper of sacred things, for there is little in our civilization more sacred than civilization itself, and nothing can trump the sacred.

It is certainly possible for an increase culture to lack the notion of man over nature. However, having no subjectivity about its own size, such cultures would probably not have had an incentive to let costs come to outweigh or even equal benefits, and so they eventually would have ceased to be increasers. This scenario likely applies to the cultures, noted earlier, that fissioned and simplified after having grown and complicated for a time. Quinn suggests that this is precisely what happened to many of history's "lost" civilizations. The collapse of such cultures as the Maya, the Olmec, the Hohokam and the Anasazi can be understood quite well if we look at them as increasers who simply did not have a preference for increase: They were able to walk away from it easily when it become more burdensome than it was worth. As William Ashworth says in The Economy of Nature: Rethinking the Connections Between Ecology and Economics, this isn't to suggest that a conscious decision was made to "stop increasing," but that, because they did not prize increase in and of itself, numerous other decisions were enabled, allowing a gradual abandonment of their cities for "self-betterment" elsewhere (Ashworth, 1995: 16-18). But in a culture that views civilization as the ultimate way of life, the way people were meant to live (Quinn, 1999: 40), with its preference unquestioned and taken to be a cultural universal, such an explanation of civilizational collapse is literally inconceivable even as debates continue over numerous other explanations that remain insufficient. The debate itself is caused by the preference for civilization which prevents us from seeing this alternative explanation (Quinn, 1999: 41-45).

Much as circumscription theory deserves criticism, it seems that the idea of adding levels of circumscription can be useful in truly understanding the rise of civilization. Dickson's notion of artificial circumscription, constraint caused by something generated by people, seems the most appropriate. But instead of being limited to anthropogenic environmental destruction, which itself is more of an effect than a cause, the most significant man-made constraint generating our particular civilization is our preference for increase. In effect, we are experiencing an ideological circumscription which explains why our civilization has persisted where others have failed.

It may be impossible to say which arose first, the view that man is superior to nature or the practices of increase. Perhaps the man-over-nature meme arose first with practices then flowing out of this conception. Alternately, the practices may have arisen first, with the conception developed afterwards as a sort of explanatory myth to rationalize practices already being pursued and, subsequently, to further impel those practices. This second scenario seems more likely. In the end, though, the answer to this chicken-and-egg question is irrelevant, for it seems clear that, just as the various aspects of growth and complexity are wrapped up together, an additional element of our civilization's meme complex is the superiority of man over nature. Without this piece, increase could not become preferred and the present scope of our global civilization could never have been reached. Deconstructing the dichotomy of man versus nature, then, is not simply an intellectual exercise but literally fundamental in understanding our present unsustainability.

The terms some use to describe our civilization's prevailing paradigm are economic/material, as in growth (Daly, 1996) or the cornucopian paradigm (Hawken, 1993: 33), geographic/spatial, as in the frontier paradigm (Ashworth, 1995: 74), or political, as in the traditional critique of imperialism. Quinn conceives of a culture as a people enacting a story or myth, living so as to make it come true (Quinn, 1992: 41), an approach with precedents in the work of others such as Georges Sorel (Gare, 1996: 114) and Aaron Wildavsky (Wildavsky, 1989: 60). For Quinn, our cultural paradigm is a direct manifestation of the enacting of a story expressing a vision of humanity's place in the world. He refers to the reigning paradigm as Taker culture, whose hallmarks collect many of the ideas expressed in this paper so far. At its root is the idea that the world was made for humans and that humans were made to rule the world — that the world is literally humanity's for the taking and that they take the rule of the world out of the gods' hands and into their own (Quinn, 1996: 253). This is a notion that Murray Bookchin, in The Ecology of Freedom: The Emergency and Dissolution of Hierarchy, also points out is not culturally universal (Bookchin, 1982: 43).

Since the world does not submit meekly to human rule, humans therefore must conquer it in order to fulfill their destiny as rulers. The world continues, though, to fight back, yielding all sorts of negative unintended consequences — revenge effects. The story is then elaborated: Since it is the destiny of humans to rule, it must be the destiny of this imperfect world to become a paradise through that rule, but humanity's persistent inability to achieve that paradise suggests an inherent flaw, a permanent incompatibility between humans and the rest of the world. If only humans could find the right piece of information to guide them, perhaps they would be able to control the flaw, to stop destroying the world and themselves *despite* the flaw. But certain knowledge about how to live is not obtainable through any of the ways people derive certain knowledge, and so the destruction can only continue (Quinn, 1992: 67-91). All this is a clear expression of man both superior and contrary to nature.

Eldredge provides a similar account, discussing how we are living out a story in which we have conceived ourselves as living outside of ecosystems and in which reliance on agriculture is "tantamount to declaring war on local ecosystems" (Eldredge, 1995: 93). The people of such a culture "prefer to assert our dominion rather than independence" (Eldredge, 1995: 157). Yet notions such as Quinn's and Eldredge's transcend the religious concepts of dominion granted by a Judeo-Christian God. Indeed, the endless pursuit of technology, rooted in science and often seen as an opponent of religion, can be understood as only superficially different. Science may have come to the forefront of intellectual thought over the last few centuries, but aspects of its program directly extend what came before, evident, for example, in the Baconian version of the science of man, which seeks the greater benefit of man not simply in understanding nature but through its mastery. In this view, revolutions in the application of science, technology and industry — and even their pursuit by, among others, atheists — are simply changes in the scale and application of dominion, not qualitatively different pursuits from the religious ideas that came before. There is thus something false in the way our culture has framed science/religion as a dichotomy.

Integrated with the vision are practices unique to Taker culture. Fundamental, of course, is that which let the population cork out of the bottle, agriculture. However, contrary to the way some argue it, not all agriculture can be subsumed by our civilization. Agriculture is merely the cultivation of preferred foods and exists in different forms, including variations on polyculture and shifting cultivation (Scott, 1998: 273-83). It not only developed independently among many non-civilized cultures but forms of it continue to be practiced sustainably (Eldredge, 1995: 92; Scott, 1998: 273-83) without leading to an increase complex, able to foster rather than diminish biodiversity (Tenner, 1996: 274).

Quinn distinguishes a specific brand of agriculture whose practices relate directly to the idea of extreme interference competition noted earlier in the discussion of the Lotka-Volterra models. He identifies three practices undertaken by Takers that are not found elsewhere in the community of life: They exterminate their competitors, destroy their competitors' food to make room for their own and deny their competitors access to food (Quinn, 1992: 129). The application of these unique competitive tactics to agriculture results in what Quinn calls totalitarian agriculture, a fundamental practical expression of man over nature which provides the necessary physical base for the pursuit of increase and which is thus inextricably bound with the rest of the Taker meme complex: "According to totalitarian agriculture, cows may live but wolves must die. According to totalitarian agriculture, chickens may live but foxes must die. According to totalitarian agriculture, wheat may live but chinch bugs must die. Anything we eat may live, but anything that eats our food must die — and not merely on an ad hoc basis" (Quinn, 1996: 96).

Mirroring the interspecies practices, totalitarian agriculture constrains within the human community as well. Takers grow all their own food, and that food is kept, as a matter of universal policy, "under lock and key," denied to those who do not earn it. Given the tremendous amounts of extra toil required to grow all one's own food, noted earlier, the agrarian way of life and all that has come from the civilization it empowers must be seen as fundamentally far more difficult and less leisurely than the non-civilized life. Indeed, given this, it might be impossible for a culture to pursue such a life if it failed to force people to earn their meals, since, with free access to food, produced agriculturally or found elsewhere, people would be able to subsist and would therefore have no need to participate in Taker increase (Quinn, 1999: 5). Denied such access, the Taker project then becomes one in which people collaborate in increase so that they can literally earn their living, obtaining, among other things, food as direct or indirect compensation. Quinn refers to increase projects as "pyramid building," using one of the most obvious early types of increase project as an evocative image to describe all economic growth projects — from the pyramids themselves and the Great Wall of China right up to the transnational corporate empires of today — even as it symbolically supports the ideas of increasing hierarchy (Quinn, 1999: 51) and, as in pyramid schemes, unsustainability.

The metaphor of pyramid building is especially apt in light of a particular interpretation of the building of pyramids in Egypt. Archaeologist Gregory A. Johnson suggests that the building of actual pyramids is merely one example of the piling behavior often observed in agrarian societies displaying incipient complexity. In a society so relatively new to hierarchy, though, large-scale tasks requiring large amounts labor, such as crop harvesting or war, are episodic and infrequent. To ensure that a sufficiently large and prepared labor force is available when these projects actually arise, a state may institutionalize a routine corvee labor system. When no other projects are on deck, the state makes some up, paralleling the present-day busy-work tasks assigned to army trainees. A curious fact about the Egyptian pyramids then finds an interesting explanation: The biggest pyramids were built earliest, eventually followed by smaller and smaller ones, until pyramid building simply stopped. Johnson suggests that bigger projects were required at first to acclimate workers to the labor system, with the pyramids getting smaller over time as the workers got used to the idea. Once the labor system was in place along with state control of that very system, and once the system's expansion resulted in the routine development of more practical large projects, the state lost its need to build pyramids per se and could apply its reliable labor force to whatever other projects arose. Thus, even the building of the great pyramids of Egypt can be seen as something of a busy-work increase project, more about reinforcing the social hierarchy in preparation for general increase than about the pyramids themselves (G.A. Johnson, personal communication, March 16, 1999).

Marx condemned capitalism for destroying the worker, forcing people to earn their living in jobs which sap the mind, body and spirit (Marx, 1932/1978: 72-3), posing that the proletariat had to oust their masters and take the means of production into their own hands (Marx & Engels, 1888/1978: 32, 46). Quinn's perspective differs fundamentally, and even puts a new spin on Johnson's take on the Egyptian pyramids. While both Quinn and Marx view the majority of society as dissatisfied with their situation, Quinn suggests that the members of Marx's proletariat merely psyche themselves up to build pyramids for themselves rather than their capitalist exploiters. This notion is supported by political scientist and anthropologist James C. Scott, who suggests that Marx wanted to place the fruits of capitalism in the service of the working class (Scott, 1998: 94), that Marx felt that capitalist fruit was worth having but poorly distributed.

While he may sound like a Marxist when he describes the unsatisfying lives of the masses in exploitative hierarchies, Quinn digs deeper into the foundation of the system he criticizes, revealing that those very masses are just as committed to the Taker project as their bosses and could never conceive of doing otherwise. The pharaoh Khufu, then, Quinn claims, "needed to exercise no more control over his workers at Giza than pharaoh Bill Gates exercises over his workers at Microsoft" (Quinn, 1999: 52), jibing well with Bookchin's notion that hierarchy does not have to entail the exploitation on which Marx focused (Bookchin, 1982: 4). People at all levels of our culture's hierarchies maintain the belief that a civilized way of life based on growing all of one's own food is the best way to live (Quinn, 1999: 35) and that there is no alternative anyway (Quinn, 1999: 52). With pyramid building as both the one way and the best way, a Panglossian notion if there ever was one, its practitioners find themselves willing to pay its costs to achieve its various benefits, which include sedentism, productivism and power. This perspective diminishes yet another dichotomy, revealing a deeper similarity between capitalism and Marxist Communism as parallel manifestations of the Taker meme.

Totalitarian agriculture and the ownership of food are related practices which merely ensure that the resources for increase will be available, in one case the food necessary for increasing population, in the other case the population necessary to carry out increase projects (among which is, of course, the increasing of food production). But these are the mere mechanics of the system. Just as classical physics moved from mechanics into dynamics when the forces of motion were discovered, so understanding the Taker vision — of man ruling the world and civilization as the preferred way of life — gives us full comprehension of what drives our increase into runaway territory, justifying and perpetuating the system's workings even in the face of fatal revenge effects.

CONCLUSION: TOWARD SUSTAINABILITY

Leaving the Tunnel

This paper has looked at our civilization's present paradigm of growth and complication, analyzing their unsustainability, their origins and our attachment to them. True to the nature of revolutionary science, such analysis has many implications, from new explanations for present and historical social phenomena to the opening up of at least as many questions as it has answered.

Much of Taker culture can now be understood as having been made in the image of the increase which is at its base. With form mirroring content, as it should in anything that is the result of an evolutionary process, growth and hierarchy became the themes upon which countless variations are played, repeating themselves in an almost fractal manner throughout our culture. This is evident in the very biases — toward growth and complexity (biological, cultural, technological and otherwise), unilineal evolutionary paths (again, in many forms), human exceptionalism (including the Anthropic Principle, cortical conceit and the Cultural Fallacy), indeed, toward unlimited progress in general (Ashworth, 1995: 81) — which our civilization continues to display, despite evidence which neutralizes these ideas. Even our failure to understand the mechanisms of unsustainability — from the limits of growth to our ignorance of food production and material expansion as the very causes of, rather than solutions to, the problems we hope they will address — can be understood as something other than indicators of innate stupidity, of a fundamental human flaw. As Quinn says, our misunderstanding of the relationship between food and production "engages our cultural mythology at the most profound level" (Quinn, 1999: 114), standing alongside related confusions as, in effect, the cultural equivalents of psychological defense mechanisms. Without such beliefs, preferred increase could simply not be culturally sustained.

The history of scientific revolutions can also be looked upon in a new way which sheds light on efforts to move toward sustainability. The Great Demotions, which remove elements of exceptionalism from humanity and its planetary home, tearing down our conceptual hierarchies, continue through the present with the recent discovery of planets outside the solar system. Sagan suggests that it may only be a matter of time until we receive further “devastating deprovincialization” with confirmation of the presence of life elsewhere in the universe or even of the existence of entirely separate universes which may not hold to the same natural laws as our own (Sagan, 1994: 39). Yet, in our culture, the discoveries of science have been routinely and invariably applied in the pursuit of further material growth and progress, entrenching us deeper in increase. It is as if a pendulum, centered on an equilibrium economy, began to be pulled to one side with the rise of Taker culture. With each “demotion,” a force attempted to tug the pendulum back toward center, but in each case the Taker project reaffirmed itself and accelerated its progress, doing so by taking the teachings of science and applying them toward its own ends, moving the pendulum ever farther from center. Through this process, the effort to put dents in Taker culture ironically made each next step not easier but more difficult for itself since an ever farther distance would need to be covered to reach center.

As Kuhn puts it, revolutions often begin when the practice of normal science comes across anomalies for which it cannot account, plunging it into a crisis which precipitates the search for new explanations (Kuhn, 1996: 67). The counterthought to Taker culture can be seen as an overall response to the various scientific crises it generated, holding the potential to reveal a new umbrella paradigm even as it led in the meantime to piecemeal paradigm shifts throughout the sciences. Now, however, this counterthought finds itself in a colloquial crisis of its own. Our conceptual hierarchies have always gone hand-in-hand with our social ones, yet the one conceptual hierarchy that really counts, the one at the very foundation of Taker culture — the preference for growth and civilization which manifests a belief in man over nature — still remains and is all that is required to ensure the continuation of increase, despite historical progress in the sciences. The paradigm shift finds itself, in effect, stuck in first gear.

Our failure to understand the increase complex at the root of our culture is the reason why the world continues to disappoint Stephen Jay Gould. He laments that we have not yet collectively accepted the evitability of the evolution of *Homo sapiens* as the “plain implication” of Darwinian biological evolution. The Darwinian revolution, though, hasn’t yet been completed because it is part of a much larger one which is not merely about mass acceptance of good scientific explanations in the face of opposing cultural concepts but about good scientific explanations which fly in the face of fundamental cultural *practices*. This is, as Gould may not realize, the plain implication of the larger revolution against Taker culture and thus the reason why the Darwinian revolution has not truly happened — speaking volumes about the biological and ecological reality of humanity, it is simply too close to the root of our powerful increase paradigm. For the revolution to be completed, and for lasting, positive social change to be achieved, we must not only think new things but act in ways fundamentally different from those we’ve followed for thousands of years.

As Kuhn says, though, even in the face of anomalies, a paradigm cannot be renounced as invalid until an alternate candidate is available to take its place: “The decision to reject one paradigm is always simultaneously the decision to accept another, and the judgment leading to that decision involves the comparison of both paradigms with nature *and* with each other” (Kuhn, 1996: 77). Indeed, the apparent opposition of science and religion stems less from any real antagonism than from science’s failure to provide replacements when it appears to contradict religious and philosophic values (Dubos, 1968: 10). Likewise, we may have uncovered the unsustainability of growth and complication, but without a new paradigm, a new way of actually living in the world, of acting and not just thinking, we are at a standstill.

Just as it illuminated our present unsustainability and its cultural manifestations, the ecological perspective also points the way toward a sustainable future. A comprehensive exploration of the basis of an alternative paradigm is, as mentioned in the introduction, beyond the scope of this paper. Without an alternative, though, the preceding analysis is just more of the doom-and-gloom pessimism so commonly associated with ecological analyses. Many have tread these critical paths before. In considering how to achieve sustainability, though, even those who claim to be steeped in the ecological perspective can remain, in subtle but pivotal ways, entrenched in the paradigm they critique, with the result that the solutions they pose may be uninspiring at best and unviable at worst. They claim that we must do whatever is necessary if we want our species to survive — make sacrifices, adopt new universal ethics, no matter how painful or counter to our thoughts and desires they may be.

A few radical minds, though, a minority within the minority that are the ecological thinkers, take a unique stance which I believe to be the most constructive — and the most genuinely ecological. They are truly optimistic, suggesting courses of action which are feasible, immediate, often simple, always empowering — in short, paths that do not demand costs but supply benefits (Hawken, 1993: xv). Since ecology and evolution help us understand how living systems work, how they succeed, such an approach only stands to reason, contrasting with endeavors to merely fix something that is broken. If unsustainability is a vicious cycle which repeatedly yields things we don’t want, then sustainability is a virtuous one, generating what we do. While the analysis of unsustainability may seem like the darkest of tunnels, the tunnel very definitely comes to a well lit end. It would be against the spirit of ecological analysis to leave things in the dark. These concluding sections on some hallmarks of a sustainable society should at least bring us to the mouth of the tunnel.

The Material Dynamic Hallmarks: Equilibria and Cycles

Sustainability is, fundamentally, an extremely simple concept. It means that resources are used, on average, at a rate no greater than that of their regeneration. When use and regeneration are balanced, a state of equilibrium is achieved. The idea of an economy based on equilibrium as opposed to growth has a long history beyond even the rise of ecology, going back at least as far as John Stuart Mill's discussion of the stationary state, in which population and physical stock do not grow (Hardin, 1993: 117; Daly, 1996: 3). Most classical economists thought that the economy would end up in such a state, which they dreaded as the end of progress. Even today, "the very hint of approaching stabilization creates apathy" in comparison to the "intoxicating atmosphere" generated by the search for mastery and growth (Dubos, 1968: 7). Yet Mill welcomed equilibrium, as there was no reason to think that it suggested an end to qualitative improvement (Daly, 1996: 3): "The steady state is by no means static" (Odum, 1975: 11; Daly, 1996: 31). Equilibrium, then, is almost invariably dynamic, characterized by a wavy line around some level rather than a straight line along it (Odum, 1975: 11).

All of this directly parallels the notion of ongoing species turnover within a global evolutionary equilibrium, in which overall biodiversity is preserved at an optimum level even as individual species come and go. Given that ecological degradation knows no political boundaries (Ashworth, 1995: 49; Gotelli, 1998: 47) — able to influence across air, soil and the water table — and that efforts to protect particular species do not account for evolution, in which extinction is part of the game, conservation and preservation as means of maintaining biodiversity become problematic endeavors (Ashworth, 1995: 24, 28). Like recycling, they may be good ideas, even necessary at times, but can never provide a complete solution to the biodiversity crisis.

Environmentalism was a crucial response to increase culture, focusing for the first time on overtly ecological issues and making obvious the need to swing the Taker pendulum back toward center. However, while environmentalism attempts to move the pendulum in the right direction, its tactics often suggest pushing it past equilibrium into the realm where people would see themselves as subservient to nature, even to the point where people simply must disappear before nature can restore "its" balance, a balance that people cannot be a part of. The typical environmentalist dichotomy of jobs vs. environment, preservationist/conservationist attempts to keep man and nature literally separate by protecting existing species rather than preventing the growth which destroys general diversity, and the deep ecologist view of man as a cancer that must be eliminated for the sake of the Earth (Gore, 1993: 217) all play into the very exceptionalism that has caused the problems they hope to solve. Just as someone in favor of expansion hopes to conquer what is beyond the frontier, an environmentalist hopes to protect it, buying into the very same cultural construct (Ashworth, 1995: 81, 310). In posing the need for an opposite but more than equal reaction, all these attempts at correction are revealed to be simply the guilty conscience of Taker culture. This is why environmentalism so often appears pessimistic, viewing the ecological project as a “truce,” actually facilitating the domination of nature (Bookchin, 1982: 14, 22), expressing fear or panic rather than proposing a constructive alternative in which humans thrive within a likewise thriving ecosystem (Dubos, 1968: 229). In the end, environmentalism is not the same thing as ecology (Worster, 1994: 413) and is in some ways incompatible with it, as one-sided and non-integrative as the similarly named environmentalism in the nature/culture debates.

This brings us back to the revised preanalytic vision of the human economy as part of the ecosphere, of economics as part of ecology. Through this integrated view, we can refuse to play the either/or game, proceeding on the assumption that there are ways of living that can be good for both humanity and the rest of nature, that they develop “cojointly” rather than one at the expense of the other (Bookchin, 1982: 316). Indeed, something will be good for one *because* it is good for the other (Ashworth, 1995: 67, 130), because “the natural, everyday acts of work and life accumulate into a better world as a matter of course, not a matter of conscious altruism” (Hawken, 1993: xiv). We must not compromise with the rest of nature, we must collaborate with it (Dubos, 1968: 205).

Kenneth Boulding argued that we obtain satisfaction from the capital stock itself, not from additions to it (production) or subtractions from it (consumption). A sensible economy, according to Boulding, would be founded on maximizing maintenance efficiency rather than production or consumption, both of which should be minimized (Daly, 1996: 68). This is precisely what would be achieved when growth is abandoned in favor of equilibrium as the hallmark of a healthy economy. And since growth *is* our merely cultural and therefore changeable ecological “cancer,” this replacement of hallmarks — and only this replacement — would yield a systematically restorative effect on ecological degradation.

Equilibrium, though, is not something to be adhered to through the calculation of maximum volumes of resource usage or wastes that can be sustained and the passing of laws to ensure that we heed these limits. As astronomer Neil de Grasse Tyson says about the laws of physics, and applicable to all natural laws and limits, “The good thing about [them] is that they require no law-enforcement agencies” (Tyson, 2000: 91). They simply cannot be broken. Indeed, one of the tenets of Benyus’ canon is that nature curbs excess from within. In this view, equilibrium would not be a precise measure to be discovered and maintained only through active management — like species preservation and conservation, this would merely collude with increase. As Paul Hawken says, our economy has a design problem, not a management problem (Hawken, 1993: xiii), and ecological undesirables like hazardous waste are merely symptoms of the underlying flaw in design (Hawken, 1993: 38). An economy operating under different assumptions, though, could *generate* a dynamic equilibrium, automatically fluctuating around some point just like population levels in the demostat and biodiverse species composition through evolutionary turnover.

Inherent in the idea of efficiency is getting as much out of as little as possible. One of the priorities in moving toward equilibrium, then, is for businesses to literally economize by decreasing costs and resource usage. Like growth, this action increases real income, yielding positive benefits for the company, its employees and its customers even as it reduces impact on ecosystems. But reducing costs and ecological impact does not have to be merely a matter of giving up market share or downsizing the payroll. Economic growth relies on linear processes, in which resources are conceived as coming from a tap, going through some production process then moving into various sinks as final products or waste byproducts (Hardin, 1993: 57) — the affluence society generated by adamant production is also an "effluence" society (Dubos, 1968: 155). But linear systems are, by function and definition, limited and short-lived (Hawken, 1993: 52; Benyus, 1997: 272-3). Equilibrium, in contrast, comes from "closing the loops" (Benyus, 1997: 238), turning sinks into taps to create economic cycles which parallel those of ecosystem function (Ashworth, 1995: 200). And cycles, by function and definition, go round and round (Ashworth, 1995: 89) — a concept at the very heart of a sustainable dynamic equilibrium.

Hawken provides an especially good example of "industrial ecology" — one of the fields attempting to integrate commerce and ecology — in action. In Kalundborg, Denmark, a coal-fired power plant, an oil refinery, a pharmaceutical company, a sheetrock plant, concrete producers, a producer of sulfuric acid, the municipal heating authority, a fish farm, some greenhouses, local farms and other enterprises work cooperatively together, with the unwanted outputs from one business becoming the raw inputs for another. For example, the power plant recycles its waste heat, providing it to several of the other companies. The oil refinery sells surplus gas to the sheetrock factory and the power plant, and excess sulfur to a chemical company. Waste heat from the refinery warms the waters of the fish farm, whose fish sludge goes to local farmers as fertilizers. Numerous other symbiotic relationships exist among these enterprises, allowing them to make money off waste which previously would have gone unused and even incurred disposal costs, while others retrieve them as raw inputs at a reasonable price. Most striking is that none of these cooperative relationships were impelled through regulation — it all happened spontaneously (Hawken, 1993: 62-3).

On a similarly spontaneous note, Ray C. Anderson changed the commercial carpeting industry when, after reading Quinn's Ishmael and Hawken's The Ecology of Commerce, he became passionate about doing business sustainably. Deciding he wanted to push his company, Interface, Inc., past mere compliance with government regulations, he reduced his company's dependence on petroleum and began to make 100% recyclable carpeting from 100% recycled materials, eliminating Interface's contribution to landfills. Through this move, his competitors were forced to adopt his standards, not just those of the government, creating a ripple effect that impelled the commercial carpeting industry toward sustainability. As Quinn says about this phenomenon, reinforcing the new vision of business as able to generate equilibrium, "If people will *willingly* reform an industry when their minds are changed, why spend billions to enact and enforce laws to *compel* them to do it?" (Quinn, 1999: 101)

Pursuing cyclical production processes, it is possible to conceive of the complete elimination of waste (Hawken, 1993: 67). One of the key implications of a cycle-based economy is the recognition that, as in biology, "waste equals food" (Hawken, 1993: 12). The more this is recognized, the more our production processes will eliminate waste before it even exists: A substance whose use would generate byproducts that could not be assimilated by another production process, human or otherwise, would simply not be used from the start. Waste disposal, which never really disposed but instead just converted waste to a different form or moved it out of sight (Hawken, 1993: 46), would disappear along with waste itself.

In a growth economy, what is good for man is not good for the rest of nature, and what is good for some people is often not good for many others. In an equilibrium economy, cycles generate relationships within the human community that mimic those found in ecosystems even as they also generate those very same kinds of relationships between the human and non-human communities. Hawken even describes ways in which decreased productivity can actually be the very cause of increased employment and profits (Hawken, 1993: 69). These extraordinary symbioses can form the root of a material economy that can not only allow both humans and non-humans to thrive but can actually contribute to the restoration of much of the damage that our growth economy has done (Hawken, 1993: 2).

The Structural Hallmark and the Non-Material Dynamic Hallmark: Egalitarianism and Fulfillment

Beyond acknowledging that sustainable production processes are likely to be more cyclic than linear ones and that a more modest level of living than that of the present-day United States will be required by humanity on average, not much more can be concretely said about sustainability in terms of material resources. As Quinn puts it, though, moving beyond civilization and into sustainability is not about what we may lose but about what we stand to gain (Quinn, 1996: 86). We must look beyond the material to discover what true benefits people can obtain from a sustainable economy, and the answer is inherent in the analysis of unsustainability. Hand in hand with material growth goes structural complexity, the hierarchicalization that generates inequality. The social-structural complement of material equilibrium is a denial of hierarchy.

Throughout his work, Daniel Quinn maintains a sharp focus on the benefits of tribalism, the egalitarian social structure with which humans evolved (Quinn, 1999: 3). While he admits there is nothing perfect or morally superior about tribalism and grants the real possibility of other viable structures, he nevertheless notes that natural selection is hard to improve on (Quinn, 1999: 60, 181). Urging that we look beyond ethnicity, occupation (e.g., hunter-gatherer) and technology (e.g., “Stone Age”), Quinn underscores the importance of the tribe as a structure that simply facilitates making a living (Quinn, 1999: 63). Whether food is obtained directly through hunting and gathering or indirectly in a money economy, it is the tribe itself, not the resources, that provides a livelihood for its members (Quinn, 1999: 64). As such, a tribal economy is inherently different from that found in our civilization. Where in civilization the economy is founded in the exchange of material resources, Quinn claims that, in a tribe, it is personal support that is exchanged (Quinn, 1997: 167). As growth is the hallmark of an economy based on material, emotional fulfillment becomes the hallmark of an economy that runs on support. And without growth and the prizing of large organizations, the structure can remain inherently egalitarian. As

Dorothy Lee says, equality exists as “a byproduct of the democratic structure of the culture itself, not as a principle to be applied” (cited in Bookchin, 1982: 44).

That the tribal life represents a genuinely different paradigm from civilization is evident from the way in which Quinn holds it in direct contrast to our current paradigm. His pair of paradigmatic terms play on the phrase “take it or leave it” (Quinn, 1992: 38), so the practitioners of the alternative paradigm are Leavers, people who leave the rule of the world “in the hands of the gods” (Quinn, 1996: 253), which is simply meant to imply that they do not attempt to circumvent natural laws. Because the focus of tribalism is individual support, material becomes, in effect, immaterial, which is precisely why tribes have little trouble achieving sustainability. One does not need to appeal to notions of the noble savage at peace with nature, much less the more recent spin which conceives of the “ecologically noble savage” as a born environmentalist (Redford, 1990). Tribal cultures may live more sustainably and less harmfully than civilized ones, but they are assuredly not harmless. Poverty and harmlessness are not moral ideals required for sustainability, and material is anything but irrelevant for a tribe, but it is simply not the highest priority that it must be in an economy based on growth. As Donella Meadows, one of the authors of Limits to Growth, wrote, “Growth is a stupid goal. So, by the way, is no-growth. Growth is beside the point. The point is caring for people and resources and meeting real needs with the highest possible quality. When that is done, the growth will fall where it may and where it should” (cited in Ashworth, 1995: 177). Materially speaking, this is just what occurs under tribalism.

The give-support-get-support economic dynamic (Quinn, 1999: 167) that takes place among individuals within a tribe is directly related — figuratively and literally — to the compatibility of humanity within nature. There is unity between individual and community and between people and their physical environment (Bookchin, 1982: 46), and what is good for one element can be good for the other. Bookchin calls such societies organic, referring simultaneously to their two manifestations of intense solidarity: first internally, lacking economic classes and a political state, second with the rest of the natural world (Bookchin, 1982: 44). Through this dual nature of tribes, egalitarianism and sustainability — cultural form and content — can mutually reinforce each other in the same way that growth and hierarchy do. Hence, in direct contrast to the Taker vision of its place in the world, Quinn distinguishes the Leaver vision, the story which they enact, as one in which humanity belongs to the world (Quinn, 1992: 239). Bookchin shares this view, suggesting that non-civilized cultures view themselves as "neither above nature nor below it but *within* it," (Bookchin, 1982: 5). This expresses simultaneously the ecological vision of the human economy as being a subset of the Earth's biosphere and the notion that humanity is not alien to nature.

With the tribe now conceived simply as an egalitarian socioeconomic structure in which people come together to earn a living, gaining fulfillment from the equality inherent in the structure itself, Quinn suggests that we do not have to think of "retribalization" as a return to hunting and gathering (Bookchin, 1982: 344), which is itself merely an occupation and not a social structure. Not only would the Earth be unable to support six billion people engaged in this occupation, but a return to ethnic tribalism would necessarily involve a return to tribes whose membership was closed to outsiders. With the vast majority of the world population currently not in a tribe, what we need is an open tribalism (Quinn, 1999: 105), one that provides a genuine and workable alternative to civilization where we thought there was none, a technical alternative to the endless pursuit of the "powers of production" (Bookchin, 1982: 88), available to anyone who wants it.

To adapt tribalism to our present situation, Quinn poses the notion of the tribal business, or the occupational tribe (Quinn, 1999: part 6), allowing us to see that tribalism has, in fact, remained in practice to some extent even within our civilization. For example, he cites the circus as an endeavor in which, just as in ethnic tribes of hunter-gatherers, a coalition of people work together as equals to earn a living, each with a necessary job and each willing to contribute all their efforts because they receive all the support they need in return. This contrasts sharply with civilized employment in which people typically hope to put in as little work as possible for their pay just as the employer typically hopes to pay as little as possible for an employee's work (Quinn, 1999: 63-73). Further, non-tribal businesses are not concerned about "taking care" of their workers, viewing their obligation as ending with the provision of a paycheck which is supposed to allow workers to take care of themselves (Quinn, 1999: 107).

As in a hierarchy, a tribe will have a leader, but its leader merely takes care of business and receives no special benefit compared to the other members of the tribe (Quinn, 1999: 73), revealing the possibility of leadership without hierarchy. Bookchin supports this revised concept of leadership:

> What we flippantly call "leadership" in organic societies often turns out to be guidance, lacking the usual accouterments of command. Its 'power' is functional rather than political... Whatever "power" they do have is usually confined to highly delimited tasks such as the coordination of hunts and war expeditions. It ends with the tasks to be performed. Hence, it is episodic power, not institutional. (Bookchin, 1982: 55)

In a tribal business, the leader's power would be likewise limited to tasks — such as hiring and firing, settling disputes, negotiating contracts and liaising with local authorities — but these confer no advantages. The boss may not even be particularly envied or admired, and his or her overthrow would yield no advantages for others (Quinn, 1999: 67, 73).

With the tribe reconceived in this way, we can now identify numerous small businesses as being essentially tribal and many more types of businesses as having tribal potential. As Quinn sees it, the minimum requirement is a group of people who have the necessary competencies to start and run a given kind of business, are content with a modest standard of living and are willing to take what they need out of the business rather than expect set wages (Quinn, 1999: 146). Through this scheme, the possibilities are almost endless, from newspapers and performing arts groups to restaurants, lawn care and construction businesses (Quinn, 1999: 140-145, 147, 153-4).

In the current context, the tribe is more of a philosophy about livelihood than a business model. It gives no indication about how to run or organize any particular business, instead providing a basic structure which itself gives people the support they need to pursue whatever venture they are interested in. Though the occupations will vary, a tribal business' members would be more concerned with fulfillment in their pursuits and consequently in the welfare of their fellow members and of the business as whole than with the size of the business or their incomes. In Beyond Civilization, Quinn goes into greater detail about the tribal business but, even so, leaves many questions unanswered. On one hand, this is simply indicative of its being a genuinely new paradigm for achieving a livelihood, opening up questions as it answers others. On the other hand, tribal businesses are more likely to find success through practice than *a priori* theorizing, involving as they always will the specificity of their members and markets.

The Operational Hallmark: Bottom-Up

The key question that remains is how to actually enter the new paradigm. If we think about this in terms of enacting a cultural premise, the Leaver vision of humanity belonging to the world could serve as a basis for the move into a genuinely ecological paradigm, contrasting with the increase culture that flows from the Taker vision that the world was made for humanity and humanity made to rule the world. But how does one put "humanity belongs to the world" into practice?

On field management of "overrepresented" and "underrepresented" species, population ecologist Robert F. Rockwell says that the typical approach is simple and two-fold: If you've got too many of something, shoot some; if you've got too few, shoot what eats them. He notes that both of these efforts, though, are top-down measures, addressing only the outputs of a population system and failing to consider the actual causes of the population sizes. In contrast, bottom-up measures are oriented toward regulating the inputs to a system. Altering the nutrients in an area's soil, for example, would affect the plant life which consequently affects the animal life. This may be more difficult to implement and may take longer to yield an effect but would almost always provide a solution that is both more stable and lasting (R.F. Rockwell, personal communication, November 16, 1999).

Top-down management of any stripe is, by definition, reactive, oriented toward dealing with the outputs of a system. The ability to react to given circumstances is a crucial one for any individual or organization, human or otherwise. However, in top-down processes, “It often — if not always — emerges that measures to control one critical factor cause another to go out of control” (Enzensberger, 1974/1996: 20). Attempts to correct something undesirable will simply be “stopgap techniques that do not touch the roots of the problem” (Enzensberger, 1974/1996: 45) and which may themselves have unintended negative side effects. Further, as Rachel Carson said, “all rules exerted from above... [are] begging to be circumvented” (cited in Benyus, 1997: 244) if the rule prohibits something that people continue to want — or something that laws of nature mandate.

Though James C. Scott never mentions revenge effects, his Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed (1998) reads like something of a sequel to Edward Tenner’s treatise, as both books catalog numerous and varied failures of top-down management. Scott focuses on governmental management of societies, from tax systems and property rights to resource use and city planning, while Tenner looks at broader phenomena that tend not to come under obvious state control, from medical technology and ecological instability to motorization, the computerization of the office and the intensification of sport activity. The common thread through all their examples, though, is the introduction of plans and procedures to improve a situation only to exacerbate the initial problem or create new ones, making the value of the improvement effort at best ambiguous and often worse. Supposedly logical solutions give with the right hand and take away with the left (Tenner, 1996: 193).

In a culture in which so many practices yield revenge effects, especially ones that may be highly separated in time from their cause, there is all the much more to react to. In a complex system, though, the links between cause and effect become unknowable (Tenner, 1996: 24). After millennia, not only the causes of those negative effects but the very evitability of the practices which are their causes grew ever more obscure. As these effects came to be seen as endemic to human society, management naturally became the primary way things get done. Thus, we have come to feel that real social change must come through the work of governments, corporations, non-profit organizations, etc. — the powerful hierarchical institutions which have the most influence over what large-scale management programs get implemented. Even under Marxism, which so prized the masses, the assumption is that "the social life of the working class will be organized either by the bourgeoisie or by the vanguard party, but never by members of the working class themselves" (Scott, 1998: 162).

Just as in Rockwell's example, though, management from the top down has never been the most significant way to achieve change. As Jane Jacobs says, social order is brought about not by policeman and public officials but from below by "an intricate, almost unconscious network of voluntary controls and standards among the people themselves, and enforced by the people themselves" (cited in Scott, 1998: 135). Even Taker culture owes its very existence not to the wielding of power by those at the tops of hierarchies but to the belief held by all its members in totalitarian agriculture and the civilized way of life. It is upon this foundation that the creation and perpetuation of the hierarchies themselves is based. Quinn points to the spread of Christianity and the Industrial Revolution as other events driven not by management programs but by the fact that many people found something worthwhile in a simple idea which was particularly good at replicating itself (Quinn, 1999: 15). Memetics expresses this very notion of social change, an epidemiology of ideas which succeed by finding hosts. As Quinn sees it, vision is what lies behind a successful meme, allowing it flourish without top-down management (Quinn, 1999: 16). The notion that little things can have big effects (Walsh, 1998: 11; Quinn, 1999: 23; Gladwell, 2000) is key in the study of memetics and indicative of its nature as a bottom-up process.

Returning to the idea of behavioral reinforcement, which establishes the connection between a stimulus and a response, we can see how it makes perfect sense that social change should occur in this way. Across species, it has been well established that receiving rewards, or possessing incentives, is much more effective in promoting the presence of a desired behavior than receiving punishments (Santrock & Yussen, 1989: 144). This holds not only in the highly artificial circumstances of scientific experimentation but in the very real-life applications of child rearing and business management (Blanchard & Johnson, 1982; Gleitman, 1987: 408-409, 411; Santrock & Yussen, 1989: 329). Memes spread because, regardless of their biological adaptivity, people find value in them. No law has to be passed to ensure their success.

In contrast to top-down methods, bottom-up management is inherently proactive, dealing with the inputs to a system. It is an expression of the old adage that an ounce of prevention is worth a pound of cure. Expanding the medical analogy with yet another cliche, top-down management efforts are revealed to be “Band-Aid” solutions, treatments that address symptoms rather than preventive measures that cause good health in the first place. Again, Band-Aids are extremely helpful when you get a cut, but their existence is no excuse to be careless about getting cuts in the first place. Given this, bottom-up efforts should not even be called management, since they are precisely about getting to the root of a situation to generate desired things in such a way that undesired ones don’t arise and, therefore, do not have to be dealt with (Hawken, 1993: 51). This was precisely what W. Edwards Deming had in mind when he devised Total Quality Management (Benyus, 1997: 243). Indeed, bottom-up efforts should not even be called bottom-up, since this merely expresses the idea of a hierarchy. Rather than confuse matters, though, by posing a more systems-oriented terminology, referring to top-down as “output-in” or “end-back” and bottom-up as “input-out” or “beginning-forward,” I will grudgingly stick with bottom-up, which at least has the virtues of familiarity and of placing focus on the traditionally downplayed part of a hierarchy.

In dealing with the diseases of civilization, the matter is, in a way, another example of the logical flaw of the converse. Without understanding that increase causes so many social and ecological ills, it may seem obvious that the way to alleviate those ills is to face them head on. But if increase does lead to ills, then the only conclusion we can draw is that a society without such widespread ills must be one that does not pursue increase. To attack problems directly instead of getting to their root is to strive at not failing rather than actually succeeding. This is not to say that top-down programs are wicked, just that they are inadequate (Quinn, 1999: 18), a direct parallel to growth's being not immoral but merely unviable. As Quinn makes the distinction between paradigms, "If the world is saved, it will not be by old minds with new programs but by new minds with no programs at all" (Quinn, 1999: 7). The reason this is so is that "old minds" ask themselves, "How do we stop these bad things from happening?" while "new minds" ask, "How do we make things the way we want them to be?" (Quinn, 1999: 8). This precisely describes top-down versus bottom-up approaches, and the new-mind outlook provides the very basis for the last two sections.

With the understanding that cultural evolution works most effectively when it acts like other natural processes, from the bottom-up, we can follow the lead of the biomimics and suggest bottom-up measures as an active method for achieving social change, harnessing it toward the goal of a sustainable social paradigm. What, then, is the content of bottom-up change to be? Is it a detailed lesson on ecology, evolution and cultural critique? Hardly. As Quinn suggests, to avoid extinction we only need to replace our lethal memes, and the best meme-killer is another meme (Quinn, 1999: 24, 54). The key to bottom-up change is the invention of a meme in which people find value, one that can simultaneously serve as cultural fuel and engine, generating a new economy in the same way that natural laws generate physical phenomena (Quinn, 1999: 11). Since our predicament is one of cultural activity, we need a preactive vision to go with our new preanalytic vision, a concept that points the way toward new things to do so that we may act on our new way of conceiving things, one that can make good on the idea that civilization is not humanity's ultimate invention and that something *better* can be found beyond it (Quinn, 1999: 54). A bottom-up approach toward achieving sustainability, then, involves finding something about sustainability in which people find more value for themselves than what they are presently doing, an incentive rather than a disincentive. As Hawken says, "humans want to flourish and prosper, and they will eventually reject any system on conservation that interferes with these desires" (Hawken, 1993: xv).

A way of living based explicitly on fulfillment should clearly be of value to anyone, desirable even in the absence of unsustainability. Yet the way our culture presently views fulfillment is best exemplified by another concept from psychology, Abraham Maslow's hierarchy of needs. In this scheme, people must fulfill their most important needs before the more superfluous ones. The basic needs are, first, physiological (e.g., food, water, air, sex, sleep), and then safety (e.g., shelter, economic security, freedom from pain and fear). When these are met, we are permitted to move up the pyramid to the higher needs: love and belongingness, self-esteem and, finally, only once all of these other needs have been fulfilled, self-actualization, which involves the feeling of contentment that comes from finding self-fulfillment and realizing one's potential (McDaniel & Darden, 1987: 79; Santrock & Yussen, 1989: 154). In Maslow's scheme, espoused as a general explanation for human motivation in introductory textbooks of psychology and marketing alike, fulfillment is the last thing a person needs and thus the last thing for which they can strive.

In a Leaver economy, though, the fundamental items of trade reside in the realm of the higher needs — fulfillment and belongingness generate each other within the tribal structure. That which is most desired is dealt with as a top priority and, as noted earlier, it is precisely through this that the basic needs become either taken care of or beside the point. Tribalism turns Maslow's hierarchy on its head. Rather than representing any sort of truth about human nature, I submit that

Maslow's hierarchy is, like so many others, merely another false universal generated by our culture. The notion that positive social change slowed down because activists found out that they had to make money and couldn't spend time in their movements (C. Schwarzenbach, personal communication, April, 10, 2000) plays perfectly into Taker economics and the hierarchy of needs, ignorant of the possibility that one can bring about social change by altering the very way one earns one's living. The cultural generator for a tribal economy, then, is the prizing and encouragement of fulfillment itself as prior to anything else. In other words, one puts the Leaver vision into practice in the same way that Leavers always have. Bromides such as Joseph Campbell's "find your bliss" and the Jobs.com slogan "When you love what you do, you're alive" are revealed to be potentially world-altering concepts.

With the focus on fulfillment, there are at least two obvious tacks for people to take. First, Quinn suggests that the test for people to determine what occupation would be truly fulfilling is that they would stick with it even if they had a billion dollars in the bank (Quinn, 1999: 80). People could thus resolve to earn their living doing that activity, letting their standard of living adjust as necessary, generally lowering it to get more of the non-material things they actually want (Quinn, 1999: 88). For those for whom a somewhat higher level of living may itself provide fulfillment, the activity for earning a living can adjust. Though this sort of scheme in itself does not guarantee sustainability, prizing fulfilling activity as opposed to material goods is a step in the right direction (Soper, 1991/1996: 93-95; Quinn, 1999: 112, 170), a move away from the "culture of maximum harm" (Quinn, 1999: 109) which demands an ever-increasing standard of material living for all. For those who don't have some particularly fulfilling activity in mind, the activity may be somewhat beside the point since the tribal structure itself provides fulfillment. Likewise, someone who has a particularly fulfilling pursuit may be able to earn a living outside a tribe and nevertheless contribute to a move toward sustainability. In this light, for example, "struggling artists" able to earn a living from their art would, in the new paradigm, not be seen as struggling at all. The upshot is that form and content provide the two complementary paths. Focusing on the content may end up yielding forms other than the tribal but those forms will be just as consistent with the cultural content of sustainability.

The focus on tribes and even individuals, though, should not be confused with an absolute idealization of the small over large. In his work on scalar stress, Gregory A. Johnson has noted that hierarchical integration is not the only possible organizational response to increases in size. Through an analysis of ethnographic data on various egalitarian societies, Johnson discovered that a pattern of individual units coming together in egalitarian structures whose size was limited actually *repeats* itself on multiple levels. Individuals form a first-level structure such as a family, but individual first-level structures form a second-level structure, with families, for example, forming extended families. The pattern can repeat itself numerous times, yielding overall aggregates of many thousands of individual people. Johnson refers to such a structure as a sequential hierarchy. In a traditional hierarchy, integration and control are maintained at all times throughout the structure, leading Johnson to call it a simultaneous hierarchy. The hallmark of the egalitarian alternative is the sequential nature of the structure's decision-making process. Consensus is first achieved within lower-level structures, then representatives from those structures come together to reach consensus in higher-level structures. Decision-making, then, occurs in a sequential fashion, one level at a time. While this may lengthen the process, it decreases the complexity of regulating social relationships and maintains equality throughout the structure (Johnson, 1982: 396-404).

Quinn discusses precisely this phenomenon in theorizing about the size of a tribal business. One of the key practices in running an occupational tribe is that it refrains from expansion merely to accomplish more, to produce more — it, in effect, denies growth as an economic hallmark. As long as the tribe provides a livelihood for its members, its size is, by definition, optimal. It expands only when people come along who can extend the business of the tribe to include themselves, since increases in size that don't extend the business must necessarily come at the expense of its members' livelihood and can only weaken the tribe. This reflects two of Benyus' tenets: The tribe uses only the energy it needs and curbs growth from within. Even if the livelihood is extended through increase, the endeavor can reach a point at which it risks losing its tribal character, echoing Johnson's notion of scalar stress. In such cases, the growth must stop or the tribe can reorganize into what Quinn refers to as a tribe of tribes (Quinn, 1999: 65), a concept which directly parallels Johnson's sequential hierarchy. Indeed, if hierarchy is by definition inegalitarian, Johnson's structure is not a hierarchy at all but, like a tribe of tribes or an individual tribe itself, a network.

As Johnson's work indicates, this sort of scheme can occur beyond explicitly economic structures. Indeed, WB2K identifies a political localization trend, in which subnational entities are beginning to assert self-determination (World Bank, 2000: 44). WB2K, of course, meets this trend with the notion of decentralization, in which states grant local control of certain activities (World Bank, 2000: 45) — the state reasserts its own power lest a smaller structure subvert it. Localization can manifest itself on many levels, from the mere election of local governments in Middle Eastern countries, to the "devolving" of responsibilities to local jurisdictions, as with education in Poland and health care and road maintenance in the Philippines (World Bank, 2000: 45), and even up to the volatile independence struggles of Ireland and Taiwan. In all its guises, though, localization is merely the present-day incarnation of the fissioning described in discussions of cultural collapse and scalar stress. An option necessarily left behind by a civilization attached to integration, fissioning transforms hierarchical structures into flatter ones, reducing conflict as it generates equality.

Certainly, the growth of populations and economies is a problem in and of itself, but even in the face of such growth, localization remains the primary way to reduce inequality. Yet localization is not isolationism. Municipalities and regions can continue to pursue relationships beyond their borders. They are simply free to do so under their own terms, coming together for whatever endeavors they wish to pursue in common while taking control over the issues they want under their own purview. The dynamic of localization and subsequent networking can play itself out wherever social structure exist — politics, economics, religion, etc. This is not about anarchy but about revealing power to be able to flow not only top-down but bottom-up, each segment in the network an independent entity, joined to the others to the extent that there is a benefit in such a relationship. Indeed, occupational tribalism is an alternative to wage slavery and corporate economics, ignoring government and politics altogether.

Such a dynamic, in effect, culturally replicates the branching bush that Stephan Jay Gould is so fond of using to characterize biological evolution in contrast to mistaken notions of directionality and hierarchy. Indeed, the geometric difference between hierarchy and branching bush may be minimal. The matter is primarily one of perspective, or vision: Hierarchy runs vertically while a branching network exists, at least conceptually, in a flat plane. Though this social dynamic is different from the biological in the same way that cultural evolution is different from biological in that its parts are not forever separated branches of a tree, the basic model holds. It is a bottom-up generation of social structure through what Quinn refers to as "walking away from the pyramid" (Quinn, 1999: 55). Instead of civilization digging itself deeper into a bigger-they-come-harder-they-fall situation, it transforms into an entirely different thing altogether, reducing both the possibility and the magnitude of a fall with each step (Quinn, 1999: 171).

A surprising and ironic conclusion flows from such an approach. The point of encouraging a fulfillment economy, through tribalism or otherwise, is merely to provide those who want it an alternative to the dissatisfaction they may experience in contributing to pyramid-building. It is certainly possible that, through this process, the human economy will eventually reach a point at which pyramid-building becomes impossible due to a lack of collaborators. Such a gradual transformation, though, in no way requires that pyramid-building be abolished, that people who find fulfillment within a hierarchy be denied (Quinn, 1999: 80). While there is clearly some urgency in achieving the new paradigm so that we can avert extinction, it does not need to be put into place everywhere or immediately, the process being incremental (Quinn, 1999: 102) as bottom-up change, by definition, is. Whether simple thought contagion or genuine social epidemic, the new paradigm will be created over time as individuals move into it and does not even require completion (i.e., the inclusion of all individuals everywhere). As Quinn suggests, the Earth is a resilient place that can cope with an ecologically harmful way of living by many people, just not by *all* people, affirming that, in contrast to the belief of the Taker paradigm, there is no one right way to live (Quinn, 1999: 97, 111).

Bottom-up thinking is not the be-all and end-all, a uniform replacement for our present uniformity. For every action there is an equal and opposite reaction, and every reaction is a new action. Top-down reactivity will always be an integral part of ecological thinking because active adaptation to one's situation is as important to the survival of an individual as passive adaptation through natural selection is for a species. Large-scale programs may have their place, and some may be invaluable, but they will also never prove the be-all and end-all. Bottom-up thinking simply means not having to wait for our hierarchy's leaders to save us through top-down measures (Quinn, 1999: 99), since it is inherently local in nature, just like evolution and, indeed, all natural laws. It is thus no surprise that such an approach should have a localizing effect.

Scott repeatedly demonstrates how designed or planned social order necessarily generalizes at the expense of existing reality which is inevitably local and therefore non-uniform (i.e., not easily generalized). It is local, practical knowledge — knowledge that is bottom-up both systemically and hierarchically and which, for these very reasons, has been downplayed by our culture — that Scott sees as playing an indispensable role in positive social change (Scott, 1998: 4, 6). Adapting to local circumstances, knowledge and culture may follow biology, inevitably gaining resilience and durability through diversity (Scott, 1998: 7, 281) instead of the uniformity imposed by ceaseless growth, integration and pursuit of "one right way." Indeed, diversity is always more difficult to design, build and control than uniformity (Scott, 1998: 141), but nonetheless always evolves on its own *without* planning.

As Scott, says, though, this does not suggest the elimination of planning or programs (Scott, 1998: 6) — anymore than it suggests the need to eliminate pyramid-builders. In the end, it seems a simple matter of altered priorities. Since the most effective way to generate a desired result — or to stop an undesired one from ever happening — is through bottom-up measures, they should always be the first choice in seeking change. The more difficulty that arises in attempting to get at the root of a situation, or the more urgently a situation must be dealt with, the more top-down measures will come into play. With a more diverse arsenal at our disposal than we previously conceived, each approach may be used when most appropriate, increasing the chances of achieving a desired result. As this strategy gradually transforms our civilization into a sustainable society, many of the undesired aspects of our society may disappear, or at least be reduced to a point where we no longer think of them as problems requiring aggressive mastery.

The hope of alleviating the diseases of civilization, combined with the rise of a fulfillment economy and the empowering prospect of reaching these achievements through bottom-up change, is why a truly ecological perspective is, in stark contrast to the analysis of unsustainability and the typical proscriptions of many who rail against unsustainability, genuinely optimistic. To achieve sustainability, we must heed Mahatma Gandhi's directive that "We must be the change we wish to see in the world" (cited in Gore, 1993: 14), but the ecological perspective reveals that this task can end up being a pleasure and not a chore. Perhaps it is no coincidence that both optimism and the optimum, a hallmark concept in a sustainable economy, come from the same Latin root meaning best. We cannot achieve utopia, but we can achieve a world that works for both people and the Earth of which we are a part.

BIBLIOGRAPHY

Altvater, E. (1994). Ecological and economic modalities of time and space. In M. O'Connor (Ed.), Is capitalism sustainable? Political economy and the politics of ecology (76-90). New York: Guilford. (Reprinted from *Capitalism, Nature, Socialism*, 1 (1989), 59-70.)

Ashworth, W. (1995) The economy of nature: Rethinking the connections between ecology and economics. New York: Houghton Mifflin.

Baldwin, J.D. & Baldwin, J.I. (1982). Sociobiology or balanced biosocial theory? In T.C. Wiegele (Ed.), Biology and the social sciences: An emerging revolution (pp. 311-317). Boulder: Westview. (Reprinted from *Pacific Sociological Review*, 23 (1980, January), pp. 3-27.)

Barkow, J.H. (1980). Sociobiology: Is this the new theory of human nature? In A. Montagu (Ed.), Sociobiology examined (pp. 171-197). New York: Oxford University Press.

Barkow, J.H. (1982). Culture and sociobiology. In T.C. Wiegele (Ed.), Biology and the social sciences: An emerging revolution (pp. 59-75). Boulder: Westview. (Reprinted from *American Anthropologist*, 80 (1980), pp. 5-20.)

Barnes-Svarney, P., (Ed.). (1995). The New York Public Library science desk reference. New York: Macmillan.

Benyus, J.M. (1997). Biomimicry: Innovation inspired by nature, New York: William Morrow.

Blackmore, S.J. (1999). The Meme Machine. Oxford: Oxford University Press.

Blanchard, K. & Johnson, S. (1982). The one minute manager. New York: Berkley.

Blaylock, B. (2000). *Pyramid schemes, Ponzi schemes, and related frauds*. Retrieved October 10, 2000, from the World Wide Web: http://www.impulse.net/~thebob/Pyramid.html

Bookchin, M. (1982). The ecology of freedom: The emergence and dissolution of hierarchy. Palo Alto: Cheshire.

Caplan, A.L. (1980). A critical examination of current sociobiological theory: Adequacy and implications. In G.W. Barlow & J. Silverberg (Eds.), Sociobiology: Beyond nature/nurture? Reports, definitions and debate (pp. 97-121). Boulder: Westview.

Carneiro, R.L. (1967). On the relationship between size of population and complexity of social organization. *Southwestern Journal of Anthropology*, 23, 234-243.

Carneiro, R.L. (1970, August 21). A theory of the origin of the state. *Science,* 169:3947, 733-738.

Carneiro, R.L. (1981). The chiefdom: Precursor of the state. In G.D. Jones & R.R. Kautz (Eds.), The transition to statehood in the New World, New York: Cambridge University Press.

Carneiro, R.L. (1987a, September-December). The evolution of complexity in human societies and its mathematical expression. *International Journal of Comparative Sociology*, 28: 3-4, 111-128.

Carneiro, R.L. (1987b, November). Cross-currents in the theory of state formation. *American Ethnologist*, 14:4, 756-770.

Carneiro, R.L. (1988a, March/April). The circumscription theory: Challenge and response. *American Behavioral Scientist*, 31:4, 497-511.

Carneiro, R.L. (1988b, November). Back eddies among the cross-currents: A reply to Claessen and van de Velde. *American Ethnologist*, 15:4, 782-783.

Carneiro, R.L. (1997/1998, December/January). Unpalatable truth. *Natural History*, 106:11, 7.

Chagnon, N.A. (1982). Anthropology and the nature of things. In T.C. Wiegele (Ed.), Biology and the social sciences: An emerging revolution (pp. 119-123). Boulder: Westview. (Reprinted from Chagnon, N.A. & Irons, W. (Eds.). (1979). Evolutionary biology and human social behavior: An anthropological perspective. North Scituate, MA: Duxbury.)

Claessen, H.J.M. & van de Velde, P. (1988, November). Response to Carneiro. *American Ethnologist*, 15:4, 782.

Cowgill, G.L. (1974). On the causes and consequences of ancient and modern population changes. *American Anthropologist*, 77, 505-525.

Cowgill, G.L. (1988). Onward and upward with collapse. In N. Yoffee & G.L. Cowgill (Eds.), The collapse of ancient states and civilizations, Tucson: The University of Arizona Press.

Crossette, B. (1999, September 19). Rethinking population at a global milestone. *New York Times*, pp. 1, 4-5.

Daly, H.E. (1996). Beyond growth: The economics of sustainable development. Boston: Beacon.

Dawkins, R. (1989). The selfish gene. New York: Oxford University Press.

deWaal, F.B.M. (1999, December). The end of nature versus nurture. *Scientific American*, 281:6, pp. 94-99.

Degler, C.N. (1991). In search of human nature: The decline and revival of Darwinism in American social thought. New York: Oxford University Press.

Deléage, J. (1994). Eco-Marxist critique of political economy. In M. O'Connor (Ed.), Is capitalism sustainable? Political economy and the politics of ecology (37-52). New York: Guilford. (Reprinted from *Capitalism, Nature, Socialism*, 1 (1989), 15-31.)

Dickson, D.B. (1987, October). Circumscription by anthropogenic environmental destruction: An expansion of Carneiro's (1970) theory of the origin of the state. *American Antiquity*, 52:4, 709-716.

Dryzek, J.S. (1994). Ecology and discursive democracy: Beyond liberal capitalism and the administrative state. In M. O'Connor (Ed.), Is capitalism sustainable? Political economy and the politics of ecology (176-197). New York: Guilford. (Reprinted from *Capitalism, Nature, Socialism*, 3 (1992), 18-42.)

Dubos, R. (1968). So human an animal. New York: Charles Scribner's Sons.

Durham, W.H. (1982). Toward a coevolutionary theory of human biology and culture. In T.C. Wiegele (Ed.), Biology and the social sciences: An emerging revolution (pp. 77-94). Boulder: Westview. (Reprinted from Chagnon, N.A. & Irons, W. (Eds.). (1979). Evolutionary biology and human social behavior: An anthropological perspective (pp. 39-59). North Scituate, MA: Duxbury.)

Durham, W.H. (1990). Advances in evolutionary culture theory. *Annual Review of Anthropology*, 19, 187-210.

Durham, W.H. (1991). Coevolution: Genes, culture, and human diversity. Stanford, California: Stanford University Press.

Eldredge, N. (1995). Dominion. Berkeley: University of California Press.

Enzensberger, H.M. (1996). A critique of political ecology. In T. Benton (Ed.), The greening of Marxism (pp. 17-49). New York: Guilford. (Reprinted from *New Left Review*, 84 (1974), 3-31.)

Fedoseev, P. (1982). A Marxist view of biology and the social sciences. In T.C. Wiegele (Ed.), Biology and the social sciences: An emerging revolution (pp. 323-334). Boulder: Westview. (Reprinted from On the problem of the social and the biological in sociology and psychology, *Social Science Information*, 15 (1976).)

Feinman, G. & Neitzel, J. (1984). Too many types: An overview of sedentary prestate societies in the Americas. In M.B. Schiffer (Ed.), Recent advances in archaeological method and theory (Vol. 7). New York: Academic.

Flew, A. (1994, September). E.O. Wilson after twenty years: Is human sociobiology possible? *Philosophy of the Social Sciences*, 24:3, pp. 320-335.

Gare, A. (1996). Soviet environmentalism: The path not taken. In T. Benton (Ed.), The greening of Marxism (pp. 111-28). New York: Guilford. (Reprinted from *Capitalism, Nature, Socialism*, 4 (1993), 69-88.)

Gladwell, M. (2000). The tipping point: How little things can make a big difference. New York: Little, Brown.

Gleitman, H. (1987). Basic psychology (2nd ed.). New York: W.W. Norton.

Gore, A. (1993). Earth in the balance: Ecology and the human spirit. New York: Plume.

Gotelli, N. (1998). A primer of ecology. Sunderland, MA: Sinauer.

Gould, J.L. & Gould, C.G. (1983, June). Advanced sociobiology: The latest fashion in thinking about your genes. *Harper's*, 266, pp. 65-70.

Gould, S.J. (1978). Biological potential vs. biological determinism. In A.D. Caplan (Ed.), The sociobiology debate: Readings on the ethical and scientific issues concerning sociobiology (pp. 343-351). New York: Harper & Row. (Reprinted from *Natural History Magazine*, (1976, May).)

Gould, S.J. (1980). Sociobiology and human nature: A postpanglossian vision. In A. Montagu (Ed.), Sociobiology examined (pp. 283-290). New York: Oxford University Press. (Reprinted from *Human Nature*, 1 (1978, October).)

Gould, S.J. (1980). Sociobiology and the theory of natural selection. In G.W. Barlow & J. Silverberg (Eds.), Sociobiology: Beyond nature/nurture? Reports, definitions and debate (pp. 257-269). Boulder: Westview.

Gould, S.J. (1984, August 16). Between you and your genes. *New York Review of Books*, 31: pp. 32-34.

Gould, S.J. (1996). Full house: The spread of excellence from Plato to Darwin. New York: Harmony.

Gould, S.J. (1997, October). A tale of two worksites. *Natural History*, 106: 9, 18-29+.

Gould, S.J. & Lewontin, R.C. (1979). The spandrels of San Marco and the Panglossian paradigm: a critique of the adaptationist programme. *Proceedings of the Royal Society of London*, B205, pp. 581-598.

Hacking, I. (1990). The taming of chance. New York: Cambridge University Press.

Hallpike, C.R. (1986). The principles of social evolution. Oxford: Clarendon.

Hardin, G. (1993). Living within limits: Ecology, economics, and population taboos. New York: Oxford University Press.

Hawken, P. (1993). The ecology of commerce: A declaration of sustainability. New York: HarperBusiness.

Johnson, G.A. (1982). Organizational structure and scalar stress. In C. Renfrew, M.J. Rowlands & B.A. Segraves (Eds.), Theory and explanation in archaeology. New York: Academic.

Kaufman, H. (1988). The collapse of ancient states and civilizations as an organizational problem. In N. Yoffee & G.L. Cowgill (Eds.), The collapse of ancient states and civilizations. Tucson: The University of Arizona Press.

Kirsch, P.V. (1988, March/April). Circumscription theory and sociopolitical evolution in Polynesia. *American Behavioral Scientist*, 31: 4, 416-427.

Knutson, M.C. (1996). *The "Ponzi scheme"*. Retrieved October 10, 2000, from the World Wide Web: http://www.mark-knutson.com.

Kuhn, T.S. (1996). The structure of scientific revolutions. Chicago: The University of Chicago Press.

Langton, J. (1988, March/April). Publius and political anthropology: Explaining the transformation of the United States, 1781-1789. *American Behavioral Scientist*, 31:4, 497-511.

Lieberman, L. (1989, December). A discipline divided: Acceptance of human sociobiological concepts in anthropology. *Current Anthropology*, 30:5, pp. 676-682.

Livingstone, F.B. (1980). Cultural causes of genetic change. In G.W. Barlow & J. Silverberg (Eds.), Sociobiology: Beyond nature/nurture? Reports, definitions and debate (pp. 307-329). Boulder: Westview.

Lynch, A. (1996). Thought contagion: How belief spreads through society. New York: Basic.

Marx, K. (1978). Economic and philosophic manuscripts of 1844. In R.C. Tucker, (Ed.), The Marx-Engels Reader (pp. 66-125). New York: W.W. Norton. (Original work published 1932.)

Marx, K., & Engels, F. (1978). Manifesto of the Communist party. In R.C. Tucker, (Ed.), The Marx-Engels Reader (pp. 469-500). New York: W.W. Norton. (Original work published 1888.)

Mayhew, B.H. (1982). Hierarchical differentiation in imperatively coordinated associations. In W. Sodeur (Ed.), Mathematische analyse von organisationsstrukturen und prozessen: Berichte und diskussionen internationale wissenschaftliche fachkonferenz, Duisburg, Germany: Sozialwissenschaftliche Kooperative.

McDaniel, Jr., C. & Darden, W.R. (1987). Marketing. Newton, MA: Allyn and Bacon.

Mead, M. (1964). Continuities in cultural evolution. New Haven: Yale University Press.

Midgley, M. (1980). Rival fatalisms: The hollowness of the sociobiology debate. In A. Montagu (Ed.), Sociobiology examined (pp. 15-38). New York: Oxford University Press. (Paper delivered at the Conference on Humanistic Disciplines in Transition (1979, December 1), sponsored by The Society for the Humanities, Cornell University, Ithaca, NY.)

O'Connor, J. (1994). Introduction to the democracy and ecology series. In M. O'Connor (Ed.), Is capitalism sustainable? Political economy and the politics of ecology (vii-ix). New York: Guilford.

O'Connor, M. (1994). Is capitalism sustainable? Political economy and the politics of ecology. New York: Guilford.

Odum, E.P. (1975). Ecology: The link between the natural and social sciences (2nd ed.). New York: Holt, Rinehart and Winston.

Perelman, M. (1996). Marx and resource scarcity. In T. Benton (Ed.), The greening of Marxism (64-80). New York: Guilford. (Reprinted from *Capitalism, Nature, Socialism*, 4 (1993), 65-84.)

Peter, K. & Petryszak, N. (1980). Sociobiology versus biosociology. In A. Montagu (Ed.), Sociobiology examined (pp. 39-81). New York: Oxford University Press.

Quinn, D. (1992) Ishmael. New York: Bantam/Turner.

Quinn, D. (1996). The story of B. New York: Bantam.

Quinn, D. (1997). My Ishmael. New York: Bantam.

Quinn, D. (1999). Beyond civilization: Humanity's next great adventure. New York: Harmony.

Rappaport, Roy A. (2000). Pigs for the ancestors. Prospect Heights, Illinois: Waveland.

Redford, K. (1999). The ecologically noble savage. *Cultural Survival Quarterly*, 15:1, pp. 46-48.

Richerson, P. J. & Boyd, R. (1989). A Darwinian theory for the evolution of symbolic cultural traits. In M. Freilich (Ed.), The relevance of culture. New York: Bergin & Garvey.

Rogers, A.R. (1988, December). Does biology constrain culture? *American Anthropologist*, 90:4, pp. 819-831.

Roscoe, P.B. (1988, March/April). From Big-Men to the state: A processual approach to circumscription theory. *American Behavioral Scientist*, 31:4, 472-483.

Rose, M.R. (1999, December). Can human aging be postponed? *Scientific American*, 281:6, pp. 106-111.

Ruse, M. (1978). Sociobiology: A philosophical analysis. In A.D. Caplan (Ed.), The sociobiology debate: Readings on the ethical and scientific issues concerning sociobiology (pp. 355-375). New York: Harper & Row.

Sagan, C. (1994). Pale blue dot: A vision of the human future in space. New York: Random House.

Sagan, C. & Druyan, A. (1992). Shadows of forgotten ancestors: A search for who we are. New York: Random House.

Santrock, J.W. & Yussen, S.R. (1989). Child development: An introduction. Dubuque: Wm. C. Brown.

Schacht, R.M. (1988, March/April). Circumscription theory: A critical review. *American Behavioral Scientist*, 31:4, 438-448.

Scott, J.C. (1998). Seeing like a state: How certain schemes to improve the human condition have failed. New Haven: Yale University Press.

Service, E.R. (1968, Winter). The prime-mover of cultural evolution. *Southwestern Journal of Anthropology*, 24:4, 396-409.

Silverberg, J. (1980). Sociobiology, the new synthesis? An anthropologist's perspective. In G.W. Barlow & J. Silverberg (Eds.), Sociobiology: Beyond nature/nurture? Reports, definitions and debate (pp. 25-74). Boulder: Westview.

Sociobiology Study Group of Science for the People. (1978). Sociobiology—Another biological determinism. In A.D. Caplan (Ed.), The sociobiology debate: Readings on the ethical and scientific issues concerning sociobiology (pp. 280-290). New York: Harper & Row. (Reprinted from *BioScience*, 26 (1976, March).)

Soper, K. (1996). Greening Prometheus: Marxism and ecology. In T. Benton (Ed.), The greening of Marxism (pp. 81-99). New York: Guilford. (Reprinted from P. Osborne (Ed.), (1991) Socialism and the limits of liberalism.)

Spencer, H. (1967). The evolution of society. R.L. Carneiro (Ed.). Chicago: The University of Chicago Press.

Tainter, J.A. (1988). The collapse of complex societies. New York: Cambridge University Press.

Tenner, E. (1996). Why things bite back: Technology and the revenge of unintended consequences. New York: Alfred A. Knopf.

Trigger, B.G. (1991). Distinguished lecture in archaeology: Constraint and freedom — a new synthesis for archaeological explanation. *American Anthropologist*, 93:3, 551-569.

Tudge, C. (1996). The time before history: 5 million years of human impact. New York: Touchstone.

Tyson, N.D. (2000). On Earth as in the heavens. *Natural History*, 109:9, 90-92.

Vaillancourt, J. (1996). Marxism and ecology: More Benedictine than Franciscan. In T. Benton (Ed.), The greening of Marxism (pp. 50-63). New York: Guilford. (Reprinted from *Capitalism, Nature, Socialism*, 3 (1993), 19-35.)

van den Berghe, P.L. (1982). Bridging the paradigms: Biology and social science. In T.C. Wiegele (Ed.), Biology and the social sciences: An emerging revolution (pp. 13-28). Boulder: Westview. (Reprinted from Gregory, M.S., Silvers, A. & Sutch, D. (Eds.). (1978). Sociobiology and human nature (pp. 33-52). San Francisco: Jossey-Bass.)

Wade, N. (1999, September 19). Why Malthus was mistaken. *New York Times*, p. 5.

Walsh, J. (1998). You can't cheat an honest man: How Ponzi schemes and pyramid frauds work... and why they're more common than ever. Los Angeles: Silver Lake.

Webb, M.C. (1988, March/April). The first states: How — or in what sense — did 'circumscription' circumscribe? *American Behavioral Scientist*, 31:4, 449-458.

Wildavsky, A. (1989). Frames of reference come from cultures: A predictive theory. In M. Freilich (Ed.), The relevance of culture. New York: Bergin & Garvey.

Wilson, E.O. (1975). Sociobiology: The new synthesis. Cambridge, MA: The Belknap Press of Harvard University Press.

Wilson, E.O. (1980). A consideration of the genetic foundation of human social behavior. In G.W.

Barlow & J. Silverberg (Eds.), Sociobiology: Beyond nature/nurture? Reports, definitions and debate (pp. 295-306). Boulder: Westview.

Wilson, E.O. (1982). The concepts of disciplines and antidisciplines. In T.C. Wiegele (Ed.), Biology and the social sciences: An emerging revolution (pp. 29-44). Boulder: Westview. (Reprinted from Biology and the social sciences, *Daedalus* (1977, September), pp. 127-140.)

World Bank (2000). Entering the 21st century: World development report 1999/2000. New York: Oxford University Press.

Worster, D. (1994). Nature's economy: A history of ecological ideas (2nd ed.). New York: Cambridge University Press.

Yoffee, N. (1988). Orienting collapse. In N. Yoffee & G.L. Cowgill, The Collapse of Ancient States and Civilizations. Tucson: The University of Arizona Press.

Yoffee, N. & Cowgill, G.L. (Eds.). (1988). The collapse of ancient states and civilizations. Tucson: The University of Arizona Press.