Ecological Evolution
Tom Lombardo, Ph.D.

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Humanity and the Environment

"The basic understanding that life on this planet constitutes an interconnected system must be considered to be one of the great discoveries of science, perhaps as profound as the discovery of natural selection."

Lee Smolin

"A New Nature, modified by men and women, is coming. It cannot be stopped, nor should it."

Gregg Easterbrook

One area of great concern for the future is our natural environment. I have included a list of websites on this topic in the notes at the end of the chapter.[1] There is great controversy surrounding the topic.[2] Within this chapter I examine the future of the environment and natural resources, along with the rise in ecological science and ecological thinking, and the various debates within this area. This broad topic of discussion continues and further develops themes introduced in the previous chapters on science, technology, and biology, in particular the ideas of evolution and reciprocity.

First, I introduce some of the main controversies associated with ecology, the environment, and natural resources. Next I survey the ecological and environmental movements and the emergence of ecological consciousness in our contemporary world. Then I explain and examine in depth the ecological theory of Gaia[3], and its connection to environmentalist thinking. I also consider the philosophical, social, spiritual, and scientific implications of the theory of

Gaia. Based on various criticisms and qualifications concerning the Gaian theory, I turn to the significance of technology in ecology and environmental management. Next I look at the hotly debated "ecological crisis" presumably facing us in the world today. I explore the issues of overpopulation, waste and pollution, food and water, land and forests, biodiversity and natural resources and consider the different arguments concerning these topics. Finally, I turn again to the general theme of humanity, technology, and nature in light of the ecological and environmental ideas examined in the chapter.

The main theses of this chapter further reinforce the ideas of reciprocity and evolution being developed within this book.

- In the coming century I foresee a collapse of dualistic thinking regarding humanity and nature. An ecological mindset and sense of reciprocity with nature will emerge in its place. Humanity will evolve an ecological consciousness, based on the idea of the reciprocal connectedness of individuals, technology, civilization, and the earth and nature.
- This change in perspective and self-identity will transform human society, economically, politically, and ethically. Ecological concerns and a global mindset of ecological cooperation could help to unite humanity. Based on the new ecological and global mindset, there could be a transformation in the philosophy of individualism, and a move from a more competitive to a more cooperative and collaborative view of self-identity.
- Aside from being pushed in the direction of having to view nature and humanity as an interdependent whole, we will also increasingly view nature as dynamic and evolutionary. We will guide the evolution of ecosystems and create new ones.
- Through the use of ever more sophisticated, ubiquitous, and comprehensive technologies, we will increasingly coordinate and manage the environment within an ecological and evolutionary mindset. Ecology and the environment are going to become more infused with technology.
- There will be continued progress in resource development. The environment, again with the necessary help from technology, will become less polluted and more habitable for both humans and other living species.
- There are numerous challenges and problems concerning the management of the environment, but one thing is certain: nature is not static and our ecological efforts need to focus on constructive evolution rather than unrealistic efforts to conserve or preserve the past.
- Life will spread through the cosmos; the earth, with the involvement of humans, is going to reproduce itself. This monumental development will clearly illustrate both purposive evolution and the fundamental connection between the earth and space.
- Life and nature are far from finished; the best is yet to come.

As I stated above, the future of the environment is a controversial topic. So is the related issue of natural resources. One reason for caution in making predictions about the future in these areas is the great array of conflicting beliefs and conflicting social forces and interest groups. Since the future is to some

significant degree a result of which belief systems, values, and social groups most strongly influence the decisions and actions of humanity as a whole, I see the environment and ecology as areas were there will be great struggle, fluctuation, and uncertainty because of intense ideological conflicts. As a starting point, I introduce below what seem to be the main controversies. These issues highlight many of the important topics in this chapter. They are examined in more detail in the coming sections. One thing though seems clear - the basic facts of our natural world, in particular its reciprocal and evolutionary make-up, will inevitably influence human beliefs and actions in certain directions rather than others. Along the way there could be various forms of resistance and counter-actions to the holistic and dynamic reality of nature.

The main controversies or debates include:

- Should nature be viewed as a stable system or a growing and changing system?[4] Should we attempt to conserve and preserve or evolve nature?[5]
- Is technology, as it pertains to the monitoring and management of the environment, something that is ecologically destructive that should be resisted or is technology overall a positive force?[6]
- Should we adopt a non-intrusive, light-touch approach to nature or should we actively and significantly attempt to control nature? Should we work toward harmony and balance with nature or should we attempt to dominate nature?[7]
- Do we take a position of reverence toward nature, attempting to learn from it, or do we take the position of leadership, seeing ourselves as the source of wisdom and knowledge regarding the future of the earth and the environment?[8]
- Should we adopt a global or a bioregional perspective on the environment and natural resources?[9] Should we emphasize unity and the whole, or should we emphasize diversity and the parts?
- Are resources finite and limited or are resources potentially unlimited, contingent upon advances in technology and human understanding of nature?[10]
- Given the trends and data observed pertaining to the environment and resources, should we be optimistic about the future or pessimistic?[11]
- Should we push for economic growth or environmental sustainability? Are these two options at odds with each other?[12]
- Is a competitive or a cooperative model of life and human society better for the environment and our future?[13]
- Should we adopt a long-term and anticipatory perspective on the future of the environment or should we have realistic faith that as new problems emerge in the environment we will be able to solve them?[14]

Ecological Consciousness

"A human being is part of the whole, called by us 'Universe,' a part limited in time and space. He experiences himself, his thoughts and feelings, as something separated from the rest, a kind of optical delusion of his consciousness. This delusion is a kind of prison for us, restricting us to our personal desires and affection for a few persons nearest to us. Our task must be to free ourselves from this prison by widening our circles of compassion to embrace all living creatures and the whole of nature in its beauty."

Albert Einstein

Rarely do the principles of nature confront humanity so dramatically as in the present controversy over the ecology of the earth and our relationship to it. The science of **ecology** is founded upon the central principle of reciprocity. Living forms and the environment, which includes other living forms as well as inorganic structures and processes, form a web of interdependencies involving a complex system of natural cycles and exchanges. Life and the environment are interactive open systems.[15] The **environmentalist movement**, over the last few decades in particular,[16] has repeatedly pointed out the varied effects humanity is having on the total earth ecosystem, and how such effects are playing back on us. We are being forced to realize that we are part of nature. We have become much more conscious of the earth and both our personal lives and industrial-economic activities are being forced to change. We can no longer bite the hand that feeds us. Our appreciation of nature is coming back after we separated and alienated ourselves in our cities, behind walls, immersed in our machines. In the coming century we must learn how to take better care of the earth, for if we don't, we are not taking care of ourselves.

Many factors have contributed to contemporary ecological thinking and the renewed sense of connection with nature, and many implications and applications - political, economic, and even spiritual - have emerged as a consequence of these ideas. **Environmentalism** and the related Far Green, Deep Ecology, and Return-to-Nature movements have all contributed to the contemporary ecological perspective. Environmentalism, which can be traced back to the work of George Marsh in the mid 19th Century, first helped us to comprehensively see how humans affect the world around them.[17] Modern environmentalism brought a renewed respect and appreciation of nature, though it should be noted that Romanticist philosophy, which emerged in the 19th Century as well, also emphasized the beauty and value of nature.[18] During the 1960's and 1970's, the immensely popular *Whole Earth Catalog* series brought together environmentalist and personal empowerment philosophies and practices, helping many people to understand the science of ecological systems and providing innumerable "tools" for constructively living with nature.[19]

Futurists have also significantly stimulated ecological and environmental thinking. Buckminister Fuller, in particular, greatly inspired contemporary discussion on the "spaceship" earth, its resources, the "synergistic" aspects of natural systems on the earth, and humanity's responsibilities regarding the future of our planet.[20] Although criticized for a variety of reasons, futuristic studies, such as *The Limits to Growth* and *Beyond the Limits*, heightened human awareness on the potential effects of population and industrial growth on the earth's resources and atmosphere.[21] The *Futurist* magazine regularly publishes articles on the environment and ecology, and World Future Society conventions usually have numerous presentations on environmental issues. The World Watch Institute, directed by a number of environmentalists and futurists, publishes both books and reports on the state of the environment and other significant world trends.[22]

Science, technology, and politics have contributed to the growing ecological awareness around the world. Theoretically, the development of open systems thinking provided a scientific model for understanding ecology. The ecological movement and the political and economic drive toward a global society have become mutually reinforcing trends in contemporary times. Both **economic globalization philosophy** and ecology ask people to think about the world as an integrated whole. Maurice Strong points out that back in the 1960's and 1970's, the pictures of the earth from the moon brought into sharp focus the true nature of the earth. Surrounded by the emptiness of cold, dark space, the earth was clearly seen as our common and fragile home.[23] Being able to view the earth from the outside gave us our first compelling images of our holistic ecological reality. Through the development of global satellite monitoring and global communication systems, not only can we get a comprehensive picture of the earth and its complex ecology and meteorology,[24] but we can also collectively dialogue and think at a global level of organization. Technologically empowered, we are learning how to think globally (think about the collective whole) and globally think (think as a collective whole).

Sahtouris argues that ecology has become an increasingly important concern of humanity as various "illnesses" of the earth have become more apparent.[25] Ecological disasters and problems, such as oil spills, deforestation, water pollution, ozone holes, acid rain, and the threatened extinction of different species are a common feature of the news. Recycling and other ecological initiatives, in response to identified environmental problems, have become part of our pop culture. As environmentalists created a "compendium of worries", to use Anderson's phrase, and publicized their concerns, the public became more ecologically conscious. Basically following a common psychological principle of perception, something is not noticed when it is working fine, but if it breaks, it immediately draws our attention. There is a famous saying, "Whoever discovered water, it certainly wasn't a fish". Yet a fish would quite quickly and emphatically notice the lack of water. The connection though between the identification of environmental problems and heightened ecological consciousness is complex.

There have been numerous national and international efforts to raise public and corporate consciousness on ecological and environmental issues. The

countries of the United Nations have agreed to make the environment a necessary concern of all social, economic, and political decisions. Maurice Strong has organized two United Nations conferences on the environment, in Stockholm in 1972 and in Rio de Janeiro in 1992.[26] At the Earth Summit in Rio de Janeiro in 1992, the U.N. Conference on Environment and Development agreed on the most far-reaching and comprehensive plans yet to address ecological concerns around the world.

Yet there are problems and complications regarding such international efforts. In spite of the U.N. resolutions, Strong believes that global environmental problems continue to get worse. He thinks that the public needs to be better educated on the issues. We will need to change social norms in many countries, and international laws will need to be developed to enforce compliance. According to Strong, all sectors of society must become involved if we are to save the earth.[27] However, as I describe in detail later in this chapter, not everyone agrees on the nature and severity of environmental problems. At the Earth Summit, developing nations contended that publicizing and emphasizing supposed environmental problems around the world was a way to divert attention away from the poverty within their nations and prevent them from pursuing necessary industrial and economic growth.[28] Moreover, attempts by modernized countries to control industrial development in underdeveloped countries are a way to maintain economic superiority and an unequal distribution of productivity and wealth. As Centron and Davies note, environmental concerns are a low priority in developing nations.[29] The goals of the Rio conference, Pearson reports, have been difficult to achieve.[30]

Thus, although there is heightened international awareness of ecological and environmental issues, there are many basic areas of dispute. The motives behind raising environmental consciousness are questioned. Are they self-serving and motivated by political and economic power? Further, Anderson states that there is no agreement on what the environmental problems are, or even if there are any significant problems. Environmentalism itself has splintered into numerous conflicting groups with different approaches and values.[31] The “facts” of the environment are interpreted differently, Anderson states, depending on the ideology. Consequently, various governments are not implementing the Rio resolutions. Strong believes, though, that we need to shift within the next thirty years to global cooperation and global initiatives if we are to sustain our environment and our modern society.[32] In a more positive vein, Anderson thinks that the fact that we are at least discussing global environmental issues at a global level is a significant advance over the past.

A heightened state of global awareness and ecological consciousness involves enhanced **holistic thinking**. Nations, business and social organizations, and individuals need to better see and understand their relationship with the whole of humanity as well as the whole of nature. Holistic thinking is seeing the big picture, rather than being concerned with just some limited part of the whole. Holistic thinking assumes that the parts are interconnected rather than separate. As noted above, a central insight of ecological science is that all life forms and their environment are interconnected. Many futurists and other writers believe

that whatever problems we have created in the environment derive from our inability or unwillingness to think and act holistically. Instead, so the argument goes, humans tend to be too self-centered, minimizing or ignoring their relationship to and impact on others and the environment. Though the nature and extent of human effects on the environment are open to debate, it is instructive to describe some holistic perspectives that emphasize the importance of ecological and global thinking.

Mihaly Csikszentmihalyi is a strong advocate for education moving toward an enhanced sense of **ecological consciousness**.[33] He believes that the main goal of education should be to develop an understanding of how all life (and existence) is interdependent. Further, he thinks that there is a powerful motivating factor behind adopting this philosophy in our thinking and education. One goal we can all agree on is the continuation of life on earth. Since the earth fundamentally operates on a complex system of ecological interdependencies for its survival and the survival of all its parts, we will be forced to unite together in our self-interest. (Uniting and cooperating in our own self-interest is a viewpoint also proposed by Sahtouris as a way to solve our environmental challenges, and according to Wright, cooperation motivated by mutual self-interest is a common social behavior prevalent throughout human history.)[34] Csikszentmihalyi believes that the most urgent moral issue today, as in the past, is the more equitable matching of people and resources. Resources are disproportionately concentrated. As he points out, our world presently faces a significant human overpopulation problem (too many people and too few resources), a growing disparity of the rich and the poor, and the continued abuse of the environment. All of these hypothesized problems could be traced to a lack of holistic consciousness and concern for the environment and fellow humans. Consequently, he argues that we need to implement some basic changes in our lifestyle and behavior. Csikszentmihalyi, in fact, thinks that we need some approach to eugenics involving the purposive control of the human population. He realizes that somehow we must balance social harmony and individual rights, the whole and the parts, for human overpopulation is one of the central ecological issues of our times.

As we can see from the above discussion, for Csikszentmihalyi, ecological consciousness involves a change in perception, a change in our way of thinking, and a change in our behavior. These changes need to occur at both an individual level and a collective and international level. He believes that various worldwide problems are motivating us to move in these new directions. The presumed problems, though, are often of our own doing and even if the ecological approach to life may seem to make obvious sense, many futurists argue that various social and political forces will resist changing to this new way of life.

One writer who captures this tension between ecological philosophy and present social institutions and human behavior is Robert Theobald.[35] Theobald thinks that at present there are two extreme views regarding humanity's relationship with the earth. One view is that we can continue our present rate of growth and preserve the environment. (An **economic – technological growth model** of the future.) The opposite view is that we are like a plague on the earth

that in some way will be controlled by the forces of nature. (A **Far Green philosophy** of the future.)[36] Theobald thinks that both views are wrong. Instead he says that humans must learn to be stewards of the earth.

Theobald sees a similarity between his futuristic philosophy of the compassionate era[37] and the hunter-gatherer societies of the past. We need to see ourselves as imbedded in nature. We cannot be like industrial humanity who thought they could overwhelm nature. We must cooperate with the natural forces of the earth lest these forces overpower us.

For Theobald, we must move beyond the American Dream and shift from an economic growth philosophy to an **environmental balance** philosophy. For Theobald his shift seems to mean moving from a growth model to a stability model of ecology. This particular philosophical clash regarding our ecology is one expression of the general conflict between dynamic and static views of the future,[38] and this is where a great deal of the tension lies in contemporary debates over the environment and ecology.

In examining Theobald's ideas, it is clear that he believes that ecological issues are clearly connected to economic issues. Theobald notes that excessive human waste has become a critical problem in contemporary times, in part because of the economic practice of accelerated obsolescence. Within modernized countries there is an accelerated rate of technological change coupled with an economic growth philosophy of production and consumption. We keep buying new versions of products and throwing away styles and models that are only a year or two old. In order to drive the growth of our modern economy, we are filling the world with our garbage. From Theobald's point of view, our economic self-centeredness creates holistic and ecological deterioration.

Theobald argues that we need to cultivate a philosophy of enoughness. We need to eliminate, or at least subdue, this desire to keep moving forward with something more. As Theobald puts it, we must work against the cultivation and expansion of needs. He thinks that the philosophy of excessive consumerism is the antithesis of peace and freedom, for we are never satisfied as obsessive consumers. Instead, we must achieve a balance between excess and scarcity. This new philosophy would be good for both Third World countries and modernized nations. The former countries have too little and the modern nations have too much.

Aside from the economic implications of ecological consciousness brought out by Theobald, we should see that he connects ecological consciousness to a philosophy and psychology of balance. In his mind, we have lost our sense of harmony both within ourselves and in our relationship with nature. Ecological thinking will bring back a sense of balance. It should also be noted that he connects ecological consciousness with stability, for according to him our drive for growth and wealth is self-centered. Yet, from the last chapter, it seems questionable whether our natural ecology is either completely balanced or stable. As Easterbrook states, the term "balance" in environmental and ecological science is usually associated with stasis and equilibrium, but ecologists have increasingly forsaken such thinking in favor of a more dynamic view of nature.[39]

One can have a holistic perspective and a sense of connectedness without necessarily supporting either stability or balance in nature.

The **Integral Culture** movement, as a philosophy and vision of the future, is associated with a variety of holistic and futurist thinkers including Barbara Marx Hubbard, Duane Elgin, Fritjof Capra, Hazel Henderson, Riane Eisler, and even Teilhard de Chardin.[40] A concise statement of the philosophy of Integral Culture can be found at the *Foundation for Global Community* web site.[41] The central theme of the Integral Culture philosophy is connectedness. Its supporters promote a holistic perspective regarding humanity's relationship with nature, with each other, and with the cosmos. In essence, they see all of nature, humanity, and the cosmos within an ecological framework. They contrast their perspective with the excessive individualism of the modern West, arguing that many of the pressing problems of today, which include environmental ones, are due to the self-centered quality of human consciousness and behavior. But what is noteworthy, in light of our present discussion, is that the Integral Culture philosophy is also evolutionary. Humanity, though connected with nature, is viewed as part of a growing and changing reality, rather than a stable reality. To recall, a main concluding argument of the last chapter, the reciprocal connectedness of all of life makes life dynamic and changing rather than static.

Elisabet Sahtouris also addresses the issues of **balance** and **egocentrism** in her discussion of ecology and environmental problems.[42] According to Sahtouris, humanity as a species is still in a state of adolescence. We are egotistical, filled with anxiety, and immature. We do not yet see that we are part of a greater whole. We have yet to achieve a "balanced dance" with our planet. We take from each other, leading to inequality, consume too much, biting the hand that feeds us, and in the process damage our world. Consequently, we are not healthy as a species and we are making our planet unhealthy as well. Although Sahtouris is highly critical of the dominance of nature philosophy of the Industrial Age and instead advocates a philosophy of balance and harmony with nature, she does see humans as having a special role to play in the ecology of the earth. With our present scientific understanding of nature and our capacity to learn even more about the dynamics of our planet, we can with wisdom and knowledge guide the future evolution of life. Even if we need to live in harmony with nature, only humans possess an abstract and theoretical understanding of life and nature. It is up to humans to grasp the whole; it is the human mind that will understand the harmony. Sahtouris also thinks that science should have an ethical dimension based on guidance from nature. Yet even if nature provides guidance in formulating an ethics of how to relate to nature, it is humans who will create the ethics and attempt to carry it out. In the hoped for harmony of humans and nature, humans will inevitably take a leadership position. Further, when Sahtouris speaks of balance, she does not discount the importance of self-interest; rather she includes it as part of the balance of nature. Self-interest becomes bad only when it is not balanced by the needs of the whole. Finally, balance does not imply stasis. Sahtouris is an evolutionist, and to recall from the last chapter, she connects evolution with an ongoing dialectic of the whole and the parts.[43]

In contrast, Michael Zey is quite openly critical of both the balance theory and the holistic perspective of humanity and nature.[44] In his mind, humanity should take the lead in determining the future evolution of our planet; individuals should not relinquish control and direction to the whole. Even if our attempt to dominate nature, without regard for the ecological consequences of our actions, is egocentric and destructive, can we realistically abandon all control and direction? Zey's argument though on individuals maintaining a leadership position over "holistic determinism" perhaps goes too far.

Sahtouris strongly supports the need for balance between the whole and the parts and between humanity and nature, yet she still sees a special role for humanity in the ecology of the earth. Acknowledging the interconnectedness of nature is not contradictory with taking a leadership role in the future direction of nature. The principle of reciprocity in fact would imply that individuals and collectives are equally essential in determining the direction of nature. We may all be connected, but that does not imply the loss of individuality. Also individuals can see how they are connected to the whole and the ways in which their actions would affect the whole; it is only egocentric individuals that do not see these connections.

Oliver Markley is one futurist who clearly sees the broad connections between the philosophical, psychological, and practical aspects of ecological consciousness. In his article "Global Consciousness", Markley defines what he sees as the central evolutionary trap of humanity.[45] If a life form dominates its ecology and out of greed and egocentrism continues to amplify its individual expression, it will eventually defile its environment and perhaps destroy itself. Markley attributes this idea to the ecological psychologist Gregory Bateson and the great visionary science fiction writer Olaf Stapledon.[46] Markley further notes that the contemporary idea of global consciousness can also be found in the writings of Stapledon. According to Markley, Stapledon articulated two related meanings in his concept of **global consciousness**.

The first meaning is an awareness of our whole planetary system as an integrated whole. As I have described, this perspective is fundamental to ecological thinking; it is to see the planet holistically; it is to see the interconnectedness of nature. Stapledon also includes in his definition of global consciousness the idea of the expansion of consciousness beyond an egocentric sense of self. Each individual mind across the globe becomes aware of other minds and is integrated into a greater holistic consciousness. Basically, these two meanings are equivalent to the related ideas of **thinking globally** (to think about global issues) and **globally thinking** (to think collaboratively as an integrated human system). The second meaning is clearly connected to Chardin's idea of an emerging integrated noosphere, as well as the concept of a World or Global Mind.[47] Criticisms of humanity's egocentric and individualistic mindset highlight deficiencies in both types of ecological consciousness. From an egocentric perspective, we do not see the whole and how we are connected to it; we tend to emphasize our own individual needs and ideas and cannot think or work collaboratively. Following Peter Russell's ideas in *The Global Brain Awakens*,[48] Markley advocates a **Fourth Wave** of human civilization involving the

evolution of a global consciousness and a movement away from ecological overload. In Markley's mind, we have created our present ecological problems by not operating at a global level. I would add that ecological consciousness is seeing the whole by becoming more of a whole, exchanging our ideas and working collaboratively, as opposed to a set of separate and often antagonistic parts. In many people's mind as we move toward this integrative state and perception, we will be able to address the ecological concerns and environmental problems of our times. From the above discussion on individualism, balance, and holism, achieving a more collectively integrated and holistic perception negates neither our individuality nor our leadership in ecological evolution.

Gaian Philosophy and Science and Ecological Evolution

"Our biggest job is to change our whole way of thinking to a larger perspective, to recognize ourselves as a body of humanity embedded in, and with much to learn from, our living parent planet, which is all we have to sustain us."

Elisabet Sahtouris

One idea that has become a cornerstone and central point of inspiration for many scientists and futurists in their ecological thinking is James Lovelock's theory of **Gaia**.[49] The theory of Gaia is relatively simple to understand. The earth is a living organism. Life and non-life on the earth form a reciprocity; the earth self-regulates its various ecological states; and the earth, as a whole, exhibits an evolutionary history. The term "Gaia" was an early name for the earth.[50] Lovelock adopted the name from Greek mythology where Gaia referred to the earth goddess, literally "Mother Earth". Within Greek mythology, the dance of Gaia with Ouranos, the male sky god, led to their fertile union that brought forth life on earth.

Within the theory of Gaia, Lovelock attempted to demonstrate that the vast array of living forms and the physical environment are interactive. Not only has life adapted and evolved to meet the changing conditions of the physical environment but also the physical environment has been structured and significantly altered by life to support the activities of life. One striking example of this phenomenon is that our atmosphere is a creation of life.[51] Lovelock even suggests that the continents have been moved about, at least in part, due to the presence of life. In general, the distinction between life and non-life is relative and life actively molds non-life as much as, if not more than, the reverse.[52] Sahtouris, a strong supporter of the theory of Gaia, proposes that the integration

of life with the earth is so pervasive and deep that it is more accurate to say that the earth is living planet, rather than just a planet with life.[53]

This **ecological reciprocity** of **life** and the **environment** envisioned in the theory of Gaia runs counter to both the dualist philosophy and absolute individualism of Western thought. Life is not a separate reality from the physical world and though living forms, as I discussed in the previous chapter, possess a degree of distinctiveness, all life is intertwined as a web.[54] As I pointed out in the previous chapter, when I first introduced the idea that life and the physical environment form an interactive reciprocity, the simple Darwinian idea that evolution involves life adapting to an environment is one-sided and incomplete. Sahtouris also contends that the theory of Gaia conflicts with the mechanistic view of nature. As she recounts, prior to the rise of the machine model of the universe, all of nature was seen as alive and possessing intelligence. Nature was inspirited and animated. This "**organic philosophy**" of the physical world was non-dualistic for matter possessed intelligence and spirit, but it was rejected by modern dualist science, which separated the world of spirit from the world of matter.[55] According to Sahtouris, the theory of Gaia re-asserts the inherent intelligence within nature. The earth, as ancients believed, is a creative, living being and not an inert lump of matter.

For Lovelock, the interactive system of life and the physical environment behave like a single self-regulating relatively **homeostatic** organism. Various populations of living forms, spread over the entire surface of the earth, collectively maintain the chemical, atmospheric, and geological conditions on the earth by modifying their effects on the system. If changes occur in the physical conditions of the earth, various living populations alter their behavior to bring the conditions back to the previous states. Just as the human body maintains a relatively stable state through the cooperative and coordinated efforts of its subsystems, the earth maintains a relatively stable state hospitable to life through the effects of life itself. The earth behaves like an integrated system that is being controlled through the collective activities of living forms. Gaia is a holistic system that seems to possess a **global metabolism** where energy and materials flow along various pathways and cycles of exchange.[56] Various science writers, such as Smolin and Capra, describe the Gaian system as a self-organizational system.[57] Sahtouris states that Gaia is autopoietic, being both self-producing and self-maintaining.[58] Similar to other living forms, Lovelock has also emphasized that the earth maintains an enhanced state of disequilibrium relative to its surround. The surrounding environment for the earth is space and the solar system. The presence of life significantly shifts the conditions of the earth away from what would be predicted purely based on the physical forces surrounding it, using the flow of energy from the sun to self-integrate and distinguish itself from its surround. As Sahtouris puts it, the earth is a living creature skilled at handling the sun.

Lovelock traces the history of Gaia through a series of epochal stages of evolution up to the present.[59] Although self-regulating, Gaia is an evolutionary system, having passed through a series of crises and stages in its three to four billion year history.[60] As one of many examples, approximately two billion years

ago primitive photosynthetic bacteria began to generate, as their collective waste product, a huge amount of oxygen that was released into the atmosphere. This increasing concentration of oxygen was highly destructive to a variety of living forms on the earth and was one of the first great cases of global pollution and significant species extinction. Out of this ecological catastrophe emerged bacteria that utilized and required oxygen for their livelihood, who were quite literally our ancestors. The Gaian system evolved an oxygen-driven biological subsystem interwoven into the earlier photosynthetic system.[61] Hence, it is important to keep in mind that although Gaia is a self-maintaining system, it can become significantly unsettled, even by its own internal activities. In fact, recall the discussion in the last chapter regarding how adaptive processes in one living form can instigate adaptive processes in other living forms. The history of Gaia has included a series of adaptive evolutions that trigger off further evolutions. As a consequence of such interaction effects and ecological disruptions evolutionary transformation occurs. As Sahtouris states, the earth, like all living forms, has both anabolic and catabolic features, and out of death and degradation, for example during mass extinctions, comes great bursts of new creation. The interplay of order and chaos within evolution occurs at the level of Gaia.

Hence, although many environmentalists romanticize nature as an idyllic and harmonious reality,[62] Gaia is not an absolutely stable system; it balances and re-balances. Easterbrook describes our natural ecology as an "**action packed balance**", where balance is perpetually sought but never achieved for very long. Although Sahtouris, as well as other science writers, highlight the supposed "balance" within nature, at best Gaia is a system that is perpetually re-balancing itself into new configurations. Constant equilibrium in life equals death. Gaia, to some degree, is always in flux, with its component ecosystems growing, shifting, and disappearing.

This process of evolutionary flux is a good example of how the multiplicity of individual systems within a whole exerts a powerful influence on the whole. The multiplicity of parts does not simply conform to the whole; they keep remolding the whole. And yet of course, the multiplicity of life forms depends upon the whole of Gaia for their existence. What we see throughout the history of Gaia is a dynamic reciprocity of the whole and the parts.

As noted above, there are some important evolutionary and philosophical implications regarding the theory of Gaia. Living forms can be viewed as in a state of competition with each other over the resources of the environment - the "**survival of the fittest**" theme. Nineteenth Century social and economic thought took the evolutionary idea of survival of the fittest as a scientific and naturalistic justification for the value of competition.[63] Social and economic organizations, as well as individuals, were seen as participating and evolving in competitive interactions. This competitive social philosophy was taken as a simple expression of a principle of nature, the "law of the jungle", where everybody was out for himself at the expense of others. Such a philosophy viewed life as a "win-lose" scenario.[64]

Yet the theory of Gaia emphasizes cooperation in nature. The various species populations around the earth appear to work together to create a

mutually beneficial habitat for all of life. As Margulis has argued, species co-evolve together in interdependency and mutual support.[65] Gregg Easterbrook, in his monumental work on ecology and the environment *A Moment on the Earth: The Coming Age of Environmental Optimism*, also underscores the preponderantly cooperative dimension of nature.[66] As I discussed in the previous chapter, life is a holistic web (or network) of symbiotic and parasitical relationships. Gaia works as a dynamic, evolving whole, rather than a set of independent, competing parts. Computer simulations of artificial life further bear this out; the most successful "life forms" develop interdependencies with other "life forms." They do not succeed by wiping out other members in their simulated ecosystems.[67] To some significant degree, life works and life evolves through "win-win" relationships rather than "win-lose" interactions. The members of Gaia have evolved by meeting each other's needs, as well as their own.

As I stated in the last chapter, the traditional competitive model of life is too one-sided and needs to be balanced by an equally important cooperative vision of the nature of life. Sahtouris has described the evolution of life as an ongoing rhythm or oscillation of individuation and integration of the parts that eventually leads to an ecological crisis that in turn leads to a creative cooperative synthesis. As described above, the evolutionary history of Gaia seems to show an ongoing process of disruption and re-balancing that lead to further disruptions and re-balancings. The whole and the parts interact. The evolutionary dynamics of Gaia clearly involve elements of conflict and competition, of parts asserting themselves in disregard of the whole, but what has emerged over time is an intricately structured cooperative network that competitive theories of life have slighted or ignored in their descriptions of life.

The Western philosophies of dualism and individualism have created absolute boundaries and separations within reality. Dualism separates humanity from nature and individualism separates each of us from the other. Traditional **Western philosophical individualism** states that each human being is fundamentally a separate, self-determined, and self-sufficient entity. Dualism elevates humanity, a mental and spiritual being, above physical nature and the environment of matter. The theory of Gaia breaks down the dichotomies and distinctions of dualism and individualism because the theory is based on the idea of the ecological reciprocity of all of life and the earth.

From the theoretical perspective of Gaia, humanity becomes part of a greater whole. In an important sense, we are participants within the global metabolism of the earth. The theory of Gaia provides a mental framework for our sense of global consciousness, of seeing the whole and seeing our place within it. Perhaps we are a unique and important living form within this whole; we may be the means by which Gaia is becoming self-conscious. Only humans, among all living inhabitants of Gaia, seem to possess a theoretical and abstract knowledge of the holistic workings of the earth. Yet, no longer can we see ourselves standing on top of nature. We can no longer see ourselves as the supreme creation. As Sahtouris and other advocates of the Gaian theory state, there is something much older, much bigger, and much more complex than humanity - Gaia, our womb, home, and mother.[68]

From a Gaian perspective, our relationship to our environment must be redefined. We neither adapt and conform to our world, nor do we subjugate and dominate it to our ends. This is "either-or" thinking; it is a "win-lose" mental set of the whole and the parts. Life and the physical environment have co-evolved in interaction and therefore mutually support each other. The whole and the parts have co-evolved and mutually support each other. Our relationship with our environment and other living forms must involve some level of understanding of how we affect the whole and some level of cooperation with the rest of life, even if we assume a position of leadership.

The Gaian perspective seems to clash head-on with the Western ideals of autonomy and conquest. In particular, our philosophy of individualism rests upon the concept of independence, if not competition. In contemporary times a dialectic has emerged between the trends of greater individuality and freedom, and an equally powerful trend toward communion, belongingness, and social-global responsibility. The theory of Gaia though, would imply that individuals only thrive in a context of cooperation and holistic support. Within the new century, our growing sense of individuality needs to be defined in a different manner than in terms of the past traditions of independence and competition. What we need is a theory of **collaborative** and **cooperative individualism.** If the history of Gaia tells us anything, it is that our survival will depend upon it.

The theory of Gaia has been a controversial idea since it was first proposed. It runs counter to modern Western views of life. How can a whole planet be considered a living organism? Yet, to recall from the last chapter, our view of life may be too limited in various ways. Perhaps, in the case of Gaia, we do not see the forest for the trees.

Dawkins is critical of the Gaian theory because he doesn't see where there is any process of natural selection involved in its evolution. There is only one hypothetical organism in this solar ecosystem.[69] Yet natural selection probably does go on regarding the compatibility of the parts of Gaia,[70] and even so, it is not clear that natural selection should be a defining criterion of life. Dawkins also asks where the genetic code exists for Gaia. Doesn't life require, as many would argue, an information storage or memory system for directing its operations?[71] To this criticism, one could respond that the total collection of genetic codes for all life on earth constitutes the genetic code for Gaia. One could also point out that the population of bacteria, which forms the foundation of all life on earth, possesses a genetic pool that is shared and exchanged among all its members.[72] One could argue that bacteria, though a collection of discrete living forms, is actually a single living organism spread across and infused into the earth and into all of us.

Margulis, who has been one of the strongest supporters for Lovelock's ideas, is still hesitant to refer to the earth as a living organism, since no other organism eats its own waste.[73] Yet it is clear that life as a whole is an intricate anabolic and catabolic system, generating waste and chaos, which in turn become the raw material and fuel for the construction of new complexity and order.

Depending upon one's definition of life, it could be argued that Gaia isn't a living organism because it doesn't reproduce. Yet Sahtouris, using the concept of autopoiesis as the defining criterion of life and Smolin invoking similar self-organizational principles, both believe that reproduction is not a necessary condition for something to be alive. In fact, to recall Maddox's point, there does not seem to be any clear way to distinguish life unequivocally from non-life.[74] Are viruses alive? They possess DNA but cannot reproduce by themselves; they require a host. To some degree, life is ambiguous. And still, it could be argued that the collective ongoing reproduction of life on earth constitutes the reproductive dimension of Gaia. Finally, Gaia may still be evolving the capacity for reproduction. Perhaps humans, in the creation of biospheres that will be constructed on other worlds or sent into space in huge interstellar ships, are the means for the reproduction of Gaia throughout the heavens.[75]

Daniel Dennett is critical of taking the presumed scientific implications of the Gaia theory that life is fundamentally cooperative and turning this "scientific principle" into a political philosophy.[76] In essence, this application of the theory of Gaia to social thinking is analogous to the use of the competitive model of evolution to support social competition in the 19th Century. Since a social philosophy of cooperation has a positive emotional appeal to many contemporary thinkers, as competition did in earlier times, it helps to vindicate the social cause by arguing that the philosophy is grounded in science. Yet, the scientific theory may in fact too easily be accepted if it supports our emotional sensibilities. The challenge though is that humans have repeatedly used scientific ideas to support their social, political, and economic ideologies and philosophies. When Sahtouris states that an understanding of the workings of Gaia should guide us in the evolution of our ethics she is using a scientific idea to support an ideology. When philosophers of the Enlightenment invoked Newton's vision of a harmonious machine to support their ideas of modern human society, they were doing the same thing. As Anderson points out in his discussion of ecology and the environment, there is a clear connection between the facts that get selected and emphasized and the ideologies (value systems) that are assumed.[77] Facts and values are not totally independent realities, but it does make sense to consider what the facts are, as best as we can, in formulating value systems and social philosophies.

As I noted earlier, Michael Zey objects to the holistic and balance viewpoints of humanity and nature, and he connects both these viewpoints to the theory of Gaia.[78] Zey, to recall, is pro-growth and development in his philosophy of the future and sees Gaian theory,[79] because of its association with the value of balance, as leading to a static view of the future. Although there were internal political conflicts at the Rio Earth Summit and its resolutions have been difficult to carry out in practice, Zey reports that the overall emphasis changed from pro-development at previous conferences to environmental sustainability. He believes this shift of emphasis was due to the increasing influence of Gaian theory, and he thinks this change in approach won't work. If one detects a sense of reverence toward the earth in Sahtouris and other advocates of the Gaian theory, Zey clearly wishes to turn the tables around, and put humanity in the

position of central importance. We shouldn't serve Gaia, as he puts it, but rather introduce something new of our own creation into nature. Further, the parts, in these case individual human beings, should not serve the whole, but rather take the lead in directing the whole. Zey's position clearly is more on the side of the distinctiveness of humans above nature and the importance of individualism over holism.

Although both of Zey's points have a degree of validity, I think that they need to be balanced and integrated with the opposing ideas of interconnectedness among the parts and the reciprocity of the whole and the parts. I think that evolution is progressive and humans represent a distinctive advance within the ongoing history of life and the cosmos; we are unique, though humanity is probably by no means the end of the story. Even a theorist like Sahtouris acknowledges the special nature of humans in the web of life. Yet our roots sink into nature and the physical world; we are clearly not absolutely distinct from nature, as dualist philosophy would imply. Second, although individualism and holism are often seen at odds with each other, the whole and the parts form a dynamic reciprocity. Individuals may lead, as well as upset the whole, but individuals require the whole for their continued existence. Excessive individualism is egocentric and ultimately self-destructive.

Gregg Easterbrook suggests a thought-provoking way to view the connection between nature and humanity. He points out that life on earth, previous to the evolution of humans, possessed various limitations in its capacity to survive and evolve, among them being a reliance upon "spontaneous ordering" through natural selection and genetic evolution as a mechanism for storing information. The emergence of humans in the scheme of life provides capacities for purposive ordering of nature and the storage of information and knowledge in cultural records. He states that a factual reading of the history of life on earth seems to indicate that nature has been working toward the transcendence of its ordering and information storage limitations. Our unique mental capacities are a product of nature's overall evolutionary direction. We are the means by which nature is transcending its past limitations. According to Easterbrook, "nature needs us." Hence, we may be unique but that uniqueness is a creation of nature and will serve an essential function in the future evolution of nature.[80] We may be in a position of leadership, but we have been created by the whole to lead it. Easterbrook's view is very similar to the idea that humanity is the means by which Gaia is becoming self-conscious.

Reciprocity and evolution are the two central principles within the theory of Gaia. If we apply these principles to our understanding of the environment and our ecology, certain implications follow. As both Stock and Kelly point out, there is no natural and eternal wilderness.[81] What is natural is for our environment to change. Attempts to preserve our "natural environment" really run against the grain of nature. Such efforts are actually attempts to preserve or recreate some period of the past.[82] Humans might be able to achieve pockets of "ecological memories" for future generations, but this would be an evolutionary advance over previous history. Nature has been more ruthless; there are no local sanctuaries preserving and protecting populations of dinosaurs, trilobites, or Neanderthals.

Although environmentalism has helped humans to see how their actions affect the world around them, according to Anderson, the philosophy and ideology of environmentalism is flawed.[83] In particular, there is a growing separation between radical environmentalists and professional scientists and ecologists in how they view nature. **Radical environmentalists** support a "**steady state**" theory of nature, whereas scientific ecology sees nature and life as evolutionary. Anderson discusses various "**ecological restoration**" efforts, as ways to preserve our environment, but since nature is dynamic and consequently possesses a history, which period or phase should be restored? As Easterbrook states there is "no fixed correct environment".[84] And even assuming an ecosystem is restored to some previous point in its history, the system won't naturally remain in that state; it will begin, quite naturally, to change. Attempts to preserve or restore an ecosystem are "unnatural" and require continued effort. As Moore and Simon point out, public opinion on the environment contradicts objective reality.[85] Public opinion has been especially influenced by environmentalist calls to preserve our natural wilderness and not to upset the balance of nature. Yet, the history of Gaia has demonstrated that there is an ongoing cycle of balance, imbalance, and re-balancing, of periods of relative stability and change; nature keeps moving, yet many environmentalists want to try to keep it the same, or in fact, actually return it to some relatively arbitrary point in the past.

The issue of stability versus change in contemporary ecological and environmental thinking comes to the forefront in the growing battle between biotechnology and conservationism. How will the introduction of new living forms affect the present ecosystems of the earth? Conservationism would emphasize caution and restraint in ecological development and the introduction of new species of life.[86] It is important to keep such values in mind. We should thoughtfully consider the possible consequences of new life forms. But it should also be kept in mind that the earth is a growing, dynamic reality, having seen the emergence of millions of new species across its total life span and the extinction of just as many others. Nature, according to Easterbrook, "enjoys" the fostering of life, and if we contribute to this continued proliferation, we are serving this creative end.[87]

As I discussed in the previous chapter, resistance to biotechnology is connected to a rejection, implicit or explicit, of the evolutionary theory of life. The argument against biotechnology is also based on the idea that humans shouldn't tamper with the natural order of things. Yet, life is dynamic and changing, and it changes to a great degree because life is incessantly influencing life. If we are part of nature and nature is evolutionary and interactive, then attempting to influence and direct the evolution of life is not an unnatural process. It is what nature does to itself. If we are creations of nature, then it is absurd to think that humans by their very presence and modes of activity are bad for nature.[88] The choice is not whether we should move into this arena of action, but whether we should do it intelligently or stupidly. As I argued in the last chapter, applying conscious thought and purpose, scientific information, and ethical reasoning to evolution is a significant advance on the evolutionary process. As Easterbrook

suggests, humans represent an evolutionary development within the context of nature; we are empowering nature or nature empowered.[89]

Thus we come to a second fundamental problem with radical environmentalism: radical environmentalism, such as the "**Deep Ecology**" movement, argues that humans should be as unobtrusive within nature as possible, and not tamper with the "**natural order**" of things.[90] Yet life is built on the interaction of living forms, and it is impossible not to impact the world around us. Ecology is reciprocities. Stock and Kelly's point that there is no natural and eternal wilderness also means that humans have affected all of nature by their presence. As Anderson reports, Deep Ecology is a "Not do philosophy" arguing that humans should "live lightly on the planet", yet this attitude and approach is next to impossible to carry out in practice and probably undesirable. First, consider the idea of attempting to preserve or restore a "natural" ecosystem or wilderness. How is this done? Doing nothing or treading lightly won't work. Rather, humans will have to make a great deal of effort to recreate and protect areas of wilderness. Science, technology, politics, aesthetics, and ongoing active monitoring and management will be required to create and maintain the ecosystem. Creating, maintaining, or protecting a "wilderness" is highly intrusive. And it isn't simply that tourists, campers, industrialists, and developers would unsettle and spoil the ecosystem, but other outside life forms in various ways would impact the system, and even those species indigenous to the ecosystem would begin to transform it by their own interactions and evolutionary directions. Anderson states that the expression "**environmental restoration**" is perhaps inappropriate since we do not simply restore an ecosystem and leave it alone, assuming that it just will maintain its restored state if we don't tamper with it. It won't. Anderson suggests better expressions would be "**eco-construction**" or "**adaptive management**" which accurately highlight the active and creative nature of the process.[91] Anderson also reports the ongoing efforts and discussions over what would be the most "natural" way to manage an ecosystem, but whatever methods we select, we are once again definitely doing something, and it will require a great deal of intellectual and technological effort to implement the most "natural" methods.

In general, all wild life around the world is already subject to human decision-making. Humans play a major role in the management of "natural" systems and our influence will probably grow rather than diminish. Pearson predicts significant growth in environmental monitoring within the next twenty years on top of what we are already doing.[92] Further, humans don't just influence by attempting to protect or preserve; humans create new ecological systems. As one important manifestation of the blurring of the distinction between the "born" and the "made", the boundary between natural and human systems is disappearing.[93] We are deeply into the business of ecological management, and it would be nonsensical and counter-productive to ignore or oppose our ubiquitous involvement in the ecology of the earth. If we ask if we should be so deeply involved in managing the environment, we need to keep in mind that we cannot avoid influencing the environment. Second, if we cannot avoid affecting our environment, then shouldn't we do the best we can at managing and

directing our ecology? Of course, this means "learning from Gaia" as Sahtouris would argue, but this is science and the application of science is technology and human action. Further, we are unique, as Sahtouris agrees, in that we possess an ever-growing theoretical and global understanding of the environment and ecology. Among all living species on the earth, we have the best understanding of the total picture and the greatest technological power to manage nature. And again, nature is not going to stand still regardless, so wouldn't it make sense to guide its further evolution, using our knowledge and technology?

Steve Lerner reports that a new phase in the environmental movement. Instead of making "doom and gloom" predictions of how we are unsettling or destroying the environment, these new "**eco-pioneers**" are attempting to design and create "natural" systems that are energy efficient and produce less pollution. They are attempting to be more constructive and optimistic in their approach to the environment. "**Living machines**" are being developed that consume waste and overall have a more beneficial effect on the environment. Such eco-pioneers are exploring ways to make our techno-ecological systems more sustainable.[94] But I should note that such efforts are clearly not examples of "doing nothing", and further, although life forms are being used in the construction of these natural systems, something new is being created that wasn't there before. Humans will need to monitor and manage such systems as well. Finally, putting two and two together, we should expect that with ongoing advances in biotechnology, we will be creating numerous "living machines" involving genetically engineered life forms that will perform various beneficial ecological functions. The natural and the artificial will continue to blur because life is interactive, for what we call the artificial are simply the creations of our interactions with the rest of nature.

A third problem with radical environmentalism, its bioregional and local approach to ecology, is also reflective of a lack of understanding of ecological reciprocity and the organization of Gaia. **Bioregionalism** argues that people should live in local regions, preferably those indigenous to the region, and focus on cultivating their unique local ecology and agriculture.[95] Bioregionalism is against big governmental, international, or corporate organizations coming into a local region and altering the local ecology and agriculture to serve some more geographically expansive plan and operation. Yet as Anderson notes, indigenous or local populations have a history of upsetting or destroying their local ecologies; they are not necessarily more ecologically wise. But, more to the point, Gaia is an interconnected and global system, and any local effort needs to be placed within the context of the whole Gaian ecology. The static view of the creation of nature describes each species as a distinct reality, but species and ecosystems are dynamically interconnected. What happens in one local region affects other regions. Smaller ecosystems are parts of bigger ecosystems. It would be tantamount to saying, "I am going to do my own thing and how it fits into society is irrelevant." If we are going to manage our ecology, we need to manage it as a global reality, and not a set of independent local systems.

One popular movement to come out of environmentalist and ecological thinking is the **recycling** initiative. Increasingly, at least in some countries,

humans are turning toward recycling wastes instead of dumping them indiscriminately into the environment.[96] Recycling though is not a way to reduce our impact on the natural environment; rather it is a way to increase our control over the environment. Individual ecosystems recycle and Gaia, as a whole, recycles; causality runs in circles where the waste and output of one species is the resource and input of another life form. The whole Gaian system is a network of mutual exchanges. The anabolic and catabolic processes of nature loop around on each other, where the expelled chaos of one system becomes the material and energetic source for the creation of order in another system. Since Gaia is a recycling system, what we dump into the environment comes back at us, as well as being distributed through countless other living forms. What we are moving toward doing now is controlled and purposive recycling. What goes around comes around, so we might as well make it come around to an appropriate place in an appropriate form. Recall the discussion on industrial ecology.[97] With the introduction of biological systems as well, either selected from presently existing life forms or created through genetic engineering, we are increasingly orchestrating the cycles of nature and redesigning and evolving the flow of materials and energy through the anabolic and catabolic processes of the earth. Recycling is therefore not really a way to curtail our impact on the environment; rather it is a way to control the ecology even more so.

Fundamentally, radical environmentalism is dualistic and anti-evolutionary. It sees species and ecosystems as static and non-interactive, when in fact life is both evolutionary and highly interactive. It is a common belief that humanity is destroying the “natural environment”, but this belief reflects dualist thinking. Are we not part of nature, as both the theory of evolution and the theory of Gaia imply? Rather, we are becoming a much more significant presence within Gaian ecology and having a greater impact upon it. It is natural for Gaia to transform; at this point in time, we seem to be significantly participating in this process of change; in fact, we seem to be accelerating the process. As noted earlier, our spreading presence over the globe may be the main cause of the contemporary mass extinction. But this ecological transformation may lead to a whole new proliferation of species.[98] Clearly, we are redesigning the cycles and ecosystems of nature. If we are part of Gaia, might it then be possible that we are also agents in Gaia's process of self-renewal and further evolution?

We cannot take a stand of passivity, irresponsibility, or disregard concerning our relationship to nature; we would be oblivious to the ecological facts. Ecology is reciprocities and we are inextricably entwined into these reciprocities. Further, we are an ever-growing presence in the process of ecological change, whether we like it or not. When we act, we can have either positive or negative effects on our world. Most of the negative changes we have produced in the environment are due to a lack of understanding or disregard of our reciprocal relationship with our world. Often, out of greed and egocentric thinking, we have been indifferent or callous to the effects of our actions. It is not so much our presence that causes environmental problems, but the types of actions that cause the problems. But the solution to the health of the environment is to understand our ecology better and to act on this understanding.

Because of our growing scientific knowledge of ecology and our increasing impact upon nature, we incur a greater responsibility in guiding the process of Gaian evolution. Because of the unique position of humans in the Gaian system, our involvement in nature should grow. Helping to take care of the earth doesn't mean trying to freeze it; it can't be frozen. Nor does it mean leaving nature alone; this is impossible. We need to utilize the knowledge we have gained regarding the interconnectedness and dynamic pattern of nature and apply this understanding to the management and evolution of our ecology. No other species possesses this knowledge and the power to constructively use it. We need to develop an ecological ethics consistent with our scientific understanding and keep in mind both our unique position of responsibility as well as the evolutionary nature of our own knowledge and efforts. There is more to learn; there is more to do.

Radical environmentalism is often connected with a "**doom and gloom**" view of our ecological future.[99] In particular, the Western philosophy of secular progress and the consequent growth of industry, technology, and the economy are seen as the primary causes of our deteriorating environment. Hence, there is a negative connection drawn between a philosophy of material growth and the quality of our environment and human life. Yet is pessimism about growth and a call to return to a simpler lifestyle a realistic or helpful attitude? Shouldn't we approach our relationship with the environment in a more constructive and optimistic fashion? Easterbrook argues that a correct reading of the history of life, including our present situation, supports an optimistic attitude about the future of life. Further, an optimistic attitude will be politically more effective, since according to Easterbrook the extremist doomsday predictions about the environment from radical environmentalists are exaggerated if not mistaken.[100] Belaboring problems and withdrawing from the arena of action is a depressive and regressive mindset. Instead of generating and reinforcing a negative and anti-evolutionary view about human civilization and the environment (that we are the "scourge of nature"), we should take, at the very least, a more balanced approach. It may not be progress per se that creates ecological problems, but self-centered and ecologically ignorant actions. Further, as Moore and Simon argue, economic growth does not degrade the environment; in fact, it corresponds with improvements in the environment.[101] Even if some aspects of industrial growth have damaged the environment, according to Anderson, it may be that further technological advances will actually help to clean up the damage.[102] It is the least technologically and economically advanced societies that produce the greatest pollution.[103] A proactive, pro-growth, and optimistic mindset is something clearly missing in radical environmentalism.

As Anderson notes, ecological management involves efforts both to control ecosystems as well as to create new ones. **Experimental ecology** or eco-construction is a quickly growing area of ecological technology. Over the last couple of decades, numerous ecosystems have been designed and created by scientists around the globe. The basic intent is to see how to put together a relatively stable and self-contained system that will recycle on its own. These experimental ecosystems range in size from small, airtight flasks containing

water, algae, and tiny shrimp to huge constructions like the Biosphere II in Oracle, Arizona. None of these systems are completely self-contained for they all admit light energy, at the very least, but they are attempts to create ecosystems based on the principles of ecological reciprocity and interdependent life cycling. Whereas before individual life forms were cultivated and bred to maximize their growth and development, the idea here is to create interdependent life systems that thrive on each other. As Anderson points out, we are moving from the management of species populations to the management of ecosystems. It is interesting yet quite understandable that the main problem encountered in these experimental ecologies is that the systems won't remain stable but keep "trying" to evolve.[104]

These ecological experiments will provide valuable knowledge toward the development of space stations and enclosed settlements on other worlds. In fact, such ecological experiments are a prelude to attempts to develop both aquatic based ecologies and the terraforming of other planets. Underwater cities and enclosed oceanic ecologies may be constructed as a preliminary experimental stage before cities on other planets.[105] The Venus Project, founded by Jacque Fresco and Roxanne Meadows, involves the planned construction of various marine and oceanic installations, including cities in the sea, undersea observatories, artificial islands, and underwater technologies.[106] As humans gradually bring more of terrestrial ecology under ecological management and development, we will also move into the oceans and the seas, expanding our reach and capacities.[107] Marshall Savage of the Living Universe Foundation has outlined an eight-step plan for colonizing the Milky Way that involves a progressive series of artificially constructed ecologies beginning with cities that float in the sea and leading to eco-bubbles that float in space, eco-domes on other planets, and the eventual terraforming of planets and the ecological transformation of the solar system.[108] As can be seen, the overall thrust of experimental ecology is the further expansion of human efforts to manage and evolve our ecological surround, extending from land to sea and into space.

Dorian Sagan, in his book *Biospheres: Metamorphosis of Planet Earth,* views the construction of ecosystems as a prelude to Gaia reproducing itself.[109] Once sufficiently perfected, such earth-like ecosystems will be disseminated outward into space and other worlds, as if the earth were spreading her seeds to take root and sprout on other lands. Basically, this proposal is similar in spirit to ideas in Marshall Savage and the Living Universe Foundation. Even though we could say that we are creating these space faring ecosystems, from Sagan's perspective we are simply the agents of Gaia, the instruments in her reproduction. All of the various living functions of Gaia involve the participation of life forms on the earth, and humans, as a unique and highly intelligent terrestrial species, are the central participants in her reproductive process.

Even if one finds Sagan's view more metaphor than scientific fact, the introduction of scientifically and technologically empowered humans into the ecology of life on earth makes possible the spread of life beyond the confines of the earth. One limitation that Easterbrook points out regarding life on our planet is that it has been constrained by the vast distances of outer space. Life is

vulnerable to a planetary catastrophe and limited in its opportunities for diversifying and spreading even further. But with technology, humans will be able to carry the seeds of life to other planets and stellar systems and open up all types of possibilities for further evolution and growth. Following Easterbrook, from an evolutionary perspective, human life empowers life to transcend its vulnerable and contained arena of habitation and spread throughout the cosmos.[110]

Aside from environmental and ecological implications that have been drawn from the theory of Gaia, the theory has either inspired or reinforced a whole host of social trends in contemporary times.[111] How can we continue to see ourselves as separate nations, peoples, races, and cultures if we are all tied together in a vast ecological system? Are we not all children of the same "mother"? Gaia has become strongly associated with the World Peace movement and the economic and social initiatives toward a global society. It has been proposed that Gaia should become the center of a new spiritual and religious perspective, the modern incarnation of the Mother Goddess of ancient mythology from which it derives its name.[112] Gaia is a prime example of the wave of holistic thinking sweeping through science, philosophy, and social theory.[113]

Elizabet Sahtouris is a strong advocate of the Gaian perspective. She places Gaia, along with the principles of evolution and reciprocity, at the center of her theory of life and of how to guide our future. She clearly draws many social and spiritual implications from the Gaian theory.[114] Another ardent supporter of the Gaian perspective is Hazel Henderson. Henderson also places the theory of Gaia at the center of her view of the future. Reviewing the general social, philosophical, and religious ideas of both Sahtouris and Henderson is a good way to conclude this section on Gain and ecological evolution. I primarily highlight below the ideas of Henderson, since I have discussed many of the ideas of Sahtouris at length in previous sections of the last few chapters.

One of the strong points of Henderson's view of the future is how she connects scientific, ecological, social, economic, and even cosmic themes in her thinking. As a true system's theorist, she sees all of the different aspects or dimensions of human reality as interdependent. Further, she integrates in her futuristic perspective both the scientific-secular and the spiritual. Henderson thinks holistically.

The basic premise of Henderson's writings on the future is the transition from nonrenewable to renewable energy sources in industrial societies and what this change will mean to all aspects of society. According to Henderson, the costs of traditional energy sources are becoming clearer all over the world and motivating a grass roots movement into a different kind of society. We cannot keep trying to bail out outdated energy and resource patterns and industries. These efforts will lead to continued economic and social problems. We must move beyond the linear philosophy of the industrial energy system toward a cyclic system of energy production.[115]

Sahtouris is also critical of the old industrial model of economic growth, though she does admit that it has produced various benefits. Yet she does think that the traditional industrial system is based on the Newtonian model of nature

as a machine, when in fact, according to her, nature is an organic integrated intelligence.

Henderson strongly supports the need to develop a global philosophy. For her, successful globalization will necessarily involve a win-win politics that is equitable and culturally diverse.[116] This global society will be an ecologically harmonious world where individual self-interests are the same as global interests. We need to move beyond a philosophy of extreme individualism that pits us against each other and against society as a whole. Sahtouris to recall also advocates for a balancing of self-interest and collective interest, of the whole and the parts. Also, in a similar vein, Sahtouris emphasizes a philosophy of cooperation over competition. Both Henderson and Sahtouris believe in the reciprocity of the one and the many.[117]

Both Sahtouris, to recall, and Henderson believe that Gaia can serve as a guide for further developing our society and living with nature. Henderson says that we should use the Earth - the "living goddess Gaia" - as our frame of reference. Gaia would provide an epistemology, a study guide and curriculum, and a feedback system for our holistic awareness and learning. We should see humanity and all of humanity's efforts within this Gaian context. She notes that the earth has always been a guide and model for our tools, technologies, and habitats. We need to reconnect with Gaia. Sahtouris highlights a similar point in her discussion of indigenous peoples around the world. According to her, indigenous people find inspiration and guidance in the workings of nature. Like Henderson, Sahtouris believes that humans need to assume a planetary identity and empathize with the earth. Moreover, Henderson thinks that her basic principles of science (Interconnectedness, Redistribution, Heterarchy, Complementarity, Uncertainty, and Change) are all based on a global-ecological-biological perspective.[118]

Henderson places her Gaian philosophy in a cosmic context. She points out that her **Solar Age** theory of the future is, in part, based on seeing the earth as nourished through the "Mother Sun." In going beyond both Industrial and Information Age models of society, we need to see both humanity and the earth as embedded in the cosmic context of nature. Evidently in Henderson's mind, space is not so empty and dark, and the earth is not suspended in a cold and indifferent cosmos. The life and energy of the earth derive from the sun. The solar system is an ecosystem.[119] Note the strong connections Henderson makes in this analysis of space and the earth, and the cosmos and life. Life on the earth fits into the cosmos and is supported by the cosmos.[120] The universe is our home; the heavens of the night are our neighborhood. Similarly, Sahtouris emphasizes the strong connection between Gaia and the sun; Gaia is an organism that has actively adapted to the sun. (To recall, Smolin also argues that space is an environment hospitable and supportive for the emergence of life.[121]) The Integral Culture movement, of which Henderson is identified as a leading spokesperson, similarly emphasizes the interconnectedness of the humanity, the earth, and the cosmos.[122]

Henderson hopes that we will co-create the future, in concert with the earth and restore the damage that humanity has done. The industrial capacity of

all nations needs to be directed toward a new "**Planet Management System and Plan**". She argues that the economic and market theory of modern industrialization did not address the overall quality of life and how to improve it. The "economic" view of life equating resources with money does not measure the social and environmental costs of its philosophy and ongoing activities. It heightens the separation of the rich and the poor.[123] Henderson contends that a new initiative of mutually assured development has already begun. It is based on a win-win philosophy, instead of the win-lose philosophy of before. Henderson states that within this new approach we must re-conceptualize the earth's holistic systems of air, water, soil, and living forms, not as free markets, but rather as commons that need win-win rules. We must transcend national and patriotic identities and become planetary citizens, identifying with all people and the mother earth, in short, to think globally and to globally think.[124]

Although Henderson is highly critical of an economic growth model of progress, she is not regressive or anti-evolutionary in her thinking. She is definitely pro-evolutionary. She sees though a need for a fundamental transformation to take place in how we relate to the planet as well as to each other. Economic growth must be put in perspective against other measurements of improvement in the quality of life.

There are clearly some differences in emphasis between Henderson and Sahtouris, both advocates of the theory of Gaia, and a pro-growth futurist like Michael Zey, who is critical of the Gaian perspective. Yet, even if Zey is correct in believing that humanity should provide the leadership in our future, I think that Henderson and Sahtouris are correct in arguing that we must take a holistic perspective on humanity and nature. We should understand and take into account the total environmental and social effects of our economic and technological actions. We should also show sufficient appreciation, if not some degree of reverence, for our planet and nature. We are children of our planet and we owe our lives to Gaia.

Ecology and Technology

"We human beings are in fact managing the entire planet Earth, every square centimeter, right now, and the illusion that we are not, that any one of us can be exempt from this task, is extremely dangerous."

Peter Raven

"Nature in the twenty-first century will be a nature that we make; the question is the degree to which this molding will be intentional or unintentional, desirable or undesirable."

Daniel Botkin

Both Kevin Kelly and Walter Anderson, among others, emphasize that the distinction between the natural and the artificial, the "born" and the "made", is blurring. Humans, in numerous ways, are being progressively integrated with their technologies and vice versa. Biological systems and life forms are being integrated into our technologies and industries, and nature, across the world, is increasingly being monitored and managed through the use of technology. There is no totally isolated, insulated, and unmonitored natural wilderness anywhere in the world.

Yet is the **natural – artificial distinction** itself an artificial distinction? Technology and other types of human constructions involve the manipulation of materials and energy sources within nature. Everything we construct comes out of nature and is inspired and informed by what we see (or believe we see) in nature. All of life to different degrees manipulates and alters its environment to serve its needs. Recall the discussion, for example, of how the Gaian system has altered the ecology of the earth. Humans very noticeably alter their environment and create new structures and systems. One could argue that such activities, which invariably include technology, are just evolutionary extensions of life's capacity to alter and structure its environment. As Easterbrook states, "To people, the distinction between artificial and natural means a great deal. To nature it means nothing at all."[125] Just as the separation of humanity and technology is dualistic, so is the separation of the technological (or artificial) and the natural. Why should we separate our creations from the other creations of nature? Are we not part of nature? Technology is in no sense unnatural. Humanity and technology are not against nature, but creations of nature.

Following Easterbrook's logic, nature welcomes the introduction of technology in so far as it facilitates the further growth and expansion of life.[126] The human-technological system is an accelerative mechanism for nature evolving itself. Technology increasingly permeates into environmental and ecological management. As technology evolves, its impact upon nature becomes more beneficial and less disruptive. As noted earlier, Moore and Simon, among

others, report that high technology actually leads to a reduction in pollution as well as increasing energy efficiency.[127] Easterbrook also points out that technology is becoming less wasteful and dangerous and cleaner and more resource efficient. Ecological management, which often serves preservationist and conservationist ends, is empowered by surveillance, data management, communication, and proactive technologies. Satellites are used for wildlife management. A network of gene banks, including collected specimens and biological and ecological data has emerged around the world to support ecological research and agricultural management.[128] In all these cases, and many more, advancing technology serves nature and facilitates its further evolution.

From this perspective, the global information storage, processing, and communication system could be viewed as the burgeoning nervous system of Gaia. Humans collect, integrate, and distribute more information than any other living species on earth, and the global information system allows for both global monitoring and global collective thought (thinking globally and globally thinking). Even though it is humans who are the architects of the system and the system is being made instead of biologically procreated, that does not preclude the possibility that we are the collective agents through which the living earth is developing a global nervous system. Our dualistic and individualistic thinking gets in the way of seeing how we are participants within a vast interdependent network. The human-technological system is not separate from nature and we are all intertwined, machine, human, and nature. The global human-technological network is the physical means by which the earth is evolving self-consciousness.

This evolving network is not the scourge or undoing of nature, but rather a mechanism by means of which nature as a whole can orchestrate and direct its activities better than in the past. Even if the earth is a coordinated system, the introduction of purposive design of new environmental systems, scientifically integrated ecological information, and instantaneous communication enhances its coordinative abilities. Again, the overall function of technology may be to enhance the further evolution of nature rather than hinder or destroy it. Easterbrook lists five basic functional limitations to life, prior to the emergence of humans:

- There is no purposive design.
- Information only accumulates through genes.
- Life relies exclusively on the sun as a source of energy.
- Evolution is limited by chance re-ordering of DNA.
- Life is restricted to planets (specifically the earth).[129]

The introduction of advanced technology, coupled with the higher cognitive capacities of humans, can break through all these limitations.

Experimental ecosystems constitute the leading edge of ecological evolution. It is important to note that all experimental ecosystems incorporate elements of both biological life forms and technology. There are pumps, valves, wires, circuits, and miles of pipes and tubes laced through the underbelly of the eco-systems enclosed in Biosphere II. The total system involves a merging of technology and “natural” ecology. Underwater and otherworldly cities, as well as

space stations, will involve a similar mixing of the "born" and the "made".[130] When we imagine a space station or city on Mars, we are liable to imagine it as all steel and glass and coldly inorganic; this idea is at best a half-truth. A settlement on Mars will also have the appearance of a garden or greenhouse, if not a Noah's Ark. And the terraforming of Mars will clearly involve elements of the organic-living and the technological. Further, for experimental ecosystems, both aquatic and extra-terrestrial, there will undoubtedly be genetically engineered life forms, as a further integration of life and technology. Experimental ecosystems are a prime example of the merging of the living and the technological.

Anderson argues that we need to rethink ecology and become proactive about technology rather than opposing it.[131] Easterbrook, taking a collaborative or cooperative perspective, proposes that in the future humanity, machines, and nature will work together for each other's mutual benefit.[132] Someone like Zey would probably suggest that technology should serve humanity in managing and evolving the environment. However conceptualized, our earthly ecology or Gaian system is being infused with our technology and knitted together by it. Anderson suggests a comparison or analogy between Biosphere 2 and what the earth is becoming. Surrounding the biosphere and coordinating it is a "thinking layer", a Noosphere, embodied in technology and informed by science. Anderson also thinks that the Gaian perspective is perhaps too limiting or inappropriate for this integrated and evolving human-techno-nature system.[133] Gregory Stock, in fact, has proposed the idea of Metaman to describe this evolutionary and integrative reality. As Stock points out human civilization, which includes the spreading technological web infusing into nature, shows all of the requisite properties of a living system.[134] Metaman could be interpreted as an outgrowth and refinement of Gaia; the next holistic level of evolution above the earth's earlier coordinative system. Following Easterbrook's cooperative vision, Metaman is the emerging reciprocal integration of humans, nature, and technology.

The Ecological Crisis: Population, Pollution, and Resources

"Both the jayhawk and the man eat chickens,
but the more jayhawks the fewer chickens,
while the more men, the more chickens."

Henry George

"There is almost no issue in modern times
in which Americans' general beliefs about the state of affairs
contradicts objective reality like the issue of the environment."

Stephen Moore and Julian Simon

There is considerable controversy over the severity and even reality of the present **ecological crisis**.[135] Over the last few decades there have been a variety of popular books that have predicted grave and serious problems concerning overpopulation, pollution, global famine, mass extinctions, climatic change, and depletion of resources.[136] Many of these negative predictions have turned out to be exaggerated if not simply wrong. As Moore and Simon state the one constant among pessimistic ecological forecasts since the time of Thomas Malthus is that they have been consistently wrong.[137] Still there are various researchers, environmentalists, and writers who believe we are heading toward ecological catastrophe if we do not drastically change our present ways of life and treatment of the environment.[138] For example, Eckersley projects the collapse of human civilization by 2030-2050 given the present rate of human population growth.[139] Other futurists think differently, such as Adrian Berry who foresees human population continuing to grow to almost unimaginable levels in the centuries ahead, yet at the same time, standards of living and quality of life improving as well.[140] Throughout this chapter I have already described some general perspectives on the state of our ecology, including the more cautionary and concerned views of Theobald, Henderson, Sahtouris, and Strong, and the more optimistic positions of Zey, Easterbrook, and Anderson. In this section I discuss the debate over the "ecological crisis" in more detail, examining different specific features of it, including natural resources, pollution, population, biodiversity, food, and water.

As a general introductory point, recall the dispute between those environmentalists who argue for stability, balance, conservation, and low impact and those ecologists and futurists who view nature as dynamic, evolving, and increasingly managed through technology. Further, there is a general conflict over whether economic growth has a positive or a negative effect on the environment. As can be seen, the two conflicting theoretical views fundamentally disagree over the issue of growth and change. Is it good, or is it bad?

Andy Hines, in fact, has described the two conflicting camps or paradigms on population growth, as "**Faith in Growth "versus" Big is Bad**".[141] The "Faith in Growth" paradigm, according to Hines, derives from the Biblical notion of humans having dominion over nature. Growth creates prosperity and although motivated by self-interest, ultimately will help to protect the environment. The "Big is Bad" perspective views humans as only one species among many on the earth, having no special rights or dominion over life. Further, economic and industrial growth is destroying the environment, using up our finite resources, and increasing the disparity between the rich and the poor. In earlier sections, I examined in depth the issue of stability and change in nature, arguing that the norm for nature was change and evolution. Extinction in fact is an ongoing process in nature. Zey, to recall, has argued that there are really only two choices in life: Grow or die.[142] One cannot stay still.

Yet, many cautionary and skeptical futurists, environmentalists, and other writers argue that unquestioned faith in growth is foolhardy and can lead to eventual collapse. The issue of long-term sustainability also needs to be

seriously considered.[143] We may be moving along with an ever-growing economy and suddenly the ground may fall out from under us. Chris Bright, for example in his article "Environmental Surprises", emphasizes the unpredictability to nature. "**Synergistic**" effects can emerge rather quickly in nature, creating holistic discontinuities and catastrophes.[144] Bright points out various individual trends such as deforestation, hunting, and mass agricultural monocultures that could compound together to produce "Gestalt" effects on the environment. As I described in the earlier sections on open systems and evolutionary change, there are relatively sudden holistic changes that occur in nature, where the outcome of such changes is not entirely predictable. Bright and others believe that we should be much more restrained in our continuing drive to expand our economy, civilization, and industry for we might trigger off an irreversible and unpredictable ecological disaster.[145]

Easterbrook has discussed this apprehensive mindset of some environmentalists over potential non-linear effects of the growing economy and industry of the modern world. Such holistic, sudden effects are possible, but this mindset is a modern expression of the anti-technological philosophy embodied in the "Frankenstein Myth". Don't tamper with nature, don't get carried away with yourself, or else nature might bite back, in ways you can't control. Easterbrook goes so far as to state that this apprehensive mindset over non-linear, holistic effects has been "seized" upon by conservative environmentalists as a way to reinforce their negative and pessimistic philosophy about nature and humanity.[146]

The issue of stability versus growth also gets connected with the themes of freedom versus control and present versus future oriented mindsets. Writers, such as Henderson and Pirages, believe that the free market has caused the present environmental problems, that it doesn't address overall quality of life, and is too present oriented without sufficient foresight.[147] Pirages believes that our present free market economy and pro-growth attitude is unrealistic and foolish in waiting for problems to emerge before attempting to fix them. He accuses free market supporters as lacking responsible foresight. Henderson contends that the "**Big Business-Economic**" **philosophy** of life is actually conservative and controlling in spite of its proclamations of continued growth. As she points out, advocates of this approach want to maintain their power and control over human society and are unwilling to change our basic way of life to something significantly different.[148] In contrast, pro-growth, optimistic writers such as Simon and Moore and Bailey argue that free enterprise and market competition will be able to solve environmental problems, present and future.[149] Simon and Moore also contend that governmental regulations often cause problems rather than solve them.[150] Further, as Anderson points out, radical environmentalists often argue for coercive and controlling measures to change people's behavior and life styles as a way to accomplish their ends.[151] And as pro-growth writers such as Anderson and Easterbrook point out, conservationists are actually significantly past oriented rather than being future focused.[152]

The clash between these different lines of thinking can be illustrated in more detail by reviewing the opposing ideas of Lester Brown and The Worldwatch Institute and Ronald Bailey and Earth Report 2000. The first position

paints a picture of impending ecological catastrophe unless some big changes are made; the second view presents a much more optimistic picture of our present environment.

Brown, Flavin, and Wolf, in an early article "Earth's Vital Signs"[153], note that the earth's forests are shrinking, deserts are expanding, and soils are eroding at record rates. One-fifth of the living species may become extinct in the next twenty years, while the total world human population could double within the next fifty years. Increased overall energy use, involving, in particular, growing non-renewable fossil fuel consumption, could raise the earth's average temperature 1-4 degrees in the next fifty years. Climatic warming could generate a greenhouse effect, melting the polar ice caps and raising the earth's sea level, in effect flooding many coastal cities. There is the possibility of growing ozone depletion in the earth's atmosphere worldwide and thousands of lakes, polluted by industrial toxins, are now dead or dying. Amidst all of this ecological degradation, the world spends huge amounts of money on military expenditures, many times greater than what is spent on ecological and environmental investments.

According to Brown, Flavin, and Wolf, the two main causes of our ecological decline are **increasing energy use** and **increasing human population**. Population growth, of course, raises energy use. In response to these perceived problems, Brown, Flavin, and Wolf outlined a plan for turning things around that involves significantly slowing down the rate of population growth. Educating women, especially in Third World countries, on birth control methods seems to have the biggest impact on reducing the birth rate. Women, however, in many parts of the world still see their primary function in life as bearing and raising children, and so a fundamental cultural and psychological change in gender roles and identities is needed as well.

Yet along with the cultural and educational efforts, there is the simple economic imperative of redirecting government expenses from the military to the ecological. The authors argue that a moderate shift in spending from military to environmental initiatives could turn the tide. This new money needs to be invested in protecting topsoil, reforesting the earth, slowing population growth, raising energy efficiency, developing renewable energy, and retiring the Third World debt. According to the authors, although we are presently in the middle of a significant ecological decline, with dire possibilities ahead of us, the possibility is also there to avoid an ecological catastrophe by producing fewer guns and planting more trees.

In a more recent assessment of the environment contained in *Vital Signs 2001: The Trends that are Shaping Our World*, the Worldwatch Institute, which includes Brown as Chairman of the Board of Directors and Flavin as the President, continues its warnings of potential ecological catastrophe if significant changes in our economy and industry are not made.[154] They are cautionary about making predictions about the future, acknowledging the sudden unpredictable nature of fundamental change, but they do believe that the earth will not be able to sustain its present economic growth for the next fifty years. They are particularly concerned about continued poverty and malnutrition, lack of

fresh water for everyone, air pollution and greenhouse effects, loss of species, and the erosion of both wetlands and coral reefs. The main causes of present and potential future environmental problems include an ever-expanding, ecologically invasive economy, industrialization and urbanization, continued high levels of fossil fuel consumption, and continued world population growth. In general, they are concerned about the health of the environment, which they see as threatened, and argue that an unhealthy environment cannot continue to support our present economy.

Now let us look at the other side of the coin. Ronald Bailey, in his "Seven Doomsday Myths about the Environment"[155] argues that we are not approaching some great ecological catastrophe. Actually things are improving. He identifies seven basic doomsday predictions made in the last few decades, all of which, in his mind, have turned out to be wrong and highly misleading. The seven false predictions and his rebuttals to each of them are:

1. A Global Famine: Although the world's population has doubled since World War II, food production has tripled. Life expectancies are dramatically going up, even in poor countries, and food costs are going down. We are not starving to death; we are eating better.

2. Exhaustion of Non-renewable Resources: Minerals and metals are not running out, as predicted, and prices are actually decreasing.

3. Skyrocketing Pollution: Although the economy and population of the United States keeps growing, pollution is dramatically declining. Air pollution, including smog, sulfur dioxide and carbon monoxide, is down and water pollution stopped increasing in the 1960's. Overall pollution is decreasing in high tech, capitalist countries and the indications are that when a country reaches a high enough level in its economic-industrial development, pollution starts to go down rather than continuing to go up.

4. The Coming Ice Age: Pollution was supposed to continue to cool the earth, but it has not happened.

5. The Antarctic Ozone Hole: It has not spread; it may be nothing more than a natural and normal fluctuation; it is not having any big negative effects on life around the Antarctic.

6. Ozone Hole Over America: There have been only minor variations.

7. Global Warming: Although the earth's average temperature increased about one degree in the last century, most of this increase occurred prior to World War II. Further, satellite monitoring shows that in the last 15 years, the earth's temperature has slightly declined. In some parts of the world, the ice caps are actually growing.

Bailey believes that there is something psychologically attractive about doomsday thinking; the idea of an impending apocalypse makes the present seem especially important. I would add that it gives one's life a powerful dramatic element and significance. Throughout history, people have foretold the end of the world, and to believe one's death is at hand is a great motivator to action.

Bailey points out in a later publication that the predictions of The Worldwatch Institute have become increasingly dire, but the catastrophes forecasted don't appear.[156] Viewpoints can become more extreme the more their validity is threatened. As Anderson comments, radical environmentalism has become a set of "solutions in search of a problem".[157] More generally, what is rather paradoxical is that as various indicators show environmental progress, fears and apprehensions in the general public over environmental disaster get worse. Moore and Simon comment that the American public is fed a steady diet of doom and gloom predictions from environmentalists and consequently they are misinformed.[158]

It could be argued that all of the ecological and environmental warnings of the last few decades are having the desired effect. Perhaps Bailey and others like Moore, Simon, and Easterbrook are right; perhaps we are on an upward turn in creating a better world. Yet some element of this ecological progress may be due to various behavioral changes motivated by the fear and concern that we are about to destroy our environment and our civilization. Just as catastrophe and destruction, according to open systems theory, can lead to creative evolution, with humans who think ahead, the perception of a possible apocalypse can generate fundamental changes in behavior. Again, nothing focuses the mind like the possibility of death.

Still many of the ideas of doomsday environmentalists clearly seem counter-indicated by the facts. Advancing technology and economic growth, two of the great enemies of radical environmentalists, seem to generate environmental progress. Further, Moore and Simon point out that government regulations often backfire. And many of the strongest negative predictions made by doom and gloom prophets, as Bailey, Moore, and Simon have noted, have actually gone in the opposite directions. Pessimism generates depression, anxiety, and inaction, and such psychological states, individually and collectively, are not healthy for human society.

Let us look more closely at some of the specific environmental and ecological issues, beginning with the related concerns of **overpopulation** and **food resources**. Regarding basic population statistics, Thayer and Kline, in their article "The Green Revolution",[159] state that the world population will peak around the year 2050 at 10 to 12 billion.[160] Pearson and Centron and Davies make somewhat similar predictions. Pearson foresees world population increasing around 1 billion every 10 to 15 years and reaching 9.5 billion by 2050.[161] Centron and Davies expect the world population to double in the next 40 years to around 12 billion.[162] However, many of the most economically modernized countries, especially in Europe, will actually shrink in population. Most of the increase in population will occur in the underdeveloped countries of Southern Asia, the Middle East, and Africa. Many of these underdeveloped countries will triple in

population in the next fifty years. Also, approximately one-third of the total world population will be concentrated in India and China, each having approximately 1.5 billion people by 2050.[163] Yet overall, the **world population growth rate** has been declining since the early 1960's[164], which is one main reason why writers such as Thayer and Kline think that the world population will level off within the next fifty years. Also, the greatest mass migration of people throughout the world is presently occurring,[165] and in particular, toward urban areas. Half the world's population now lives in urban areas and one in six live in million plus cities. Increasingly the largest cities are in Asia.[166]

Although the expression "overpopulation" obviously carries with it a strong negative meaning, there is debate over whether the growing world population is good or bad. Writers like Zey and Berry contend that our population will continue to grow past the turn of the century and living conditions will not worsen but actually get better overall.[167] Zey argues that increasing population is a sign of health and vitality, and efforts to control population are illustrative of an anti-growth philosophy, which Zey finds destructive to the human spirit. If the population of a society begins to diminish it is an indication that the society is dying. Following this logic, the escalating population growth in non-Western countries and the slowing of population growth in the West indicate that there is a shift in vitality occurring away from the West.

Still there are many individuals who believe that our growing population is one of the root causes of whatever environmental problems we now face. Further, there is considerable worry that our food production system will not be able to keep pace with our increasing population. Education of women in Third World countries on birth control is one of the most popular and effective approaches to slowing down world population growth, but cultural values over gender identity and large families often work against efforts to slow down the birth rate. The real problem with population growth, if indeed it is a problem, may arise at the other end of the human life span. As I described in the previous chapter, extending human longevity significantly past the present upper limit of approximately 120 years is quite possible in the century ahead. If humans begin to live much longer lives, this increasing longevity may ignite a new population explosion even if the birth rate has been brought under control.[168]

Brown, Gardner, and Halweil of The Worldwatch Institute list no less than 16 negative impacts of population growth, arguing that our environment is at a significant level of demographic fatigue and ecological crisis due to the increasing number of humans worldwide.[169] Their list attributes almost all fundamental environmental and ecological problems to overpopulation:

- In the last few years, grain production has fallen behind population growth.
- There is no new fertile land. It has been used up.
- Fresh water is threatened.
- There are fewer fish per person than in the recent past.
- Increasingly we need more meat to feed the world's population.
- Recreation land is being encroached upon.
- Loss of forestland is proportional to population growth. Seventy-five per cent of all loss has occurred in this century.

- Biodiversity is diminishing in the greatest mass extinction since the Cretaceous Period.
- The climate is changing. China and developing countries will soon match more modernized countries in carbon emissions.
- The demand for energy increased twice as fast as the world population in the last 50 years.
- There is increasing waste.
- The population is growing faster than available jobs.
- There is increasing homelessness.
- The urban population is increasing at approximately one million people per week worldwide.

Many of these problems are individually addressed below, but again, it is noteworthy that population growth, at least for The Worldwatch Institute, is seen as such a pivotal and central factor in environmental problems.

Assuming for the moment that the world population does level off by 2050, Thayer and Kline believe that by that time we will have either developed a sustainable society, or hit some highly devastating state of poverty and famine, at least in some parts of the world. They do see though the continued efforts associated with the **Green Revolution** as providing some hope that we will be able to avoid a worldwide famine. They state that the Green Revolution, which in the 1960's began with efforts to change farming methods and technologies in order to produce more food and expand irrigation has, in fact, dramatically increased food production. They point out, though, that there are still challenges and obstacles. Many people around the world remain hungry or undernourished. (Pearson notes significant malnutrition especially in Africa.[170]) Further, according to Thayer and Kline, we are using up available land and the new methods of food production have not reached many areas. They also note that a greenhouse effect, if it occurs, would reduce food production significantly.[171]

Still there is no denying that in many important ways **food production**, especially since the beginning of the Green Revolution, has increased dramatically. The application of modern technologies, chemical and biological science, and modern farming methods have transformed agriculture. Anderson describes the Green Revolution as the "most spectacular single development in the history of food production".[172] To recall, in the same time period since the world population has doubled, food production has tripled.[173] World grain production has tripled since 1950 and soybean production has increased ten-fold in the same period. The world farm animal population has increased from 7.3 billion in 1961 to 20.6 billion in 2000 and milk production has increased steadily during the same period.[174] As Moore and Simon point out, farm productivity has "skyrocketed" in the last fifty years, particularly in the United States, where modern farming methods have been extensively applied. The United States now produces one-quarter of the world's food. World wide, food has become increasingly more available and affordable over the last hundred years. Focusing on the United States, they note that famine, hunger, malnutrition, and food poisoning were common throughout history, but have drastically been reduced in the last hundred years. People in the United States eat foods of higher nutritional

value and there is significantly less nutritional deficiency disease. They also point out that pessimistic predictions regarding world hunger and famine in the future have repeatedly been contradicted by the facts. They note, for example, that Paul Ehrlich mistakenly predicted that in the 1970's millions worldwide would die of famine.[175]

Far from everyone is enthusiastic about the Green Revolution and the prospects in the future for feeding the growing world population. Sahtouris and Bright are both critical of the "**monocultures**" created in many local regions, where one specific crop is raised instead of the past tradition of raising many different ones in a region. They argue for a return to diversity of agriculture in local regions because monocultures are "brittle" and ecologically less stable than complex ecosystems.[176] Sahtouris in fact contends that hi-tech agriculture is much less efficient than older practices, producing only one calorie of output for every ten calories of input, whereas traditional agriculture produced ten calories of output for every one calorie of input. Besides, as she points out, the new forms of big, high-tech agriculture are destroying the land. In general, Sahtouris believes that humans have overextended their balance with nature and modern countries, as measured in terms of accumulating wealth and over-consumption, are putting increased pressure on the environment. We may be producing more food, but in developed countries we are over-consuming and pushing the limits of the environment. Indeed, Sahtouris thinks that over-population is due to a loss of balance with nature. Local rural populations in underdeveloped countries are being uprooted from their regions and migrating in great numbers to large urban areas where their population growth skyrockets amidst poverty, malnutrition, and substandard living conditions.

As can be seen, the ecological issues of population growth, food, and hunger are not separate from other aspects of human life. Sahtouris suggests that the modern consumer culture and big business farming operations are creating environmental stress. Thayer and Kline note that many factors contribute to hunger, including politics, and there is no one single solution to the problem. They believe that we need to empower underdeveloped countries and peoples. We should give them the necessary scientific knowledge and technologies, let them compete in an open market, and provide them the opportunity for reward and personal success. Still, they believe that the best hope for addressing our future food requirements lies in biotechnology. Literally, we need to create better food sources. Our food supply must increase another threefold by 2030 to feed the growing world's population.[177] Will we be able to keep up the pace of increasing food supply and availability to match the growing population of the world?

Anderson traces the history of **agriculture** from its beginnings through its modern stages involving the successive introduction of scientific plant breeding, new machinery, and organic chemicals. As he puts it, agriculture keeps "reinventing" itself, empowered by continuing scientific progress and advancing technology. The last few decades saw the development of the "**knowledge farmer**" and "**precision farming**", involving computer monitoring and computer control of chemicals. He foresees further transformations occurring in the future.

These new changes will affect society as a whole. He notes that there is a strong anti-technology, radical environmentalist voice in agriculture and food production, but he believes we must find a synthesis of technology and environmental responsibility in the future. Emphasizing his general view that ecology and technology are increasingly integrating, he argues that agriculture should evolve into a global, information-based, flexible, and pluralistic food production system. Future agriculture should be motivated not just by economics but by ecological considerations as well and involve increasing knowledge and monitoring of our bio-ecology. In particular, he foresees the increasing importance of genetic engineering in agriculture. In the future, all basic crop plants will be genetically modified and "**food farms**" or "food factories" will emerge which grow highly nutritious foodstuffs from tissue cultures.[178]

Following the lead of Anderson, Thayer, Kline, and others,[179] among the many possible innovative approaches to future agriculture, advances in biotechnology seem especially promising. According to Shapiro, genetic engineering is absolutely essential. In spite of the rapid growth of food production in the last fifty years, Shapiro states that our present agricultural system isn't sustainable and will not be able to keep pace indefinitely with world population growth. We would be forced to destroy increasingly more land to get a greater yield. The answer, according to Shapiro, is to produce genetically designed agricultural products that have significantly higher nutritional value and are much more hearty, robust, and resistant to the disruptions of nature.[180] Genetically engineered new species of life that are exceedingly high in nutritional value should appear in the very near future, probably the next decade[181]; we have already made inroads in this direction.[182]

Besides genetic engineering, other types of technology could also greatly benefit future agriculture and food production. Walter Anderson foresees the increasing importance of computer technology in agriculture. Berry and others have proposed that we take to the seas and develop underwater farms and agricultural sites.[183] Fishing could be significantly enhanced with the introduction of robotics.[184] In general, we should expect a technologically enhanced evolution of food in the coming century with new forms of food and new technological systems for creating them and supporting their cultivation and growth. Technology is not the only important factor to consider in discussions of population growth and food production, but our future ecology will probably involve more technology rather than less. Even the development of a more "ecologically conscious" food production system, as Anderson recommends, will require more technology devoted to the monitoring and management of nature. The "born" and the "made" are integrating and co-evolving within agriculture and the production of food.

Humans need water as well as food. Moore and Simon report that water quality has vastly improved in the United States in the last century, which includes phenomenal progress in the cleaning up of lakes, rivers, and streams.[185] Yet at a global level, The Worldwatch Institute reports that 1.1 billion humans lack clean water.[186] As Pearson states though, the problem with clean water is not that there isn't enough worldwide. There is enough clean water, but it is

unevenly distributed and he foresees conditions worsening in the coming decades with Africa and the Middle East hit hardest. Developing countries will need double the clean water in the next fifty years.[187] Centron and Davies, again pointing out that Africa will suffer significantly in the decades ahead, predict that global water shortage problems will increase ten-fold by 2040.[188]

A second major area of environmental concern is **pollution**, which is obviously connected with the issue of clear water. Industrial pollution has been one of the most significant causes of unclean water, but as Moore and Simon state, at least in the United States, water pollution has been dramatically reduced. Oil spills are also declining.

Industrial pollution also affects the air we breathe. Moore and Simon report that air pollution in major cities in the United States has also significantly decreased and the overall quality of air across the country is much better than twenty-five years ago.[189] Again critical of the pessimistic predictions of Paul Ehrlich, they note that he predicted that hundreds of thousands of people would die from smog in New York and Los Angeles by 1973, but both cities have shown a huge decline in air pollution levels over the last few decades.

Moore and Simon, as well as Easterbrook, are very optimistic about eliminating pollution problems in modernized countries. Easterbrook expects the pollution problem in the West to be solved in the very near future and makes a point of noting that pollution is declining right when radical environmentalists are saying that it is getting worse.[190] Moore and Simon state that one of the greatest trends of the last hundred years is the rate of progress in reducing pollution. One significant point that they make is that although the automobile is strongly connected with air pollution, the auto is in fact much less polluting than the horse, which it replaced as the major source of transportation. Overall, in the United States there has been a phenomenal decline in pollution per unit of manufacturing output measured in terms of Gross Domestic Product; it is six times better than in 1920.[191] As a worldwide pattern noted earlier, when a country reaches a certain level of technology and industry, it becomes less polluting.[192]

Yet at a global level, there are reasons for concern. Centron and Davies report that by 2025 China will generate more air pollution than the United States, Japan, and Canada combined.[193] As they illustrate, there is a worldwide growing concern over air and environmental pollution and the consequences of pollution will become more apparent in the years ahead. The global challenge will be for growing economies like China, which uses huge amounts of fossil fuels, to advance to higher tech, less polluting industries in the coming decades.

Even if modernized countries are polluting less, global statistics on pollution still leave a lot of room for improvement. Worldwatch Institute reports that global carbon emissions have increased fourfold since 1950, though they have been falling since 1996. Carbon dioxide concentration has shown an approximate 15 per cent increase worldwide since 1960. Global fossil fuel consumption, which in large part has caused these increases in air pollution, has also quadrupled since 1950, but has remained relatively steady since 1995.[194]

One particular area of concern regarding air pollution is whether the release of carbon emissions into the atmosphere might trigger a greenhouse

effect and **global warming**. Statistics provided by the Worldwatch Institute indicate that the global temperature has remained relatively steady for the last five years and shows an approximate 0.2 degrees Celsius increase since 1850.[195] Other researchers, such as Ronald Bailey and Thomas Zey, report different statistics, arguing that the average earth temperature has been declining for the last couple of decades, while paradoxically carbon emissions have been going up.[196] Zey, in fact, contends that the warnings of "global warming" are dubious at best and, in his mind, motivated by efforts to slow down social and technological progress.

Another important issue connected with pollution is the problem of **waste**. Sahtouris believes that our excessive waste is due to an unhealthy, unbalanced relationship with nature.[197] Centron and Davies report that in the United States the "waste stream" has tripled since 1970 and similar trends are apparent in other countries such as Brazil. Further, in the United States our landfills are being used up.[198] As discussed earlier, recycling and industrial ecology are two approaches to dealing with waste and pollution, and given advances in science and technology, on the horizon we also see nanotechnological and biotechnological approaches to "eating up" waste. Waste, though, is the entropy of civilization and the more complex and expansive our society becomes the more waste will be generated. Order begets chaos. Technology can become more efficient, producing less energy and material loss in its operations, and modernized countries with more advanced technologies are achieving just that, but waste is not going to go away or significantly diminish unless we dismantle the structure of our civilized world. The general approach of re-channeling waste, garbage, and other pollutants into technologically designed systems that can use this chaos to create new order is ultimately the "natural" solution to the problems of pollution and waste.

As can be seen by the above reviews of food, population, and pollution, there are plenty of statistics, yet there are clearly at least two opposing camps regarding the nature and severity of problems, and these two different interpretations of the "facts" are connected with opposing viewpoints concerning how to approach the future. Although Easterbrook argues for reason and realism in dealing with environmental issues, there is clearly, as Anderson points out, significant emotion as well as simple aesthetics involved in the ecological debate.[199] The first approach, which sees the statistics in a more promising and optimistic light, is the pro-growth perspective. As Moore and Simon state, "It's Getting Better All the Time". The second approach sees the statistics as ominous and advocates for considerable more restraint, if not reduction, in present economic, industrial, and demographic trends. Those that oppose pro-growth philosophies and practices include Far Green, radical environmentalism and more moderate positions that argue for sustainability. In general, the clash is between those who urge us to keep moving forward versus those who want us to slow down, stop, or go backwards. A third approach though might be to go in a new direction, neither continuing along our present path nor stopping or retreating into the past.

The environment and human society is a web of interactions and interdependencies. As a prime example, air pollution, energy use, and **transportation technologies** are all connected. Even if the automobile is less polluting than the horse, the greatest single cause of air pollution and increasing energy use is modern transportation vehicles, which includes, of course, the car and the ever-growing armada of trucks and SUV's. Deborah Gordon, in her article "Transportation", takes a holistic approach to the topic and states that we must change our overall approach to issues of transportation.[200] According to Gordon, the construction of more highways and bigger airports is leading to environmental and resource problems, congestion, and a deteriorating transportation infrastructure. She states that the two principle factors affecting transportation problems are the increase in the number of vehicles and the usage of vehicles. Automobile production increased from 8 million per year in 1950 to 41 million per year in 2000.[201] And yet, both the number and the usage of vehicles are projected to keep increasing in the future.[202] In spite of a recent momentary downturn, air traffic is growing rapidly as well.

Gordon connects our present transportation problems to social and urban issues. The mass exodus in modernized countries into the suburbs dramatically increased driving distances, pollution, congestion, and energy use. Gordon states that we need sustainable and smaller scaled communities and new types of transportation systems in these smaller communities, including powered walkways, efficient public transportation, more bicycles, and "green cars" with alternative fuels.[203] In fact, Gordon says that we should keep gas automobiles out of cities. We need sustainable, energy efficient cities. All of the elements of life - work, stores, services, and homes - should be closer together.[204] Although we may imagine cities of the future consisting of towering skyscrapers and highly visible technological razzle-dazzle, our communities may become increasingly green and imbedded within nature.

We live in a holistic reality of open, interactive systems. Recall Brown's argument that overpopulation has effects on almost all other ecological realities; it is not an isolated phenomenon.[205] As Capra has argued, we cannot address the problems of the modern world separately and analytically; we need to adopt a holistic approach.[206] In Gordon's mind, possible solutions to our transportation problems involve changes in human society, culture, and lifestyles, as well as new types of technology. Many concerned writers on the environment, including Sahtouris, Henderson, and Brown, see a fundamental connection between our ecological challenges and our contemporary economic and industrial policies and activities. They see the problems holistically. Even Easterbrook, who is much more optimistic about environmental conditions, suggests that our modern culture does need to change from a materialistic, consumer society to a more naturalistic and mentally focused social order in the future.[207] Because of the holistic nature of ecological variables, it is understandable that general positions regarding the environment and human society have emerged. Specific issues are interpreted, evaluated, and linked together differently depending upon the overall theory of the future put forth by these writers.

Increasing human population, urbanization, and the sprawling transportation systems impact the land, forests and grasslands, and ecological communities. Bright reports that estimated forestlands 8000 years ago totaled 14.8 billion acres. Today there are 8.9 billion acres remaining, with 90 per cent of the loss occurring in tropical forests.[208] Pearson predicts that another 10 per cent of forests will disappear by 2050, with Asia, Africa, and South America suffering considerable losses.[209] The Worldwatch Institute reports that wetlands are also disappearing, with a 50 per cent loss in the last century, and coral reefs are showing signs of significant damage as well.[210] Moore and Simon though have a somewhat different view of the situation. They state that world forestland has remained steady for the last fifty years, and that in the United States we are actually growing more forest than we are using. Further, in a more general vein, they argue that we are not using up land in the United States for increasing urbanization and sub-urbanization at any significant rate. In the last fifty years the ratio of protected land to urban and agricultural land rose from 6.4 to 22.9.[211]

Although Bright, as a general principle, argues for minimal impact upon the environment, all of the "natural" land and ecological communities that we may wish to protect against urban-recreational development and industrial use are increasingly under the watchful eye of modern science, technology, and human society. Planting new trees, re-cultivating ecosystems, and erecting ecological barriers are human-technological activities. As Anderson has pointed out, ecological management and re-construction will involve high-tech rather than no-tech. If trends in the United States are more positive than in other places around the world, it is because of our advanced technology coupled together with a high level of environmental activism. Things are not better here because we are passive and non-intrusive. Easterbrook, who argues for a "New Eden", clearly realizes that this natural environment of the future will not be a reconstruction of the past, but a new synthesis of technology, humanity, and nature.[212] So, although we should be very concerned about our forests, grasslands, wetlands, and coral reefs, we are already in the process of creating a new natural ecological order for these systems in the future.

Because the ecology of the earth is an interdependent system, the loss or shrinking of forests, wetlands, and other components of our environment is having a significant impact on the **biodiversity** of life. As noted earlier, we are witnessing the greatest mass extinction of living species since the Cretaceous mass extinction that spelled the end of the dinosaurs. According to Pearson, the single biggest cause of this extinction is the loss of habitats.[213] Estimates on species loss range from 1000 to 50,000 species a year and projections are that we will continue to lose species at this rate over the next few decades at least.[214] Peter Raven, in his article "A Time of Catastrophic Extinction: What We Must Do", states that we are losing species at 1000 to 10,000 times as fast as when humans first appeared on earth.[215] Since according to Raven there are about 10 million species on the earth, at the above rate we will wipe out two-thirds of all living species in the next century. Pearson estimates we will lose up to 20 per cent in just the next few decades.[216] According to various writers, large numbers of primates, mammals, birds, and fish across most of the Southern Hemisphere,

as well as in the United States and China, are already threatened with extinction.[217]

Raven believes that this impending mass extinction is the most rapid and significant ecological problem confronting us today and the growing presence of humans is the cause of it. Based on the Cretaceous mass extinction, it would take five million years to recover from such a catastrophic event, but of course such an estimate is based upon recovery processes that do not involve biotechnology. To put this event in historical perspective, there have been numerous previous mass extinctions throughout the history of the earth, though this is probably the first mass extinction instigated by the presence of a single species. Still the rapid loss of biodiversity on such a mass scale is a highly significant event that will greatly transform our world.

Raven asks why biodiversity should be a priority for humans. He gives three reasons. First, from an ethical perspective, we have a responsibility to protect what are our only known living companions in the universe. Second, we derive a multitude of products from diverse life forms. Life is a significant resource; there is an economic reason for protecting diversity. A third reason for valuing biodiversity is that life supports an essential set of ecological services and maintenance functions. Our environment, as we noted in the above discussion on the theory of Gaia, is controlled by the cooperative efforts of many different living forms. Could the Gaian system continue to function with such a great reduction in bio-diversity? More to the point, could we survive and continue to function through a mass reduction in biodiversity?

Raven argues that we can only preserve biodiversity if we stabilize human population and bring over-consumption under control. He states that humans use 40 percent of the net photosynthetic production on the earth and a third of the fresh water. Further, most of human consumption comes from an ever-shrinking percentage of the total human population living in modernized industrialized countries. Modernized countries, as Theobald and others note, are obsessed with consumption as a way of life.[218] Yet approximately four-fifths of the biodiversity in the world is in developing countries. These less developed countries account for three-quarters of the world population and their populations are growing much faster than in modernized nations. Consequently, their expanding populations will put increasing pressure on local natural habitats. These same developing countries also possess little scientific, engineering, and technological expertise, thus generating the greatest amount of pollution per gross domestic product. Between the growing efforts of developing countries to improve their own lives and supply the modernized world with the resources needed to fuel their excessive consumption, most of the biodiversity within our world is being significantly threatened. According to Raven, we need to enhance the biotechnological capabilities of underdeveloped countries quickly to put less pressure on the ecosystems in these parts of the world. Further, excessive modern consumerism needs to be brought under control. In general, biodiversity is a global issue that will necessitate input and action from both modernized and developing countries.

Raven's points on biodiversity and the ongoing mass extinction bring into sharp focus the uncertainty of our future. Although I presented, in the last chapter, the hypothesis that the present mass extinction could be followed by a repopulating of the earth with a whole new variety of living forms, we should keep in mind that with any massive system change there will be elements of chaos and uncertainty in the transition. Will we be able to successfully re-enhance the diminishing biodiversity in the world? The process of ecological transformation though has begun and our ecosystem is going through a period of significant global change. To recall Markley's central evolutionary trap, our success in spreading across the globe and bringing all of the earth's resources within our sphere of influence could spell our downfall. If the population of living forms on the earth is changing, we must remember that we are highly interdependent with them, and we need to do our best to guide the coming transition with heightened ecological and scientific understanding, evolved cultural values, advanced technology, and foresight. The most important point to keep in mind concerning the present crisis in biodiversity is that we are all, animal, plant, and human, in this together.

Just as our growing world population may push us into applying genetic engineering on a global mass scale to supply sufficient food to feed us all, the ongoing mass extinction of life forms on the earth may push us into heightened efforts to create life forms to maintain the necessary complexity of ecological dynamics on the earth. As Clifton Anderson points out, genetic engineering could impact, for better or worse, all major environmental problems, including biodiversity.[219] Again, it seems probable that a "**New Nature**" will emerge in the future, in this case, involving new species as well as new habitats.

Concerns about population growth and over-consumption are also connected with the issue of natural resources. Dennis Meadows, in his article "Global Environmental Problems", highlights the relationship between population, consumption, and resources.[220] Meadows is one of the original authors of *The Limits to Growth*, as well as one of the authors in the follow-up study *Beyond the Limits*.[221] He thinks that the warnings set out in *The Limits to Growth* on using up our physical resources have still not been addressed. According to Meadows, the challenge still exists over how to sustain modern human society in a growth-oriented world. He believes that in the next fifty years we will be forced to reduce our population and reduce our use of energy, raw materials, and resources. This change will occur either reactively, in response to some worldwide ecological catastrophe, or proactively, in order to prevent such a catastrophe. For Meadows, we need to achieve an equilibrium and sustainability within the resource and ecological limits of the earth.

Meadows thinks that the fundamental ecological question is how to harmonize humanity and the environment of the earth. We need to develop a "**sustainable society**" that meets its present needs without sacrificing the future needs of humanity. In agreement with many other writers, he notes that the present system is so inefficient and wasteful that with a significant increase in industrial, economic, and ecological efficiency we might be able to maintain our present quality of life and significantly reduce our use of resources. Meadows

believes that a sustainable society is not necessarily a zero growth system, but rather a society that considers the long-term issues and value of growth and tries to control it.

Meadows clearly sees the reciprocal relationship between humanity and the earth. He also believes, as do many others, that overpopulation and over-consumption underlie most of the present ecological problems. His concepts, however, of equilibrium and harmony do not reflect open systems thinking and contemporary ecological science. Humanity's relationship with the environment needs to be cooperative, but it will not be totally balanced or homeostatic. I think, though, that Meadows does make an important point when he distinguishes between proactive and reactive change. These seem to be the two fundamental choices facing us in our future ecological reality. As good stewards do we anticipate the future and try to guide the inevitable process of change? Or do we remain egocentric and focused on the present and ignore the potential consequences of our actions on the world? Yet in the context of these two choices, we should keep in mind Kelly's philosophy of "Out of Control". One of the basic lessons of contemporary chaos and self-organizational Theory is that the future is always full of surprises.[222] Risk is unavoidable. We cannot think like Newtonians, believing that some master ecological plan could be created and successfully implemented.

Sustainability is a central theme in Meadows' thinking. All living systems require resources for their sustainability. Human societies require energy, materials, food, air, and a host of other resources for their continued functioning. Life is an open system; societies are open systems. An open system might be able to operate, if not even grow and expand, for some period of time but the system could fail at some point because the necessary resources for its continued operations get exhausted. Meadows and other environmentalists and futurists believe that modern human society is pushing the limits of its sustainability basically because we are using up our resources and damaging our resource base through increasing population and consumption.[223] Individuals who voice concerns over sustainability often oppose and are opposed by pro-growth advocates.[224] Because of this opposition to pro-growth positions, the sustainability argument is often interpreted as a rejection of social and economic growth. Sahtouris though, who supports the sustainability thesis, does not think that we have to make a choice between growth and preservation. She sees the sustainability argument as leading to a "win-win" arrangement, where growth can still be pursued while the environment is preserved in the process. Both humanity and the environment win. She believes that currently we are operating in a "win-lose" mode, where one privileged group of humans takes (consumes) and everyone else and the environment lose. She sees this imbalance as unhealthy. If we continue to bite the hand that feeds us and allow the immense material wealth of modern society to benefit only a small percentage of all humanity, we will inevitably lose. We all win or nobody wins.[225]

As a result of population growth, increasing consumption, and our modern life style, **energy use** worldwide continues to rise. Sustainability advocates are especially concerned about this ongoing trend. Recall that fossil fuel

consumption is four times higher than in 1950. As Pearson reports, energy use is increasing in all corners of the globe. He predicts a further 25 to 30 per cent increase in the next ten years alone, with a doubling of use in Southern and Southeast Asia. But on the positive side and also to be factored into the equation, he foresees a 46% increase in renewable energy use in this same time period. Solar, wind, and nuclear energy use are all rising.[226] The problem though remains that the huge developing economies in India and China have primarily depended upon the increasing use of non-renewable energy sources and this trend should continue in the near future.[227]

Yet, to recall from Chapter One, there are predictions that human society is only scratching the surface of energy production and consumption and that in the future human civilization could expand its production-consumption rates a thousand, a million, and even a billion fold.[228] Where is all this energy going to come from? As discussed in Chapter Four, one likely candidate is solar energy, for the sun produces billions of times the energy presently used in our modern economy. There is though a deeper philosophical and scientific issue regarding both energy and natural resources. Are energy sources and natural resources in general finite or limitless? This question came up in Chapter One regarding the power of advancing technology to create resources as a society evolves.[229] Anderson criticizes the idea that nature has limits. He points out that as society and technology have progressed, there are actually more possibilities and options for supplying and empowering our growing modern civilization.[230]

Moore and Simon present a strong case that modernization and advancing technology generate rather than diminish resources. Further, the benefits spread across the entire population, with increasing economic wealth and technological development leading to improvements in the environment. As they argue, each generation in a growing society produces more than it consumes. Throughout their book, *It's Getting Better All the Time: 100 Greatest Trends of the Last 100 Years*, they are highly critical of individuals and organizations who paint a pessimistic picture of our present ecological and social conditions. In particular, they disagree with the viewpoint, as expressed in *The Limits to Growth,* that natural resources are limited. As they recount, Simon once bet Paul Ehrlich on whether the prices of any five resources would increase or decrease for a specific period of time, assuming that higher prices would reflect scarcity and lower prices more abundance. Simon bet that prices would go down and he won the bet. As they state, all natural resources are, by any measure, both more available and cheaper than in the past. They contend that we are not running out of food, energy, forests, or minerals. The resource base is not shrinking but expanding and this growth is due to economic and technological advancement.[231]

Their extensive study and collection of data focuses primarily on the United States, but Moore and Simon, as well as others, such as Bailey and Easterbrook, make the general point that when advancing technology and economic growth reach a certain point, environmental benefits begin to accrue and material human welfare increases along almost all measurable dimensions. Moore and Simon note that although the United States is criticized for using 20 to

40 per cent of the total resources used worldwide while it only has 5 per cent of the world's population, it creates resources rather than destroying them. As a general point, they state that the Darwinian-Malthusian notion that an increasing population would end up competing over finite resources and cause the population to diminish turns out to be wrong, because life can create resources. As the world's population has increased, food production has increased even faster. Hence, Moore and Simon present the argument that life does not simply adapt to an environment but alters the environment to support its existence.

One resource that is not factored into calculations on possible resource limitations is the resource of knowledge. Knowledge empowers any living system, including, obviously, human social systems. The correlation between increasing technology and economic growth, and environmental improvements and human welfare seems to indicate that the development and application of new knowledge keeps human society growing without necessarily damaging the environment. Knowledge opens up new technologies and more understanding of the realities of our world. Knowledge opens up new possibilities of action; it empowers the whole human-ecological system.

Although our advancing scientific and technological knowledge is critical to the future evolution of human society and the environment, our future ecological reality needs to be guided by other factors as well. As both Henderson and Sahtouris suggest, an inspirational vision of humanity and nature is needed as well.[232] They both suggest a Gaian-centered spirituality, a sense of reverence for the "living earth". It is not just our particular theories, plans, and actions that matter; it is our overall attitude and consciousness toward the earth, nature, and our place within the scheme of things that is important. The philosophy of Integral Culture also makes this basic point about ecological and cosmic consciousness, emphasizing the importance of love and emotional connectivity to nature and humanity.[233] Although technology and science are critical in understanding and managing our ecology, ecology is equally a matter of the spirit and the heart.

There is the Biblical prophecy of a Paradise on Earth within the future, a return to Eden so to speak. This Utopian image promises love and fellowship among all humanity, a peaceful and cooperative global society, as well as a deep sense of oneness with nature and all living species. All human needs will be satisfied, including food, shelter, health, and happiness. This religious image is strikingly similar to some contemporary ecological dreams. Further, the Biblical promise of Paradise presumably will be fulfilled and maintained through the obedience to and worship of God by all humanity. Similarly, Gaian inspired philosophy identifies the Mother Earth as a spiritual object of reverence and promises harmony and peace with nature if we show our reverence for the earth.

Yet the Biblical concepts of Paradise and the Garden of Eden seem to entail the view that humanity has dominion over nature. The sense of dominion follows from the dualist philosophy of spirit and nature within Christian thought. The sense of superiority and control became a basic tenet of Industrial Age thinking, and Hines suggests that contemporary pro-growth philosophy derives from the Biblical notion of dominion over nature.[234] Yet, as we have seen, the idea of separateness from nature is scientifically invalid. Our spiritual views must

be informed by science. Sahtouris, who is highly critical of dualist philosophy, argues for a naturalistic spirituality, where the living earth is the object of reverence rather than some otherworldly reality. The idea of dominion also seems ethically wrong, for it implies a sense of arrogance and disrespect for nature. If we are living beings naturally selected to evolve the ecological system to new levels of organization and development, to further foster the growth of life as Easterbrook would argue, then we should see ourselves as responsible stewards over life on earth. We are not masters, but loving caretakers and leaders who learn as well as guide and direct.

The spiritual reverence that comes with an ecological mindset implies a sense of belonging and a sense of the cosmic context of all of life. Yet this belonging is not static or totally balanced. Although there are radical environmentalists who would wish to create a harmony and equilibrium among humanity, life, and the earth, nature appears to be evolutionary and filled with chaos and disorder. Contemporary ecologists argue that we cannot preserve a stable and harmonious ecosystem; the earth evolves. Paradise will not hold, or at the very least, we are going to move through a series of ecological Paradises. Again spirit needs to be informed by science. What indeed do we worship then within a scientific ecological mindset? Perhaps we should worship the never-ending opportunity for growth, renewal, and creativity.[235] A philosophy of growth, while emphasizing the importance of all life and our interconnectivity, provides a sense of inspiration and direction.[236] Since the cosmos is evolving, our cosmic context is not static but fluid and transforming. Life is a process, not a thing, and ecological consciousness is about collective evolution, rather than static harmony.

Sahtouris also sees, as do many other futurists and environmentalists, a necessary connection between **ecology** and **economics**. In her view, ecology provides the organizational design of our world and economics provides the operating principles. Following a logic and ethics similar to Henderson, Sahtouris advocates a cooperative win-win economics rather than the competitive win-lose economics that both she and Henderson believe has dominated the modern world.[237] Many writers have identified our present economic system as a central contributing cause to our ecological and social problems. As I have noted, many critics of our modern economic system believe that it has created an unequal distribution of wealth and a steady deterioration of the environment. As Sahtouris would state, the system has produced great imbalances in our world. There are others, such as Moore and Simon, who believe that our economic system, as it generates wealth and technological sophistication, ends up benefiting both the poor and the environment. However the relationship between our modern economy and our ecology is construed, positive or negative, it is clear that our economy and ecology are interactive and intimately connected. I think that everyone would agree that a good economy, in both the monetary and ethical sense, must be integrated with ecology and embody a significant win-win dimension, benefiting all people as well as the environment. Economy should provide for a better ecology. The win-win, cooperative dimension of economy though cannot be absolute for a dimension of competition is also important. Even

Sahtouris acknowledges the need for a balance of individual and holistic interests. The argument for competition is that it helps to drive economic and technological development, which ends up benefiting all of humanity and nature. Competition and self-interest become egocentric and destructive if they are practiced to the exclusion of cooperation and concern for others.

From the above discussion on the spiritual and economic aspects of ecology, it is clear that ecology involves both ethical thinking and principles. Again taking a holistic perspective, Sahtouris highlights the need for an ethical dimension to ecology. To recall, she believes that our ecological ethics should be inspired by a study of Gaia, in essence, a synthesis of scientific understanding and reverence concerning the earth.[238] Critical to the social and ecological ethics of Sahtouris, as well as Henderson, is the importance of cooperation, rather than an exclusive emphasis on competition.

Our cultural values are relevant to ecology. Cultural values guide the economy, and undoubtedly, vice versa as well, stimulating the production of goods and products, which of course impact our environment. Many writers have critically commented on the consumer culture of modern society, blaming our environmental and social injustice problems on the excessive, ever-growing need of developed countries to accrue more and more material possessions and use up more and more of our resources on unnecessary and indulgent activities. Recall Naisbitt's comment that America is "technologically intoxicated with its gadgets".[239] Writers such as Theobald and Easterbrook, among others, have argued that we need to move beyond our materialist consumer culture.[240] In fact, Easterbrook believes that a distaste and objection to modern consumer culture underlies much of the critique of radical environmentalism.

Ecology is also connected to art. As Anderson notes, often the debates over the environment come down to questions of aesthetics. What type of ecology and world do we find most beautiful? Should we live in a world where the presence of humanity is highly visible or should we live in a world where our technology and cities do not dominate the landscape? Even if advanced technology is good for the environment, perhaps it is seen as just ugly? Further, Anderson states that though we may wish to find some independent arbiter to decide such questions, there isn't one.[241] What indeed is natural? Gardens by all accounts are seen as objects of beauty, but gardens are created by humans.

As a general ecological philosophy, Anderson proposes that we should support a **proactive environmentalism**, that is global, active, and future oriented. We should support economic and technological development because such developments will in the long run probably solve whatever environmental problems we face. Rather than focusing on past mistakes, which he sees radical environmentalists doing, we should learn from our mistakes. Learning from our mistakes is going to entail more action, not less. As he argues, the world is becoming more, not less, anthropocentric; our involvement in our ecology is growing. We can't leave nature alone.[242]

Easterbrook, in his *A Moment on the Earth*, also articulates a general philosophy and prognosis for the future of ecology. Beginning with his assessment of present conditions, he states that in the West, the age of pollution

is nearly over, and although the environment in the West is quickly becoming cleaner, the general public believes (or is being led to believe) that it is getting worse. Concurring with the review within this section, he notes that modernized countries are much cleaner than developing countries, and that environmental trends in some cases are actually getting worse in the Third World. Even though there are clearly problems with environmental damage and pollution in developing areas, he believes that modernized countries are capable of responding to our global environmental problems. As he notes, almost all technological trends are toward more efficient, less wasteful, and less ecologically disruptive systems that use fewer natural resources. Between advancing technologies and a free market economic system that takes into account a cost-benefit analysis of its actions, the most feared environmental catastrophes will almost certainly be avoided. He believes that our most pressing issue is the prevention of the further extinction of species around the world, and though humans undoubtedly have triggered the ongoing mass extinction, in the long run we might be able to preserve innumerable species past the point where they would have become extinct.

As a guiding principle he argues that logic and realism, rather than sentiment and "doomsday emotion", should serve as the basis of our environmental policies and actions. Easterbrook states that an "**ecorealism**" will serve nature best, and nature in the long run will thank us for it. Nature is not ending and the human damage to our environment is not "unprecedented"; there have been various ecological calamities of equal or greater scope in the past. Humans are not the enemies of nature; in fact, humans might have a special beneficial role to play in the further evolution of nature. Nature in fact may be on the verge of re-asserting itself with the unique involvement of humans in the process.[243]

The Future of Nature

"Nature's powers are on the increase, its wonders barely begun.
Nature is just getting started."

Gregg Easterbrook

"The only real hope of people today is a renewal of our certainty
that we are rooted in Earthand, at the same time, in the cosmos.
This awareness endows us with the capacity for self-transcendence . . ."

Vaclav Havel

"Is there life on Mars? No, but there will be."

Christopher McKay

At present we live in the middle of a controversy with different possibilities looming ahead of us. Are we heading straight to heaven or straight to hell? Do we need to fundamentally change our modern way of life, or will our advancing economy and technology save our world? As can be seen from the above review, the ecological crisis is multi-faceted and open to highly different interpretations. The ambiguity of existence, a fundamental principle of quantum theory, confronts us regarding our environment and the health of our natural world. Yet this very ambiguity makes our future actions important. It is neither a foregone conclusion that nature is falling apart, nor a certainty that we are creating a new Garden of Eden. What is certain is that our world is changing and we will be participants in the future unfolding of events.

Within this chapter I looked at how humanity's understanding of the environment and our place in the great ecosystem of the earth is undergoing some great and fundamental changes. Although science, technology, and the modern way of life are often blamed for the destruction of the natural environment, it is our enhanced scientific thinking and technical skills that have brought a much deeper and more comprehensive picture of our global ecological system. Further, it is science and technology that are helping to solve the problems of our contemporary natural world.

The holistic model of contemporary science has been one central theme of this chapter. A holistic view of our place within nature runs counter to Industrial Age practices, as well as the deeper traditions of dualist and individualist thinking in Western civilization. It reveals that humanity is embedded in a web of interdependencies within the natural world; it reveals that our actions come back on us. This type of image, although developed in science, is influencing our social, economic, philosophical, and spiritual thinking as we enter the 21st Century. Economy impacts the environment and vice versa; society and culture are interdependent with the environment, and so are technology and industry. We need a broad based, comprehensive ecological consciousness in order to correctly understand our world.

A second fundamental theme within this chapter is evolution. Nature is not static but transforming. The network of systems on the earth and within human society exists within the context of the cosmos, which is evolving. Although we may wish to preserve nature and our present environment, life is going to change whether we like it or not. If nature is going to change, it is best that we understand its dynamics and attempt to guide its transformation in an intelligent, informed, and ethical manner.

The Gaian theory reflects both holistic and evolutionary thinking, where all of the various natural processes across the surface of the earth are interconnected and integrated into a vast evolutionary system. The various systems are involved in a process of reciprocal evolution. And yet the Gaian theory also acknowledges the significance of individual systems that can play a special role in the transformation of the earth’s ecosystem. We are part of the Gaian system, having a unique role in its future evolution, if not reproduction.

If we abandon our dualistic thinking in favor of the principle of reciprocity, our science and technology will be seen as integral parts of the evolution of Gaia. A new evolutionary and ecological mindset, which includes technology, could transform the face of the world. This holistic and dynamic approach, although scientifically inspired, could serve as the foundation of a new society, spirituality, and philosophy that places humanity within the context of nature and an evolving cosmos.

Gregg Easterbrook is one environmentalist who understands the evolutionary nature of the earth and sees the integral role humanity plays in the workings of the ecology on our planet. Further, Easterbrook sees no realistic way to go backwards in time, in hopes of restoring what once was, with both its "virtues and vices". Instead Easterbrook envisions a **New Eden** that will involve the unique capacities of humans and human technology, in a new synthesis and cooperative relationship with nature. He provides the following list of potential new features to nature in the future.[244]

- Nature will no longer be a result of "spontaneous ordering" and natural selection, but rather will be directed by intentional conscious design. Humans will provide this intentional conscious design.
- High tech will continue but become less obtrusive and much cleaner.
- There will be a renewal of wonder over nature. Humans have lost their sense of wonder with nature and need to regain it.
- There might be an end of predation of animals against animals, people against animals, and people against people. Predation may not be a necessary feature of a viable ecosystem. Hopefully, humans, through genetic engineering, can end the pain and anguish of animate life being attacked and consumed by animate life.
- There might be an end to extinction of species. At our present time, this is Easterbrook's top environmental priority.
- Within the "New Nature", there could be an end to disease.
- We may be able to protect nature and life against "killer rocks" from outer space. Human technology will provide a defense system for collisions with comets and asteroids.
- We should be able to end the waste of the incredible amount of energy being produced by the sun. We may harness the power of the sun and develop into a solar civilization.
- There may be an end to aging. There may be an end to the death of conscious minds. Based upon possible developments in biotechnology and computer technology, human minds could achieve immortality.
- Life will no longer be restricted to reliance upon the sun for energy and no longer restricted to planets for habitation. The biosphere will extend. Life will spread to the planets and throughout the galaxy, diversifying into a multitude of life forms and ecosystems.
- Humans, in migrating to other worlds, may return to the earth to its "previous management".

In the final chapter of his book, Easterbrook asks what the meaning and significance of life is. For him, this is the central question to be addressed in our debates and concerns over the environment. His answer, inspired by Freeman Dyson's *Infinite in All Directions*,[245] is that life seeks to extend and diversify itself and reach upward into consciousness and intelligence. The goal and meaning of life is the evolution and spreading of mind. In the next chapter, I explore the possibilities of life and mind, empowered by technology and science and inspired by wonder and awe, reaching outward into the vast ecology of the universe and outer space.

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Awakening Earth – Duane Elgin - http://www.awakeningearth.org/
Connecting with Nature - http://www.pacificrim.net/~nature/.www.html
Ecotopia - http://www.ecotopia.org/
EnviroLink Network - http://www.envirolink.org
Global Change and Environmental Education Resources - http://www.gcrio.org/edu.html
Hazel Henderson Home Page - http://www.hazelhenderson.com/
Life Web - The Writings of Elisabet Sahtouris - http://www.ratical.com/LifeWeb/
Nature - http://www.nature.com/nature/
Planetary Engineering Group Earth: The Age of Solar Power - http://www.pege.org/
Sustainability Institute - http://www.sustainer.org/
Trees for the Future Index - http://www.treesftf.org/
WebEarth - http://www.webearth.org/
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