CHAPTER 13

LEAVING A HABITABLE PLANET FOR OUR DESCENDANTS: THE QUEST FOR SUSTAINABILITY

By the time I had finished my first major research project in 1948, my primary professional goal was to develop the means for protecting ecosystems from the damage I had viewed that summer and then rehabilitating them when they had been damaged. Although many of my colleagues over the years have viewed my research activities as disparate, I have viewed the study of stressed ecosystems as a unifying theme. The presumed discontinuity comes from the present structure of science, i.e., ecotoxicologists and traditional ecologists still rarely communicate regularly, although this lack of communication is changing. Even so, in the early years of my career, I had to publish in a variety of journals because no one journal was dedicated to publishing transdisciplinary work. My colleagues accused me of having no fixed objective in my research and believed that this variety suggested a grasshopper approach, leaping from one focal point to another. I have also been criticized for not having enough "hard science" publications—that is, those articles essentially preoccupied with data. However, over half of my journal articles are in the "hard data" category (over 250 journal articles). What apparently bothers others in science is the diversity of subjects in my publications: ecotoxicology, ecological restoration, microbial community structure and function, ethics, and sustainable use of the planet. I view these as interconnected by the theme "use without abuse of natural systems." However, the main problem may be that the articles are written so that non-specialists can understand them. Diamond's (1997) article on Carl Sagan emphasizes that Sagan lost potential membership in the US National Academy of Sciences not because he failed to produce sufficient important scientific research but because he had too much success as a popularizer of that research. As Diamond suggests, rejection of Sagan by other scientists appears incomprehensible because they themselves continually advocate that the public's understanding of science be improved. Yet, a scientist successful in improving these communications is paradoxically and frequently faced with hostility, penalties, and the like. Unquestionably, this situation is changing; for example, the Aldo Leopold Traineeship of the Ecological Society of America is focused on increasing communications abilities of ecological scientists and has been quite popular.

My awareness of the difficulties of moving from one disciplinary group to another was heightened when I served on a National Research Council committee in 1977 (Gloyna et al., 1977). The committee considered, among other things, the possibility of effectively re-educating individuals from other, somewhat related disciplines to serve as professionals in the water quality field. However, even professionals then unemployed were reluctant to make such a move because they feared being permanently excluded from their original field. After this experience, I wrote "Academic Blocks to Assessing Environmental Impact of Water Supply Alternatives" (Cairns, 1979) as a chapter in the *Thames/Potomac Seminars*. The next year (May 13, 1980), I spoke on this issue in the lecture "Suppression of Creativity in Academe" at "The Not Your Average Lectures Series" organized by the students of my own institution. I discussed the unfortunate consequences for young faculty members and students who ventured outside of their disciplines too early. I had another opportunity to draw attention to this subject when my home institution's president James McComas launched a series named "President's Symposium," which focused on concerns for large societal problems. *Environmental Literacy and Beyond* was produced from the symposium (Wallace et al., 1993). In my chapter in the volume ("Intellectual Electric Fence"), I noted that people who stayed within a discipline with a very strong specialization should not impede scientists who attempted to examine the larger system, a sine qua non for environmental problem solving. Another attempt to explore this issue is my article "Communication and Status: The Dilemma of an Environmental Scientist" (Cairns, 1993), which was reprinted by permission in two other sources after it first appeared in *Speculations in Science and Technology*. All these publications resulted in correspondence, telephone calls, and exchanges at professional meetings from people who feared the consequences of straying beyond disciplinary boundaries, but who felt powerless to correct the situation. Diamond's article (1997) made a deep impression on me because it illustrated that, if someone as famous as Carl Sagan could be singled out, then what protection does an untenured assistant professor or a professional in industry or government at early stages in career development have? Wilson's (1998) volume, *Consilience: The Unity of Knowledge*, provides hope that disciplinary boundaries can be surmounted without damaging their quality control systems. Aldo Leopold (1966, p. 197) states:

> One of the penalties of an ecological education is that one lives alone in a world of wounds ... An ecologist must either harden his shell and make believe that the consequences of science are none of his business, or he must be the doctor who sees the marks of death in a community that believes itself well and does not want to be told otherwise.

The turning point for me in making the decision to devote much of the remainder of my career to sustainability issues occurred at the first Abel Wolman Distinguished Lecture given at the National Academy of Sciences. In a lecture entitled "Ethos, Equity, and the Water Resource," Luna Leopold (1990) discussed each agency acting as if "it were the only flower facing the sun" and deplored the compartmentalization in organizations and disciplines. I reasoned that, if a distinguished scientist and the son of Aldo Leopold could focus on these issues at that stage in his career, I was obligated to do what I could in another context that faces the same problems of compartmentalization and reductionism.

The dichotomy in thinking about sustainability is between those who believe in infinitely replaceable resources (e.g., Julian Simon in Myers and Simon, 1994) and those who believe in a large pool of recolonizing, globally distributed species.[1] The latter point of view assumes that humans are dependent on a biospheric life support system and that they cannot manipulate everything for their own needs. Sagan (1994) calls attention to humankind's curious belief that the universe was made especially for it. The most plausible explanation is that the self-esteem of humans is so fragile that only a custom-made universe will do. Humankind's actions support this view: (1) humans are taking essential habitat from a huge number of species, (2) humans co-opt a huge proportion of the planet's resources, leaving the 30+ million other species with less resources each year, (3) toxic chemical substances reduce the ecological value of habitats far distant from the place where they were used, (4) facilitating invasions of alien species without their biological controls causes great ecological disequilibrium. The evidence for infinitely replaceable resources, given sufficient economic incentives, fits the free market concept of willingness to pay, but ignores a number of issues I consider important. An illustrative list of these issues follows.

(1) Even if humankind could manipulate the planet and the solar system, and perhaps even the universe, so as to achieve sustainability by sequential substitution of resources, implicit in this belief is the right of humans to deprive other species of resources necessary for their existence. Thus, this idea is not, for me, a guiding belief; and, even if it were possible, I would reject it.

(2) If the present generation depletes resources during its lifetime, leaving the next generation to develop substitutions, does this action show a lack of compassion for future generations or does it show a blind faith in the ingenuity of future generations? One billion people go to bed hungry nightly, and two billion live on an income that would cause most American citizens to riot. These two facts should at least indicate that problems exist with carrying capacity and infinite substitutability of resources.

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[1] The MacArthur/Wilson (1963) equilibrium model demonstrates that, when a particular species disappears from a particular community or locale, it is replaced from a pool of species better suited to that particular habitat at that particular time. For species with a cosmopolitan distribution, a replacement species is always available. One might reasonably consider this a renewable resource situation. For species with a much more restricted distribution, the loss may well be permanent for that particular locale. Biological impoverishment will markedly reduce the number of potential colonizing species. The more of the latter that are available, the greater the resilience of natural systems. However, natural capital is finite on a finite planet and natural resources are not infinitely replaceable. This is the main obstacle to a rapprochement between economists and most ecologists.

Although I have published many articles based on the continued use of natural resources with the clear view that continued use would not be possible if natural resources were damaged, my most important article (Cairns, 1997) on this concept came about purely by chance. Peter Raven, Director of the Missouri Botanical Garden and then Home Secretary for the U.S. National Academy of Sciences, invited me to participate in a small workshop on sustainability in February 1997 in Wisconsin. Accompanying the invitation was a four-page, undated, publisher-unspecified description of the Natural Step Program, originated by Karl-Henrik Robèrt and his colleagues. I was horrified that I had not even been aware of this splendid development and was intrigued by the four conditions stated in that four-page leaflet. One important feature of the Natural Step Program was reaching a consensus on the conditions for sustainability. What, I wondered, would happen if someone produced a set of conditions likely to prove effective in preserving the biospheric life support system and its services upon which human society depends, even though a consensus at this time would be clearly unachievable? The four conditions seemed so self-evident that I would almost describe them as platitudinous to someone moderately literate on environmental problems. However, I was astonished that Robèrt and his colleagues had achieved a consensus even on these issues, given the anti-environmental backlash described by Ehrlich and Ehrlich (1996) or the ecological denial so beautifully described by Orr and Ehrenfeld (1995). Robèrt, and a number of others whom I would dearly have loved to discuss these matters with, would be present at the meeting. However, health problems (blood clots in deep veins of one leg and asthma that was precipitated by exposure to second-hand cigarette smoke) precluded any long-distance travel for me.

I pondered the concepts and decided that the consensus conditions, while a splendid start, were far short of what was needed. I immediately produced a list of eight conditions, including the existing four. I became almost obsessed with this task and by May had produced a list of illustrative goals and conditions that would have to be addressed if a sustainability strategy were to be developed. Fortunately, I had a number of invitations from nearby areas to teach and speak, which permitted me to test these ideas on a variety of interest groups. The first was an Elderhostel at The Mountain Conference Center in Highlands, North Carolina; followed by a regional Phi Beta Kappa luncheon talk; a banquet address for the local society of Sigma Xi; a convocation address at Roanoke College, Salem, Virginia; an address to over 200 high school students for a regional meeting sponsored by the Society for Sigma Xi; a lunchtime seminar talk for a group of businesspersons in Roanoke, Virginia, sponsored by my university's regional graduate school in that city; a seminar on campus in an urban and regional planning class; and a talk at an economics seminar. The response was reassuring, although most of these people had not even thought about problems of sustainable use of the planet, which were now my major preoccupation. The response of the high school students to the talk by a person worried about their future was touching. In fact, the 10-minute question period at the end of the talk was extended by 40 minutes because of school bus schedule changes. Even with this extended time, the students were still asking questions and discussing various issues when the buses arrived.

Service on an award committee for selecting a person who had achieved excellence in implementing sustainable practices in industry made me aware of the industrial ecology publications of Graedel and Allenby (1995), Graedel (1999) and Tibbs (1992). My exposure to the Natural Step Program made me belatedly aware of Hawken's superb book *The Ecology of Commerce* (Hawken, 1993).

My doubts that mainstream science, engineering, and economics could achieve transdisciplinarity were dispelled by service on a number of National Research Council (the operating arm of the U.S. National Academy of Sciences and Engineering) committees. The committees consisted of individuals who had achieved notable success in their specialties, but this success did not impede their ability to collaborate with other disciplines. I was fortunate to chair one 15-person committee that enthusiastically and skillfully connected science, technology, and public policy (National Research Council, 1992). The volume produced by the committee recommended that the rate of aquatic ecosystem restoration exceed the rate of damage. The target date of 2010 for the first stage of this process seemed quite reasonable in 1992. With only five years remaining, the target date will probably not be met. Since the publication provided both numerous case histories and literature citations to document that the science and technology *of that time* were adequate to implement the recommendations, it is a great disappointment to me that a wealthy and scientifically and technologically advanced country such as the United States has done so little to repair ecological damage that humankind has perpetrated.

Arguably, the greatest threat to the security of humankind is an alteration in the functioning of the biospheric life support system so that conditions are less favorable, or even unfavorable, to the human species. Polls indicate that most American citizens want clean air and water and greatly reduced hazardous chemical substances in their environment. However, this aspiration has not markedly affected public policy. Earth's environment, at present so favorable to humans, will not remain so for the entire estimated 15 billion years until the sun dies. Consequently, continued serious damage to the biospheric life support system upon which humankind depends is stupid. If humans are unwilling to protect their life support system, then perhaps intelligence, as presently defined, does not have as much survival value as once thought. However daunting the obstacles, humans can still achieve long-term sustainable use of the planet if unsustainable practices cease.

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