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Research and Theory in Human Ecology
As we enter the twenty-first century, ecological concepts have been adopted by, and adapted to, virtually every academic and applied field—from the social sciences and humanities to engineering, planning, medicine, business, and politics. With ever-increasing awareness, humanity is arriving at an understanding that we live in an ecological—and a human ecological—world.

Ecology, as an interdisciplinary science, has always wrestled with topics of complexity and comprehensiveness. However, some of the most challenging issues have occurred at the intersection of natural and human ecology. For some, ecology should focus on the scientific study of nature; for others, humans are an inescapable part of the living world and the domain of ecology must include them. These concerns date to before the founding of the Ecological Society of America (ESA); indeed, they were a significant aspect of ecology from the outset.

Human ecology has a complex history. The first decades of the twentieth century saw multiple attempts to initiate the field, coming not from scientific ecology, but from social sciences and human studies disciplines such as geography, sociology, anthropology, and psychology. During the 1950s and 1960s, similar attempts were made in various applied fields, including health, planning, architecture, and design. However, these initiatives seldom extended beyond their fields of origin, and they rarely had any relation to one another. ESA produced multiple advocates for human ecological orientations over the years, along with many attempts to establish formal organizational structures—though these efforts tended to be periodic and not sustained (see Cittadino, 1993; Young, 1974, 1983).

In the 1970s and 1980s, a truly interdisciplinary human ecology began to emerge, stimulated in part by the advent of the environmental movement and by the founding of an assortment of academic degree programs in human ecology worldwide. Further developments followed with the emergence of regionally based professional societies, including the Commonwealth Human Ecology Council, the European Association for Human Ecology, the Nordic Society for Human Ecology, the Indian Society for Human Ecology, and the Japanese Society for Human Ecology, among others. One of the last groups to form was the US-based Society for Human Ecology...
(SHE), founded in 1981. Between then and now, SHE has organized more than two dozen international human ecology conferences in Europe, Asia, and North and South America—frequently in partnership with the above organizations. Since 1993, the society has also offered *Human Ecology Review* as a leading research and scholarly publication for the field. More recently, SHE has become the coordinating hub for international human ecology activities, education, research, and professional networking (see e.g., Borden, 1989, 2008, 2014; Dyball, 2012; Ekehorn, 1992; Suzuki et al., 1991).

Another major step toward the development of an interdisciplinary human ecology took place in 2007 at the Third International EcoSummit in Beijing, China, which SHE co-sponsored. At the time, I was SHE’s executive director, and my colleague, John Anderson, was president. In a conversation with ESA President Alan Covich at the close of the EcoSummit event, we discussed the possibility of re-activating a human ecology section within ESA. Alan was enthusiastic about the idea. Shortly after the conference, he and Katherine McCarter, ESA’s Executive Director, guided us through the steps of preparing by-laws, enlisting a founders’ group, receiving governing board approval, and launching ESA’s section on human ecology.

The section’s first meeting was held in August 2008 at ESA’s 93rd annual meeting in Milwaukee. John Anderson was elected as the section’s first chair, with Rob Dyball—also a founding member—as vice-chair. Our group, still quite small in comparison to older, more established sections, has been growing steadily ever since and has enjoyed active collaborations with other human-oriented sections of ESA, such as the urban ecology, environmental justice, applied ecology, and agro-ecology sections. We have also contributed our own symposia and organized annual sessions.

In the lead-up to ESA’s centennial conference, Rob took an active role in ensuring that human ecology was meaningfully incorporated into the activities of ESA’s Historical Records Committee. At the 99th annual meeting in Sacramento, he and I were co-presenters of “Human Ecology: An Historical Review” within a nine-part session on the history of ESA. I was elected section chair at that meeting for the forthcoming year and, as one of my centennial-event responsibilities, took on the task of organizing a historically oriented session on human ecology: “Human Ecology—A Gathering of Perspectives: Portraits from the Past—Prospects for the Future.”

The aim of the session was to review a century of contributions to understanding the human dimensions of ecological thinking by highlighting some of the influential individuals whose articulations of their concerns about human–nature relationships have helped to shape the field. Exploring some of these long-standing interests across the timeline of ecology’s history illustrated the myriad ways in which human ecological questions have arisen and re-emerged over the years.
Each presenter composed a historical “portrait” of a notable individual—reviewing his or her early life, educational background, professional contributions, and broader influence. The “human ecological” thinking of each person was highlighted within the context of his or her lifetime, as well as in terms of its current and prospective significance. We began with Ellen Swallow Richards, a Massachusetts Institute of Technology chemist and public health researcher, who visited Ernst Haeckel’s lab in Jena and, some say, was the first American to publicly use the word “ecology” (see “New Science,” 1892). The next three portraits were of ESA past presidents who, in various ways, touched upon human environmental issues. Victor Shelford, ESA’s first president, was an ecological scientist and avid conservationist, whose work reflected the perennial ‘is–ought’ complications of humans-in-nature. Paul Sears was likewise a serious scientist and conservationist, and a forthright spokesperson for human ecology. Frank Golley, the most current of our selected ESA past presidents, advanced landscape ecology, emphasizing environmental ethics and other human-oriented issues. The remaining portraits focused on significant contributors to the history of ecological thought from outside ESA. Rachel Carson, through careful research and skillful writing, conveyed the basic concepts of ecology in everyday language—as did René Dubos, a leading scientist and a prolific author, who developed a rich range of human ecological ideas. Ian McHarg brought ecology to regional planning through his pioneering program at the University of Pennsylvania and influential book Design with Nature (1969). We ended with Gregory Bateson, whose work on the “ecology of mind” charted a distinctive exploration of ecological epistemology and the deeper questions of mind-in-nature.

Following the meeting, all the presenters welcomed the opportunity to prepare written versions of the profiles they had presented. The backgrounds of these authors are as diverse as the individuals they portrayed; they come from the fields of ecology and social science, history, literature, psychology, and environmental design. The chance to simultaneously look backward and forward on the occasion of ESA’s 100th anniversary was a special opportunity. We hope that our gathering of perspectives renders a multifaceted and valuable overview of the meaning(s) of human ecology from the past, in the present, and for the future.

References


A Brief History of Human Ecology within the Ecological Society of America and Speculation on Future Direction

Section Editor: Robert Dyball

The relationship of knowledge, including scientific knowledge, to improved policy and decision-making is a vexed one (Fischer et al., 2012, p. 8). Like any other organization of significance in its field, the Ecological Society of America (ESA) has, throughout its history, hoped both to contribute to the accumulation of knowledge and to influence policy and public opinion. In a recent editorial in the society’s premier journal, *Frontiers in Ecology*, Jane Lubchenco (2017) argued for the need to make “scientific information understandable, credible, relevant, and accessible to help inform (not dictate) decisions” (p. 3). Yet, there is an unavoidable tension between the ambition to be a “proper science” whose object of study is all things ecological and the goal of influencing change to make the world a better place. Human ecology has long existed as a subfield within ESA. Its ability to contribute, or not, to ESA’s ambitions to influence policy in relation to the pressing problems of the day has been constrained by two related issues: how these problems have been framed, and the role and best mode of science for informing policy directed at resolving these problems. For as long as these problems have been interpreted as the consequence of humans’ “interference in nature,” and for as long as the mode of science deemed most appropriate for informing policy change has been quantitative data-based “objective” descriptions of change in ecological processes, the ability of human ecology to contribute to resolving these problems has been constrained. A brief history of this tension is laid out here, with some speculation on how recent moves to reinterpret both the nature of today’s problems and the most appropriate mode of science for informing policy to help manage those problems may allow human ecology to contribute in new ways.

The story of human ecology within ESA can be told as the tale of two sciences. The first, running on and off through the first decades of ESA’s existence, was an attempt to form an applied problem-solving science studying the nature of human influences on ecological processes as a new sub-discipline within the broader discipline of ecology. This endeavor failed, or at least it “failed to materialize as a consistent and coherent field of inquiry” (Cittadino, 1993, p. 253). The suggestion made here is that this failure stemmed, at least in part, from a trend toward ever-narrower specializations within ecology, resulting in what Worster (1977) called a “cacophony of subfields” (p. 340). This fracturing would have been antithetical to what was recognized at the time as the inherently synthetic nature of human ecology. Further,
a scientific methodology that generates knowledge by decomposing complex systems into ever-smaller parts is ill-suited to understanding human ecological interactions. Thus, while human ecology continued throughout the second half of last century, it did so without formal recognition by ESA. The greater success of the recent re-activation of human ecology within ESA depends on human ecology developing a scientific mode more suited to the phenomenon it seeks to study, and whether this mode of science can be regarded as legitimate by other ecologists. Some general characteristics of such a science have been proposed under the name “post-normal science” (Funtowicz & Ravetz, 1991; Ravetz, 1997, 2006).

Despite Ellen Swallow Richard's hopes that ecology be understood as essentially human ecology from the beginning, as the “science of the conditions of the health and well-being of everyday human life” (Dyball & Carlsson, this volume), history records that it was originally conceived as a sub-branch of biology. The earliest formal definition seems to be that ecology is “the exploration of the endless phenomena of animal and plant life as they manifest themselves under natural conditions” (Sanderson, 1893, p. 613). Many would take the word “natural” to exclude “human.” ESA was originally understood as being concerned with the two main sub-branches of biology—botany and zoology—distinguished primarily by an emphasis on fieldwork (Burgess, 1977). ESA's first president, the zoologist Victor Shelford (1917), added emphasis to the interrelational aspect of ecology, saying:

While primarily concerned with the physiological relations of organisms to environment, and while tending to become to a marked degree an experimental science, the workers in the field have thus far derived, and probably will always derive, their inspiration from the dynamic relations of organisms to their environment. (p. 1)

In this ecology, humans manifest primarily as disturbers of nature—as Borden (this volume) notes, Shelford was an “avid conservationist.” One of the first committees ESA established, in 1917, was for the “Preservation of Natural Conditions for Ecological Study” (Burgess, 1977, p. 13). However, the society did not exclude studies of humans in their use of environmental resources, with forestry and agriculture both present as disciplinary subfields in the inaugural handbook (Burgess, 1977, p. 4).

With time, ESA was to grow increasingly interested in the effect of humans’ behavior on their environments and, in turn, the effect environments have on them. “Human ecology” started to be used as a term for this sub-area of concern from the late 1920s, with ESA founding member Charles (“Chas”) Adams writing on the “Relation of General Ecology to Human Ecology” in 1935. At this time, ecology was well

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1 In his biography of Ellen Swallow Richards, Clarke (1973) misquotes this as “exploitation” (p. 154).

2 A paper on Victor Shelford was given in the ESA conference session, but could not be included in this special issue.
advanced in its efforts to establish itself as a bona fide science by establishing law-like principles that could be applied to its field of study to account for its behavior. Adams (1935) wrote that ecology deals with:

The causes and laws of change in the environment and in organisms, distinguishing the energies involved, the activities of the agents or the systems, their dynamic status, their relative optima, limiting factors and the orderly sequence or succession of their internal and external changes. (p. 319, emphasis in original)

In Adams’s view, human ecology’s contribution was to understand the effect humans have on the dynamics of the processes driving these “laws of succession” and, in turn, the effect these dynamics have on humans and their cultures. For example, he argued that where different ecotones produce different levels and a diversity of biological resources, this creates a sociocultural need for humans to adapt and differentiate to appropriate those resources. In time, this sociocultural heterogeneity, and the uneven wealth of resources, creates pressures, competition, and friction between groups. Social sciences such as archaeology and history can contribute insight into these processes of sociological succession, seen as equivalent to, and interrelated with, the process of ecological succession. Adams saw the role of human ecology as to sit within ecology, but also cross into those social sciences that explain human social interactions with, and social responses to, ecological processes.

Clearly, there was a sense that the reciprocal interactions between humans and the environment were an important issue and worthy of study, and many fields in the social sciences also thought the term “human ecology” was appropriate for what they were doing. The question was, was the envisioned synthetic partnership between the various contributing “human ecologies” possible? The answer soon came—not yet. A major issue of the day was that the presumptive social science partners became rapidly embroiled in something of an academic turf war as to who owned human ecology. Starting with sociology (Park & Burgess, 1921), but soon also challenged by geography (e.g., Barrows, 1923), ethnology (e.g., Forde, 2013), and anthropology (e.g., Bews, 1935), one discipline after another claimed the field for their own. However, each field set research agendas, and interpreted and validated results purely within the theoretical frameworks of their parent discipline. Beyond finding metaphorical extensions of ecological concepts like competition, mutualism, and succession—a useful way to think about certain patterns or processes in human contexts—there was no commonality or interaction between these contested monodisciplinary forms of human ecology (Dyball et al., 2009). From the ecological perspective, there was also an alarming lack of ecology in any of them.

Despite this contest over human ecology in the social sciences, the ESA Bulletin recorded considerable time and effort spent on the promotion of human ecology within ESA from the 1940s onward. At this time, the ESA annual conference was
jointly convened with the American Association of the Advancement of Science (AAAS). With Charles Adams and prominent ecologist Paul Sears as discussion leaders, the 1940 conference featured a session on human ecology, convened jointly with members of the AAAS Section on Social and Economic Sciences (Section K). Papers were presented on such topics as “The Relation of Man to the Natural Environment,” “Agriculture as a Problem in Biological Environment,” and “Man’s Relation to Land.” Paul Sears emerged as a strong proponent of human ecology, as documented by Cittadino (this volume). Across the next two decades, Sears contributed to ESA, building a range of activities in the name of human ecology, and becoming increasingly concerned that ecologists needed to better understand the role of culture in human decision-making as the ultimate explanation for their effects on ecosystems.

Sears became president of ESA in 1948, further enhancing the status of the human ecology approach, which he saw as fundamentally synthetic. Good landscape ecology needed to integrate with other subject areas, and work with affected committees to generate solutions to problems in terms that the community could understand. Sears saw patience, understanding, and good communication skills as crucial. Most problems were not due to “foolish individuals or bad laws, but rather [needed to be understood] in terms of the basic structure and values of society” (Sears, 1954, p. 963). His repeated concern was that human ecology was not making the contribution it could to the pressing environmental concerns of the day because it, and ecology more generally, were misunderstood, belittled, or ignored by other more prestigious sciences, and by extension the policy-makers whose ear those sciences had.

The formalization of activity in human ecology within ESA was related to the International Technical Conference on the Protection of Nature, convened in 1949 by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) and the International Union of the Protection of Nature (now the International Union for the Conservation of Nature). ESA member John P. Shea presented a paper at this conference, “Human Relations: An Essential Factor in Resource Protection and Use” (“Program of the New York meeting,” 1949, pp. 68–69). Following this, the United Nations (UN) and UNESCO requested ESA to provide input on the “development of an adequate methodology for Human Ecology” (“Program of the New York meeting,” 1949, p. 68), to help them to pursue their conservation goals. That December, at ESA XXXIV New York, Shea proposed a resolution for “the Study and Application of the Methodology of Human Ecology by the UN and UNESCO, its Specializing Agencies, the United States Government and other cooperating agencies” (“Announcement and call for papers,” 1950). Following the passing of this resolution, ESA then moved to appoint a committee to cooperate with the UN and the United States (US) government in implementing the
resolution. This was the Committee on Human Ecology, with Shea as its founding chair. The resolution was proudly announced in a letter sent to a range of august bodies, including the US president.

The Committee on Human Ecology was involved in a range of activities through the early 1950s, commencing with a major symposium on Science and Human Values in Cleveland in 1950. Activities, including symposia and projects, were regularly reported on by the committee through the later 1950s, with the chair of the 1958 committee, George Happ, flagging a range of initiatives, including research programs, the prospect of a dedicated journal, and plans to reconstitute the committee as a formal ESA section. Happ predicted confidently that “as the values of human ecology become clearer and more important, and the techniques for the research become more developed, that research projects in human ecology will be carried on more frequently” (“Proceedings,” 1959, pp. 21–23).

It is something of a mystery as to why no further evidence of activity or the existence of the Human Ecology Committee, or any other formal grouping within ESA around human ecology, can be detected from here onward. In his analysis of ESA history, Burgess (1977) wrote that “a committee on human ecology, while never pushing towards section status, has continued to function” (pp. 12–13), with the use of the present tense suggesting that the committee was still operating. However, his chart tracking the periods covered by the sections within ESA showed the Human Ecology Committee ceased to exist in the early 1960s, and no further reports from it are recorded in the *Bulletin* from this time. There is no doubt that individual members continued to work and publish with reference to human ecology (e.g., Paul Ehrlich and Garrett Hardin; see Borden, this volume), but from the early 1960s, it ceased to be a term that ESA officially acknowledged. It is noteworthy that ecology itself was at this time fragmenting into numerous sub-disciplines with little agreement concerning the important and unifying themes across ecology (Neff & Corley, 2009). Such fragmentation would not sit well with the synthetic nature of human ecology. Further, ecologists’ desire to gain the respect of other sciences by refining modeling and prediction in their subfields (soon to be aided by computers) would clash with the unpredictable sociocultural aspects of human decision-making and behavior. Finally, at this time, humans were very much identified as “the problem,” with many ecologists preferring to work in pristine ecosystems in which humans’ pernicious presence was not felt—a preference that continues in some quarters today.

It could be argued that whether human ecology was formally acknowledged did not matter, so long as the work for which it advocated was being done, which appears to have been the case. More than a decade after the disappearance of the Human Ecology Committee from ESA’s records, Sears’s protégé, Paul Shepard, wrote a piece titled “Whatever Happened to Human Ecology,” in which he indicated that work related to human ecology continued, but under a “myriad other names.” He wrote,
“one might conclude that the destiny of human ecology is to accept its eclectic nature. It would be impertinent to attempt to define it now so as to exclude its historical forms or its descendent and peripheral disciplines” (Shepard, 1967, p. 911). While this view may have been valid, no such undefined field of study would be acknowledged by ecological scientists as a science. Its lack of status as a science explains why human ecology had no formal presence in ESA at this time.

Borden (this volume) discusses the circumstances of the re-activation of human ecology as a section within ESA. An obvious question is, is this new manifestation likely to be any more successful than its predecessors? In the intervening 50 years, both human ecology’s field of study and its means of conducting that study have changed considerably. This suggests that, in part, its success within ESA will depend on whether the science of ecology regards human ecology, as it has developed, as a legitimate methodology and valid body of knowledge. Space precludes a detailed overview of modern human ecology, which continues to take many forms, but the subject remains concerned with the ecological conditions that make life possible, blended with questions of how the human ecological system ought to be, and what constitutes living well. These questions have a normative dimension, as they involve judgments about what is good or bad; how a community should set its goals; and which of myriad means for achieving those goals are the most desirable to pursue, and in whose interest. This presents the challenge of making good decisions and policy when “facts are uncertain, values are in dispute, stakes are high, and decisions are urgent” (Functowicz & Ravetz, 1993, p. 744). In these circumstances, the role of applied disciplinary science is decidedly limited, either individually or in multidisciplinary combinations. Good policy is fundamentally synthetic, as it involves context augmentation, blending knowledge and values from different sources. Disciplinary science is fragmentary, simplifying phenomena through context reduction. Vital as it is for describing the case under consideration, it has little to say about what should be.

ESA has set itself a guiding framework through the Earth Stewardship initiative. Through this, ESA has tasked itself with “shaping trajectories of social-ecological change at local-to-global scales to enhance ecosystem resilience and human well-being” (Power & Chapin, 2009, p. 399). Human ecology is, or should be, ideally positioned to contribute to such an initiative because the initiative itself contains fundamentally normative aims of engaging with and changing society and policy. This aim demands a democratic transdisciplinary science of the kind that modern human ecology can be. Post-normal science provides very useful guides to how science might re-invent itself in this form, especially in regard to democratically informing policy decisions in complex situations. Key challenges for a post-normal human ecology include establishing the means of achieving mutual understanding between knowledge holders; enabling common understanding of the dynamics of change in complex systems that capture and intervene to affect the feedback structure.
of the system; contributing to the co-production of knowledge and decisions with stakeholders and problem owners; combining qualitative and quantitative elements equally; and developing a framework that promotes open dialogue about “what if” questions and debate on “what should be the system’s goal,” with an ultimate aim of facilitating discussion between stakeholders as to whether the system behavior is “what we want.” A tentative approach to establishing a coherent theoretical framework that will enable human ecology to help to meet these challenges is given in *Understanding Human Ecology* (Dyball & Newell, 2015), and other frameworks also exist. Whatever form it might take, if human ecology can establish itself within ESA as an operational post-normal science, then it has great potential to make its long-sought-for contribution to ESA’s goals, such as those currently articulated as Earth Stewardship. This will, of course, require ESA to accept a form of post-normal science as a valid and appropriate mode of knowledge production. If such an accommodation is possible, then ecology and human ecology have the potential to contribute in a significant and greatly needed way to making the Anthropocene a just, worthwhile, and sustainable era for all humanity.

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Ellen Swallow Richards: Mother of Human Ecology?

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Life and times

The first person to use the term “human ecology,” in 1892, was the remarkable Ellen Swallow (later Richards). She was born into the small, isolated rural community of Dunstable, Massachusetts, in 1842 and raised on the family farm. Both Ellen’s parents were well educated for the times, and both had been teachers. They resolved that Ellen would be better educated at home by them than at the local school, and so as a child she received no formal education. Ellen was bright and learned readily, but she was also considered frail and sickly. On her doctor’s orders, she was instructed to spend as much time as possible outside, in the belief that fresh air and exercise would be good for her. As was considered natural at the time, she also helped around the house, with duties such as cooking, cleaning, and needlework. Prizes won at the local country fair suggest that she was skilled at these arts too. These formative experiences of the curative power of a healthy environment and the importance of household arts are pointed to as the basis of her lifelong interest in the influence of the environment on the health and well-being of humans (Hunt, 1912, p. 77).

Ellen’s family sold their farm and opened a store in the nearby town of Westford in 1859. At this time, Ellen commenced her formal education at Westford College, at the age of 17. She proved a very capable student, developing a range of interests, and demonstrating an aptitude for languages and mathematics. She also tutored, helped in her father’s store, and cared for her sick mother. On graduating, she became a teacher, but remained impatient to advance her own knowledge, and particularly to pursue an interest in science. In the 1860s, opportunities for advanced education for women were few, and even fewer for a “male” subject like science. However,
Vassar College for Women in Poughkeepsie, New York, had opened in 1865 and was offering the then unheard-of program of science studies for women. Ellen applied in 1868, aged 26, and was admitted as a third-year student, on the grounds that her entrance examination demonstrated advanced levels of learning. Given that only 100 women were admitted each year from the thousands that applied, this was a remarkable achievement (Swallow, 2014, pp. 22–23).

Figure 1: Ellen Swallow Richards
Source: Wikimedia Commons.

Vassar College made a significant impression on Ellen’s future in two major ways. One was that her professor of chemistry, Charles Farrar, was convinced science could and should be applied to everyday household and community situations. The other was the professor of astronomy, Maria Mitchell, who was a strong activist promoting the role of women in science (Vassar Historian, 2016). Graduating after two years, Ellen took the remarkable step of applying to the then all-male Massachusetts Institute of Technology (MIT) to further develop her knowledge of chemistry; a move Farrar likely influenced. Supported by Farrar’s recommendation, Ellen was
accepted by MIT under a “special student” classification. This status saved Ellen from paying fees; however, rather than indicating MIT’s generosity for her circumstances, it appears this status was to open an option for the institute to deny that a woman had ever been enrolled should the “experiment” of admitting one backfire (Kwallek, 2012). Regardless, Ellen went on to graduate from MIT with a Bachelor of Science in chemistry in 1873, making her the institute’s first female graduate. By then, Ellen had already established herself as a “preeminent international water scientist” (Clarke, 1973, p. 39) through her painstaking laboratory work analyzing the extent of industrial chemical pollution of urban water supplies. Far from pretending she had never been there, MIT kept her on as a laboratory assistant and, in due course, instructor and laboratory head, for the rest of her life. However, they could not bring themselves to ever confer a doctoral degree on her.

Environmental constraints on human health and well-being

The laboratory analysis of industrial pollutants that Ellen conducted was not merely driven by an emerging concern for the health side effects of industrialization, although it certainly included that. Her concerns were also both ethical and pragmatic. The process of industrialization was, as she saw it, charging ahead with no thought for its broader consequences or need for governance by appropriate new social institutions and regulations. As her friend and biographer, Caroline Hunt (1912), recalled:

> The flow of industry had passed on and left idle the loom in the attic, the soap kettle in the shed. The form of the home was being gradually but surely changed, not, however, because of intelligent direction from within, but through pressure from without. The thoughtless were content to allow the changes to proceed, lead where they would, but the wise were anxious. They began to ask, to use Mrs Richards’ own words … “what forces in the community can be roused to action to secure for the coming race the benefits of material progress”? (p. 260, emphasis added)

The forces in the community that Ellen devoted her life’s work to rousing were those at the household level (primarily women) and local governance (primarily municipal) levels. She recognized the reciprocal impacts between household activities and the social and ecological environment.

Impact on household, loss of power

During this time, how a citizen’s basic lifeworld was enacted was undergoing massive reconfiguration. Industry and technology were changing what stood as normal everyday life and, through newly emerging modes of consumption, the health of consumers and the environmental load of consumption.
With the rapidly industrializing nature of American society in the late nineteenth century, the population was shifting from rural to urban living. By 1920, just over half of Americans lived in cities (Bryant et al., 2003). This brought about changes in what and when people ate. The availability of adequate, nutritious foods for the working class did not always keep pace with the growth of industry, causing widespread malnutrition. The work day also meant a change from rural midday main meals, to a large breakfast and supper, with little to no lunch.

Transportation, refrigeration, and canning technologies stepped in alongside other industry to satisfy the need for inexpensive food that could be transported into cities and did not require significant cooking time at the end of a work day. However, this brought with it unintended consequences. Canning and processing led to the loss of essential vitamins (yet to be discovered) in staples such as canned milk, refined flour, and polished rice. Processing also led to the adulteration of foods with dangerous toxins (typically additives for preservation, texture, or color)—a fact known as early as 1820 (Bryant et al., 2003), but not acted on in the United States (US) until the Pure Food and Drug Act of 1906.

From a feminist perspective, control was an issue. Industrial technology also brought with it a shift in power as “many resource producing activities once controlled by the Family moved from the domestic (private) to the civic (public) domain” (Thompson, 1992, p. 16). According to Thompson (1992), home economics was not about “traditional” women's roles, as some critics claimed, but strove to answer the question of “what knowledge is essential for people in each generation to live a satisfying life and maintain sustainable environments for human development?” (p. 19). Ellen's contribution can be seen very much in this latter sense. She was determined that the people who adopted the “new normal” did so to benefit themselves and their families, and not merely the industries that would profit from the sale of the new modes of consumption. As Clarke (1973) put it, “she meant to make collective the homes that industry had collectively exploited, to organize them by educating their occupants for intellectual self-defence” (p. 174). The importance of Ellen's work lay in the fact that, as Thompson (1992) articulated, “the skills, technologies, and knowledge necessary to perform household duties change from generation to generation, but their collective significance for human wellbeing is not thereby diminished” (p. 16).

Although Ellen concerned herself with the plight and education of women, she did not do so out of concern for a women's equality and was not an outspoken supporter of women's suffrage. Indeed, Ellen seemed quite accepting of men and women having distinct roles and responsibilities. Hers was a fundamentally pragmatic outlook: since women had responsibility over the household domain (Thompson, 1992), including most of the decisions and actions concerning consumption in the home, discharging their duties wisely required that they have the necessary education and practical knowledge to do this.
Impact on environment and need for control (euthenics)

In addition to her concern for increasing household (women's) knowledge, to allow them to regain some control over the industrializing economy, Ellen was also concerned with governing the sources of pollution, and the promotion of a clean and healthy environment across a range of scales. We might recognize this concern today as relating to the concept of “nested systems.” At her 1910 MIT convocation address, she said “the quality of life depends on the ability of society to teach its members how to live in harmony with their environment—defined first as the family, then with the community, then with the world and its resources” (Swallow, 2014, p. 95). She gave great importance to the therapeutic value of the pristine environment.

At the municipal and local levels, she was concerned with those polluting processes that could be “controlled”—one of her later labels for her work was “euthenics,” which she subtitled “The science of the controllable environment” (Richards, 1910, p. v). Her faith in science to facilitate the improvement in humanity’s condition was unshakable and, for her time, understandable. After all, she was one of the first people to analyze urban water systems and to propose sewage treatment standards, and her work prompted the introduction of the first factory and food inspection laws in Massachusetts. At all scales, from the home to the broader environment, she held that knowledge could be liberating and a force for good, and she had “high hopes for the improvement of the controllable environment of human beings through the application of scientific knowledge” (Hunt, 1912, p. 406). She certainly thought that those environments that were largely constructed by humans and in which the primary problems in health and well-being were due to human activities could and should be controlled, which they had not been to date. It is also understandable that the primary location for her program of emancipation through knowledge was in the home. In practical terms, this is where “normal” everyday decisions were made about such issues as what foods to purchase and how to prepare them, and when and how to clean the body and the home. The home occupants’ bodily health and disease exposure followed directly from these choices. Similarly, ecological resource pressure followed directly from these choices, and Ellen recognized both as part of a systematic challenge. Elizabeth Shove (2004), writing around a century later, argued along similar lines, saying:

Notions of what it is to be a normal and acceptable member of society have far-reaching environmental implications: they carry in their wake a trail of inescapable resource requirements like those associated with daily showering, with wearing freshly laundered clothing, with not having a siesta, with eating imported food or having foreign holidays. (p. 77)
Oekology/ecology

By the mid-nineteenth century, the term “nature’s economy” had for some time been used to describe the dynamic relationship between species and their habitats. The metaphorical extension of “economy” to nature implied that the way nature orders and distributes resources to its animal population could be understood as being like the way households acquire and distribute resources to their members (Gaziano, 1996). In 1866, Haeckel suggested a science for the study of nature’s economy that would focus on the interrelationship between organisms and their environments. “Oekology,” as it was originally spelled, was defined by Haeckel as “the body of knowledge concerning the economy of nature [in the original German, ‘Naturhaushalt’—literally ‘nature’s household’]” (Lawrence, 2001, p. 675).

Even within Germany, there was little immediate uptake of the term, and Haeckel himself seemed to have had no further use for it. Over two and a half decades would pass before Ellen picked up the term and used it for the first time in the US. There is no evidence that Ellen met Haeckel in person, although she could speak German and did visit his laboratory in Jena in 1876, and presumably encountered the term around that time.

Ellen saw the term “ecology” (focused specifically on humans) as neatly capturing her broad concerns for human-created environmental conditions and the health consequences for people living in those conditions. She resolved to use it to name her science. In her biography of Ellen, Pamela Swallow (2014, p. 93) claimed that Ellen formally wrote to and obtained Haeckel’s permission to use the term. In late November 1892, in a grand opening at the Boot and Shoe Club in Boston, Ellen formally launched what she termed “the science of the conditions of the health and well-being of everyday human life,” elaborating:

For this knowledge of right living, we have sought a new name … As theology is the science of religious life, and biology the science of [physical] life … so let Oekology be henceforth the science of [our] normal lives … the worthiest of all the applied sciences which teaches the principles on which to found … healthy … and happy life. (Clarke, 1973, p. 120)

Central to this concept was that the environment formed people’s lived experiences and that they responded to that both physically, in terms of their health and well-being, and socially, in that they came to accept as normal what was in fact constructed by societal arrangements and policy process. Conditions could be improved if people only knew about and agitated for that change. She said, “the environment that people live in is the environment that they learn to live in, respond to, and perpetuate” (Clarke, 1973, p. 159). Haeckel’s unused term was adopted in the English language for the first time as the science of the everyday social and
environmental conditions conducive to humans living well. The *Boston Globe* front page headline of December 1, 1892 announced, “New Science. Mrs Richards Names it Oekology” (Swallow, 2014, p. 93).

It was not to last. The following year, in September 1893, Ellen’s use of Haeckel’s term was claimed in the *British Medical Journal* for a much narrower application. “Oekology,” the definition stated, “chiefly rests on the exploration of the endless phenomena of animal and plant life as they manifest themselves under natural conditions” (Sanderson, 1893, p. 613).

There was no question which of these two incompatible uses of the term would persist. Ellen’s application of “oekology” was doomed for several reasons. First, despite Ellen establishing herself as a scientist, the practice of science was male-dominated, and if an established group of men wanted the term to mean one thing, there was little chance a woman’s alternative use of the term would prevail. Relatedly, from this group’s perspective, the only valid practitioners capable of conducting a proper science were bona fide scientists. Ellen’s science encouraged the involvement of non-scientists, such as civil engineers, public works officials, teachers, and business. From an orthodox perspective, knowledge generated by such individuals was inadmissible. Further, Ellen’s science was concerned with what *should be*, rather than only describing what *was the case*. She took an ethical stance in the conditions she studied. People were experiencing sickness, disease, and malnutrition, leading them to live lives far shorter and more miserable than they could be. Her science aimed to change the world, not just record it as a purely objective science would do. But, perhaps above all, the “ecology” that the male scientists were promoting had no room for the study of humans. Despite Darwin’s application of his evolutionary ideas to humans in, for example, *The Descent of Man* (1871), a newer interpretation of his thesis was being developed under the name of “eugenics.” In this view, unlike plants and animals, humans were not subject to evolutionary pressures from the environments in which they lived. The betterment of the human race, it was held, would come through breeding and the purity of bloodlines. To someone that held this perspective, Ellen’s notion that the condition of the environment largely determined the condition of the human that lived in it was anathema. As Clarke (1973) put it, “plants and animals were responsive to environment. But not man. Heredity predestined the human species, not environment, they said” (p. 155).

Although it was some years before Ellen completely gave up on her use of the term “oekology,” it was slowly and inevitably slipping from her grasp and into the male-dominated domain of professional biological scientists. She would have to find another term for her work.

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2 Clarke (1973, p. 154, quoting Sanderson) attributed to this definition the more dominating word “exploitation,” with italics for emphasis.
Home economics and human ecology

This search took her to Lake Placid in 1899, at the invitation of Melville Dewey, then the Director of the State Library and of Home Education in New York State. Lake Placid Club was Dewey’s summer home. Dewey had a pragmatic issue: domestic science had been included as part of the state’s test for college entrance and Dewey needed assistance in what questions might appear in that test. There was also the related issue of where in his library cataloguing system the subject would appear, which also required settling on what it should be called. More broadly, the general attributes of the home and domestic studies were very much under discussion at the time and these discussions needed an identity around which to coalesce. Dewey wanted Ellen to be the catalyst for that process.

It was a wrench for Ellen to throw in her lot with domestic science. Her vision had always been a conjunction of the science of the environment with its application in the domestic sphere. Overtly siding in a leadership role with the domestic consumer — nutrition side would mean diminishing the science. Interestingly, this disciplinary politicking would see the field of nutrition distancing itself from home economics for the same reason a century later. However, the reality was that the science side of the equation was not prepared to accept the partnership that she envisaged. Further, the science side was on stronger grounds than the domestic side and in less need of her help, which it had in any case rejected. Conversely, the domestic, female side “had too few scientists, less discipline, little agreement, and no direction” (Clarke, 1973, p. 169). Partly with Dewey’s cajoling, and partly because it was clear which side needed her most, Ellen resolved to pour her efforts into domestic science.

For the next decade, Ellen led the annual Lake Placid conferences, always under her regime of daily morning outdoor walks to clear the mind and prepare the body. The conference drew in an ever-widening group of male and female intellectuals, academics, and progressive thinkers to discuss the form and content of domestic science. Eventually, the name “home economics” was settled upon. For Ellen, the term represented something of a compromise, but she accepted it, saying:

It is the economy of the human mind and force that is most important, and so long as the nurture of these is best accomplished within the four walls of the home, so long will the word Home stand first in our title. (Hunt, 1912, p. 270)

Home economics was more than teaching sewing and cooking, as Ellen unkindly characterized pre-existing domestic science programs. Home economics was:

The study of the laws, conditions, principles, and ideals which are concerned on the one hand with man’s immediate physical environment and on the other hand with his nature as a social being, and is specially the study of the relation between these two factors. (“Lake Placid Conference on Home Economics”, 1902, p. 70)
It was both a practical science and a philosophical study of the ecology of everyday (human) life, which rested implicitly on early versions of the holistic and systems theory that would later emerge in the ecological sciences in the 1920s and 1950s, respectively (Thompson, 1992). It was also clearly influenced by the early work of Ellen in developing her ecology as a field.

In 1908, the American Home Economics Association was established, with Ellen as its president. Although she died in March 1911, home economics went on to be a major program of study in many institutions in the US and elsewhere. While its academic status is looked down upon in some quarters, at its time, it was a major part of a significant social and educational reform addressing pressing issues in poverty, health and aging, food and nutrition, and education and community development, all under great pressure from large-scale in-migration. Moreover, many of these issues endure in different forms today (Gentzker, 2012).

Despite this, some programs have sought to circumvent the stigmatizing gender-stereotypical association of “home economics” with “womanly household duties,” such as by adopting the title of “human ecology” for their studies, citing Ellen’s original consideration of that label for the field (“Cornell University Library”, 2001). Both terms share etymological roots in oikos (the household) and oikonomia (originally meaning the management and economy of the household). Had Ellen Swallow Richards not been blocked by male gate-keepers to “proper science,” there is evidence to suggest that the evolution of home economics may have been more closely tied to that of ecology and, moreover, human ecology. As Glaeser and Glaser (2010) commented, the fields may be related, with the difference being of scale and purpose:

> These two [distinct ways the subject matter can be approached] represent two different directions of human ecology, the first [“home economics”] mainly oriented towards problem-solving and policy support, the second [as generalizable principles] towards methodological innovation. Both directions are needed because they mutually reinforce each other. (p. 135; see also the elaboration in Christensen [2014])

**Conclusion: Was Ellen Swallow Richards a human ecologist?**

Ellen Swallow Richards does indeed deserve recognition as the mother of human ecology. She was undoubtedly the first person to use the term “human ecology,” as a specific elaboration of what she had earlier intended “ecology” to cover. In the introduction to her book on eugenics, she wrote:

> “Eugenics” was another term she coined to try to capture the broader sphere of concern of which home economics was but a part. The root is again Greek, with “eu” meaning “well.” It can be related to Aristotle’s “good life” or state of human flourishing, as literally the state of the “good spirit.” Eugenics is the cause of wellness or flourishing; that is, the conditions under which Aristotle’s “flourishing” can be achieved.
Human Ecology is the study of the surroundings of human beings in the effects they produce on the lives of men. The features of the environment are natural, as climate, and artificial, produced by human activity, such as noise, dust, poisonous vapors, vitiated air, dirty water and unclean food. (Richards, 1907, p. v)

Beyond noting the terms she used, we can seek key attributes that might identify Ellen as a human ecologist in the way we understand it today. Some general criteria describing a present-day human ecologist include:

• Their object of concern is the interrelationship between humans, their cultures, and their ecosystems.

• They seek a holistic or “comprehensive” approach to understanding these interactions as acting within a larger context, and hence hold that part of the situation cannot be remedied in isolation of the whole of which it is a part.

• They are concerned with the sustainability of any resource use in terms of the environment’s capacity to continue to provision that resource over time, or its capacity to assimilate or otherwise remove hazardous pollutants over time.

• They are concerned with the social and ethical dimension of the current social-environmental arrangements, asking are they fair or ethical? This includes the fairness by which the burden of creating a “solution,” however desirable, might be distributed.

• They are at least aware of the motivational aspects of social change and are concerned with what might enthuse people to work together to try to achieve a just, sustainable, and worthwhile future.

And finally:

• The attainment of such a future is a collective effort with unavoidable political challenges to overcoming entrenched barriers, including those that involve disparities of power, as well as those arising from the underlying cultural values (“paradigms”) that legitimize everyday assumptions about what constitutes normal, everyday behavior (Dyball, 2011; Dyball & Newell, 2015).

Without repeating key points from the above discussion, we can turn to Richardson (2002), who summarized Ellen’s contribution neatly:

Richards found it impossible to isolate the physical environment from the social responses of people to their surroundings. She actively used the term “social environment.” Daring to question the prevailing paradigms in the life sciences and social sciences alike, she urged more dynamic and interdependent views of global humanity in its relationship with the natural environment. Her hopes for the betterment of the human condition and conservation of nature’s ecological equilibrium led her to ask fundamental sociological and political questions about the environmental costs of capitalist technology. (p. 46)
Although there are several terms and concepts that Ellen would not have used or that did not exist in her day, broadly speaking, she shared the key concerns of contemporary human ecology and went some way to develop methods to understand and tackle the issues of this field. She also introduced the term “human ecology” in the US, and her sphere of concern and methodological approach was that of a human ecologist as we would understand it today. The rift between human ecology and home economics was not of her making, and provisional indications are that it is not such a rift at all. In fact, given current sustainability challenges with our food system (Ingram et al., 2016), it would be timely to re-examine how Ellen’s original conceptions of the intersection of human ecology and home economics could strengthen the contributions of both fields to a sustainable food future.

References


Paul Sears: Cautious “Subversive” Ecologist

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In January 1960, columnist Jack Anderson (not yet number one on Richard Nixon’s enemies list) wrote to Paul Sears at Yale, asking if he would answer two questions for Parade magazine, the widely circulated Sunday newspaper supplement that he edited: 1) “Do you believe in life after death?” and 2) “What scientific reasoning or theories can you offer to support your belief?” Ever the careful scientist and the diplomat, and not one to pass up a teaching moment, Sears (1960a) replied:

The question you ask is one which science is unable to answer because its competence is limited to those matters which can be investigated by observation through the senses, an approach which to the present time has been unable to shed any light on the mystery. You may, however, be interested in the following quotation from the opening chapter of my book Deserts on the March.

The face of earth is a graveyard, and so it has always been. To earth each living thing restores when it dies that which has been borrowed to give form and substance to its brief day in the sun. From earth, in due course, each new living being receives back again a loan of that which sustains life. What is lent by earth has been used by countless generations of plants and animals now dead and will be required by countless others in the future (Sears 1935:1). (p. 1)

Those were indeed the first four sentences of Deserts on the March, the book that established Sears’s reputation in 1935. Nearly 30 years later, he wrote a much smaller piece that also attracted some attention: “Ecology—A Subversive Subject.” Its opening lines are also memorable:

My choice of titles is not facetious. I wish to explore a question of growing concern. Is ecology a phase of science of limited interest and utility? Or, if taken seriously as an instrument for the long-run welfare of mankind, would it endanger the assumptions and practices accepted by modern societies, whatever their doctrinal commitments? (Sears, 1964a, p. 11)

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These words reflect a theme recurrent in Sears’s writing in various forms since *Deserts on the March*: ecology, which he purposely held off mentioning by name until the final chapter of *Deserts*, is a science that forces us to reflect on the larger picture, to see things whole, and perhaps to question the underlying assumptions by which we live and work. Sears himself was no subversive. He once characterized his politics as “a bit to the right of Herbert Hoover” (Sears, 1964b, p. 8). In his review of *Deserts* for the *Journal of Ecology*, Arthur Tansley (1936) rightly pointed out that, despite the left-wing politics prevalent in the 1930s, Sears did not call for the abolition of private property as a solution to abusive land use practices. However, Tansley did ridicule Sears’s suggestion toward the end of the book that every municipality or civic unit of reasonable size hire an ecologist as a consultant, just as cities and counties regularly hire engineers and chemists. The suggestion does seem a bit naive, but Sears himself actually played that role briefly. He was head of the botany department at the University of Oklahoma when he wrote *Deserts*. After the book was published, the governor of the state appointed him to chair a committee to push through legislation to create a soil conservation district. He succeeded against strong opposition from Oklahoma business leaders. In a description of the incident published years later, Sears (1954), referring to himself in the third person, discreetly praised himself for winning the businessmen to his side: “A bitter fight was in prospect, but it was avoided by quiet and reasonable explanations, based strictly on the most traditional American practices and upon the firsthand knowledge that the chairman had of ecological conditions within the state” (p. 963). That description appeared in a paper that Sears presented in a symposium on human ecology at the Ecological Society’s meeting in Gainesville, Florida, in 1954. This was one of Sears’s many efforts over the previous two decades to promote human ecology within the Ecological Society of America (ESA) and apply an ecological perspective to a wide range of practical problems. Since Sears did not start out as an ecologist, it will be helpful to take a brief look at his career.

Paul Bigelow Sears was born in Bucyrus, Ohio, in 1891. His father was a lawyer who also ran a farm just outside town. Paul worked at both the law firm and the farm when he was growing up and took lessons from both into his adult life. At the law office, as he described in several autobiographical sketches found in his papers and his published works, he developed an appreciation for clear thinking, gained some insight into the vicissitudes of human nature, and learned to type (Figure 1). The accompanying photo shows him working in his makeshift office on the site of the old family farm while he was teaching at Oberlin College. Eventually, Sears let the farm succumb to the process of old-field succession and donated it to the state, where it exists today as a nature preserve (Figure 2).
Figure 1: Paul Sears in his “office” on the family farm circa 1940

Figure 2: Sears Woods, just outside Paul Sears’s hometown of Bucyrus, Ohio
Source: Photo by author.
After graduating from Ohio Wesleyan in 1913, Sears went to the Universities of Nebraska and Chicago for his MA and PhD degrees, respectively, and not to study ecology. His main interests then were in plant morphology and the new field of cytogenetics. His 1922 doctorate at Chicago was based on research he had begun at Nebraska on morphological and cytological variations in a species of dandelion. However, at Nebraska, he came under the influence of ecologists John Weaver and Raymond Pool, and at Chicago, a field course to Door County, Wisconsin, in the summer of 1919 made him a lifelong fan of Henry Chandler Cowles (Figure 3). A year earlier, during the First World War, Sears was stationed with an army air force unit in Florida, where he did some experimentation, never followed up, with the use of aerial photography to study vegetation. To summarize his academic career, following the war, Sears went from the University of Nebraska (1919–1927), to the University of Oklahoma (1927–1938), to Oberlin College (1938–1950), and then to Yale (1950–1960), where he chaired the country’s first graduate program in conservation. After retiring from Yale, he held visiting positions at a half-dozen universities and colleges between 1960 and 1965, teaching courses on conservation and human ecology.

Figure 3: Paul Sears, center with hat, with classmates from Henry Cowles’s field course in Wisconsin, 1919
Source: Paul Bigelow Sears Papers (MS 663). Manuscripts and Archives, Yale University Library, Box 133, Folder 194.
Paul Sears

Sears may well have had an early interest in ecology, but his full transition from morphology and cytogenetics to ecology was the result of a pet project that he had begun as an instructor at Ohio State University, just before the war. Inspired by the existence of prairie relics in the part of Ohio in which he had grown up, he attempted to reconstruct the vegetation of the entire state before European settlement (Stuckey, 2010). He received initial assistance from his Ohio State colleague Edgar Nelson Transeau and a lot of encouragement from Henry Cowles. After exhausting the information he could glean from old county records, Sears learned about the work that Swedish researchers were doing to reconstruct vegetation history by studying fossil pollen found in bog and lake bottoms. From that point on, Sears’s major research field was the study of vegetation history, and therefore climate history, by means of pollen records. He became a United States (US) pioneer in paleoecology and coordinated his findings with anthropological records as well, correlating changes in vegetation and climate to changes in means of subsistence and related cultural changes among Native American societies from the Midwest to the Southwest and eventually to Mexico (Sears, 1932a, 1932b, 1948, 1952, 1956; Shane, 2010). However, Deserts on the March turned his career in a different direction. Sears (1960b) alluded to this directly in an assessment of his achievements in an address given in 1959 as the outgoing president of the American Society of Naturalists:

If it has not been my privilege to engineer any of the dazzling advances in biological science of recent decades, I assume that my efforts to interpret some of them to laymen have been appreciated. It was, in fact, the shock, nearly thirty years ago, at discovering the serious consequences due to public ignorance of basic ecological principles, that diverted me from interesting technical studies. Even so, this experience has been professionally rewarding, for it has obliged me to give considerable thought to principles, and enabled me to effect some synthesis of social and biological science. (p. 193)

After publishing Deserts, although he continued his pollen studies, Sears became a kind of public intellectual, writing articles on the Dust Bowl, conservation, and land use policy for Harper’s, The New Republic, American Mercury, and other periodicals, and carrying on a dizzying schedule of lectures and radio talks. He also became a regular book reviewer for both the New York Herald Tribune and the Saturday Review for more than two decades (Figure 4).
Within the Ecological Society, he became active in promoting the broad application of ecology to a wide range of practical problems and in encouraging more emphasis on human ecology. In these efforts, he often worked with his friend, pioneering ecologist Charles Adams, who was then director of the New York State Museum. Sears chaired the ESA’s Symposium Committee from 1938 to 1940, during which time he and Adams organized sessions at both the summer and winter meetings, often held in collaboration with the American Association of the Advancement of Science (AAAS), in which they tried to integrate the perspective of social scientists with that of ecologists. Sears was also an active member of the ESA’s Committee on Applied Ecology during the 1940s. In one symposium organized by the committee for a 1946 meeting, Sears presented a paper on the “Importance of Ecology in the Training of Engineers.” In this, and in his many popular works, there was nothing particularly profound about the understanding of ecological principles that he wished to convey to engineers and the public. His message was simple: basic knowledge of community structure and composition, population dynamics, and the general properties of ecosystems will help engineers, planners, and ordinary citizens make
better policy decisions at all levels. When the Ecological Society honored him with its Eminent Ecologist award in 1965, it was mainly for his role as a spokesperson for ecology and not for his original scientific work ("Paul Sears," 1965; see also Kingsland, 2015).

When Sears was hired to chair the new graduate Conservation Program at Yale in 1950, the appointment was given much national publicity. His old friend Charles Adams saw the announcement in the *New York Times* and wrote Sears a letter of congratulations praising the proposed Yale program as a fine answer to the general opposition of the editorial board of the Ecological Society toward human ecology (Adams, 1950). Adams was referring to a recent incident in which Donald Lawrence and Thomas Park, then editors of *Ecology*, had conducted a survey of the journal's editorial board and concluded that *Ecology* could publish human ecology articles provided they were not propagandistic, they were grounded in science rather than economics or politics, and they made "an intellectual contribution" to ecology (Lawrence & Park, 1949). Adams had complained about the lack of attention to human ecology in the journal for years. Sears, ever the more practical and cooperative kind of colleague, agreed to chair a new ESA Committee on Human Ecology and tried to work more of a human ecology perspective into the society's meetings and publications, which he continued to do throughout the 1950s, despite a ridiculously crowded schedule.

Two themes that preoccupied Sears in much of his writing were the low status of the biological as compared with the physical sciences, and the general lack of ecological knowledge in society and among experts in other fields. In an address in December 1957, he stated: “The biologist who attempted to apply his knowledge in defiance of known physical principles would be laughed out of court. Yet we seem singularly trustful of engineering projects carried out in disregard of ecological principles” (Sears, 1958, p. 13). Yet, less than two years after speaking these words, Sears found himself on a distinguished committee giving his blessing to perhaps the most ill-conceived of all engineering projects: Project Plowshare. This was the Atomic Energy Commission's (AEC) program to use nuclear detonations, mainly hydrogen bombs, for all sorts of large-scale excavation and mineral extraction projects. Sears was the only member of the Plowshare Advisory Committee who had any knowledge of the science of ecology, and yet he approved of one of the early Plowshare experiments, Project Chariot—a very controversial plan to use a series of nuclear explosions to simulate the excavation of a harbor in a remote corner of Alaska. He was not just an observer, he was deeply involved in the committee’s deliberations over this project. Barry Commoner later admitted that Project Chariot was the incident that transformed him from an anti-nuclear activist to an environmentalist, since there were issues involving patterns of fallout in the Arctic ecosystem that he had been unaware of, as he was not trained in ecology (O’Neill, 2007, pp. 228–229). Why did Sears have such a different reaction?
I explored this question in a recent paper (Cittadino, 2015). In my view, Sears’s positive response to Plowshare was due to three factors: his association with the AEC, which had begun a few years before; his willingness to believe AEC scientists like Willard Libby, who dismissed the harmful effects of fallout, and other AEC scientists who claimed to have invented “clean” bombs; and, most importantly, his strong conviction that nuclear excavation, whatever its harmful effects, was certainly preferable to all-out nuclear war. Sears was a loyal citizen who trusted the US government, a team player, and a very careful thinker who was reluctant to jump to hasty conclusions. In short, his approval of Chariot and other Plowshare projects was consistent with his character and personal history. Sears had an often humorous, sometimes even homespun, style of expression, so I will let him have the last words with two examples of his humor and one more serious reflection. As the outgoing president of the AAAS in 1957, Sears chose to speak on “The Inexorable Problem of Space.” In the wake of the recent hysteria over the Soviet launching of Sputnik, he tried to make the point that the space race was diverting attention from the much more serious problem of the condition of the space on planet Earth in which we live. He put it this way: “The golden moment for the pickpocket comes when everyone at the county fair is craning his neck at the balloon ascension” (Sears, 1958, p. 9). Always concerned about the status of ecology among the sciences, he once made this observation:

I have recently heard ecology described as a kind of intellectual halfway house, whose justification will disappear when physiology has been reduced to proper mathematical precision. I feel no particular urge to combat this suggestion otherwise than to remark that halfway houses exist because of their usefulness on the way up and that their occupants are not necessarily half-wits. (Sears, 1960b, p. 195)

Finally, on a more serious note, in one of his last books, The Living Landscape, Sears (1966) returned to the issue he raised in “Ecology—A Subversive Subject”:

It may sound fatuous to suggest that since ecology, economy and economics have a common root they may have common principles, to be ignored at our peril. Perhaps human cleverness may be able to outwit Nature. But, in the meantime, civilization based so largely as ours on the use of conceptual models should weigh the risk it takes in ignoring the model set before it in the dynamics of natural ecosystems. (p. 192)

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Frank Golley’s Perspectives on Environmental Ethics and Literacy: How to Avoid Irreversible Impacts of Hydro-Power and Inter-Oceanic Canal Development on Mesoamerican Tropical Ecosystems

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Introduction

Having recently celebrated the Centennial of the Ecological Society of America (ESA), it is timely to look back into history as well as to the future regarding how ecologists can effectively inform other scientists, decision-makers, and their own communities about the need for objective ecological information. ESA’s focus on Earth Stewardship extends ecological thinking to further define environmental sustainability (Chapin et al., 2015) and facilitates ecologists’ continuing contribution to clarifying the fundamental ecological principles underpinning environmental literacy (e.g., Berkowitz et al., 2005; Golley, 1991, 1998). These principles developed over the last 100 years, with the many contributors emphasizing the importance of people being part of natural ecosystems. As the impact of humanity on the functions of our complex adaptive ecosystems is an ongoing and increasing problem today, both the early and current ideas of ecology remain important. Ecologists also continue to create new approaches for resolving these complex problems to avoid unexpected and unwanted consequences (Levin, 1999; Taylor, 2005).

From the perspective that it is important to consider how single individuals have contributed to transforming how both professional ecologists and the public change their thinking about the environment and its dynamic uncertainty, this paper focuses on one individual who served ESA in myriad ways during his long career. This contribution included a major research project on a proposed sea level canal across Darien, Panama (Covich, 2015a, 2015b), which is especially timely to revisit given the recent centennial celebrations for the Panama Canal. Frank Golley inspired numerous students and colleagues to think at multiple scales and to work with other

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disciplines to innovate and educate the widest possible audiences. A central theme of Golley’s research was the essential importance of connectivity. He emphasized that defining the many connections among people and their understanding of natural systems was critical for resolving environmental problems, from local to global. Golley actively participated in exploring local issues that emphasized how individuals value their historical connections to the land. For example, he enjoyed being a part-time farmer to raise some of his own food for his family. He advocated for protective buffer zones around a local reservoir and many other local and regional issues related to environmental design and planning. At the national and international scales, Golley pioneered the development of landscape ecology and the use of isotopic tracers in detailed food-web studies to demonstrate the importance of biogeochemistry and the bioaccumulation of toxins. His building of new research programs at the University of Georgia’s Institute of Ecology and the Savannah River Ecology Laboratory created an academic environment with worldwide intellectual connections (Golley, 2001).

Golley recognized that the challenge was to develop programs that would foster the necessary appreciation of nature by society at large. To be effective, these “nature-centered” programs would also need to include ecological fundamentals for people to achieve both environmental and economic well-being. This challenge to clarify the fundamentals remains, although more students and more among the public are now aware of the critical importance of environmental education and literacy. For example, effective networks among educators, such as the Council of Environmental Literacy, bring together economists, ecologists, and others to exchange information, which in turn provides the public with a science-based perspective on current environmental issues. However, many people still have only a superficial knowledge of what Golley called “connectivity” among environmental issues. Aiding more students, citizens, and policy-makers to obtain objective information on these issues and to develop the critical thinking skills necessary to understand them remains an enormous challenge, especially in developing countries.

Golley’s own work to develop international academic programs and his leadership with numerous professional societies and world organizations, from the United Nations Educational, Scientific, and Cultural Organization to the International Society for Ecology, provide an important framework for use today in resolving increasingly complex global problems. Golley recognized the importance of helping the next generation of ecologists learn from firsthand experience about the human dimensions of environmental literacy and environmental ethics. For example, Golley met Stanley Heckadon-Moreno, then a graduate student working on the impacts of deforestation in Darien, at an international meeting in Panama City. Golley encouraged him to seek a career in ecology that would connect the many issues related to tropical deforestation with migrations of poor farmers seeking new lands to convert to pastures. Since those early discussions, many studies by
Heckadon-Moreno and others in Panama have analyzed the sustainability of the Panama Canal’s operation and management of the surrounding rainforest (e.g., Condit et al., 2001; Dale et al., 2005; Heckadon-Moreno, 1993, 2005; Heckadon-Moreno et al., 1999). Public outreach and educational programs drawing on the work of these researchers, such as Aqua Salud, have helped to improve policies that retain rainforest cover. The natural vegetation sustains the watersheds and improves the water quality of runoff during intense tropical rainfall (Stallard et al., 2010). Golley also helped to stimulate innovative ideas in environmental ethics among his faculty colleagues, such as the environmental historian Paul Sutter. Sutter (2007, 2009), who has examined a series of human environment issues related to disease control in the early development of the Panama Canal, emphasized the importance of considering multiple viewpoints when reflecting on how people have changed their environment.

Golley’s work demonstrated that the basis of environmental stewardship and environmental justice rests on having adequate and objective ecological information to propose alternative solutions to large-scale, complex problems. Most significantly, his research and leadership encouraged many of his colleagues and students to expand their perspectives to include public outreach and to focus on the values of environmental ethics based on sound environmental literacy. Golley (1998) also understood the need for people to connect with each other as global environmental citizens because many issues extend well beyond local, regional, or national boundaries. The growth of environmental education throughout the world has increased awareness and changed how generations relate to the many environmental issues in their communities.

Golley took a landscape approach to understanding the linkages between terrestrial and aquatic components of tropical ecosystems. In the 1960s, many sub-disciplinary specializations in ecology were developing. Golley noted that these sub-groups were too often focusing only on the “trees” and were beginning to literally lose sight of the “forest” as a natural habitat. Golley’s view was that natural ecosystems included human interactions along with the many species of plants and animals. His interest in forest structure and function, as well as the succession that followed disturbances, was closely linked to biogeochemical cycles of nutrients and the roles of humans in those cycles. As a biologically trained ecologist, Golley’s later development of strong interests in environmental literacy and environmental ethics allowed him to synthesize these areas in a way that continues to engage students, teachers, the public, and professional ecologists.

Golley emphasized that some rare species do have special value and need to have their habitats protected and managed long term. Assemblages of species and their interactions also have high value; management of nature reserves requires a landscape perspective. To achieve and sustain protected areas, Golley emphasized the need for the public to appreciate the value of these areas and to develop an interest in
their long-term stewardship. In his own ecological research, he highlighted the many ecological and socioeconomic connections affecting ecosystems, especially in tropical regions with exceptionally high biodiversity and significant risk of loss of unique habitats. He expressed concern that policy-makers and planners were not sufficiently aware of these complexities, which needed consideration in large development projects.

What can we learn about the impacts of flooding rainforests?

The 2015 Centennial of the Panama Canal generated interest in how the first inter-American canal was completed (e.g., Carse, 2014; Keiner, 2017), and especially in the completion of the current canal expansion project (Rivera & Sheffi, 2013). The creation of Lake Gatun in 1913 by damming the Chagres River and Lake Alajuela (Madden) in 1934 by damming the Madden River led to the need to manage the region’s tropical rainforests and reservoirs to sustain the water supplies for the Panama Canal (Carse, 2014, 2016; Heckadon-Moreno, 1993; Zaret, 1984). Several ongoing, long-term studies analyzing the environmental impacts of these earlier projects provide sources of data. This information could help to estimate some of the costs and benefits of future large-scale construction projects. As any such estimation needs to consider a broad scope of socioeconomic factors, expanded interdisciplinary collaboration is needed well beyond what was available a century ago. Previous research from a long series of studies in Panama provides insights into how tropical ecosystems function. These studies have analyzed, among other things, forest succession and restoration following deforestation and construction, variable water and nutrient budgets, and projections on climate change. Current forest protection programs sustain hydro-ecological functions that provide the freshwater supplies needed for the operation of the Panama Canal and for municipal uses (e.g., Carse, 2012, 2014; Condit et al., 2001; Dale et al., 2005; Ibáñez et al., 2002; Stallard et al., 2010).

A proposed inter-oceanic sea level canal across Darien, Panama

Golley’s studies, along with others from the Darien proposal, illustrate how this perspective could help future generations to transform interdisciplinary studies on the loss of tropical habitats because of mega-projects, such as those that flood rainforests. Golley’s study of the rainforest ecosystem of Darien, Panama, was conducted in conjunction with the review of a proposed sea level canal as part of a project to be funded by the United States Atomic Energy Commission (Covich, 2015b).
Golley’s rainforest study contributed to a holistic, landscape-level analysis (Golley et al., 1969, 1975; McGinnis et al., 1969). This proposed additional inter-oceanic canal was intended to complement the existing Panama Canal, which was thought to require a wider channel. More than 50 years since that original proposal, some new wider locks are being added to the original locks from 2016 (Davis et al., 2015). Over time, it became apparent that a new canal through Darien, Panama, was not needed, and that the existing Panama Canal could be expanded safely and with much less environmental impact. Results from the research of Golley and his colleagues contributed to a decade-long series of controversial debates regarding the impacts of the proposed canal as part of Project Plowshare (e.g., Kaufman, 2013; Keiner, 2017; Kirsch, 2005; Rubinoff, 1968). Reflecting on Golley’s research on the proposed Darien canal is particularly timely because the collaborative, holistic approach that he developed is still appropriate for mega-projects today.

From Darien, Panama, to the proposed inter-oceanic canal across Nicaragua

Environmental research-based discussions of decision-making processes are especially relevant now in evaluating the potential impacts of a proposed inter-oceanic canal to cross Nicaragua. This project would involve dredging a channel across Lake Nicaragua (Lago Cocibolca) and flooding rainforest habitats in the construction of large reservoirs (see Figure 1). The canal dredging would disrupt protected Ramsar wetland sites near the eastern lakeshore. The eastern section of the canal would also intersect the currently protected areas and lands occupied by indigenous and Afro-American groups (e.g., Jordan et al., 2016). If completed, this canal project would be the largest civil excavation ever undertaken. The project, which is being planned by the Hong Kong Nicaragua Development Group, would flood large areas of rainforest and affect water quality (through increased turbidity and salinity) in Lake Nicaragua and its outflow to the Caribbean via Rio San Juan (Environmental Resources Management Group [ERM], 2015). The canal would require construction of a series of large storage reservoirs and hydroelectric production reservoirs to provide a reliable supply of vast amounts of freshwater to sustain use of the locks. However, even the most water- and energy-efficient lock designs are at risk during prolonged dry periods. The water budget and biodiversity of the regions will be significantly affected by how the tropical forests and watersheds are managed to sustain the necessary water supplies to operate the locks (Condit, 2015; ERM, 2015). Reviews by the Nicaragua Academy of Sciences (Acosta, 2015; Huete-Pérez et al., 2015, 2016) and by an independent group of scientists concluded that further detailed studies are needed of the most likely impacts (e.g., Covich et al., 2015).
Given the increasing uncertainty regarding changing climates and global economics, there is a need for long-term studies of the effects of the project. Excavations for construction of the proposed Brito locks along the western canal route would likely have extensive social and environmental impacts. The canal would link the Brito River and the Las Lajas Rivers for the first time (Muñoz Ardila et al., 2017), resulting in the bi-directional movement of freshwater species between these two river drainage basins and Lake Nicaragua. Mixing of native and non-native invasive species could greatly alter the biodiversity and food web of the lake. Impacts of the proposed excavations on freshwater fish continue to be identified, but much more study is needed (Härer et al., 2017). Large environmental impacts on the Brito River Estuary and unique western tropical dry forest ecosystems are also highly likely (Muñoz Ardila et al., 2017). Moreover, the eastern locks and canal construction would intercept migratory species that rely on the MesoAmerican Biological Corridor and the various river drainages that connect with Lake Nicaragua (e.g., Jordan et al., 2016).

The use of brief snapshots to model ecosystem dynamics has proven inadequate. Many species interactions and socioeconomic responses are non-linear and characterized by tipping points. Consequently, responses to environmental changes can be sudden once thresholds are exceeded or cumulative resulting in the disruption of expected outcomes based on short-term monitoring. This uncertainty can result in major surprises created by complex direct and indirect relationships. For example, a combination of events can change how tropical ecosystems respond to the timing of seasonal and inter-annual variations in extreme rainfall. Natural disturbances such as droughts, hurricanes, volcanic eruptions, and earthquakes can further complicate
possible cumulative impacts, making it impossible to be prepared for all possible outcomes (e.g., Bommer & Rodríguez, 2002; Kanamori & Kikuchi, 1993; Pielke et al., 2003).

The likelihood of some alternative future shipping through a northern sea route creates additional ambiguity regarding the economic values and environmental impacts of the proposed canal construction (e.g., Liu & Kronbak, 2010; Smith & Stephenson, 2013). Although considerable uncertainties continue to slow the proposed canal construction, economic geographers have developed several scenarios based on the potential for future shipping through the proposed canal and the savings related to the cost of fossil fuel and carbon accumulation in the atmosphere. Yip and Wong (2015) concluded that “large net benefits are likely to occur from this new canal” (p. 12). However, they did not include any consideration of the social and environmental costs that would likely occur in Nicaragua if the canal were constructed. Nor were the potentially significant costs of marine pollution considered (Chen et al., 2016). Much more interdisciplinary research is needed to evaluate fully how these types of mega-projects can create irreversible environmental and cultural losses before estimating the actual long-term net benefits.

**What lessons are learned?**

Golley conducted fundamental research for many decades on how ecosystems function. This experience led to his understanding of the need for regional and global scales of research related to large development projects. Comprehensive study of mega-projects at regional scales using integrated approaches and long-term studies provides the types of insight needed for effective evaluation of these projects and the information necessary to avoid catastrophic local impacts (Covich, 2015a). The results of Golley’s research in the 1960s provide an example that can inform current studies of similar mega-projects. It is critically important to avoid the irreversible impacts that these projects can have on natural ecosystems, and especially the people who live in them. The sense of place that multiple generations acquire over their lives is usually undervalued by cost–benefit analyses. The loss of land and the difficulties of relocation can offset benefits and leave local communities impoverished in the long term (Carruthers, 2008; Nygren, 2004). The removal of people from their land to make way for large construction projects in tropical landscapes creates a cascade of disruptions over many years that can include diminished public health and well-being (Wali, 1989).

More than four decades have passed since Golley and others first expressed their concerns about the implementation of large development projects in the tropics without sufficient environmental analysis. Their goal, expressed at that time, remains relevant today: “Our aim is to work within the natural processes and to maintain their
conservative impacts on the physical degrading process of the planet, with adequate and sustained production” (Golley & Medina, 1975, p. 3). Further, the many excellent studies over the last five decades mean there is a growing recognition of the value for achieving this goal of holistic approaches that integrate socioeconomic and ecological research into equitable policies. The need for objective science coupled with a concern for transparency and engagement of diverse stakeholders was a main tenet of Golley’s ecological perspective. His approach to linking research and policy is needed now as in the past to resolve current environmental issues. Understanding these issues still requires a deep understanding and appreciation for scientific concepts by a wide range of people (Elliott, 2017).

A need for environmental ethics and justice

Ecologists and other scientists have responded to both the environmental and ethical consequences of economic developments over many decades through their participation in international and interdisciplinary research projects and global efforts to provide environmental justice, especially in Latin America where sustaining biodiversity remains an important concern (Carruthers, 2008; Rozzi, 2015; Wakild, 2013). These interdisciplinary interests focus on how difficult choices can be made that reconcile the needs of conserving habitats while also ensuring people’s economic and social well-being (e.g., McShane et al., 2011). Measures that can provide insights regarding the costs and benefits of large construction projects include human well-being and societal values of biodiversity. Evaluating the benefits of ecosystem services focuses on the value of sustainability for protecting and managing biodiversity (Brandon, 2014; Dale & Polasky, 2007; Simonit & Perrings, 2013). This approach is useful in the analysis of stewardship and managing biodiversity at local and global scales (Golley, 1994; Hall et al., 2011; Mace et al., 2012).

Bioregional, landscape, and local place scale connections

Golley recognized that comparisons among bioregions must consider the cultural history and current economic concerns that limit options for ecosystem management and sustaining habitat protection in those regions. The combined approach of enhancing the public’s basic understanding of ecology through well-developed environmental literacy and the professional education of policy-makers and natural resource managers can lead to more sustainable ecosystems. Golley (1991) noted the importance of focusing on beginning students, who can, in turn, inform their families. However, it is difficult to make generalizations that assist in transferring lessons learned in one community or country to another, especially given the enormous differences in biological and cultural diversity that often generate contradictory values. Cultural identity reflects a sense of place, which includes attitudes and values associated with natural resources and biodiversity, among other attributes. Consequently, local, national, and international efforts
to build a resilient understanding of environmental literacy require a recognition of the different ways that people value their “place” in nature. In some cases, this important link to the land can lead to a strong local consensus on how to sustain ecosystems, but in other cases, the results are increased fragmentation and loss of an integrated approach to bioregional sustainability. This conundrum continues to be a challenge for developing an effective pluralistic environmental literacy. Comparing international perspectives on sustainability and stewardship provides opportunities for learning from successful and unsuccessful outcomes. Too often environmental considerations of mega-projects and economic development in Panama have only had a forestry-centric perspective related to impacts on a few types of diversity. Recent calls to expand the scope of these tropical studies emphasize the need for more comprehensive analyses (e.g., De León & Lopez, 2016; Velásquez Runk, 2009, 2015, 2017).

A need for long-term studies

Many developing countries in the tropics, such as Panama and Nicaragua, continue to need evaluation of large-scale development projects, which can result in declining biodiversity and loss of ecosystem services. Planning for sustainable stewardship requires interdisciplinary collaboration to conduct the long-term studies needed for defining the values of different ecosystem services that can be sustained by well-designed development projects. Environmental history demonstrates that reviewing the full values of development projects often includes multi-generational studies that document conditions before and after project completion. Implementing these studies requires interdisciplinary expertise and comprehensive educational innovations, such as the emphasis on environmental ethics across higher education curricula that Frank Golley championed. Many of the benefits associated with tropical ecosystems are based on cultural use and non-use values, which are often lost when only short-term gains are considered. Knowledge-based planning requires that the current and next generation of ecologists actively engage in communicating what information and values are known in order to avoid irreversible losses.

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Rachel Carson: Saint or Sinner?

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Those who honored Rachel Carson after her death in 1964 knew how hard she had struggled to warn against human abuse of the Earth. In memory of her heroic efforts and her inspiring prose, they initiated a process that one scholar compared to a “secular canonization,” inspired by a vision of “Saint Rachel of the Silent Spring” (Howarth, 2005, p. 42). That view did not go long unchallenged. A range of conservatives associated Carson with the two ‘isms’ of the 1960s that galled them most: feminism and environmentalism. They seemed unaware that Carson resisted efforts to link her to the feminists, preferring to stress her reputation as a writer and scientist. All the same, she was unabashedly proud of her contributions to the popularity of environmentalism and the science of ecology.²

Conservatives were headed in the opposite direction. Richard Nixon’s dalliance with environmentalists, despite his Machiavellian motives, deepened their long-held suspicions. With the election of Ronald Reagan in 1980, conservatives launched a powerful counterattack against the political and cultural legacy of the 1960s. One of their primary targets was the environmental movement and the regulatory apparatus that it promoted. Economic conservatives and libertarians, who resented government regulations and were eager to limit the size and power of government, chafed at the host of laws and agencies created to improve the quality of air and water, save wilderness, protect endangered species, and limit pollution. Many business leaders charged that environmental red tape hamstrung the nation’s ability to compete against foreign manufacturers; libertarians argued that regulation denied private citizens their right to exploit public resources.³

Embracing both views, Reagan’s Secretary of the Interior, James Watt, maintained that “failure to know our potential, to inventory our resources, intentionally forbidding proper access to needed resources, limits this nation, dooms us to shortages and damages our right as a people to dream heroic dreams” (Shabecoff, 1993, p. 204).

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With missionary zeal, Watt set about reordering the nation’s priorities: opening vast areas to mining and oil drilling, refusing to enforce environmental rules and regulations, turning national parks over to private concessionaires, and selling off public lands. In time, Watt’s zeal turned him into a political liability and forced his resignation in 1983. He was not, however, a lone voice crying against wilderness, but rather an outspoken representative of what came to be known as the “Sagebrush Rebellion” and, more generally, the “Wise Use” movement. These conservative rebels were determined to free property owners from environmental regulation and argued that transferring government-controlled resources into private hands would promote economic growth (Helvarg, 1994; Shabecoff, 1993).

To their dismay, Reagan’s Wise Use allies discovered that the public remained loyal to the values Rachel Carson promoted. Most Americans did not want to abandon environmental rules and favored the clean-up of the nation’s air and water. Thus, the Reagan revolt against environmentalism proved stillborn. Efforts to dismantle the Environmental Protection Agency (EPA) did not simply die, however, nor did the Wise Use rebels fold their tents and head for high ground. In 1994, they were back in action as Congressman Newt Gingrich of Georgia helped Republicans win control of both the house of representatives and the senate. The centerpiece of their broad agenda to limit government and restore “family values” was a plan to reduce environmental regulation.

The EPA once again lay in their sights. Congressman Tom DeLay of Texas called their plan for deregulation “Project Relief.” As a former exterminator, DeLay knew something of the restrictions imposed by environmental rules. He boldly announced to the press, “You’ve got to understand, we are ideologues. We have an agenda. We have a philosophy. I want to repeal the Clean Air Act” (Hacker & Pierson, 2005, p. 142). One moderate Republican senator, dismayed at the boldness of DeLay’s plan to revise environmental law, called it “terrible legislation. When all the artichoke leaves are peeled away, they are out for the Clean Air Act, the Clean Water Act, the Endangered Species Act; that is what they are gunning for” (Hacker & Pierson, 2005, p. 142).

In their zeal to destroy the environmental movement, conservatives trained their fire on Rachel Carson. How better to discredit the movement than by tarnishing the reputation of its patron saint? In many ways, their tactics differed little from those used in the 1960s by critics of *Silent Spring*. Carson, they charged, had practiced bad science and thereby misrepresented the value of DDT. More than that, the reverence for nature she encouraged created formidable roadblocks to the rapid exploitation of natural resources they advocated.

Political scientist Charles Rubin launched an early attack to discredit Carson’s science, though his primary target was the “Green Crusade” to protect the environment, and not simply Carson. Rubin (1994) agreed with Paul Brook’s assessment that
Silent Spring was “one of those rare books that change the course of history … by altering the direction of man’s thinking” (pp. 30–31). Given what he saw as the shoddiness of her research, how then to account for its enormous significance, Rubin wondered. Was it her literary skill? Rubin thought not, since he believed nature writing was a well-established genre before Carson began to publish. Was it her warning against pesticides? No, others had done so before her and nothing in her research for Silent Spring was original. “Was it her fanatical attacks on DDT and modern chemical technology that set the tone for the subsequent excesses of environmental fear-mongering?” he asked, expecting no answer (Rubin, 1994, pp. 30–31).

Rubin did make a persuasive case that Carson was not always neutral in her use of sources and that she was sometimes driven by moral fervor more than by scientific evidence. Indeed, her use of evidence was selective, and she made no attempt to catalogue the benefits of pesticides, as critics such as Rubin insisted she should have. But there was no need to. The chemical giants required little defending. They had at their disposal vast public relations and advertising resources and spent millions extolling the virtues of pesticides without ever acknowledging their toxicity. Carson provided information that neither the companies nor the government had ever made public but that she believed people had both a need and a right to know.

Such attacks against Carson suggest her critics had a bigger target in mind. Writing in 1995, after the fall of the Berlin Wall and the collapse of communism, Rubin believed that Carson’s disciples in the environmental movement—those he dismissed as “utopian reformers”—posed a new threat to freedom and liberty. He suspected that “as ‘red’ totalitarianism declines, the aspirations of our radical reformers may become increasingly ‘green’” (Rubin, 1994, pp. 31–52). In that way, many conservatives believed that environmentalists now replaced communists as the enemies Americans should fear.

Other Carson detractors claimed that her arguments were not based on science, but on faith. They described environmentalism, as Carson and her followers envisioned it, as a pseudo-religion. “Green worshippers can keep their religion,” snorted one critic of ecology, while another described it as a “new religion, a new paganism that worships trees and sacrifices people” (Dunlap, 2004, p. 5). Physician and novelist Michael Crichton (2003) called environmentalism “one of the most powerful religions in the Western World.” In the spirit of Judeo-Christian beliefs, Crichton (2003) suggested, environmentalism begins with an Eden:

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4 See also the jacket liner notes for the “green menace” quotation.
A state of grace and unity with nature; there’s a fall from grace into a state of pollution as a result of eating from the tree of knowledge, and as a result of our actions there is a judgment day coming for all of us. We are all energy sinners, doomed to die, unless we seek salvation.

In this environmental religion, salvation comes as “sustainability.” Crichton dismissed this “Green” worldview as romantic nonsense. “People who live in nature,” he assured his audience, “are not romantic at all” (Crichton, 2003).

With the election of George W. Bush, anti-environmental critics moved far beyond accusing Carson of bad science and misguided beliefs. They accused her of murder. An outraged blog writer claimed that around the world, a pandemic wrecked a terrible toll: a child died every 15 seconds; 3 million people succumbed each year; and from 1972 to 2003, 100 million people had been lost. “These deaths,” the author fumed, “can be laid at the doorstep of author Rachel Carson” (Makson, 2003). How had Carson done this horrid deed? “Her 1962 book *Silent Spring* detailed the alleged ‘dangers’ of the pesticide DDT, which had practically eliminated malaria.” Without that “cheap, safe, and effective” weapon to control insect-borne disease, “millions of people—mostly poor Africans—have died due to the environmentalist dogma propounded by Carson’s book” (Makson, 2003).

Writing in the *New York Times* in April 2004, Tina Rosenberg (2004) made such claims credible: “DDT killed bald eagles because of its persistence in the environment. *Silent Spring* is now killing African children because of its persistence in the public mind.” Crichton abandoned derision for moral outrage. “Banning DDT is one of the most disgraceful episodes in the Twentieth Century history of America,” he commented. “We know better, and we did it anyway, and we let people around the world die and we don’t give a damn” (Crichton, 2003). Crichton pursued his crusade in his footnote-studded 2004 novel, *State of Fear*. “Banning DDT killed more people than Hitler,” his hero charges. “And the environmental movement pushed hard for it” (Crichton, 2004, p. 487).

Leading the political charge was Republican Senator Tom Coburn of Oklahoma. Coburn blocked bills to honor Carson and to name a Pennsylvania post office for her. His website linked visitors to “Rachel Was Wrong,” sponsored by the Competitive Enterprise Institute (a think tank for climate change deniers). Beside grim pictures of malaria victims, the Competitive Enterprise Institute claimed, “millions of people around the world suffer the painful and often deadly effects of malaria because one person sounded a false alarm. That person is Rachel Carson” (Rachel Carson’s dangerous legacy, 2007).

These latter-day Carson critics marshaled some disturbing evidence. According to Rosenberg (2004), health officials estimated that malaria killed 2 million people every year, with the largest proportion being children under five living in Africa. Until the recent explosion of the AIDS epidemic, malaria was Africa’s leading killer,
taking the lives of one in 20 children and leaving countless millions of others brain
damaged. Worldwide, health officials estimated 300–500 million people contracted
malaria each year. Beyond the loss of life and untold suffering it caused, malaria
shrank the economies of some of the world’s poorest countries by some 20 percent
over 15 years (Rosenberg, 2004). What so disturbed Crichton, Rosenberg, and
others was that a cheap and effective way to curb the pandemic existed. The solution,
Rosenberg asserted, “lasts twice as long as the alternatives. It repels mosquitoes in
addition to killing them, which delays the onset of pesticide-resistance. It costs
a quarter as much as the next cheapest insecticide” (2004, p. 83). The answer,
Rosenberg assured her readers, was DDT. Semi-annual spraying of the interior of
huts in South Africa with DDT greatly reduced malaria and the related health costs.

Even though the EPA banned DDT in 1972, it did not ban its manufacture, nor did
international law prevent other countries from using it. What then stopped the poor
nations of the world from spraying DDT to curb the malarial scourge? The simple
answer offered by these critics was “Rachel Carson.” The prejudice against DDT
that Carson aroused in Silent Spring made it difficult for health officials to press for
its use. Moreover, alongside the US, most other developed nations banned DDT
as well. By 2005, this situation had put the developing world in a double bind.
The health organizations assisting the poorer countries in the battle against malaria
received their funding from the wealthier nations in which prejudice against DDT
was strongest. One foreign aid administrator admitted that her agency would not
finance DDT because “you’d have to explain to everyone why this is really OK and
safe every time you do it, so you go with the alternative that everyone is comfortable
with” (Rosenberg, 2004, p. 83).

This case would offer a withering indictment of Carson and “her coterie of
admirers,” if it held up to close examination. Is it true, for example, that 300–500
million people a year become ill with malaria? That number seems unreasonably
high. If it were accurate then within as few as 14 years, malaria would infect all the
world’s 8 billion people. Clearly, that is not the case. What then does this number
actually mean? Not that 300–500 million people contract malaria each year, but that
300–500 million people show symptoms of the disease. Many of those “incidence[s]
of clinical disease episodes” occurred in people who had been infected for many
years, and so were not, in fact, new cases (Hamilton Lytle, 2007a, p. 223).

What then of the 1.1–2 million people who die from malaria, most of them African
children under the age of five? Would the wider use of DDT reduce this level of
mortality? Surely, such a number would justify a worldwide effort to contain the
disease, even if that meant a significant increase in the use of DDT. Looking at
statistics collected by the World Health Organization (WHO) offers a clearer
picture of the death rate of African children under five (Weir, 2007). As frightening
as malaria might be, it ranked only fourth as a cause of infant mortality. Respiratory
infections and diarrhea claimed over twice as many lives as malaria, while neonatal
conditions such as preterm birth and low birth weight killed as many as 10.6 million infants annually. AIDS has been another deadly killer, but its victims die less often in infancy. Such comparisons suggest that if those who condemned Carson and *Silent Spring* truly cared about the children of Africa, they might move beyond their preoccupation with malaria and DDT and propose alternative solutions to the AIDS crisis, water pollution, malnutrition, and infectious diseases, which are the continent’s greatest killers. However, unlike DDT for malaria, there is no easy fix for these serious issues afflicting Africa. Addressing them requires a more comprehensive plan than DDT’s advocates have supported.

As Kristen Weir noted in a 2007 *Salon* article, “Overseas, DDT was being phased out of the fight against malaria, but Carson and budding environmentalists were not the reason.” A WHO scientist explained that the global eradication program “oversold the possibility of eradication” and the US withdrew its financial support. By 1969, the WHO had officially abandoned the eradication effort. A 2001 article explained, “Despite the successes of the WHO eradication campaign in many parts of the world following the Second World War, most of Africa was regarded as a lost cause, and in practice the eradication of malaria in Africa was never attempted” (Weir, 2007). The WHO, because it could never afford a massive insecticide-spraying program and at the same time help countries to build up basic health services, chose the latter. Better public health services helped to improve childhood mortality in Africa, but malaria programs faltered.

Malaria is a complex disease caused by a parasite with a complicated life cycle. “For malaria control, you need to have a really good understanding of mosquitoes, the malaria parasite and human behavior,” observed Richard Tren, chair of the board of Africa Fighting Malaria, an advocacy group that champions DDT (Weir, 2007). He believed that many health programs were ill-equipped to handle that complexity. By contrast, malaria researchers at the Johns Hopkins Bloomberg School of Public Health stressed that aid organizations were pro-medicine not anti-DDT. Through the 1970s and 1980s, most countries, on the advice of the WHO, “changed their approach to malaria control from insecticide treatment to treating people with chloroquine”—which kills the parasites that cause malaria—“because that was a way they could impact the mortality of the disease” (Weir, 2007). According to research, malaria caused 18 percent of deaths in Africa before 1960 and 12 percent of deaths between 1960 and 1989. In other words, malaria-related mortality decreased after treatment shifted from insecticides to medicine. As for the DDT debate Crichton and others promoted, well-regarded researcher May Berenbaum said, “it’s all emotional and not rational” (Weir, 2007). “Carson’s point wasn’t that DDT was evil, it was that if you put all your eggs in one basket, that basket’s going to break” (Weir, 2007).
Equally problematic for DDT advocates, many agricultural producers in the developing world also supported the DDT ban. The US and Europe generally barred any imported crops containing traces of the pesticide. The chemical companies that once attacked Carson and vigorously defended DDT also ceased doing so, although this was because DDT was no longer under patent, which meant that any company could now manufacture it. Chemical companies thus found it more profitable to sell other insecticides. As Janet Hemingway of the Liverpool School of Tropical Medicine observed, “Clearly, they’d like to see DDT banned—it cuts into their markets” (Rosenberg, 2004).

Another question worth asking in response to a recurring argument among Carson’s critics is, is it true that DDT poses no significant risk to humans? One advocate of DDT claimed, “if you use DDT properly, it has a record of safety and effectiveness for humans that is really unmatched” (Hamilton Lytle, 2007a, p. 226). By demonstrating that DDT is in fact harmless, critics enhanced their claim that Carson’s work was based on bad science, unwarranted assumptions, and “fear-mongering.” Yet, two highly respected researchers who studied the impact of DDT exposure on preterm births and the length of time mothers nursed estimated from their data what might happen if Africans resorted to wider indoor spraying (Hamilton Lytle, 2007b). They found, for example, that among women in Mexico and North Carolina, those with higher concentrations of DDT nursed for shorter periods. In Africa, where food is scarce, mothers breastfeed for an average of 18 months. If lactation there fell to the levels found in Mexico and North Carolina, infant mortality might reach a level surpassing any benefit from spraying DDT. Thus, those who have spoken with such moral passion about the virtues of DDT may well have been recommending a cure that was more dangerous than the malaria they were trying to eradicate.5

In a 1963 televised debate with Carson, a scientist from the American Cyanamid Corporation argued in defense of the chemical industry that “man is steadily learning to control nature.” To that, Carson replied that the big challenge was to prove “our maturity and our mastery, not of nature, but of ourselves.” Maturity required thinking of “ourselves as only a tiny part of a vast and incredible universe” (CBS Reports, 1963). With more humility, humans might better ensure the future for themselves and their fellow species. As environmental historian Donald Worster (1994) concluded, this idea became “the central creed of the ecology movement: a vision of the unity of life, as taught by science, and a moral ideal of living cooperatively with all members of the natural community” (pp. 348–351). The idea of living in harmony with nature contradicted the central assumption of a generation of scientists who preached the conquest of nature, whether through manipulation of the atom, synthetic materials, or deadly pesticides.

5 This reconstruction of Carson’s defense depends heavily on Karaim (2005).
In another way, Carson challenged the authority of corporate and scientific elites. If, as she charged, the dangers of pesticides were real, through silence or, even worse, deceptive claims on this issue, science and industry had abdicated their responsibility. “This is an era of specialists, each of whom sees his own problem and is unaware of or intolerant of the larger frame into which it fits,” she observed (Carson, 1962, pp. 12–13). Carson wanted the future to be decided by an informed public with a holistic view of nature, rather than self-serving businesses or narrowly trained specialists. As she argued:

> It is the public that is being asked to assume the risks that the insect controllers calculate. The public must decide whether it wishes to continue on the present road, and it can do so only when in full possession of the facts. In the words of Jean Rostand, “The obligation to endure gives us the right to know.” (Carson, 1962, pp. 12–13)

In essence, Carson’s determination to have the public rather than the experts make such vital choices required a radical transformation in public policy. She advocated nothing less than “Power to the People.” That ideal of participatory democracy inspired much of the political dissent during the 1960s. In *Silent Spring*, Rachel Carson challenged Americans to gain control of their future. If that was subversion, then long live the people.

Despite her critics, Carson would have been among the first to support limited applications of DDT in order to save lives. In *Silent Spring*, she never spoke against responsible use of pesticides. Rather, she urged that the methods of insect control “be such that they do not destroy us along with the insects” (Carson, 1962, p. 9). What she did condemn were uncritical and often untested claims that these chemicals were harmless to humans and other living things. She further decried the anthropocentric point of view that saw humans as somehow separate from and not responsible for their impact on nature. For Carson, life was a wondrous mystery to behold and she asked her fellow beings to be aware “that we are dealing with life—living populations and all their pressures and counter-pressures, their surges and recessions” (Carson, 1962, p. 296).

Perhaps she was not a saint, but she was far less a sinner than those who condemn her.

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René Dubos: Wooing the Earth, from Soil Microbes to Human Ecology

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Figure 1: René Dubos at home on the woodland property he restored after buying an abandoned farm, Garrison, New York. 7 April 1972
Source: Photograph © Lawrence R. Moberg.

René Dubos was an ecologist from the beginning. He championed the philosophy that a living organism—whether a microbe, human being, society, or the Earth itself—could be understood only in its relationships with everything else (Moberg, 2005). Each stage in Dubos’s career broadened his exploration of this philosophy

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as he evolved during half a century from studies of soil microbes to promoting a “humanistic biology,” in other words, ecology as a humanistic science. Although unknown to Dubos, the term “humanistic science” was not new. In 1922, *Ecology*, the Ecological Society of America’s (ESA) journal, published an article by Stephen A. Forbes, “The Humanizing of Ecology,” arguing that economic and humanistic values, with applications of botany, bacteriology, zoology, entomology, and physiology, were all “related to the protection and restoration of health and hence to the prolongation of human life.” Of all the biological sciences, Forbes (1922) wrote, ecology is “the humanistic science *par excellence*” (pp. 90).

For Dubos, the philosophical basis of ecology was health. During his final years, he focused on the human condition and how the world that humans inherit, alter, and leave behind would shape their own health. To him, ecology was not just protecting the environment. It was equally about humans creating something of health, charm, and beauty in their environments. Dubos’s views of a human ecology focused on a sense of the possible, the power of vision and creation, and the building of wholesome environments for all of life. Ultimately, just as human health depends on the health of the environment, the Earth’s health depends on humans who can change, repair, restore, and create such environments.

**Agronomist**

Dubos was born in a French village in 1901 and raised in Paris. He graduated from the National Institute of Agronomy, where one of his favorite courses was the relation of soil fertility to climate. A chance meeting with Selman Waksman in 1924 at a soil congress and his dream for adventures in America led Dubos to pursue a PhD with Waksman at Rutgers University. He studied which soil microbes decompose cellulose and discovered that the active microbe and its digesting chemical depended on the type of soil in which the cellulose was placed. After presenting these results at an international soil congress, they were published as Dubos’s first independent scientific study by *Ecology* in 1928.

In 1927, Dubos brought this ecological perspective to the hospital laboratory of Oswald Avery at The Rockefeller Institute for Medical Research in New York City. He isolated an enzyme from a soil microbe that he found in a New Jersey cranberry bog. This enzyme decomposed the cellulose-like capsule of the most virulent strain of pneumonia, allowing white blood cells to destroy the naked bacteria and curing infected animals. Importantly, he discovered the enzyme was produced only when the microbe was grown in a medium that contained the cellulose capsule as its sole source of food. This finding, he said, brought him face to face with one of the most important principles of ecology; namely, that cells have multiple potentialities, which operate only when they are placed in an environment that compels their use.
When he later applied this biological law of adaptation to human life and behavior, he taught that “each one of us is born with the potentiality to become several different persons but what we become depends on the conditions under which we develop, conditions, furthermore, that are of our own choosing” (Dubos, n.d.).

**Medical microbiologist**

In 1939, Dubos became a medical microbiologist and focused on finding a cure for pneumonia. During another systematic soil search, he extracted two substances from the soil bacterium *Bacillus brevis*, which he named tyrothricin and gramicidin. These were the first natural antibiotics produced commercially on a large scale and used clinically. Within three years—before penicillin and other antibiotics were in general use—Dubos discovered that the bacteria in patients being treated with his antibiotics at Mayo Clinic and elsewhere were becoming resistant to them. Realizing microbes are as adaptable (and resistant) in human bodies as they are in soil, he warned that antibiotics would fail, cause resistance, and set the stage for new diseases (Moberg, 1999). Rachel Carson predicted a “Silent Spring” in warning about DDT. Today, the term “Antibiotic Winter” is being applied to antibiotic resistance for the very reasons given by Dubos more than 70 years ago. Controlling this, he said, will require human, social, and physical environmental changes.

**Experimental pathologist**

In 1945, Dubos published his first book, *The Bacterial Cell*, with a novel theme on the relation of bacteria to disease. Its reception and a personal tragedy—his wife’s death from a resurgence of childhood tuberculosis—encouraged him to abandon soil research to pursue another aspect of his ecological philosophy. He speculated that wartime stress and concern for her family in France triggered its resurgence. This alerted him not just to a balance between humans and bacteria, but especially to the impact of physical and mental environments on that balance (Dubos, 1945).

As an experimental pathologist, he turned his studies from isolated microbes to the ecology of infection versus disease. The Dubos laboratory created a culture medium that allowed the first accurate, quantitative studies of mycobacteria and enabled studies of facets of virulence and immunity in tuberculosis. In 1952, acting on his beliefs that infection is the rule, disease is the exception, and prevention is better than cure, he published *The White Plague* with the subtitle *Tuberculosis, Man, and Society* (Dubos & Dubos, 1952). The book’s main argument is that throughout history, this disease—which even today infects one-third of the world’s population and causes nearly 2 million deaths a year—is influenced by the total environment, including sociological, psychological, and physicochemical factors.
Weighing evidence from laboratory experiments, Dubos determined that health is an equilibrium in which everyone harbors disease germs, but not everyone is sick. He adopted the Hippocratic view that health is a result of balance in the body and ill-health is a disruption of that balance. In 1959, reflecting his shift in medical thinking, he published *Mirage of Health*, subtitled *Utopias, Progress, and Biological Change*, which addressed health from these perspectives. This remains his most popular, influential, and frequently cited book and it is still in print. Viewing infectious disease as an ecologist, he argued that perfect health is utopian and cannot be purchased, measured, or achieved by pursuing one drug or one therapy after another. Health, in his definition, is “not necessarily a state of well-being, not even … a long life. It is, instead the condition best suited to reach goals that each individual formulates for himself” (Dubos, 1959, p. 233).

**Environmentalist**

Renaming his laboratory “environmental biomedicine” in 1961, Dubos enlarged his research to study typical, yet seemingly subtle, environmental stresses on the susceptibility of animals to disease. He tested malnutrition, antibiotics, pesticides, toxins, and crowding, and found each stress increased an animal’s susceptibility to disease. When the same stresses were applied to newborn animals, they produced lifelong deleterious effects, a phenomenon Dubos coined “Biological Freudianism” (Dubos et al., 1966).\(^2\) Other pioneering research revealed the digestive tract is an ecosystem in which intestinal microbes profoundly influence an animal’s ability to utilize food as well as to resist various infections and toxins. By showing that microbes are essential for maintaining health, Dubos planted seeds of a new scientific field; the Human Microbiome Project is demonstrating the human body itself is an ecosystem and that changes in our microbial ecology correlate with numerous diseases, some caused by the misuse or overuse of antibiotics. A recent extensive scientific review evaluated some of these discoveries by Dubos concerning the influence of natural environments, nutrition, and microbial ecology on health and disease. The authors analyzed how current research in these areas not only supports but intensifies Dubos’s views on human well-being, quality of life, and planetary health (Logan et al., 2005a, 2005b).

Concurrent with his bench experiments, Dubos (1953) began what he called “a philosopher’s search for health” to examine diverse environmental manifestations and influences on human life and behavior. In several books and dozens of lectures and essays, he devised various proposals for a novel—and, to some, an impractical—science devoted to human nature that he named “humanistic biology” (Dubos, 1965a). Research in such a science would identify the *formative* responses to the

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environment that are organically conditioned by past experiences, social structures, emotional attitudes, and ethical concepts; it would also find ways to show humans how to take a constructive role in creating desirable futures.

As much at home in philosophy and history as in science, Dubos (1968) addressed a mass-market audience in his book *So Human an Animal*, subtitled *How We are Shaped by Surroundings and Events*. This timely book appeared just as the popular American environmental movement was emerging. He balanced the alarms about environmental degradation and the dehumanization of mankind with constructive views about how humans could do something to restore their quality of life. The final chapter, “The Science of Humanity,” argued for a new ecology to plan for the future by developing human potentialities and pursuing the significance of life, not its mastery. After this book won a Pulitzer Prize in 1969, Dubos became a major public figure during the environmental crusade.

### Human ecologist

Also in 1969, Dubos gave a lecture titled “Human Ecology” to the World Health Assembly, the World Health Organization’s highest health policy–setting body, composed of health ministers from all member states. Human ecology, as defined by Dubos (1969), is the scientific expression of biological wisdom; that is, “knowledge of the relationships between man and the innumerable factors of his environment” (p. 499). This lecture introduced the paradox that the apparent ease with which humans adapt themselves biologically, socially, and culturally to civilized life in fact constitutes a real threat to individual well-being and even to the future of the human race. He predicted that the more a population is exposed to modern technology, the more it becomes subject to chronic and degenerative diseases, what he termed “diseases of civilization” (Dubos, 1965b). Human ecology, he concluded, requires a scientific and intellectual attitude to deal with such indirect and long-term effects of environmental forces as the abundance or scarcity of food, pollution, noxious chemicals, noise, overcrowding, and even compulsive leisure.

During his final years, Dubos served as a *provocateur* who shared the biological wisdom of a *human ecologist*. He previously had a vigorous public lecture schedule, talking at least once a week to physicians, medical students, and public health and government officials. After receiving the Pulitzer Prize, the size and number of his audiences increased substantially to include students and faculties in liberal arts colleges, universities, environmental organizations, international societies, and local community groups. He reached an enormous number of uncommitted students, committed activists, and concerned citizens, the very people he believed could put into action what he professed in words. Not inconsequently, Dubos during his lifetime received 41 honorary degrees from universities worldwide that sought
his vision of relating human health to human environments. His audience grew
even wider following numerous television and radio interviews related to the first
Earth Day in 1970 and, two years later, to the first United Nations Conference on
the Human Environment in Stockholm. Walter Cronkite (1997), iconic anchorman
of CBS News, wrote in his autobiography that his interview with Dubos was, in his
words, “the most provocative of my career” (p. 285). Cronkite was asking “Can the
World be Saved?” to which Dubos provided optimistic and creative ways that
humans could change conditions before the crises occurred.

Compared to other prominent scientists, such as Margaret Mead, Linus Pauling,
Paul Ehrlich, and Barry Commoner, Dubos stood alone, in part because he was
much older and less controversial. These credible scientists were attractive for their
hot or controversial topics, maverick or iconoclastic status, and colorful images.
While often interacting with them, Dubos remained distinct by deliberately not
discussing political issues. On scientific and technological matters, he offered social
rather than technical comments by advocating that solutions to environmental
problems would also need organizations, methods, and social forces that were
currently outside established traditions and structures. This did not keep him
from being effective. He spoke in a questioning, almost conversational manner,
rather than a dogmatic one. With an eloquent flow of stories told with a gentle
French accent and avuncular charm, he could move audiences to laughter, anger,
tears, and routine standing ovations. He masterfully implied, without ranting, that
if his concerns were as important to them as they were to him, they should also
become involved. There were constant, gentle reminders of collective responsibility
for offences against the environment in biologically based “sermons,” such as how
“we must learn,” “we must identify,” “we must limit,” or “we must change our ways
of life” by developing positive values.

Trying to summarize Dubos’s broad visions of human ecology is comparable to
a comment by Hobart Lewis, the long-time editor of Reader’s Digest. He once
introduced Dubos by saying he had spent his entire life digesting the work of others
but found it impossible to reduce the richness of Dubos’s work to a few ideas or
pages. Fortunately, Dubos was a master phrase-maker who coined many aphorisms
to simplify vast messages, many of which are also the titles of his two dozen books.
Here are just four: “despairing optimist,” “where humans are concerned, trend is not
destiny,” “improving on nature,” and “think globally, act locally.”

**Despairing optimist**

In 1970, Dubos assumed a distinct persona and characterized himself in his
columns for the American Scholar as a “despairing optimist.” His despair was that
the real environmental tragedy was the progressive degradation and dehumanization
of life due to our failure to see ourselves as integral parts of the Earth’s ecosystem. His optimism lay in his faith in the resiliency of nature and creative adaptations of human beings to undo the damage they had wrought.

Where humans are concerned, trend is not destiny

Other environmentalists were describing future scenarios of vanishing wilderness, depleted resources, approaching famine, species extinction, population bombs, energy shortages, greenhouse gases—in short, doomsday predictions. Dubos argued instead that these trends were not destiny but symptoms of a much larger affliction that was not the destruction of life but its progressive degradation, and not death but a worthless human existence. Unlike the doomsayers, he contended there is no longer such a thing as a natural ecology because humans have changed everything in nature, and that people’s choices profoundly influence the downward environmental trends.

Improving on nature

Dubos offered a new and, to many, greatly contested insight that nature does not really know best. Pointing out that much of what we think of as nature is man-made and many of the world’s most admired environments are products of human activity, he made clear that improving the environment depends on ecological wisdom and social will. Whether he advocated open horizons, village atmospheres, or natural surroundings to intensify human encounters, or specified changing agricultural patterns, creating safer chemicals, planting more interesting trees, or removing unecological lawns, the message was the same: cultivate environments to nourish such human biological needs as tranquility, beauty, involvement, fertility, and inspiration.

Dubos considered himself a kindred spirit of conservationist-ecologist Aldo Leopold, whose land ethic stated that “a thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community” (Leopold, 1949, pp. 224–225). However, Dubos went further to say that this ethic does not rule out the transformation of nature but was rather another form of improving on nature. Just as Leopold planted lots of trees to heal his abandoned farm, so for three decades Dubos had been rebuilding a diverse healthy landscape by planting trees on his 90-acre worn-out farm in the Hudson River Highlands. Just as Leopold (1991) defined conservation, or land health, as a “positive exercise of skill and insight, not merely a negative exercise of abstinence or caution” (p. 257), so Dubos defined the human counterpart of conservation or health as making creative adaptations; that is, by cultivating the healthy functioning of living organisms, whether animals, plants, humans, landscapes, or communities.
Think globally, act locally

Without a doubt the most famous maxim of the twentieth-century environmental movement, this phrase emerged as the world moved from the local euphoria of the first Earth Day to the global environmental challenges considered at the 1972 United Nations Conference on the Human Environment. British economist Barbara Ward and Dubos (1972) prepared the conference’s conceptual framework, called Only One Earth: The Care and Maintenance of a Small Planet. In a lecture Dubos (1973) gave at an unofficial forum during the Stockholm conference, he said:

In practice a global approach is needed when dealing with the problems of the spaceship earth which affect all of mankind. But local solutions, inevitably conditioned by local interests, are required for the problems peculiar to each human settlement. (p. 42)

The actual four-word motto first appeared six years later, in a 1978 EPA Journal interview (Temple, 1978).

This iconic phrase spread so quickly and universally that very few people know that it originated with Dubos. It galvanized innumerable crusades by grassroots activists, nature organizations, and political campaigns and continues to proliferate on bumper stickers, billboards, lapel buttons, and tee-shirts. “Think globally, act locally” was used sparingly by him, although he enhanced its ethical implications in his penultimate book, The Wooing of Earth, in 1980. He wrote:

Ecology is nothing more than the study of interrelationships between living things and their environment; it is therefore ethically neutral. These relationships, however, are always influenced by the human presence, which introduces an ethical component into all environmental problems … ecological thinking must be supplemented by humanistic value judgments. (Dubos, 1980, p. 157)

When this book was translated into French, it won the Prix Littéraire Eugène Le Roy. At the award ceremony, French President Valéry Giscard d’Estaing saluted Dubos in person for espousing an “écologie civilisatrice” and remarked that ecology was no longer only a defensive effort but now a civilizing force “where nature needs man who can alone reestablish the natural equilibrium compromised sometimes by his own actions” (Giscard d’Estaing, 1980).³

The important legacy of Dubos’s human ecology in “Think globally, act locally” resides in its spirit of practicality infused with a sense of environmental citizenship. Between abstract awareness and concrete action, between imagination and experience, lay its decree that Earth housekeeping and Earth health begin with human beings. Local was not necessarily a place; it was also Dubos’s way of saying

³ This prize was one of three Prix Sully Olivier-de-Serres awarded in 1980.
that what seems small and personal can have profound implications, and that what seems right is worth doing. For this reason, the motto’s concept remains practical and empowering.

As much as any individual of the twentieth century, Dubos became the conscience of health. His ability to think ecologically allowed him to accept and expect nature’s changes, grasp its complexities, and fathom paradoxes in health and disease. With broad vision, he conceived of a human science of ecology in which human health is symbiotic with the Earth’s health, and both had to be evaluated in light of human needs, tastes, and aspirations. Reaching beyond conventional gloom with heartening belief in diversity, resilience, and innovation, he suggested ways to preserve, enrich, and create healthy individuals and environments. The essential biotic view of humans and Earth, to rephrase his grand motto, is think ecologically, act ethically. To whichever ecosystem Dubos applied his thinking, his integrative wisdom focused on seeking health. As a good doctor, he practiced and preached ecology as a healing art.

**References**


Healing the Earth: The Relevance of Ian McHarg’s Work for the Future¹

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Ian McHarg opened a new way for us to see the world. His approach for interpreting the play between natural and cultural systems has become the dominant visualization tool of our time and provides a roadmap for applying ecological information to how we interpret, plan, and shape our surroundings. The use of ecology in design and planning became his quest and his principal contribution.

¹ This essay was adapted from Frederick R. Steiner (2004). Commentary: Healing the Earth: The relevance of Ian McHarg’s work for the future. Philosophy & Geography, 7(1), 141–149.
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Nature’s design

Ian Lennox McHarg (1920–2001) was a child of the Great Depression in industrial Glasgow, Scotland. He experienced the transition between adolescence and manhood as a soldier in the Second World War. He entered military service as a lanky teenage private and left as a confident major in command of one of Britain’s most elite combat units. After the war, McHarg, “the major” as he was called then, marinated in modernism at Harvard.

McHarg finished three degrees in landscape architecture and city planning at Harvard and returned to Scotland to help rebuild his war-ravaged homeland by working on housing and new town programs. He experienced a near-deadly bout of tuberculosis before Dean G. Holmes Perkins enticed him to build a new graduate program in landscape architecture at the University of Pennsylvania. There, McHarg fused his desire to practice with a new-found love for teaching.

His most important contributions derived from this reflective academic practice. At first, this practice was grounded in the modernist principles McHarg had learned at Harvard. Influenced by his mentor, Lewis Mumford, McHarg began to move away from the aesthetic dogma of the international style. He grew highly skeptical of the one-size-fits-all stylistic palette of modernism, but remained committed to its ideals. Specifically, he believed knowledge should guide action. Further, this action would result in better housing, more open space, more efficient transportation systems, and, in the end, healthier and safer communities.

McHarg explored these ideals through the design studios at Penn as well as through his growing professional practice, Wallace, McHarg, Roberts, and Todd. Both in his academic department and at his firm, McHarg engaged in action research advancing several disciplines and professions. This work represented a meaningful dialogue between the academy and his professional practice, and it is a synthesis of this dialogue that is provided in Design with Nature (McHarg, 1969). This clarion call-to-arms presents insightful case studies and advances a new theory for design and a new mandate for public policy.

What are the origins of McHarg’s ecologically based theory? Again, it came from both within the academy and from experience. From the early 1960s, McHarg became a public personality. He hosted his own high-profile CBS talk show and later narrated a popular PBS documentary. He served on several important commissions and panels, including the influential 1965 White House Conference on Natural Beauty. For a series of 26 Sundays in 1960 and 1961, McHarg invited the leading theologians and scientists of the day to discuss our place in the world on the CBS television show The House We Live In. He had initiated this format in his “Man and Environment” course at Penn in 1959. Leading scholars were invited to discuss
values and ethics, as well as entropy, the universe, evolution, and plate tectonics in the classroom and on television. McHarg's razor wit, intelligence, and relevance attracted students and television viewers alike.

Through the 1960s and into the 1970s, “Man and Environment” was the most popular course on the Penn campus and it alone changed many lives. For instance, I had a colleague who was a Wharton Business School undergraduate when he took “Man and Environment.” He promptly transferred from finance to hydrology, eventually earning a PhD and becoming a significant environmental planner. During Earth Week in April 1970, I was the co-chair of the student-led Earth Day events at the University of Cincinnati. Our activities included a book fair. Compared to the present, there were relatively few environmental books then. The one with the word “Design” on the front cover and the whole Earth from space on the back stood out to those of us studying landscape architecture, architecture, planning, and design. Over the next couple of decades, many of us flocked to Penn. Many more read Design with Nature.

Nothing is as practical as a good theory. The dictum “design with nature” not only changed design and planning, but influenced fields as diverse as geography and engineering, forestry and environmental ethics, and soil science and ecology. The evidence is ubiquitous: almost every geographic information systems (GIS) presentation begins with a depiction of what McHarg called a “layer cake.” He used the metaphor to describe how maps of various components of the biophysical and sociocultural environment in a specific place can be stacked, like a layer cake, to reveal how landscapes function. However, contemporary GIS applications rarely credit McHarg. They also lack his eloquence or insight into how the data should be collected and analyzed. Environmental impact assessment, new community development, coastal zone management, brownfields restoration, zoo design, river corridor planning, and ideas about sustainability and regenerative design all display the influence of Design with Nature.

However, McHarg’s theoretical and practical contributions extend beyond this important book. Two other topics occupied much of his considerable energy in the decades after the initial Earth Day. First, he sought to advance the understanding of the ecology of our own species. Second, he advocated the extension of his theoretical framework to the national and global scales. We relate with one another as well as with our physical and biological environments. Like other organisms, our species is part of the web of life. The challenge is to see ourselves as part of that web.

McHarg recognized the need for us to understand the medium we inhabit as well as how we shape it and it us. He sought support from the National Institute of Mental Health (NIMH) to address this topic, writing “My colleagues and I had concluded that geomorphology synthesized physical processes and that ecology synthesized both physical and biological processes. How could we extend this model to include people?” (McHarg, 1996, p. 269).
He turned to anthropology and human ecology for the answer. As he had recruited geologists and ecologists to his department beginning in the 1960s, he added anthropologists and ethnographers in the 1970s. These individuals taught us that culture is our most important instrument of adaptation. Further, our ability to evolve our culture distinguishes us from other species. Design and planning can then be viewed as adaptive mechanisms; that is, tools for resilience. Adaptation and resilience are related to our health, which has been defined by the World Health Organization as the ability to recover from disease, injury, and/or insult.

McHarg generated big ideas. As he witnessed the growing application of those ideas through GIS and other visualization techniques, he realized that they could be used at the national and even global scales. In the early 1990s, McHarg and several colleagues produced a prototype database for a national ecological inventory. Then US Environmental Protection Agency (EPA) administrator (and McHarg admirer) Bill Reilly commissioned the study and the prototype was submitted to the EPA in 1993.

McHarg and his team proposed an extensive inventory at three scales—national, regional, and local—including information about the physical oceanography (where applicable), geology, geomorphology, physiography, hydrology, soils, vegetation, limnology, marine biology, wildlife, and land use. They urged that chronology be employed as “the unifying rubric” (McHarg, 1996). In his autobiography, A Quest for Life, McHarg (1996) stated, “We observed that the greatest problem lies not with data, but with integration” (p. 363). Two decades later, integration remains the greatest problem.

In the final decade of his life, McHarg advocated a national ecological inventory for the US and other nations, and also believed the approach could and should be expanded to the planet. This global view was deeply rooted in McHarg’s philosophy. As early as 1968, he wrote: “We must see nature as a process within which man exists, splendidly equipped to become the manager of the biosphere” (McHarg, 1998a, p. 71). He called this global responsibility our “greatest role.” If we agree, then how do we fulfill this role?

Drivers of landscape change

Change does not just happen. A variety of economic, social, and technological forces drive it. Let us look at some global drivers of landscape change and the consequences of those changes to illustrate the continued urgency of McHarg’s vision. A few probable drivers include:

1. population dynamics and consumption
2. urbanization
3. global and regional environmental processes.
Population growth and migration include those factors that will change the demographic structure of the planet. At the beginning of the twentieth century, there were 2 billion people in the world. Now, over 7.6 billion people inhabit the planet. The United Nations projects the world’s population to plateau at 9.4 billion by the year 2050 then creep up to 10.4 billion by 2100 (Barrett & Odum, 2000). This translates into some 12.6 billion more folks joining us over the next century (Brand, 1999). We live in the first urban century. For the first time in human history, more than half the world’s population lives in metropolitan regions. In the future, even more people will move to cities. Global urban populations are expected to double by 2030. By 2050, two-thirds of the people in the world will be living in urban regions (World Resources Institute, 2000).

Population growth drives change because everyone requires water, food, shelter, clothing, and energy. Our desires to consume the basics and amenities of life affect the level of resources necessary to fulfill those demands, our ecological footprints, as well as the character of the living landscapes that serve as the sources and sinks for those resources.

Population changes—such as growth and migration—and consumption are related to urbanization. The movement of people to metropolitan regions involves the transformation of spaces from rural and natural to urban and suburban, the urbanization of the wild, the abandonment of the rural, and the recovery of the core city and older suburban neighborhoods. Here are some key questions related to both population growth and urbanization:

1. Why do people choose to live where they do?
2. What policies direct and affect growth and development?
3. What are the long-term impacts of these policies?
4. What knowledge is necessary to inform interventions designed to mitigate those impacts?

Global environmental processes also drive landscape changes and adaptations. Global warming trends are well known (Harrison & Pearce, 2000). These changes already influence the life cycles of many species. For example, polar bears in the Arctic normally spend much of the year on the ice bulking up on enough fish to allow them to survive winter hibernation. As the winter seasons shrink and the bears are forced to spend more time on land, they have less time to build their body weight. The health of the species becomes threatened when smaller cubs are born to mothers who have less time to look after their young because of their need for food.

Additional environmental drivers of change influencing the global commons and, to varying degrees of possibility, specific regions and landscapes, include natural disasters (which create more refugees than wars), water quality and quantity, the nitrogen cycle, and energy uses and greenhouse effects. As we learn more about these drivers, we can connect them to change occurring in urban, rural, and wilderness landscapes.
The consequences of landscape change

The consequences of landscape change are all around us. A few changes evident in our daily lives include suburban sprawl, the conversion of prime farmlands to other uses, the decline of biodiversity and cultural diversity, social inequity, urban heat island effects and global climate change, and our health.

Suburban sprawl is dispersed, automobile-dependent development outside compact urban and town centers, along highways, and in the rural countryside. Such development consumes more land, water, and energy than do more traditional settlement patterns. Sprawl fragments open space and tend to be homogenous in appearance.

Sprawl consumes around 365 acres (147.7 hectares) of American countryside every hour. Across the nation, the amount of developed land is growing faster than the population. For example, between 1960 and 1990, the metropolitan population grew by 50 percent while the acreage of developed land increased by 100 percent. The Chicago metropolitan region now covers over 3,800 square miles (9,842 square kilometers). Between 1990 and 2000, the population of the region grew only 4 percent, but land occupied by housing increased by 46 percent and by commercial uses by 74 percent (US Secretary of Agriculture, 2001). Meadows and forests are converted to strip malls and subdivisions that serve cars better than people.

Suburban sprawl consumes significant amounts of prime farmland. According to the US Department of Agriculture’s National Resources Inventory, an average of 105 acres (42.5 hectares) of farmland was converted to non-agricultural use every hour of each year between 1982 and 1992. In California’s Central Valley region alone, 15,000 acres (6,070 hectares) of farmland are developed each year. That area produces 10 percent of the value of US farm output on less than 1 percent of the nation’s farmland (US Secretary of Agriculture, 2001).

Farmlands produce more than food; farms also contribute to our quality of life. Agricultural land uses create a diversity of landscapes, which are aesthetically pleasing to urban and rural neighbors. They add to the culture and traditions of places that provide character for metropolitan regions. Agriculture creates social opportunities because farm families have historically provided pools of civic leadership for many communities. Roughly one-fifth of the US’s 250 million acres (101 million hectares) of prime agricultural land can be considered at risk of development because it is within 50 miles of the 100 largest cities in the nation (US Secretary of Agriculture, 2001). We depend on that land for much of our food and clothing.

Our current growth patterns also affect other species. Biodiversity refers to the variety of life and its processes, which includes the abundance of living organisms, their genetic diversity, and the communities and ecosystems in which they occur.
Ill-planned development, poor land-use decisions, and bad land management policies are often incompatible with existing natural habitats (Environmental Law Institute, 2003). Farm and forest lands, threatened by suburban sprawl, can contribute to biodiversity by providing habitat for a variety of wildlife, including rare and endangered species. Large, unfragmented tracts of farm and forest lands and forest corridors allow interaction and crossbreeding among population groups of the same species, which increases population health and genetic viability (US Secretary of Agriculture, 2001).

According to the Environmental Law Institute (2003), the “primary cause of biodiversity loss in the United States is habitat destruction and degradation, followed by competition with or predation by non-native invasive species” (p. 3). Further, the Environmental Law Institute identified the main causes of habitat destruction and fragmentation as “land conversion for development, road building, water development, outdoor recreation, agriculture, and resource extraction or harvest (e.g., mining and logging)” (p. 3). Intervention in natural processes, such as forest fires and flooding, can also negatively influence biodiversity. Such activities and processes are best understood through the landscape perspective pioneered by McHarg.

Current patterns of suburban sprawl exacerbate social inequities in the US. As growth and prosperity occur at the fringes of metropolitan regions, central cities and inner, older suburbs experience a declining tax base and increasingly concentrated poverty. For example, residents of inner-city neighborhoods are more than twice as likely to live in poverty as are their suburban counterparts in the US (PolicyLink, 2002). Poverty is especially pronounced in minority communities, since African-Americans and Latinos have poverty rates nearly three times as high as white Americans (Institute on Race and Policy, 2002).

As metropolitan regions grow, the local climate changes because of the urban heat island, or heat archipelago, effect. This effect involves the additional heating of the air over urban settlements as a result of the replacement of naturally vegetated surfaces with those composed of asphalt, concrete, rooftops, and other human-made materials. For example, between 1970 and 1990, summer night-time average temperatures in the Phoenix metropolitan region increased by 2.2°C, and by 6°C between rural desert and inner urban locations (Brazel et al., 2000).

Sea level rise projected by future global climate change will also affect human settlements, especially vulnerable populations such as the young and the elderly, the poor and the disabled, and racial minorities. A sea level rise of 0.9 meters (3 feet) “places a land area projected to house 4.2 million people [in the continental US] at risk of inundation, whereas 1.8 [meters, 5.9 feet] affects 13.1 million people [in the continental US]” (Hauer et al., 2016, p. 691).
As cities and suburbs and our planet become hotter, we grow fatter. According to the Centers for Disease Control and Prevention (CDC), some 60 percent of Americans are overweight and at least 18 percent are obese. The lack of walking opportunities and the easy access to fast food are two contributing factors. Thus, the design and planning of our surroundings, our landscapes, is a public health issue. In most American cities, there is a lack of safe and accessible sidewalks, crosswalks, and bike paths. Transportation alternatives are limited, with little pedestrian access to buses and transit systems. Parks and recreation facilities are unsafe, ugly, and inaccessible. Shopping and services cannot be accessed without automobiles (Frumkin, 2002).

We need to see the connection between obesity and our health in general and the design of our built environments. As Dr. Richard Joseph Jackson (2001), formerly of the CDC and now with UCLA, observed in an article titled “What Olmsted Knew”:

> Even though the United States spends one of every seven dollars on medical care, we will not significantly improve health and the quality of life unless we pay more attention to how we design our living environments. Healthy living environments include not just a clean and heated kitchen, bath, or bedroom, but also the landscape around us. Health for all, especially for the young, aging, poor and disabled, requires that we design healthfulness into our environments as well. (p. 12)

To summarize, just as other species’ habitats are disappearing, we are losing our best farmland. The gap between rich and poor is widening, urban and suburban places are heating up, and our waistlines are expanding.

**Toward a science and an art of landscape intervention**

Each of these consequences of ill-conceived landscape change can be addressed through the design and planning interventions championed by McHarg. In 1967, McHarg initiated a scientific approach for landscape intervention grounded in design after obtaining funding from the Ford Foundation to recruit a faculty of natural scientists into his department at Penn to “integrate their perceptions into a holistic discipline applied to the solution of contemporary problems” (McHarg, 1996, p. 192). As previously noted, he broadened this approach to encompass human ecology because of NIMH support in the 1970s. The notion that one can practice landscape architecture, planning, and architecture by integrating the views of soil scientists, hydrologists, ecologists, climatologists, ethnographers, and other scientists echoes the multi-layered view of geography that McHarg did much to popularize with his *Design with Nature*, and has been important in the building of many environmental programs.
McHarg grounded his approach for landscape intervention in ecology. He argued that ecology, including human ecology, should inform the schemes of designers and planners by helping them to understand interactions among natural phenomena and landscape patterns. His approach is based on collecting data in a chronological order; that is, regional climate helps shape the geology of a place, which in turn affects other abiotic processes such as physiography and hydrology, which influence the specific soils and microclimates of the place. These abiotic processes come together in combinations that provide niches for plant and animal communities. McHarg (1969, 1996) suggested that information about these processes could be mapped and overlaid in what he called a “layer cake” model, which could then be used to determine opportunities and constraints for potential land uses. In this way, the suitability of land uses could be presented to local decision-makers.

The multi-layered model with which McHarg experimented, initially using transparent overlays, has evolved through GIS technology. GIS and other new technologies provide us with the ability to intervene in landscapes to address the pressing issues facing communities and regions. For instance, to ameliorate urban heat island effects, the amount of black asphalt should be reduced in streets and parking lots, more shade should be created, and more trees and other plants should be added to urban environments. GIS and visualization programs present tools for planning where such interventions would have the most positive effects. GIS can also enable designers and planners to locate and reconfigure transportation systems according to need. Visualization technologies, such as geodesign, help architects, landscape architects, and planners to show how these changes will look in neighborhoods and shopping areas (Steiner & Shearer, 2016; Steinitz, 2012).

We need to focus on the nature of cities—our most significant human ecosystem (Steiner et al., 2016). Landscapes provide an ideal framework for urban intervention because they represent a synthesis of natural and cultural features. Each landscape is distinguished from others because of its unique combination of natural and cultural characteristics.

We know more about our planet now than at any time in our history. We can watch hurricanes move through the Caribbean in real time on CNN. NASA offers its own station with endless Earth views. We are connected to one another and to vast amounts of information through the Internet. Science continues to advance our understanding of land and sea. We have created an informational central nervous system for the planet, but the system lacks a brain. What good is all this information if we cannot use it to improve our planet for future generations? The challenges we face require that we pursue and advance the vision McHarg provided.
Through the dual lens of nature and culture, we can begin to use our increased knowledge about our surroundings to take the actions necessary to halt suburban sprawl, to protect prime farmlands and environmentally sensitive areas, to redirect development and investment to existing cities, and to green those cities and reduce the urban heat island in the process. We need to design with nature to heal the Earth.

As McHarg (1998b) observed, “Let us plan to save lives, to protect the environment, to achieve savings from appropriate ecological planning, to improve prediction and placement, and to improve the human condition” (p. 83).

References


Gregory Bateson’s Search for “Patterns Which Connect” Ecology and Mind

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Figure 1: Gregory Bateson
Source: Institute of Intercultural Studies. Now in the public domain.

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Background and early life

Gregory Bateson was born near Cambridge, England, in 1904. He died in California in 1980. His grandfather, William Henry Bateson, was master of St. Johns College, Cambridge. His father William, a naturalist, was professor of biology, also at Cambridge (Levy & Rappaport, 1982).

Shortly before the turn of the century, William Bateson was conducting research on hybridization in birds and insects when he discovered the papers of the Austrian Monk Gregor Mendel. He immediately recognized their importance given his own experiments, had them translated into English, and became a strong supporter of the Mendelian laws of inheritance. Bateson is credited with coining a number of pioneering biological terms, including “genetics,” “alleles,” “zygote,” “heterozygote,” and “homozygote”, among others. He was also instrumental in founding, in 1908, the Cambridge School of Genetics. It was fitting, perhaps, that his first-born son would inherit his given name from Mendel.

Gregory Bateson grew up in a rich intellectual environment. From childhood, he was surrounded by a lifeworld of preeminent scientists, philosophers, and scholars of history, the classics, and literature. But Bateson belonged to no academic discipline. He took his bachelors at Cambridge in biology and then switched to anthropology for graduate study.

His anthropological concerns were rooted in the natural biological sciences, not only as a result of his early academic training, but also from the intense informal childhood and adolescent education with his father and his father’s circle. His father's interest in biological morphology (particularly questions of symmetry and asymmetry) and its generation, maintenance, and disruption was shared by Bateson, who enlarged it to include the morphology of behavior.

His early fieldwork was among the Latmul of New Guinea (1929–1933), and was the subject of his first book in 1936 (Bateson, 1936). During this time, he collaborated with—and married—Margaret Mead. His interest in behavioral morphology, which for him involved structures of meaning and communication, led him to be distrustful of reductionist models of cause and effect, which seemed to leave out too much and to distort understanding. He felt that explanations—and thought in general—that were not of the proper complexity in relation to the events being described were not only false in ways that he tried to specify, but were dangerous in that they led to destructive action.

Bateson developed his way of thinking and extended it to other issues, including cultural transmission, the study of play, of dance and of ritual, frequently relying on filmmaking as a methodological tool. Later in the 1940s and 1950s, he developed this style of thought further in relation to psychiatry (especially schizophrenia), social
organization, cybernetics, and communication in general. In the 1960s, he returned to his early interests in biology, embryology, and morphology, integrating them into his own broad-based and unique approach to problems of epistemology, evolutionary processes, and, ultimately, human ecology.

At the core of his thinking was “the relationship of mind and nature”—a theme that permeated his most widely read books: *Steps to an Ecology of Mind* (1972) and *Mind and Nature: A Necessary Unity* (1979). He collaborated closely on these, and other works, with his daughter Mary Catherine, who was herself a cultural anthropologist and successful author. Bateson also produced many hours of recorded lectures at Esalen, Lindesfarne, Saybrook, and Santa Cruz. I was given copies of these recordings many years ago, totaling more than 30 hours, and have listened to them multiple times.

According to Bateson, the major problems in the world were the result of the difference between how nature works and the way people think. His major goal was to discover “the pattern which connects” the realms (Bateson, 1978). This phrase comes from a letter to his fellow regents of the University of California in the late 1970s about the shortcomings of western education. He put it this way: “Break the pattern which connects the items of learning and you necessarily destroy all quality” (Bateson 1979, p. 8). This was his overarching aim—not only with regard to education, but to the living world as a whole (Bateson, 1979; Nachmanovitch, 1982).

To my ear, he was voicing something much like what Alfred North Whitehead once said. Near the end of his life, Whitehead wrote a synthesis of his philosophy for *The Library of Living Philosophers*. The book begins with a “philosopher’s summary” of the work. The preface also includes a facsimile of Whitehead’s final handwritten letter to the editor: “The progress of philosophy,” he noted, “does not primarily involve reactions of agreement or dissent. It essentially consists in the enlargement of thought, whereby contradictions and agreements are transformed into partial aspects of wider points of view” (Whitehead, 1926, p. 664).

Whitehead was surely among Bateson’s favorite references. But so were a great diversity of others, from Lamarck, Darwin, and Conrad Waddington to R. G. Collingwood, Von Neumann, Norbert Wiener, Lewis Carroll, William Blake, Samuel Butler, St. Augustine, and the Bible. He drew liberally from all of them to weave his way of thinking.

Bateson tended to move from general principles of the highest order of abstraction directly to (and from) examples, which he connected by metaphor or analogy, without seeming to be concerned with middle-range analytic problems.
Logic, psycho-logic and eco-logic

Let us begin with deduction. Bateson knew Bertrand Russell and Whitehead; he was also well versed in the rigor of their “Theory of Logical Types” (Whitehead & Russell, 1910). However, he believed that the project of classical logic left out most of the things he wanted to study. As he put it: “The if … then of causality contains time, but the if … then of logic is timeless. It follows that logic is an incomplete model of causality” (Bateson, 1979, p. 58).

One way to grasp Bateson’s position is to look at the ways that human thinking relies on processes of story-like patterns. But even here, Bateson was skeptical about our rational bias for explaining life, rather than discovering how to experience it. At the heart of this confusion is something we frequently encounter in the comparison of denotative and connotative modes of meaning; namely, the problem of different kinds of mind. Bateson illustrated the problem by comparing two types of syllogism. The first form, from classical logic, goes like this:

Humans die;  
Socrates is human;  
Socrates will die.

The conclusion is reached deductively from the first (major) premise and the second (minor) premise. The basic structure of this logical tool is built upon classification. The predicate (“will die”) is attached to Socrates by identifying him as a member of a class whose members share in that predication. Despite its honored role at the core of logical reasoning, Bateson maintained that this logical device is of little use in understanding how the mind actually works.

Induction

On the other side of the coin, he was likewise familiar, and unsatisfied, with inductive logic. And here I am quoting Bateson (1972):

Many investigators … seem to believe that scientific advance is predominantly inductive, and should be … They believe that progress is made by the study of the “raw” data, leading to new heuristic concepts. The heuristic concepts are then to be regarded as “working hypotheses” and tested against more data. Gradually, it is hoped, the heuristic concepts will be corrected and improved until at last they are worthy of a place in the list of fundamentals. About fifty years of work—in which

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2 Portions of this paper were drawn from a discussion of metaphor and figurative language, which appears in my book Ecology and Experience: Reflections from a Human Ecological Perspective (2014).
thousands of clever people (men) have had their share—have, in fact, produced a rich crop of several hundred heuristic concepts, but, alas, scarcely a single principle worthy of a place in the list of fundamentals. (p. xix)

Bateson came to see the sociopsychological forms with which he was concerned as related to larger processes of evolution and adaptation. He discerned systematic relations of a number of kinds between processes of evolution viewed as phylogenetic “learning,” and the learning that takes place at the individual human and cultural levels.

**Abduction**

To overcome the limitations imposed by the deductive and inductive methods, Bateson invoked a quite different form of syllogism, known as abduction (a notion he got from C. S Pierce):

- Grass dies;
- Humans die;
- Humans are grass.

The logical error here is known as affirming the consequence. But the “syllogism in grass,” as Bateson called it, is the very basis of metaphoric relationships. Consider Walt Whitman (2006): “I bequeath myself to the dirt, to grow from the grass I love; If you want me again, look for me under your boot-soles” (p. 105). Whitman’s thoughts may be bad logic. But they are good poetry. That is precisely what Bateson wanted us to realize. Metaphors are not logical deductions. Nor are they instances of enumerative induction. They constitute an entirely different type of thought, illuminated best in the mind-like processes of abduction; and they are enormously widespread.

He called this *abduction* “the lateral extension of abstract components of description,” which he took to be as important as deduction and induction. “Metaphor, dream, parable, allegory, the whole of art, the whole of science, the whole of religion, the whole of poetry, totemism … the organization of facts in comparative anatomy—all these are instances or aggregates of instances of abduction” (Bateson, 1979, p. 142).

He then, characteristically, pushed the idea further in his search for analogies of order. “But obviously the possibility of abduction extends to the very roots also of physical science, Newton’s analysis of the solar system and the periodic table of the elements being historical examples” (Bateson, 1979, pp. 142–143). Bateson saw “mind-like” (abduction) processes throughout evolution and ecology; he likewise saw evolutionary ecological-like features throughout mind. In short, his aim was post-Cartesian, and his main tool was the study and elucidation of “syllogisms of grass.”
One of his major themes was the recasting of epistemology. For Bateson, epistemology was not a minor branch of philosophy. He used the term in a much broader sense, as a “knowing how” to make connections common to all living things. A plant knows how to be a plant, in its own sort of way. Though not conscious of its epistemology, as we might epistemologically know how to do something, plants nonetheless carry within themselves an embedded knowledge-ability.

Bateson was not concerned with the specific features botanists used to classify a particular plant. He knew them. But his way of looking at an organism was more similar to what Goethe had done in his 1790 *Metamorphosis of Plants*. Like Goethe, Bateson went beyond normal scientific thinking. He wanted to penetrate the living sphere of creative morphology and expose the internal language of biological epistemology. This biological language, of how an organism’s parts are held together and develop, was at the core of how the world fit together for Bateson.

He was not satisfied with explanations in terms of anatomical, physiological, or taxonomic definitions of what an organism *is*. Instead, he was seeking to comprehend how individual life forms develop, how they change, and, ultimately, the pattern through which all living things are connected. From his perspective, evolution was an ongoing process (like learning). And to understand it, according to Bateson, we must learn to think in terms of contextual relations.

It may be helpful here to consider the work of Jean Piaget and his theory of cognition known as “genetic epistemology.” Genetic here does not refer to genes, but rather the broader meaning of genesis; that is, “the growth” of (epistemological) operations from birth to adulthood (Piaget, 1971). Most people consider Piaget to be a child psychologist. In fact, though, Piaget’s doctorate was in biology–malacology, or more precisely in his case, the study of snails. His mapping of the stages of cognitive development is a close analog to how snail shells adapt and grow over time in their aquatic environment. The reciprocal adaptive processes of assimilation (taking in the environment) and accommodation (physical growth changes), seen in the progressive re-patterning of the organism, as Piaget discovered, are likewise characteristic of human mental growth.

For Piaget, the psychologist, cognitive development is about the adaptive growth of complex thinking and finding ever-better answers for cognitive problems. For Bateson, it seems to me, the issue was more on the side of “How do questions arise?” and the role of abduction-like processes in mind and in nature.
Metaphor

According to Bateson, “to fight all syllogisms in grass would be silly … These syllogisms are the very stuff of which natural history is made. When we look for regularities in the biological world, we meet them all the time” (Bateson & Bateson, 2004, pp. 26–27). This is Bateson’s real jumping off point. Metaphors are a universal feature of life’s connection to life, essential for understanding the unity of ecology and mind from his point of view. “Metaphor, dream, parable, allegory, the whole of art, the whole of science, the whole of religion, the whole of poetry, totemism … the organization of acts in comparative anatomy—all these are instances of abduction” (Bateson, 1979, pp. 142–143).

The cure for the inadequacies of consciousness, of purposive rationality, is not to reject it in favor of a passionate non-rationality—and here Bateson separates himself from the extreme romantic position—but to augment and complete it. For him, the inadequacies of linear, purposive, discursive processes of consciousness were corrected by enlisting the aid of the non-discursive, pattern-comprehending, emotionally saturated “primary processes”—akin, in some respects, to the early psychoanalysts’ descriptions of the unconscious. As he himself put it:

Freudian psychology expanded the concept of mind inwards to include the whole communication system within the body—the autonomic, the habitual, and the vast range of unconscious process. What I am saying expands mind outwards. And both of these changes reduce the scope of the conscious self. A certain humility becomes appropriate, tempered by the dignity or joy of being part of something much bigger. (Bateson, 1972, pp. 462–463)

He had extended his idea of “mind” beyond the skin. He extended it once again, particularly in his last book Mind and Nature. There, he elaborates the characteristics of systems that seem to him to have the essential features that also characterize human mind. He found them essential aspects of living systems in general (including ecological systems comprising “living elements”), as well as of complex cybernetic systems constructed by humans.

To bring this back to the article by Cittadino (this volume), I am reminded of something Paul Sears once said: “The scientist climbs and climbs the mountain, and when he gets to the top, he finds the footprints of the poet” (cf. Burch & Carrera, 2003, pp. 420–421). Bateson was one of that rare breed of intellectuals who could get there both ways. This may be why he has been so difficult for most people to understand and appreciate.

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3 For a useful exploration on the psychology of metaphorical thought, see Glucksberg (2001).
The Batesonian metalogue

In my experience, it is far better to hear Bateson that to read him. His talks were not organized in the style of a formal scholarly lecture. He was, instead, performing a “metalogue”—a communication whose form is meant to illustrate its content. According to his long-time friend and colleague Lynn Hoffman, what Bateson was doing was an enactment of T.S. Eliot’s paradigm of literary criticism, and particularly his notion of “the objective correlative.” For Eliot, as Hoffman (2008) explained:

a poem or a novel that was successful often contained a symbolic reference that stood for the meaning of the work. The Great White Whale in *Moby Dick* seemed to represent the obsessive quality of Ahab’s search; in like fashion, the compass in John Donne’s “The Lovers” pointed both to the outer arm that traces a distant trajectory and the center one that stands for the lover’s return.

In sum, the epistemological error Bateson was fighting was what he called the “thingification of nouns.” This correlates, I believe, with Whitehead’s “fallacy of misplaced concreteness,” and is similarly, perhaps, why Whiteheadian process philosophy is so difficult to grasp. For Whitehead, the ultimate nature of reality is not material (that is, matter, substance, or stuff). It is process. In other words, what we take to be “things” are actually more like “events”; akin to standing waves that come and go over time, though they may appear to be permanent, they are variable, transitory concrescences.

As Roger Keesing put it in his 1974 review of *Steps to an Ecology of Mind*, “Gregory Bateson has been blessed, and cursed, with a mind that sees through things to a world of pattern and form that lies beyond” (p. 370). He then adds, “To have a vision of the world one’s fellow members (men) do not share is lonely and even frightening” (Keesing, 1974, p. 370). On a more upbeat note, here is the closing paragraph of the Oxford human ecologist Philip Stewart’s (1975) review of Bateson’s ideas:

What is Bateson’s contribution to human ecology? The answer is perhaps that he makes it possible for the first time to conceive of a unified and rigorous science which will embrace both a man’s material relation to his physical environment and his mental relation to his informational environment … With this new insight, the old partition between nature and culture fades to nothing, and one wonders how borderline phenomena were ever assigned to one or the other. Bateson’s … essays show that he was the first to take some of the essential steps. They deserve to be read and reread by every human ecologist. It is my guess that we shall be adapting our minds to these new ideas for a long time to come. (p. 60)
References


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The inaugural conference of the Society for Human Ecology, held on the 26th to 28th of April 1985 at the University of Maryland, was themed “Human Ecology: A Gathering of Perspectives.” This meeting brought together diverse delegates and speakers from around the world to discuss exciting new and emerging ideas in the field of human ecology. Papers from that conference were published in 1986 in a book of the same name (Borden, 1986). This special issue of Human Ecology Review has selected and reproduced here three representative papers from that book. New invited commentaries introduce each paper, noting the context of their original contribution, and which of their ideas remain current. All papers have been re-typeset from the originals, and minor stylist updates have been made.

Robert Dyball, Editor, Human Ecology Review.

Reference

Introduction to Garrett Hardin’s “Human Ecology: The Subversive, Conservative Science”

Richard J. Borden

Garrett Hardin alarmed the fledgling environmental movement with a cautionary tale, published in 1968 in *Science* magazine, about “the tragedy of the commons.” The essay made the stark claim that environmental problems were the collective consequence of human action—rooted in unrestrained individual self-interest. For Hardin, the most daunting example of environmental destruction was population growth. This theme remained a central feature of his lifelong concerns about ecosystem carrying capacity, human overpopulation, reproductive rights, and “lifeboat ethics.” His controversial ideas about overexploitation of common resources opened the door to a growing awareness that many environmental problems are problems of human beliefs and behavior. They were also a major impetus for the development of alternative models of sustainable development, consensual decision-making, and common property resource management.

Garrett Hardin’s career as an ecologist began at the University of Chicago, where he studied under W. C. Allee. Following receipt of his PhD at Stanford, he joined the faculty of the University of California Santa Barbara in 1946—initially in zoology, but later as professor of human ecology—until his retirement in 1978.

When invitations for the First International Conference of the Society for Human Ecology were sent, we were pleased to draw participants from across the United States, Europe, and as far away as Australia. The meeting took place at the University of Maryland in April 1985. The following paper by Garrett Hardin, by then well into retirement, was among them. His delivery was characteristically forceful—and, perhaps, intentionally provocative as well. Nonetheless, it was a welcome addition to the Society for Human Ecology’s launching as a professional society, and generated a lively discussion.

It is not easy to provide a simple summation of Garrett Hardin’s contributions to human ecological thought. His positions often seemed contrary-minded, even contradictory. Hardin’s ideas on birth control and abortion rights were at odds with the political right. His positions on immigration, food aid, and welfare were infuriating to the left. At the same time, his maxim that “we can never do merely one thing” has become something of an ecological truism. The following essay encapsulates the “hard realism” of Hardin’s convictions. Whatever we may think of them, individually or together, they remain a potent stimulus within the history of human ecology.
Human Ecology: The Subversive, Conservative Science

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Identifying a single science as both “subversive” and “conservative” may seem a perverse thing to do, but I will explain the combination before I am through. To begin with let us see how the first adjective came to be applied to ecology. Paul Sears (1964), just two years after the publication of Rachel Carson’s *Silent Spring* (1962), asked:

> Is ecology a phase of science of limited interest and utility? Or, if taken seriously as an instrument for the long-run welfare of mankind, would it endanger the assumptions and practices accepted by modern societies, whatever their doctrinal commitments?

In the discussion that followed Sears made it quite clear that he regarded ecology as being of almost unlimited interest and utility for everyday life, acknowledging that its principles threatened many assumptions and practices in the existing social order. Sears, far from a radical in ordinary political matters, was forced to conclude that ecology is a subversive science.

A short time later Paul Shepard and Dan McKinley (1969) borrowed Sears’s words for the title of a useful anthology. Before a decade had passed, William Ophuls (1973), in a remarkable dissertation offered in support of a PhD degree in political science, identified the subversive threat more clearly:

> Human ecology is against the conquest of nature; against growth as we think of it; against the isolation of thought and action; against individualism as an ideology; and against moral absolutes like the inalienable rights of man. “The subversive science” is thus a pitifully weak soubriquet for ecology, which demands only that our current political, social, economic and moral order be stood on its head.

When the human ecologist fully understands the irony of Ophuls’s concluding words he realizes how lonely is the path he must walk as he is belabored by both Left and Right of the political spectrum. I would not have the ecologist turn aside because of a justifiable fear of vested powers; rather I would urge that he make use of the resources of humor, stiffening his backbone by recalling a comment made

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1 This manuscript has been transcribed from the article originally published in R. J. Borden (Ed.) (1986). *Human ecology: A gathering of perspectives*. Bar Harbor, ME: Society for Human Ecology. While all care has been taken, minor typographical differences to the original may occur.
by the professional humorist Art Hoppe (1970), who caused an imaginary happy-go-lucky student radical to say: “The great thing about ecology as a cause is that everybody’s guilty.”

Yet another burden falls on human ecologists: the science is inescapably interdisciplinary. To quote once more from Sears (1971):

“It may clear matters somewhat to modify the usual definition of ecology as the science of interrelation between life and environment. Actually, it is a way of approaching this vast field of experience by drawing upon the best information available from whatever source it may come. (emphasis added)

Should we, then, assemble teams of scholars to carry out the needed interdisciplinary work? The proposal seems logical enough, but this approach seldom has a happy outcome. Great though the personal risks may be, it is the individual who must carry out the work of synthesis. Individuals must be prepared to make mistakes and be castigated by the narrow specialists. Every statement made by a daring synthesizer will tread on someone’s toes. Controversy is unavoidable. Obviously, a field like human ecology is not everyone’s cup of tea. I happen to enjoy it. Let me see if I can explain its attractions and the way in which I think human ecology should be presented to students.

The boundless multiplication of recorded facts makes it advisable that every well-developed subject be first presented by way of broad generalizations. Generalizations are always dangerous, but they are less dangerous than a refusal to make generalizations. At the very least a generalization has heuristic value; that is, it has the potential of leading to fresh discoveries. If a statement has exceptions these are more likely to be discovered if the principle is expressed in simple, dogmatic terms. (Is this a consequence of the contrariness of human nature? Whatever the explanation, the fact is useful.)

I advance the following thesis: the heart of human ecology can be presented as a set of rather dogmatic generalizations, most of which are in the form of negative statements. Let me take as my first example a well-accepted dogma from the subdivision of ecology known as “economics.” (Card-carrying economists may not like to hear their specialty identified as a subdivision, but I call your attention to the fact that the names of both sciences are derived from the Greek οίκος, house or home. Economists tend to focus only on the people in Household Earth, thus making their subject only a fraction of the total science of ecology, which deals with all of Earth’s inhabitants and their environment.)

Popularly expressed, the central dogma of economics is this: “There’s no such thing as a free lunch.” Asked if this is always true the economist replies, “You’d better believe it!” He cannot prove there are no exceptions, but neither does he believe that an understandable, reliable science of economics can be created without this
generalization (whether explicitly expressed or not). This dogma, which natural scientists would call a conservation principle, leads to the assumption of business practice that accounts must balance. It is intolerable to suppose, or hope, that actual income might exceed the sum of intake minus outgo. (When a set of books seems to indicate that such a miracle has occurred the cause is sarcastically referred to as “creative bookkeeping.”)

Why should a major dogma be best presented in a negative form? We could have expressed the major assumption of economics in a positive way: “Every lunch has its price.” I doubt very much if many people would make the idea part of themselves if the positive form had been used. There is something about a negative formulation that captures the human attention. Perhaps this fact is related to the observation of Sigmund Freud (1950) that, at the subconscious level, the human mind cannot deal with negation. Since the subconscious mind cannot deal with negation, even to refute it, the conscious mind must: so the negative form captures our attention. Whether or not this speculation uncovers the truth, the fact remains: negative statements make us think.

The greatest dogmas of the natural sciences are given in negative form: they tell us what we cannot do. Take the facetious (but profoundly true) forms of the laws of thermodynamics:

- You can’t win.
- You are sure to lose.
- And you can’t get out of the game.

Here is negativity in earnest—but it gets our attention. The mathematician E. T. Whitaker (1942) has called the foundation stones of science its “postulates of impotence,” saying that each one asserts the impossibility of achieving something, even though there may be an infinite number of ways of trying to achieve it. A postulate of impotence is not the direct result of an experiment, or of any finite number of experiments; it does not mention any measurement, or any numerical relation or analytical equation; it is the assertion of a conviction of the mind, that all attempts to do a certain thing, however made, are bound to fail.

This is a remarkable, perhaps even shocking, view of science. That science might, at the bottom, be based on a conviction of the mind, rather than experiments, brutally contradicts a common textbook view of science as an aggregation of empirical statements. In a sense, perhaps both contradictories are true. We will not tolerate a dogmatic statement that always contradicts empirical findings; on the other hand, in the practice of science we put a great deal of trust in a very few dogmatic statements that have proved so useful in the past that a contradictory new empirical finding will itself be doubted for a long time before we are willing to throw out a dogma that has become “a conviction of mind.” It is, for instance, difficult to imagine an empirical
finding that would lead us to scrap any of the laws of thermodynamics. Without impotence principles, without conservation laws—without closure of the analytical system—intellectual anarchy threatens to take over.

What, then, are the central dogmas of ecology? To begin with, ecology must admit all the conservation laws of the physical sciences. Those accepted, ecologists go on to generate additional postulates of impotence. Let me lay out what I regard as the foundation stones of human ecology.

1. *We can never do merely one thing.* Implicit in Darwin’s *Origin of Species* is the image of a complex web of life, with every species having strong or weak ties with every other species. Darwin was not the first person to be aware of widespread connections in the world. In the words of Ophuls (1977): “With their vision of total interdependence and connectedness the mystics were in effect the first ecologists” (p. 248). To John Muir is attributed the saying that “Everything is connected to everything else.” They are less the words of a scientist than of a mystic, though they are often identified as the “First Law of Ecology.”

Muir’s mystical sentence is can be criticized on two grounds. First, it is a positive statement and so is not well suited to be a prime principle. Second, by dispersing our attention over literally everything, it interferes with our seeing particular things. To achieve practical control of natural forces we need to focus on singularities, even though we thereby risk not seeing the forest for the trees. Pursuing the opposite course puts us in danger of becoming the mystical Hamlets our opponents accuse us of being.

In contrast to Muir’s statement, the assertion that “We can never do merely one thing” (Hardin, 1963), though it does not tell us exactly what to look for, does tell us to look very hard at every proposed intervention in an existing system to make sure we are not about to carry out actions we may later regret. Muir’s statement encourages passivity and fatalism; the revised version encourages study and prudent action.

2. *No effects are truly “side effects.”* Strictly speaking, all effects are effects, period. He who wishes to control the perceptions, and hence the actions of others, labels as “side effects” those consequences he does not wish people to become aware of or to act upon. A variant of this rhetorical ploy is pinning the label “external costs” or “externalities” on the costs a businessman wants to keep external to the account books of his company (Hardin, 1972).

3. *No system can long survive the effects of unopposed positive feedback.* This, of course, is the heart of the Malthusian insight, an insight that has been vigorously attacked by many in the academic community—particularly by sociologists—for more than a century. I know of no better way to sweep away the mental miasma of the dream of
perpetual growth than by exposing the student to an essay by A. A. Bartlett (1978), “Forgotten fundamentals of the energy crisis,” the printed version of a lecture Professor Bartlett has delivered more than six hundred times to general audiences.

Perhaps the simplest way to bring home to the average citizen the magnitude of the threat of unopposed positive feedback is to point out the logical consequences of putting out money at interest. Suppose that the 30 pieces of silver Judas received for betraying Christ had been worth $30; and suppose that he had put this into a bank account bearing five percent compound interest, payable in gold. Presuming the present price of gold, the initial capital would amount to about 2.5 grams of gold. How long would it take for the Judas Account to be worth a weight of gold equal to the weight of the entire Earth ($5.983 \times 10^{27}$ grams)? Just 1,292 years. This means that at about the time of Dante’s death the heirs of Judas could have presented themselves at the bank and demanded the world’s weight in gold. Such is the power of exponential growth (or “geometric growth,” as Malthus called it.)

4. **Negative feedback can be a positive boon.** Banks sell their services with the implied promise of absolute safety for savings accounts—forever. So long as such accounts bear a positive rate of compound interest, no matter how small, such a promise is ridiculous. Interest is tolerable only because the exponential growth it promises is opposed by bank failures, theft, fraud, government expropriation, revolution, conquest, and repudiation. We regard all these negative feedbacks with distaste, but one or more of them must be included in every workable system in a finite world, if no limit is put on time.

More relevant to our interests, the positive feedback of biological growth must be opposed by the negative feedbacks of predation, parasitism, socially induced sterility, and many other factors that interfere with reproduction and favor death—in Malthus’s terms, by “misery and vice.” Biologists are in a particularly favorable position to oppose the Pollyanna attitude that has been nurtured by the remarkable technological progress of the past two hundred years. Death is still a necessity and a boon.

5. **Thou shalt not transgress the carrying capacity.** If every agreement is reached on a Decalogue of Ecology, this surely will be one of the commandments. If the language seems too theological, reword the advice to your taste, but do not lose the imperative flavor. To disarm the defenses of Growthmanship, it may be well to bring forward the implications of carrying capacity by first analyzing a non-human situation, say the history of the reindeer herd on St. Matthew’s Island (Hardin, 1982; Klein, 1968). Two evils follow from transgression. First, per capita well-being falls as overpopulation takes over. (This phenomenon, in fact, gives us an operational definition of the controversial word “overpopulation.”) Second, once transgression has occurred, the carrying capacity in successive years spirals downward to very low levels. Uncorrected transgression can ultimately extinguish a population.
6. The “sanctity of life” must give way before the “sanctity of the carrying capacity.” This statement presumes that “sanctity” is an admissible concept in rational thought, and that a cardinal aim of policy is to minimize the loss of life (over an extended period of time). In discussing problems of game management, biologists should be able to convince students that maximizing the number of healthy lives is the proper aim of game management. The herd on an overcrowded range is peremptorily thinned, by killing if necessary, so as to reduce the size of the herd to the carrying capacity; and it is kept at or below that level so as to maximize the amount of life over a long period of time. This year is only a moment in time, and the present population is only a fraction of the total. The rational game manager kills in order to maximize the number of lives over time. It is carrying capacity, not the individual life, that needs to be invested with “sanctity” (Hardin, 1976). This should be obvious, but the teacher who discusses game management problems will discover that some students bridle at the thought of killing an animal today even if this is the only way to save more animal lives tomorrow.

Application of the principles acquired in game management to human situations will be strongly resisted. In controversial areas it is not the function of the teacher to demand agreement; his role is to expose assumptions and arguments. It may come as a surprise to biologists to learn that some professional philosophers (e.g., Taurek, 1977) have ranked “fairness” above life itself in discussing human analogs of the game management problem. Triage aimed at maximizing the number of lives saved (Hardin, 1980) is viewed by Taurek as “unfair,” and he would rather be fair than save lives.

One cannot but wonder how such a philosopher would react if he were in fact made responsible for the well-being of a herd of animals in an overpopulated range. Out of “fairness,” would he passively allow almost an entire herd to die of starvation, as the reindeer on St. Matthew’s Island did, rather than “unfairly” eliminate a considerable number so that the environment could be saved for the reindeer’s posterity?

I find it difficult to believe that our philosopher would stick to the principles he evolved in the quiet of his study. (I find it even more difficult to believe that anyone would knowingly hire such a philosopher for the management of herds on an estate he hopes to pass on to his posterity.) I have made numerous public recommendations for dealing with the problems of regional hunger now surfacing with increasing frequency throughout the human world (Hardin, 1974, 1976, 1980, 1982, 1985). For more than a decade ecologists have pointed out that the population of Ethiopia is beyond the prudent carrying capacity of the land. Now that the crash has come well-intentioned people, upholding the sanctity of life rather than the sanctity of the carrying capacity, are eagerly sending in food from the outside thus insuring that the Ethiopian population will remain above the carrying
capacity. The consequences of good intentions that are uninformed by ecological principles will be the transformation of a presumed temporary crisis into a veritable permanent crunch (Hardin, 1974).

It is time to recall the prescient words of William Ophuls (1973): “Human ecology is against ... the isolation of thought and action; against individualism as an ideology; and against moral absolutes like the inalienable rights of man.” Ophuls’s insight may be too strong a medicine for the student to take; the good teacher, like the good psychoanalyst, must carefully choose the time for revelation.

7. Not all elements of the human carrying capacity are expansible. We are rightfully proud of the technological advances humanity has made in the past two centuries. These advances have significantly enlarged the usable carrying capacity of the Earth, but only with respect to some of the elements that we include in the aggregative term, “carrying capacity.”

To the extent that capital investment is an important element of production costs, population growth brings the benefits of economies of scale. Food production and energy extraction have increased greatly, but the fundamental absorptive capacity of the Earth for harmful waste products has not increased. Time moves no faster now than it did a thousand years ago, so high-quality goods that require much time in their production, such as cabinet-quality hardwoods, have become increasingly scarce. Amenities that cannot possibly be increased in quantity—lonely beaches and wilderness are examples in point—continually decrease on a per capita basis.

8. Population growth ultimately makes democracy impossible. Easy communication is the sine qua non for an enduring democracy. All communication functions are inherently afflicted with dis-economies of scale, since (for every well-defined communication network) the burden created by the communication of n people increases as the square of n. This burden expresses itself in information-overload, which leads to misunderstandings, social pathologies, and (ultimately) the acceptance of a totalitarian regime as the least of the evils available to an overpopulated political unit. In the face of unlimited population growth the word “democracy” can be retained, but not the fact.

Biology teachers usually avoid dealing with political matters, but I recommend that in this case they depart from custom to emphasize the scale effect. Ever since Malthus, apologists for perpetual population growth have shown great ingenuity in the selection of data to bolster their position. (For recent instances see Julian Simon [1981], and Simon and Kahn [1984].) Always implicit, and often explicit, is their repugnance at the thought of the loss of individual freedom through population control measures. It needs to be brought home to the Growthmanship crowd that the fundamental dis-economies of scale inherent in communication means that the freedom they cherish cannot be retained if the growth they advocate comes to pass.
When Pasteur and others brought about a revolution in public health they intended only to conquer disease. We, the beneficiaries of this great revolution, now face the bitter truth that “We can never do merely one thing.” Now that the providential negative feedback of density-dependent crowd-diseases has been eliminated, the question that people in all societies must ask is this: In which way would you prefer to lose your freedom? Through the community’s regulation of the number of children, or through nature’s cruel elimination of the excess population?

9. *Selection dictates the direction of evolution*. This is so obvious to biologists that the point need not be debated. Let us go on to see some of the practical applications of the principle.

10. *Every biocide selects for its own failure*. Until *Silent Spring*, technological optimists seldom had to face this principle. When first introduced, DDT did indeed seem a miracle stuff; but it selected for insects that had genetic resistance to its action. Similarly, antibiotics select for microbes that are genetically resistant to their toxic qualities. Control of pests and disease germs is not impossible, but neither is it simple. No single control agent can be expected to be effective for very long; combinations and alternations must be used. The price of liberty, it has been said, is eternal vigilance; this is also the price of freedom from disease.

11. *Every human law selects for its own evasion*. Discussion of pesticides sets the stage for discussion of phenomena of human ecology customarily related to political science. I recommend that such matters be brought into a course in human ecology, not as an act of academic piracy, but to emphasize the artificiality of academic boundaries and the unity of knowledge. Obviously, the word “selects” is here used in a sense different from the biological meaning. Genetic selection is not involved; the selection invoked is of the most general sort. Behavior is socially selected for and rewarded; and as bystanders observe the way an unintended reward system works they may be tempted to imitate the rewarded behavior. A few examples should clarify the idea of social selection.

Every new tax law creates new “loopholes”: people who discover them are rewarded with lower taxes. An unmanaged commons (Hardin & Baden, 1977) selects for the selfish behavior that will, under conditions of scarcity, tragically exhaust the resource (Hardin, 1968). A managed commons, usually called “socialism,” selects for managerial behavior that primarily protects the interests of the manager. This gives rise to the ancient question, *Quis custodiet ipsos custodes?*—“Who will watch over the watchers themselves?” On the other hand, a privatistic politico-economic system favors a positive feedback of social power that threatens to create unbearable economic and social inequalities (Hardin, 1963).
12. No inning is the last inning. There is no easy answer to the problem of creating an acceptable and stable social order. In biology, the “climax community” is recognized as a fiction fostered by the short time span of human attention. In principle, every species is part of the selective environment for every other species, so change in the numbers of one species tends to set off a prolonged domino process of selection and change in other species. In human sociology, analogous process (even in the absence of genetic differences and genetic changes) lead to similar domino processes.

The environmentalist who focuses on strictly scientific facts is likely to become disillusioned as he observes the multitude of ways in which people can evade sensible environmental laws and regulations. In the biological realm, selection determines evolution; in the social realm, rewards (intended or not) determine behavior. A strict law governing water quality may be evaded by shifting pollutants to the atmosphere. Control the air as well, and polluters may bury their byproducts in the ground. As for the regulators themselves, in their desire to survive and prosper they may find it to their personal advantage to be “captured” by the powers they are supposed to regulate. Once captured, they are in a good position to be offered much higher paying jobs in the regulated industries.

In human affairs there is no such thing as a last inning, and the ways in which competing forces can more or less adjust to one another are beyond numbering. The complexity of a politico-economic system is comparable to the complexity of the ecological systems biologists study. Put the two together into a system of systems and we have real complexity. The most carefully thought out intervention in this system of systems will not always produce the results we want. Interventions are often counterproductive.

Having begun with Sears’s perception that ecology is a subversive science, let us end with a balancing contention by Ophuls: “Ecology is a profoundly conservative doctrine in its social implications” (Pirages, 1977, p. 165). The truth of the statement depends on the meaning imputed to the word “conservative.”

In a century and a half the word has accumulated many meanings, some of them contradictory. No definition can be said to be the correct one. Whenever we hear the word “conservative” we should automatically ask, conservative of what? Which of many known kinds of conserving actions can the human ecologist, qua ecologist, support?

Conservative of ancient beliefs? Science is ineluctably married to doubt, and the antiquity of a belief is no warrant of its truth—though it may be a reason for seriously examining it. Many non-scientists would, if they could, enforce public belief in unexamined ancient dogmas for the sake of social stability. As a scientist, no ecologist can support such an action. In this sense, ecology is clearly not conservative.
Conservative of existing political and social institutions? Conditioned by the First Law, “We can never do merely one thing,” the ecologist has to be somewhat sympathetic with this policy. This hesitancy to embrace institutional change is, for the ecologist, less a matter of principle than a matter of prudence. The undeniable bad effects of institutional arrangements that worked well under conditions of lower population densities make the ecologist more willing than non-scientific conservatives to seek improvements in human institutions.

Conservative of existing social privileges? An ecologist sees no compelling reason for supporting the existing power structure. Because of the positive feedback of social power those who possess it will do quite well enough supporting their own interests. In fact, in the absence of deliberately engineered negative feedbacks in the social realm, the powerful will do too well. The eternal need for limitations on the runaway feedback of social power is a point that escapes the understanding of doctrinaire “libertarians.”

Conservative of environmental resources and amenities? Yes: this is a primary interest of human ecologists, who wish to preserve as much as possible of our real wealth for subsequent generations. With some political and economic conservatives human ecologists can make common cause. On the other hand, there are many people who now call themselves “conservatives” who have absolutely no interest in this sort of conversation. To this type of conservative the proposals of human ecologists seem subversive. In turn, ecologists say that those who refuse to regard themselves as posterity’s trustees of nature’s riches do not deserve the name “conservative.” In the game of survival, the conservation of any particular social system is ultimately futile in the absence of the truly essential conservation of natural resources.

The greatest commonality between ecological conservative and political conservatives is in their attitudes. Two common attitudes deserve notice. First, committed conservatives of all kinds hold that the social value of actions is determined more by their consequences than by the intentions of those who performed them. “The road to Hell is paved with good intentions.” Good intentions, though they may explain poor results, do not excuse them.

Secondly, true conservatives take a long view of time. Not as long as the geologists, whose unit may be a million years, but certainly much longer than that used in business-as-usual and politics-as-usual, where the horizon is no more than five years off. Such short-sightedness grows logically out of the economic practice of “discounting the future” in terms of the going rate of interest (Hardin, 1985). The higher the rate of interest, the more heavily the future is discounted, which means that short-sightedness “pays.” Times of trouble—inflation, social disorder, revolution—raise the interest rate and thus make provision for the future more difficult. In consequence, it becomes ever harder to escape the trouble. Positive feedback generates a vicious circle.
The economic theory of discounting the future makes a certain amount of sense, but the permanent features of an enduring civilization are built on actions that ignore this sort of economic theory. There are times in the life of every community when even the investment that must be made in bearing and rearing children cannot be justified by “hard-nosed” economics. It would be going too far to claim that the future belongs to those who reject the economic theory of discounting; but the future does belong to the descendants of those who reject the simple implication of this theory. Subversive ecologists can take pride in the fact that they are the true conservatives.

References


Introduction to Philip J. Stewart’s “Meaning in Human Ecology”

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In this paper, published over 30 years ago, Philip Stewart argued that human ecology needs to take meaning seriously. For him, meaning is not just a property of language (linguistic meaning), nor is it the patterns of signs that animals use to get around their world; rather, for human ecology, it is a framework for synthesis: one that potentially accommodates both the physical and mental aspects of the human experience.

Unlike narrowly focused disciplines that ignore meaning, Stewart regarded the identification of meaning in context as offering an entry point for an integrated human ecology: one that offers more than just an extension of knowledge about the relationships that people and other living organisms have with each other and with the world in which they find themselves. For Stewart, meaning involved recognizing patterns, and the study of patterns offered a route to a scientifically acceptable ultimate pattern within which people could live meaningful lives. All traditional human cultures have evolved such unifying patterns, and Stewart saw human ecology as a means of exploring and developing patterns that bring harmony between the experiencing mind and the world of science.

Stewart, who was with the Commonwealth Forestry Institute at Oxford at the time he wrote this paper, went on to promote an intriguing presentation of the periodic table of elements in a spiral form that better captures the relationships between the elements of nature. The traditional tabular form of the periodic table highlights differences and obscures the way that nature’s elements emerged during the evolution of the cosmos. In his later work, Stewart argued that patterns could often be better represented visually and with greater subtlety than with words.

At the time Stewart wrote this paper, most disciplines were actively avoiding meaning as too subjective for their scientific methodologies. Only anthropology and a handful of linguists were dealing with meaning directly. Since then, an adequate theory of meaning has become the Holy Grail for many disciplines, especially for neuroscience, information theory (cybernetics), artificial intelligence, and evolutionary psychology. The approaches being taken in these fields to identify meaning typically involve matching external stimuli with internal neural activity or, in the case of artificial intelligence, building models that can recognize stimuli and translate it into meaning. The difficulty with these approaches is that meaning
is contextual. Linguists study the role of context within the new sub-discipline of *pragmatics* (in addition to their traditional work in phonology, syntax, and semantics) but their narrow focus on language *per se* ignores the role of meaning in ethology and human behavior. What Stewart was calling for 30 years ago is still not being adequately addressed, not in human ecology nor in other disciplines.

More than three centuries ago, Gottfried Wilhelm Leibniz thought that it should be possible to identify a relatively small set of meaningful elements that could be used to define meaning precisely and unambiguously: a kind of *alphabet of the mind*. Just as all words (in all languages) can be represented by a small number of orthographic symbols (standardized as the International Phonetic Alphabet) or Chinese logograms or Egyptian hieroglyphics, and just as all matter can be represented in terms of some 100 or so chemical elements, so too can the elements of meaning, of both humans and animals, be simply represented. Since Stewart wrote his paper, linguists such as Anna Wierzbicka (2003) and Cliff Goddard (2013) have developed a technique for defining linguistic meaning in terms of a relatively small set of semantic primes. They also introduced the concept of cultural scripts for dealing with contexts.

Just as the application of standard systems theory to understanding human ecology offers a rigorous new tool for addressing what Boyden et al. (1981) called “the excessive compartmentalisation, fragmentation, and specialism which are so characteristic of education, research and government” (p. xii), the analysis of meaning offers a new tool for human ecology to approach transdisciplinary or integrative science. The standardization of time, mass, and distance enabled the application of powerful mathematical and statistical techniques to understanding the physical world. Now is the time to apply similar standardization and rigor to the subjective experience of meaning.

Living meaningful lives requires a deeper understanding of the way the world works than has so far been available through the rapidly spreading utilitarian values espoused by market economics and consumption. Stewart suggested a way forward, and the intervening time has provided the tools needed to do it.

**References**


Meaning in Human Ecology

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No one would describe the elephant without its trunk nor the kangaroo without its jump, yet much of what passes for scientific description of our species ignores its most striking feature—an extraordinary capacity for finding and making patterns. Of special importance is the peculiar pattern of relationships between patterns that is called meaning.

The word “meaning” is commonly thought of as referring in its strict sense only to language; expressions like “the meaning of a certain smile” or, still more, “the meaning of your life” are regarded as metaphor. However, linguistic meaning is only a special case; more generally, meaning can be defined as the association in a nervous system of certain patterns (signs) with others that they call up (referents). However, this definition seems to cover the whole of mental life, for the whole content of our minds is made up of the association of patterns. More precision is needed.

At its elementary level, meaning is simply part of the process by which any organism with a nervous system knows its environment. Certain patterns are found to recur regularly in association with others, of which they become the signs. In this way, for example, the experienced lion knows where its prey are, not by seeing them directly but by finding the signs of their passage. In so far as the patterns are naturally connected, this may be called inherent meaning. In a sense we never perceive anything but signs, inferring from patterns of light and sound, scent and touch, the objects we thus suppose to underlie them. Even at this level, there is a syntax of signs, two or more coming together to mean what none of them would mean separately. Thus, for example, the lion learns the combination of patterns that make up a waterhole and mean game.

Inherent meanings are all around waiting to be learned, and the mature adults of a given species end up by learning all or most of those that enable them to survive. In many species much of the repertoire is genetically transmitted. The higher animals, however, learn many signs in the course of their life, and this enables them also to pick up what may be called accidental meanings, where there is no natural or

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necessary connection between signs and referent. There is of course no hard and fast frontier between inherent and accidental; the extent to which patterns are associated varies continuously from totally to not at all.

For animals, accidental meaning is usually peculiar to the individual. For example, a dog that has been kicked by a man with a hat may afterwards cringe from anyone wearing a similar hat, but this is not passed on to other dogs. Human beings are peculiar in their ability to transmit belief in accidental meaning to a whole cultural group, making it into intentional meaning. Patterns are arbitrarily chosen for their convenience and deliberately used as signs or symbols. It should not be thought that these are all artificial. Natural objects and events can be used as symbols; indeed, bodily functions carry a heavy burden of symbolism. Eating, for example, is hardly ever undertaken as something purely functional, for each food and drink is invested with meaning. Sex can perhaps be the most potent symbol of all, which leads to frequent conflict between the meaningful and biologically desirable.

Each culture except the simplest surrounds its members with a wealth of patterns out of which to read meaning. Clothes and hairstyles, tools and utensils, toys and games, art and music, houses and gardens, roads and vehicles all contribute to making visible the social pattern into which each person fits. The demand for food and materials thus created shapes the landscape in which people live. This cultural world is already there, waiting for each new child who is born into it, and so it seems like something given and not like the sum of countless attempts to express meaning.

The most complex, flexible, and versatile system of symbols is language, which has been found fully developed in every human society ever described, however simple its material culture. The achievement of Washoe and Sarah, the signaling chimpanzees, showed an unexpected ability to convey intentional meaning, and the communication of dolphins and whales probably has surprises in store for us; but human linguistic capacity undoubtedly far exceeds that of any other species. Starting with nothing but observation of the sound patterns associated with different contexts, each child in a few short years learns thousands of words and the rules of syntax implicit in hundreds of sentence patterns.

With mastery of language comes entry into the social environment of the people who use it. Slight differences in speech act as signs indicating the place of each individual in the pattern of society. Marked differences act as barriers to communication, dividing the human species into thousands of linguistic pseudo-species. The invention of writing vastly increased the potential of language, making it possible to store huge quantities of utterances. For hundreds of years—thousands in some countries—bookish education has been the way to the predominant places in society, giving prominence to people whose concern with words is often so great that they have lost much of their ability to read other kinds of signs.
Skill in the use of words brings abstraction—the ability to describe patterns of patterns and patterns of patterns of patterns—sinking deeper and deeper beneath surface phenomena. To the ape in its forest almost every sign is part of a natural process—the reddening of a fruit, the darkening of the sky, the threatening stance of an old male—and each points to something tangible. Human beings alone can talk of quarks and black holes, of nothing and the Universe, of God and the Devil. They also have an extraordinary ability to convey half-truths, errors, lies, fantasies and nonsense. Words and symbols thus take on an apparent autonomy, seeming independent in the real world. This has given rise to a persistent dualism—the belief that pattern can exist without the thing patterned, soul without body, mind without matter, God without Universe.

It seems to be a universal characteristic of human beings to use the capacity for abstraction to reach a concept of the total pattern of all things. Traditional cultures point to this ultimate pattern with symbols such as the dance of Shiva or the meditating Buddha, and with phrases such as “God is Love” or “There is no God but Allah.” Some individuals have such a strong sense of ultimate pattern that they find it reflected everywhere, being able “to see the world in a grain of sand and a heaven in a wild flower.”

The most remarkable thing of all is that people of every culture have tried to make the pattern of their individual and collective lives correspond in some way with the ultimate pattern. They have imitated the life of those who are supposed to have embodied it. They have laid out their buildings and cities as little models of the cosmos and adorned them with countless symbols. They have punctuated their existence with rites and festivals that reflect universal cycles. But this correspondence of small and large pattern is precisely the relationship that is meaning. In other words, human life itself becomes a symbol—a fitting destiny for a meaning-centered species.

Attachment to ultimate pattern can be even stronger than the desire to live. Throughout history there have been examples of martyrdom, in which healthy people in the prime of life die willingly—even joyfully—making their death the final symbolic act. Conversely, those who fail to fit their life to an ultimate pattern live listlessly—even miserably—seeing their existence as meaningless, “just one damned thing after another,” “a tale told by an idiot, full of sound and fury, signifying nothing.” A meaningful death can thus be preferred to a meaningless life—strange behavior indeed for mere biological matter!

Shared belief in ultimate pattern has provided the framework into which all lesser symbols and beliefs are integrated. It has also enabled the members of certain societies to risk their lives in spreading their cultures at the expense of others. In very ancient times it brought Hinduism to all of India. Later on it took Christian missionaries all over western Eurasia and Buddhists all over the East. Still later it
sent Muslim armies, settlers, and missionaries throughout Central Asia and North Africa, Protestants to North America, and Catholics to South and Central America. Most recently of all it has carried Christianity and Islam to most of Africa. The cultural geography of the world has thus been radically simplified, thousands of older versions of ultimate pattern being destroyed by—or integrated into—four major ones.

The rich world of meaning has had immense importance not only in regulating the internal affairs of the human species but also in determining its effects on the rest of the planet. Take the landscapes of the Muslim world, for example. The predominance of grazing land can be directly attributed to the sacrificial role of the sheep and other herbivores, which is traced back to Abraham’s miracle of the ram in the thicket. The widespread disappearance of forests owes something also to the ban on the meat of the pig, the one domestic animal capable of thriving in woodland without destroying it. Similarly, the infrequency of vineyards, which elsewhere bring prosperity and protection to poor soils and steep slopes, results from the prohibition of alcohol. The prominence of the olive and the fig tree can be traced partly to the mention of both in the Koran. None of this can be explained in purely material terms.

In recent centuries the traditional symbols of ultimate pattern have come under sustained attack. At too many points they have, at least if taken literally, been contradicted by the findings of experimental science. At the same time, modern travel and communications have brought people face to face with traditional accounts that, on the surface, cannot be reconciled, which has led many to conclude that all versions are false. The symbolic value of things has come to be seen as something essentially private and subjective, leaving the public domain to be governed by the criterion of utility. To eyes that have seen the rich symbolism of older cultures, the utilitarian modern world can look very drab.

Deprived of an integrating framework of ultimate pattern, the various branches of knowledge and action have drifted apart. People are led to believe that life consists of an assortment of self-contained departments: politics, the economy, defense, religion, science, medicine, law, nutrition, sex, art and so on. Countless specialists work, often with large sums of public money, to change the world according to their own narrow idea of what is best, largely in ignorance of the bad effects they may have on ordinary people or on the rest of the biosphere.

The present century has seen rapid progress toward an integrated scientific account of the material world, with bridges built between the physics of the very small and the very large, between physics and chemistry, chemistry and biology. As yet, this account has not had a place for the mental world of pattern and meaning. Now that is changing. Cybernetics, information theory, and catastrophe theory have thrown light on the nature of self-patternning systems. Computing has made possible
the simulation of highly complex phenomena. The study of cellular automata has brought a new humility in the face of that which cannot be simplified. And the discovery of genetic code has brought concepts analogous to those of linguistics into the heart of biology.

Scientists have not yet shown much interest in meaning, although the correspondence between sign and referent is often visible in behavior, in a way that should satisfy the strictest Skinnerian. They have so far preferred information, which is quantifiable as the amount of improbability present in a pattern with a given number of degrees of freedom. Great interest was aroused when it was shown by Shannon and Weaver that the concept of information is closely related to that of negentropy. Indeed, Shannon called his uncertainty function “entropy.” This identity results from the fact that both are applications of the same mathematics—those of probability. Total randomness, if that is possible, would be total absence of pattern and therefore of information.

Unfortunately Shannon’s information is not the same thing as the information of everyday life. It is, for example, possible to calculate the number of kilobytes in an Etruscan text; but until we know the language, it will convey no information. In other words, information in the sense of “bytage” is an intrinsic property of a pattern; information in the ordinary sense is a one-for-one correspondence between elements in two different patterns. Usually, in fact, exact correspondence is not possible, and there is approximation. Where the source pattern is capable of corresponding to more than one other pattern there is ambiguity.

The word “meaning” is sometimes used to refer to information in the ordinary sense, as in the example of “RSVP” meaning “please reply.” More usually, however, there is a one-to-many or few-to-many correspondence between the elements in the sign and the elements in the referent. Put differently, the emitter and the receiver of a sign must already possess information about the referent. For example, a vast pattern of political events could be translated into a single bit of information—say the turning on of a switch—which in turn would mean to its military recipients all the events rehearsed for the start of a war. In terms of bytage, meaning can thus be far more concentrated than information.

From the switch that means war up to the dance of Shiva that means the way of the Universe and down to the waterhole that means game, there is a unifying concept of meaning that can now be scientifically approached, thanks to advances in the understanding of pattern. So far only anthropologists seem to have given meaning its rightful place. For too long academic psychologists have been exclusively concerned with observable behavior, sociologists with structure and function, economists with utility and efficiency. Human beings have thus been studied as if they were little more than ants or rats and devoid of their most precious faculty.
Academic human ecology has so far failed to give pattern and meaning a central place. For historical reasons ecology, the study of the relations of species with the external environment, grew up separately from ethology, which studies the relations of members of each species with the internal environment of their own society, in which most signaling behavior takes place. A similar distinction was observed when the ideas of ecology came to be applied to human beings. In recent years, however, it has become increasingly plain to biologists that the two sets of relations cannot properly be separated. For example, the reproductive behavior of a species, which constitutes much of its ethology, is closely related to its population structure and its demands on the ecosystem.

It is time to recognize that human ecology must include the human equivalent of ethology, and that our relationships with the rest of the world can only be understood in the light of our relationships with each other. The insights of the psychologist, the anthropologist, the historian, the linguist, and the critic of art and literature are as necessary as those of the physiologist, the geneticist, or the demographer. Human ecology, in other words, is a framework for synthesis rather than just another discipline parallel with the rest.

Within this framework, the mental and physical both have their place, with pattern and meaning as the unifying concepts. This implies a view of the world distinct at once from materialism, which denies the reality of the mental, from idealism, which refuses that of the physical, and from dualism, which sees the two as essentially separate. Such an approach is in keeping with modern physics, which sees matter as a pattern of atoms, atoms as a pattern of electrons and nucleons, nucleons as a pattern of quarks, quarks and electrons as a pattern of energy, energy as a pattern of disturbances in a field … in short, a Universe of patterns of patterns of patterns …

An integrated human ecology offers more than just an extension of knowledge. By providing a comprehensive model of human relationships with the intricately patterned physical world, it points the way to a scientifically acceptable account of ultimate pattern, within which people may find the meaning of their lives. The exploits of Greenpeace suggest that an ecological account is as capable as the traditional ones of inspiring people to risk their lives.

Many of the ancient myths and symbols of ultimate pattern are consonant with an ecological view. This is not to suggest that all traditional accounts can be fused into some vague synthesis, still less that they are mere forerunners of modern secular ideas. Each is partly the reflection of its own social matrix and inappropriate to others. At their worst they can be crassly dualist or idealist. At their best they reach heights of incomparable sublimity. Always they are in danger of being understood literally instead of metaphorically; but they also go with techniques such as meditation that can be more effective than words for achieving harmony between mind and larger patterns.
In the Indian parable of the blind people trying to describe an elephant, the one who felt at the trunk said: “This animal is like a snake.” In the same way it would be only part of the truth to say of our species: “This creature is like a string of signs.” A full account must also include all the other aspects of human life. Even if we human ecologists succeed in making such a synthesis, we must keep a sense of humility. Like the blind in the parable, we shall never achieve a description that is complete or final or free from error and dispute. In the words of the Tao Te Ching: “Knowable pattern is not ultimate pattern.”

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Introduction to John Visvader’s “Philosophy and Human Ecology”

William Throop

Although much has changed since 1986, when John Visvader’s paper was originally published, his guidance is still wise and necessary for today’s reader. It is still tempting to pigeon-hole human ecology as a particular kind of study with distinctive methods. After all, we tend to allocate funds and prestige to interdisciplinary fields once they have adopted a clear paradigm and some defining achievements that serve as exemplars for future research and that contain the norms and concepts defining the field. Conservation biology and sustainability science have come into their own in just such a fashion. Professor Visvader warned us against interpreting human ecology as having an essence—a defining set of characteristics. He argued that given the complexity of socioecological systems, we should expect to find many different ways of studying their dynamics, with some being largely descriptive and others being highly value-laden. Following Wittgenstein, he suggested that these approaches share a range of family resemblances in virtue of which they are all ways of conducting human ecology. It follows that human ecology is more open-ended and inclusive than many interdisciplinary studies, which is both a curse (for those who crave clarity and consistent standards) and a blessing (for those whose curiosity is stimulated by new connections).

But is there a unity among the different approaches in human ecology? Visvader suggested there is, and it is not just that all approaches investigate what the human relation to nature is or ought to be. He talked somewhat obscurely about human ecology addressing a “nested set of questions.” The interrelations between the questions create a unity, but they avoid the unachievable unity that is associated with reductionism. The nature of these interrelations deserves a great deal more investigation. This paper is a useful starting point for such work.

Another important question Visvader raised is how we should evaluate normative human ecological work—how we can know anything about the values humans should have regarding nature. He stated that “there are no experts in values,” which might suggest that values are purely subjective, so normative work would not itself be objectively evaluable. But he then said that “the realm of values has its own … methods of arguments and demonstration.” He later suggested that these methods result in judgments of what relations to nature are practically prudent. A great deal of fruitful work has been done in the last 30 years on the epistemology of values, though the issues are far from resolved. Visvader’s overview invites more integration of values epistemology into human ecology.
Philosophy and Human Ecology

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The subject matter of ecology has excited the pens of a great many philosophers. Not since the advent of Darwin's version of evolution theory have we seen such a cross-disciplinary interest in a particular area of biology. I think this interest is chiefly due to two important factors. In the first place, ecology, in its study of the relationship between organisms and their environments, represents a new kind of contextualism. As such it has become a model for all those who have been critical of atomistic and isolationist investigations in the sciences and the humanities. Secondly, the scientific findings of ecology provide us with new information concerning the consequences of human actions and their impact on the natural world. This information leads us to re-evaluate the significance of certain of our behaviors and to question many of our goals and practices. The perception of the need to change is the beginning of politics, and thus ecology has lent its name as well as its findings to the causes of various political movements.

Both of these issues are of obvious interest to philosophers and constitute problems of both theoretical and practical concern. Though these issues arise in the study of natural ecology they attain a clearer focus when we come to the study of human ecology, because the nature and consequences of human behavior become the central topic of investigation. Human ecology also provides us with additional problems of philosophical interest.

The attempt to apply scientific and naturalistic principles to the study of human behavior raises some long smoldering problems concerning the limits of naturalistic explanation. This problem expresses itself in a kind of identity crisis of subject matter. Is the study of human ecology to be considered merely as the extension of the theories and techniques of the science of ecology to the behavior of human groups, or does it include the various kinds of cultural studies usually associated with the social sciences and the humanities? Does it include, for example, both descriptive and prescriptive investigations of values? We have been careful to keep disputes over values separate from the investigations of the various sciences. In the case of evolution theory, the great philosophical debates it inspired can be seen, from

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1 This manuscript has been transcribed from the article originally published in R. J. Borden (Ed.) (1986). *Human ecology: A gathering of perspectives*. Bar Harbor, ME: Society for Human Ecology. While all care has been taken, minor typographical differences to the original may occur.
our perspective, as peripheral to theory itself and not an essential part of its subject matter. The extension of the idea of evolution into almost every other subject area and the philosophy of Social Darwinism cannot be considered to be part of biology.

In a like manner the new rise in contextualism and the politics of the environmental movement cannot be seen as an essential part of the science of ecology. They belong to the periphery of ecology, that shadowy area where science as a social institution intersects with the general culture in which it functions and whose purposes it serves. But in the study of human ecology there are many philosophers and others associated with the humanities who think of their work as essential to the subject matter, and whose work includes various kinds of value investigation. Either the concerns of these investigators belong more properly to the periphery of the subject, or human ecology has to be thought of as something other than a natural or social science. This raises serious philosophical issues concerning the relation of the sciences to the humanities and the nature of human ecology. I think it would be worthwhile to look at some of these questions in further detail.

Ecology and context

The word “ecology” is being used, properly or improperly, for many different kinds of contextual and non-isolationist studies. We hear of such subjects of study as “plant and animal ecology,” “social ecology,” “ecology of the family,” “design ecology,” “urban ecology,” “ecology of mind,” “ecology of freedom,” and so on. About all that these many topics have in common from one point of view is that they consider their subject matter from a very broad perspective. This wide interest in the general concept of ecology can be explained in part by the rise of a new contextualism in the approach to problems. It is necessary to understand this interest in its historical as well as in its logical perspective.

The world of intellectual culture has its fads and fashions as does the world of popular culture. These fashions or styles often reflect deep seated and more general views concerning the nature of the world and as such will come to embody certain kinds of metaphysical beliefs. Such beliefs reinforce practices and the success of practice helps in turn to verify beliefs. When the usefulness of a particular practice reaches its limits, both the practice and its associated beliefs can be called into question and a general re-evaluation may take place. This general kind of re-evaluation seems to be taking place in many intellectual disciplines simultaneously.

The development of the scientific method in the seventeenth and eighteenth centuries had a tremendous influence on the rest of European culture. The beliefs and techniques that had been applied with such great success in the areas of physics and astronomy were copied in all the other areas of intellectual endeavor. Complex systems were analyzed into their constituent parts and deterministic laws were sought
that governed the behavior of these elements. Individual elements were studied in relative isolation to determine their essential properties, and the system to which they belonged was treated as if its properties were derived from the mechanical summation of the actions of its parts. The experimental method became almost synonymous with isolation studies in the laboratory. There is nothing terribly wrong with this method of analysis, in fact it is not only useful but it is even necessary for the attainment of certain kinds of knowledge. A problem arises when this kind of analysis receives a metaphysical justification, when the elements of analysis are treated as more basic or more “real” than the system to which they belong. In the sciences this view led to a mechanistic reductionism in which the whole of the natural world, including organic as well as inorganic processes were to be understood in terms of atoms and their physical properties. Any phenomena that were not ultimately subject to this kind of analysis were considered at best as incapable of scientific study, and at worst they were considered as “unreal” or merely subjective phenomena.

The atomic and mechanistic models were also applied to the study of human behaviors and social groups were understood in terms of “atomic individuals” subject to the “forces” of desire and personal interest acting in accordance with “natural law.” Individuals were more “real” than the groups to which they belonged and were possessors of “inalienable rights” and “free will.” Though this model has been useful in justifying the development of democratic institutions, we have discovered that a community cannot be formed by the mere summation of atomic individuals.

It is the metaphysical bias that has dictated an almost exclusive use of the method of atomistic analysis that is presently under attack and not the method of analysis itself. We have discovered that there are laws and regularities that govern the behaviors of systems that are autonomous in their own right, and that, while they may be in accord with the laws that govern the parts of the systems, they are not reducible to them. While it is obviously important, for example, to study an animal in the isolation of the laboratory, we must not allow a metaphysical prejudice to prevent us from studying the animal in its natural environment. Both kinds of study provide us with information that is important and useful and need to be used in conjunction with each other. The science of ecology has become an important model for other disciplines, not because it has renounced the method of atomistic analysis, but rather because it has demonstrated the importance of contextual analysis and the relative autonomy of systematic regularities. The fact that the nature and behavior of an individual are intimately connected to its context has led us to the realization that the autonomy and isolation of an individual within a system is at best the result of an abstract and relative narrowing of attention. The broad use of the word “ecology” marks a conceptual trend away from isolationist studies toward analysis at more complex levels, and represents on both practical and theoretical levels the attempt to rethink the relationship between parts and wholes. It provides us with a model for rethinking the meaning of community in all of its significant uses.
Ecology and human action

The findings of ecology come to us at a time in which we are all aware that the world is growing smaller. If we were to look for a word that would express the greatest lesson of the twentieth century, it might be something like “interconnectedness.” The interests of anybody easily become the interests of everybody. We have fought wars in and for countries on the other side of the world that we can barely find on maps. Some of our actions can be felt almost instantaneously and with unprecedented magnitude anywhere in the world. It is very difficult to be an isolationist, to merely attend to our own business—other people no longer allow us this luxury.

The news that ecology brings us makes us feel that the world is even smaller than we may have imagined. Our actions reverberate through nature and rebound toward the human world with frightening consequences. This news does not merely trickle down to us through textbooks or Sunday afternoon nature programs, it makes headlines in the newspapers and speaks to us of pollution and poisonings and vanished species—things we can hardly ignore. It is unwelcome news that adds to the sense of crises in our times.

By placing human action firmly in the causal matrix of ecosystem dynamics, ecology changes our understanding of the significance of action. The word “action” has some interesting conceptual implications. It is usually applied to something that I do by accident or that I am somehow caused to do by something like a nervous spasm. There is a great difference between a wink and a blink. I can get my face slapped for the former but not for the latter. A wink is an action, a blink is not. The science of ecology shows us that the scope of our intended actions is much wider than we may have imagined. I may intend to do my laundry, but I may also, as we trace the causal consequences of my action, be polluting my neighbor’s drinking water and killing various plants and animals. The first time I do it we can consider it an accident, but once I learn that my action will be continuously attended by undesirable consequences, the significance of my action changes and the question of responsibility rises where it had not been raised before. An action becomes morally questionable when it threatens the well-being of others, and it becomes the focus of political attention when the action is collectively performed, for the essence of politics is the attempt to change the behavior of others.

Many philosophers feel that ecology presents us with a mirror that critically reflects the nature of our collective actions. Its descriptions of possible ecological catastrophes present us with a clear “ecological imperative” that is “change or be changed,” “change or become extinct.” This imperative not only speaks to moral sensibilities, but to self-interest as well. As a science, ecology reinforces our awareness that the world is a strongly interacting causal community, and its findings cannot help but awaken the basic values of the culture it serves and inspire a new attempt
to integrate the human and natural communities in the pursuit of survival and well-being. Just what changes and accommodations will be necessary becomes a major issue for all the different sections of society.

The range of human ecology

Ecologists cannot help but study the effects of human behavior on the natural world for it is often difficult to find a natural setting that has not felt the significant impact of human actions. Why, it might be wondered, do we need a special area of ecology devoted to human beings? There are of course many answers to this question, chief among which will be our desire to increase our scientific understanding of ourselves. But there is an important difference between the study of plant or animal ecology and the ecological study of humans. In studying the ecology of a particular animal species we are concerned with the relationship of its behavior to its environment. But unlike other animals, whose behavior is determined by genetic and environmental factors, human behavior is largely governed by personal and social values. We are predominantly cultural creatures. This adds a whole new level of complexity to the study of ecology. It means that for a certain range of questions concerning the ecology of human beings, the analysis of cultural values and practices will be important. Social systems and ecosystems are intimately connected, and the study of one casts light on the nature of the other. Cultures differ in their value systems and thus in their behaviors, and so in some sense, there will be as many different human ecologies as there are significantly different cultures.

We can sidestep this cultural issue by limiting the kinds of questions we ask about human behaviors. Cultures cancel out at one level of investigation. If, for example, we are concerned with the energy impact on the environment of different cultural technologies, we need not concern ourselves with the relation between values and technology. But this only carries out one-half of the ecology project—how a behavior affects the environment. Ecology is essentially a study of natural feedback systems and also includes the investigation of how the changed environment affects the species in question. Since cultural systems mediate these changes, the full study of the interrelationship between humans and the environment will require that the study of human ecology resembles a social science more than it will a natural science. Indeed, many people think of human ecology as a social science that makes use of the principles of evolutionary and ecological biology to cast light on the structures of cultural institutions and behaviors.

But such social science will run into certain kinds of conceptual difficulties if it construes its scope too narrowly. It will examine various cultural behaviors in terms of the “natural economies” that other species are subject to, and will apply various forms of the “adaptivity principle” to show how a particular behavior is retained
because of its adaptiveness to the environment. Unfortunately the concept of adaptation is often very vague and borders at times on the edge of being tautologous. We can conclude from the persistence of a certain trait or behavior in a species that it meets certain minimal energy requirements. But the mere presence of a trait or behavior does not automatically tell us whether it is more adaptive or most adaptive when compared to other possibilities. Its survival merely tells us that it is “adaptive enough.” To make a stronger claim we will have to define our terms independently of the mere fact of survival, and show both that other possibilities are less adaptive and that the energy niche is so narrow that only the most adaptive trait or behavior can be retained. In the absence of this kind of demonstration, the most we can do is declare that adaptiveness is a necessary but not a sufficient condition for the continued presence of the behavior in question. Even at its best the adaptivity principle constitutes a very low level of explanation, for it gives no account of the origin of the behavior or trait in question.

If we construe the task of human ecology more broadly, we can investigate the extent to which cultural behaviors are strategic responses to the economies of nature. When we come to the realm of strategic and practical behavior, a realm we do not enter when we investigate the behavior of other animals, belief systems and cultural models of the natural and social worlds will become important areas of study. This involves the investigation of all the relevant aspects of culture including the history of the culture, its religion, and its arts and politics. Human ecology, understood in this way, has a conceptual advantage over ordinary ecology in the sense that we are often in a position to explain the origins of a particular behavior.

The importance of these kinds of far ranging cultural studies become particularly clear if we are to understand our own behaviors from the perspective of human ecology. Here we will attempt to understand our own relationships to the natural world in terms of our cultural beliefs and practices. This self-reflexive investigation is subject to the dictates of the uncertainty principle, for what we observe we tend to change. Reasons can be good or bad, if only in a prudential sense, and when we investigate our own strategic and practical behaviors, it is natural, given the values we hold, to try to change them. Some philosophers believe that human ecology applied to our own culture becomes an applied science akin to medicine. Here, of course, human ecology provides a greater scope for ethical disputes than does medicine, for we can only know what medicine will be best if we have a clear idea about the conditions of individual and societal health.

Thus we see that any general understanding of human ecology opens a kind of Pandora’s box of approaches and issues. It is not as easy to relegate some area of interest in human ecology to its periphery as it was in the case of ecology proper. How can humanists who are concerned with value issues be an essential part of the same discipline as scientists whose work is supposedly value free. This issue is the source of an identity crisis in human ecology and has animated a search for a clearer definition of subject matter.
The definition of human ecology

In an old-fashioned sense, to give a definition of something is to describe its essence or essential properties, and thus disputes over a definition are seen to be disputes concerning the correct characterization of a real property that the thing in question possesses. I call this an old-fashioned idea of definition because we realize today that many things called by the same name do not necessarily have the same common thread that clearly runs through all the instances so named. Things may have a common name because they share what the philosopher Ludwig Wittgenstein referred to as “family resemblances.” Failing to find a simple thread running through all the things that are called ‘games’, he said that we find instead:

A complicated network of similarities overlapping and criss-crossing: sometimes overall similarities, sometimes similarities of detail. I can think of no better expression to characterize these similarities than “family resemblances”; for the various resemblances between members of a family: build, features, color of eyes, gait, temperament etc. etc. overlap and criss-cross in the same way. And I shall say: games form a family. (Wittgenstein, 1953, p. 32)

This concept of family resemblances provides us with a helpful way of considering the field of human ecology. Almost everyone concerned with the subject seems to have a favorable definition that reflects, in one way or another, the interests of their own particular field. Many of the proposed definitions are strongly prescriptive in the sense that in attempting to say what human ecology is, they are also saying what it ought to be. These kinds of definitions seek to limit the subject matter and restrict the nature of the questions to be pursued. Is this necessary?

Everyone will probably agree that human ecology is the study of the relationship between human beings and their environment. Why not leave it at that? At present the subject seems to consist of a whole range of overlapping and interconnected questions and concerns that involve disciplines that have been traditionally thought of as fundamentally distinct in purpose and method. There are good reasons for making a logical distinction between the sciences and the humanities, but this does not mean that human ecology must be understood in terms of the traditional model of an intellectual discipline. There are no good reasons to give it an artificial unity by imposing a particular set of purposes and methods on its subject matter; by giving it the stamp of one discipline rather than another. It has its own unity in terms of its nested and interconnected questions. Its wide-ranging investigations need not compromise the integrity of the particular disciplines involved, as long as the investigations are carried out in the spirit of pluralism.

The humanist's investigation of the relation between belief structures and environmental behaviors need not conflict with the biologist’s attempt to measure the relative adaptivity of those behaviors. Neither one alone can answer all the kinds
of questions that might be relevant, nor does either one possess a complete list of all the questions that might be of interest. Unfortunately, there is a long-standing quest for the unity of knowledge that has become synonymous with a kind of simple reductionism. According to this reductionist model all knowledge will be unified by being translated into the languages of the sciences. But this is akin to thinking that all maps, including those mapping social and political divisions, can be reduced to maps of physical geography. A more realistic approach to the idea of the unity of knowledge is to think of constructing a series of maps covering a common terrain but displaying different levels of relationships between concepts and objects of different kinds. Some of the features on different maps will be able to be closely correlated, other features will be found to be related only to items that appear on their own map. This cross-mapping approach to the search for knowledge is used all the time in the sciences, particularly those that deal with human behavior. The reductionist model prevents us from noticing it.

As the natural sciences are committed to a non-teleological approach to phenomena, teleological references to reasons and purposes will not appear as features in a scientific mapping. Yet, in an area with neurophysiology, we are constantly locating interesting phenomena in teleological terms and then studying their projections on a map of physiological structures and events. Many of the questions of neurophysiology are “nested questions” in the sense that questions that are stated on one level of conceptual mapping are given subsidiary information in terms of a different conceptual map. The bankruptcy of reductionism is shown when the attempt is made to reduce all questions and answers to one particular mapping.

Human ecology can be generally understood then as a pluralistic approach to a series of nested, interrelated, and overlapping questions concerning the relation between humans and their environment. It is interdisciplinary in nature and yet is not a discipline itself in the usual sense.

Something new and something old

If human ecology is to be understood generally as the study of the relationship between human beings and their environment, or more particularly, the relationship between human beings and nature, then its subject matter must be as old as human culture itself. For the natural world is the stage upon which all human action takes place—it sets the basic problems of survival and tests the strategies that guide a variety of human behaviors. Without some knowledge of the working of nature, and without some set of successful strategies for dealing with the natural world or the immediate environment, no group can long survive. Thus the search for this kind of knowledge is as old as it is necessary. That a group survives for an extended period of time is a testament to its knowledge and understanding of
the practical economies of nature. This knowledge becomes embedded in its folk
wisdoms, its images and ideals and in its cultural institutions in such a way that
it seems largely unconscious and unreflective. Its value structures will determine
which actions will be permitted and which actions will be proscribed. In a relatively
unchanging world the form of a culture comes to fit the form of its environment on
a very basic level.

Our own society is a peculiarly dynamic one. We are continually changing both
the form of our society and the form of the world. Our actions often run ahead of
our knowledge of their long-run consequences so that it is difficult for us to decide
which of our actions to permit and which to proscribe. Many of our cherished beliefs
and ideals seem to make self-restraint a virtue that is difficult to practice. Yet, we
stand in need of the same kind of knowledge—or if you will permit—the same kind
of wisdom that others have sought before us. Our task is made more difficult not
only because of the complexity of our society and its relationship to nature, but also
because our knowledge is so vast and fragmented by the necessities of concentration
and specialization. Where else but in the area of human ecological studies, with
its rich pluralism, can all the necessary information be brought together with the
right kinds of questions? To its diversity must be added the ability to raise questions
concerning new strategies and new goals in our relationship to the environment.

This broadens the field of human ecology still further by including not only
questions concerning what our relationship to the environment is, but also
questions concerning what our relationship to the environment ought to be.
These are, after all, the questions that most interest philosophers and politicians.
But in what way can prescriptive investigations and descriptive investigations be
considered part of the same enterprise? There are no major difficulties here if we
remember the prevalent use of “nested questions” that are already part of many of
our investigations. The study of medicine does not compromise the field of biology
merely because the pursuit of health is a societal value. Values guide and inform
almost all of our behaviors including the pursuit of knowledge and truth in the
most theoretical of our investigations. The so-called “problem of values” arises in
two different ways. In the first place we must not allow our values to distort and
prejudice our investigations or our judgments in certain areas. This is the issue of
objectivity, and it is as important in the law courts as it is in the laboratories. In the
second place we must remember Hume’s warning that we cannot get value out of
nature unless we first put it in. This is especially important for philosophers who
are concerned with what our relationship with nature ought to be. The danger lies
in thinking that we can somehow discover what ought to be valued by studying the
way nature is. What we can discover by studying nature are better strategies or more
intelligent goals, but these already presuppose a set of accepted values. The scientific
facts of ecology, or the facts uncovered by the study of cultures add at best merely
prudential weight to a philosopher’s arguments. There can be experts in ecology but there are no experts in values. The realm of values has its own kind of dialectic and its own methods of arguments and demonstration.

The facts disclosed by ecological investigations can show us that given certain values and goals, our strategies are mistaken. We can do one or both of two things upon this kind of realization. We can change our strategies while leaving our goals and values intact—this is the approach of the “technological fix,” or we can give various kinds of arguments to change our goals and values, and thus ultimately our strategies as well. The decisions to deal with the important disclosures of ecology or human ecology in either of the two ways is a matter of practical prudence and, in our society, of practical politics. This is the best that the “human ecology project” can accomplish. There are no short cuts to wisdom. We can only assemble the best information we can get concerning the relationship between human beings and their environment and present it in such a way that we can inform the dialectic of decision-making. Nature cannot help us here, we have to help ourselves.

References

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