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Response to Holling 1998. "Two Cultures of Ecology"

Two Cultures: Not Unique to Ecology

[Marc A. Saner](#)

Carleton University, Department of Philosophy

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ABSTRACT

Using examples from different disciplines, I show that the dualism between "analytical" and "integrative" approaches to scientific investigation is not unique to ecology. I argue that the resolution of (1) the apparent conflict between the two cultures of ecology and (2) the problem of finding a sound direction during the transition of ecology would benefit from a transdisciplinary approach. Candidate disciplines are any science within which complex systems are being investigated, as well as philosophy of science and environmental ethics.

KEY WORDS: complex systems; cybernetics; dualism; environmental ethics; holism; philosophy of science; reductionism; systems approach.

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In an editorial to this journal, Holling (1998) states: "Ecological science is in transition. Previously separate schools of ecology are being linked across scales - from physiological to landscape. ... The focus and the projects of *Conservation Ecology* have been chosen to facilitate the transition in ecological science by bridging gaps between two different ways of viewing the world." Holling then presents these two world views in his Table 1, where they are labeled "two cultures of biological ecology" (referring to opposing analytical and integrative approaches).

This very insightful editorial offers justification for the necessity of a broad approach to ecology. In this commentary, I argue in support of an even broader approach. I introduce this argument by showing one example of how Holling's observation has been presented by an author in the field of cybernetics to illustrate close similarities across fields of inquiry. In a second step, I shall present a selection of candidate disciplines that could be consulted as sources of ideas on how to best accomplish the transition of ecology.

Joel De Rosnay (1979) wrote a uniquely multidisciplinary book entitled *The Macroscope: A New World Scientific System* (originally published in French as De Rosnay 1975). He addresses the wide-ranging topics of ecology, economy, urban planning, business and industry, living organisms, and the cell, and also addresses applications, social, and political issues. He characterizes his project as follows: "Today we are confronted with ... the infinitely complex. ... We need, then, a new instrument. ... I shall call this instrument the *macroscope*. ... The macroscope is unlike other tools. It is a symbolic instrument made of a number of methods and techniques borrowed from very

different disciplines. It would be useless to search for it in laboratories and research centers, yet countless people use it today in the most varied fields. The macroscope can be considered the symbol of a new way of seeing, understanding, and acting." (De Rosnay 1979: xiii-xiv).

The "macroscope" is characterized by the so-called "systemic approach" developed principally at the Massachusetts Institute of Technology, starting with the invention of the field of cybernetics in the 1940s (De Rosnay 1979: 57-64). The following table (Table 1) is taken from De Rosnay (1979: 79) except for the title, which I have added. It was also reproduced in a highly popular German book by the cyberneticist Frederic Vester (Vester 1984: 43), an indication of how widely it has been discussed. De Rosnay (1979: 79) qualifies it as follows: "This table, while useful in its simplicity, is nevertheless a caricature of reality."

Table 1. Comparing two approaches to investigation, according to DeRosnay (1979: 79).

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Analytic approach	Systemic approach
<ul style="list-style-type: none"> •isolates, then concentrates on the elements •studies the nature of interaction •emphasizes the precision of details •modifies one variable at a time •remains independent of duration of time; the phenomena considered are reversible. •validates facts by means of experimental proof within the body of a theory •uses precise and detailed models that are less useful in actual operation (example: econometric models) •has an efficient approach when interactions are linear and weak •leads to discipline-oriented (juxtadisciplinary) education •leads to action programmed in detail •possesses knowledge of details, poorly defined goals 	<ul style="list-style-type: none"> •unifies and concentrates on the interaction between elements •studies the effects of interactions •emphasizes global perception •modifies groups of variables simultaneously •integrates duration of time and irreversibility •validates facts through comparison of the behavior of the model with reality •uses models that are insufficiently rigorous to be used as bases of knowledge but are useful in decision and action (example: models of the Club of Rome) •has an efficient approach when interactions are nonlinear and strong •leads to multidisciplinary education •leads to action through objectives •possesses knowledge of goals, fuzzy details

The tables provided by De Rosnay (1979) and Holling (1998) are not identical. De Rosnay's is more complete in terms of the social context, whereas Holling's is much more detailed in terms of diverging statistical foundations. Nevertheless, I submit that the two tables bear a close resemblance. This resemblance indicates that the dualism that characterizes the "Two Cultures of Ecology" is not restricted to the discipline of ecology. According to De Rosnay, the dualism surfaces in any science within which complex systems are being investigated and "the macroscope" is being employed. Consequently, there is hope that some of the problems emerging from the existence of two divergent cultures in ecology already may have been addressed in such varied disciplines as economy, urban planning, or computer science.

What can be said about the prospect of reconciliation between the two cultures? De Rosnay's goal is to characterize the legitimacy of the systemic (integrative) approach. Consequently, he does not focus on the problem of the

reconciliation between the two. He simply calls them "complementary" (De Rosnay 1979:79).

The discipline of philosophy may prove helpful. At least two fields within philosophy provide useful insights into the problem of reconciling analytical and integrative approaches in ecology: philosophy of science and, somewhat surprisingly, environmental ethics. The problem at hand, if conceived as a purely scientific issue, would be in the domain of the philosophy of ecology. Unfortunately, only very little work has been done on the philosophy of ecology (see, e.g., Ruse 1988: 80, 1998). Advances in the philosophical analysis of other scientific fields illustrate what could be accomplished in a fully developed philosophy of ecology. The philosopher of science Alexander Rosenberg describes a situation, analogous to the one found in ecology, within the discipline of social science (Rosenberg 1995). Rosenberg's discussion of social science provides a link to the more general debate over "atomism" (or "reductionism") vs. "holism" that is central to much of philosophy. There is no room here to describe this debate. I mention it to draw attention to an important and large body of literature.

If the problem at hand is conceived to not be purely scientific, but intertwined with questions of values (politics), then environmental philosophy and ethics should be considered. Because the development of environmental policy requires a certain level of consensus, environmental philosophers address problems of reconciliation at both the ethical and scientific levels (note that these two levels cannot always be clearly separated). At the theoretical level (ethics), the prospects of reconciliation or convergence between "ethical atomists," who focus on the moral consideration of (human or non-human) individuals, and "ethical holists," who focus on the consideration of "ecosystems," have been addressed by James Sterba and Bryan Norton (Norton 1991, Sterba 1995). At the applied level (science and policy), Baird Callicott (1997), Bryan Norton (1997), and Kristin Shrader-Frechette (1997) have all recently commented on the relative merits of reductionist (traditional animal toxicology-based) vs. holistic (ecosystem health) approaches to environmental risk assessment. This is a highly relevant discussion in the context of Holling's (1998) editorial of *Conservation Ecology*. A case in point: the formulation of "the exactly right question" (last entry in Table 1 of the editorial) is, at least in the applied context, value-laden and, therefore, informed by an underlying (implicit or explicit) ethical framework. Thus, such a scientific question cannot be completely separated from the question of values even if the answer to the question is solely a problem of scientific methodology.

The logical basis for the existence of two cultures of ecology is not restricted to ecological science. Therefore, an investigation of the dual foundations of modern ecology may profit from a transdisciplinary approach. Such a broad view could not only result in useful information for conceptual problem solving, but also may provide a compass to guide the transition of ecological science in the most desirable direction. Last but not least, it may lead to an improved understanding of policy and politics in environmental protection and conservation.

RESPONSES TO THIS ARTICLE

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Address of Correspondent:

Marc A. Saner
Department of Philosophy
Carleton University
1125 Colonel By Drive
Ottawa, Ontario
K1S 5B6, Canada
Phone: (613) 520-2110
Fax: (613) 520-3962
saner@magma.ca

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