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ABSTRACT

In this issue of ABT that focuses on ecology, I believe it should be of interest to reflect briefly on its history and development to provide a context for what ecology is at present. Much of what follows is derived from my previous publications (Kormondy, 1965, 1996).

Key Words: Ecology; ecosystems; history.

○ First, Is Ecology a Science?

Insofar as ecology describes, classifies, hypothesizes, and tests hypotheses, it fits the classical mode of science as exemplified by physics and chemistry. However, because ecology extends to human interactions, including aesthetics, ethics, politics, and economics, it doesn't fit that mold. Further, because ecology is a multidisciplinary enterprise, it doesn't fit precisely into one channel of scientific inquiry; instead it ranges from reductionism in the study of individual species populations, through less reductionist approaches in the study of communities, to the holistic in studies of biomes, the totality of communities. This often results in strong disagreements on the methods and viewpoints used by different ecologists investigating different phenomena at different levels of complexity and organization (Pomeroy et al., 1988).

Like many fields of contemporary biology, ecology is multidisciplinary and almost boundless in its concern.

○ The Beginnings of Ecology

In his excellent historical review of the development of ecology, Robert McIntosh (1985) noted that the polymorphic nature of ecology as a science contributes to diverse and even contradictory opinions about the origins of ecology. He notes further that ecology is "more a bush with multiple stems and a diffuse rootstock than a tree with a single, well-defined trunk and roots." This botanical metaphor fits the model of the seminal philosopher of science, Thomas Kuhn (1970), who proposed that a developing scientific discipline may represent a fusion of several separate trunks that lack a common initial rootstock.

At base, the antecedents of ecology certainly extend to the origins of humanity itself. Our human forebears must have learned about their environment, else *Homo sapiens* would not have survived. Humans' conscious observations of their natural surroundings can be traced to ancient civilizations, especially in matters of agriculture and aquaculture. But, as in the case of the beginnings of the different sciences, more formal and systematic study of the environment began in Greece in the third and fourth centuries B.C., in the natural-history writings of Aristotle and, particularly, of his student and successor as head of the Lyceum, Theophrastus. These writings initiated the period of the great naturalists that reached its zenith in the 18th and 19th centuries in the works of Buffon, Linnaeus, Réaumur, Darwin, and von Humboldt, among others. Notable in the craft of the best of these natural historians was their careful attention to detail, precision in measurement and recording of information, recognition and interpretation of variables, awareness and questioning of previous contributions to theory, and the development of new tools of analysis. A few excerpts from these earliest naturalists follow.

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Enquiry into Plants. Theophrastus. c. 300 B.C. (Hort, 1916)

The differences between trees of the same kind have already been considered. Now all grow fairer and are more vigorous in their proper positions; for wild, no less than cultivated trees, have each their own positions: some love wet and marshy ground, as black poplar, abele, willow, and in general those that grow by rivers; some love exposed and sunny positions; some prefer a shady place.

History of Plants. Linnaeus. 1750. (Rose, 1775)

The native places or stations of plants respect the country, climate, soil, and situation, nature of the ground, earth and mould.

The only true foundation of gardening, and the right cultivation of plants, depends on the knowledge of the native places of their production from whence the rules and principles of the art ought to be derived.

The Natural History of Ants. Réaumur. c. 1742. (Wheeler, 1926)

When we follow ants through their various stages we see that those that are born without wings pass their lives without having them, whereas those that are to be winged have wings from the moment of their birth, like the other flies and butterflies; that is, after the transformation which enables us to recognize them as ants.

○ What Does the Term *Ecology* Mean & How Did It Get There?

Hanns Reiter (1885) appears to have been the first to combine the Greek words *oikos* (house) and *logos* (study of) to form the term *ecology* (Egerton, 1977). However, it was Ernst Haeckle (1870) who gave definition and substance to the term, which he had first used in 1886, as follows: “By ecology we mean the body of knowledge concerning the economy of nature.... [E]cology is the study of all the complex interrelations referred to by Darwin as the conditions of the struggle for existence.” Seven years earlier, French zoologist Geoffroy Saint-Hilaire had proposed the term *ethology* for “the study of relations of the organisms within the family and society in the aggregate and in the community” (McIntosh, 1985). In 1894, English naturalist St. George Jackson Mivart coined the term *hexicology*, defined as “the study of the relations which exist between the organisms and their environment...” (McIntosh, 1985).

Although the term *ecology* was coined in 1886, it was not widely used until the end of the 19th century, but by 1913, the term became institutionalized with the formation of the British Ecological Society and, in 1915, with the formation of the Ecological Society of America. However, this institutionalization of the term did not mean a consensus on ecology’s purview. For example, British ecologist Charles Elton (1927) defined ecology as “scientific natural history” concerned with “sociology and economics of animals”; American plant ecologist Frederick Clements (1905) considered ecology as “the science of the community”; American animal ecologist Victor Shelford (1937) regarded it as “that branch of general physiology which deals with the organism as a whole...”; and German ecologist Karl Friederichs (1958) regarded ecology as “the science of the environment” (*Umweltlehre*). But it was American ecologist Eugene P. Odum (1953) who had the most influence in defining the parameters of the discipline as “the study of the structure and function of ecosystems.” Interestingly, the term *ecosystem* had been introduced much earlier by the British ecologist Arthur Tansley (1935) as

the whole system (in the sense of physics) including not only the organism-complex, but also the whole complex of physical factors forming what we call the environment of the biome – the habitat factors in the widest sense.

Like many fields of contemporary biology, ecology is multidisciplinary and almost boundless in its concern. In the 1960s, when popular usage of the term became commonplace, it seemed that everyone had a particular use of the term that became expanded politically to encompass a philosophy that broadly interpreted a variety of environmental concerns in a yet more ambiguous term, *environmental science*.

○ Ecosystem Ecology

A system consists of two or more components that interact and is surrounded by an environment with which it may or may not interact (O’Neill et al., 1986). A system is thus a construct of the human mind, in that it is an arbitrary unit of the universe selected for study and some logic is applied in deciding what to include and what to exclude. However, ecosystems are real – like a pond, a field, a forest, an ocean, or even an aquarium. They are also abstract in the sense of being conceptual schemes developed from a knowledge of real systems. There is great diversity in the types of actual ecosystems – from large to small, terrestrial to freshwater to marine, field to laboratory. There are also unique combinations of particular abiotic and biotic components in any particular ecosystem. Nonetheless, they have in common certain general functional and structural attributes that are recognizable, analyzable, and predictable.

Among the earliest studies that demonstrated these characteristics were those by Raymond Lindeman (1942), Howard Odum (1957), and the multiple studies on Hubbard Brook by Frank Bormann and Gene Likens (e.g., 1979). Ecologist Frank Golley (1993) provides a very full account of the development of the ecosystem concept in ecology.

○ Modern Ecology

Most historians of science mark the rise of modern ecology with the introduction and elaboration of the ecosystem concept (Kormondy & McCormick, 1981). This “new” ecology has reached highly sophisticated levels of abstraction and developed increasingly powerful theoretical constructs and methodologies. The worldwide emphasis on ecosystem ecology derives in large measure from the source of educational preparation and advanced training of ecologists in American universities at the feet of such giants as the University of Georgia’s Eugene P. Odum (Golley, 1993) and, most notably, Yale University’s G. Evelyn Hutchinson (Skelly et al., 2010; Slack, 2010). No less important has been the omnipresence of Anglo-American textbooks and major international initiatives and collaborations in research. In addition to continuing basic research published in such journals as *Ecology* and *Ecological Monographs*, contemporary ecology is showing increasing emphasis on applications (e.g., Wasser et al., 2011; Pringle, 2012) and valuing (e.g., Millennium Ecosystem Assessment, 2003; Jepson et al., 2011; Perrings et al., 2011).

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