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Hierarchy Theory: A Vision, Vocabulary, and Epistemology

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Hierarchy Theory: A Vision, Vocabulary, and Epistemology

Valerie Ahl and T. F. H. Allen

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There is a growing interest in various fields in the abstract properties of complex systems and ways of studying them. Hierarchy theory, a product of the cross-fertilization of several disciplines, including economics, physics, chemistry, psychology, philosophy and ecology, is believed to be a promising analytical approach for understanding complexity. Central to hierarchy theory is the attempt to provide a framework for considering relationships among levels (whether spatial, temporal or both) and their ordering. The term 'hierarchy,' as it is applied to complex systems, refers not to its original meaning denoting the vertical authority structure in human organizations, but to a "partial ordering" (more tree-like than rung-like) (Simon 1973: 5) that is believed to be common to all complex systems–whether physical, chemical, biological, social or artificial.

While earlier works by Allen and Starr (1982) and Allen and Hoekstra (1992) focused on potential applications of hierarchy theory to the study of complex ecological systems, Ahl and Allen, in this general, more philosophical work, are concerned with challenging the current epistemology of science–that of 'naive realism'–and building a vocabulary of hierarchy theory. In the first three chapters, *Confronting the Complexity of Our Time*, *Levels of Analysis as a Challenge to Realism*, and *The Critical Dualities in Observation*, the authors introduce an alternative paradigm to 'naive realism,' which they refer to as "constructivism" (p. 73). Inspired by Jean Piaget from psychology, 'constructivism' describes how the pursuit of understanding should proceed, maintaining that knowledge comes from the interaction between the observer and the world, not from the external world itself (p. 13).

The authors uphold 'constructivism' as a more appropriate epistemology for science, arguing that the time has come to recognize the active constructivist role of the scientist in all branches of science. Ahl and Allen are quite persuasive in their arguments and convincingly demonstrate (for those who need convincing) that the process of doing science is teeming with observer decisions. Examples of such decisions include: posing a question, defining entities or units, choosing measurements, noticing phenomena, and evaluating models (p. 50). The authors are quick to emphasize, however, that a constructivist position does not lead to the solipsistic assertion that the observer controls system behavior, only that behavior occurs in the context of the observer's decisions. Under 'constructivism,' the goal of science is not the discovery of objective 'truth' which exists independent of the observer, but rather the development of more reliable predictive models.

In addition to raising important questions about the philosophy of science, the authors define key concepts and review some properties of scale derived from hierarchy theory. Some of the key concepts examined are: 1) context and constraint; 2) filters and response rates; and 3) surfaces, bond strength and integrity. Important conceptual distinctions between definitional and empirical entities, laws and rules, and nested and non-nested hierarchies are also discussed. While it can be argued that some propositions from hierarchy theory may only weakly apply to human systems (e.g., the postulate that most interactions that occur between systems of all kinds, decrease in strength with distance), other recounted properties of scale hierarchies seem plausible. Broader or higher levels of observation are occupied by entities with relatively slow-moving, low-frequency behavior, which are sometimes spatially larger, and serve as the context for finer or lower levels. To take a rough example from Islamic jurisprudence, the *Qur'ân*

and the *Sunna* (inspired conduct and statements of Muhammad) serve as a relatively constant upper level context for *qadis*' 'judges' decisions. Judges' decisions draw upon a long (slow-moving) legal history. Among the most important points made by the authors lies in their recognition that the ordering of levels in an empirical hierarchy depends on the researcher's question. Change the question and you potentially change the ordering of levels. To take an example given in the book, if the question is, "Which species serves as a food source for the other?" and the animal species in question are deer and wolves, then the deer are the upper-level relative to the wolf. This is because deer are a relatively constant food supply upon which wolves depend. However, if the question is, "Which species controls the number of the other through predation?" then the wolf is the upper contextual level for the deer (p. 98). The reordering of levels comes about because the relationship emphasized by the new question gives a different order in terms of the frequency of behavior and the context.

This book serves as a powerful reminder of the importance of scale in scientific investigation, particularly in developing a more coherent set of explanations for complex questions. The ideas in the volume are presented in clear, non-technical language and accompanied by numerous effective illustrations, making the book ideal for nonspecialists with limited exposure to the study of complex hierarchical systems. One of the book's minor drawbacks is that key concepts are sometimes defined but not sufficiently elaborated. Nevertheless, by expanding on the working vocabulary of hierarchy theory, the book makes an important conceptual contribution to the field of ecology. Anthropologists and other social scientists interested in questions of scale should find this book valuable for its clear discussion of the ordering of levels in an empirical hierarchy and their interrelationships, as well as for its persuasive demonstration of the need for an alternative paradigm to that of reductionist science.

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