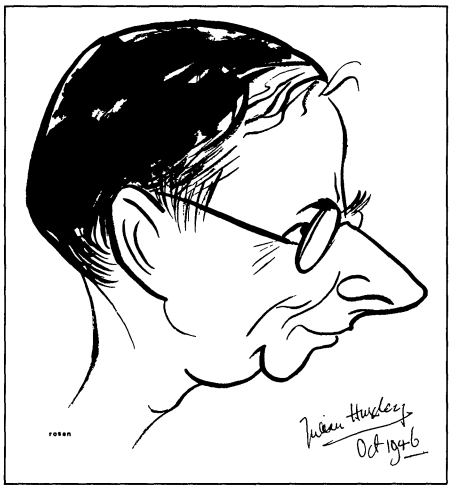
a common conceptual framework for people working in a number of different fields.

In the literature of the past couple of decades, eugenics has become the *bête noire* of liberal and leftist students of science, so much so that previous commentators on Huxley hardly mention his extensive contributions to this cause. In a surprisingly sympathetic discussion, Garland Allen rectifies this omission. Most important, he distinguishes between old-style and reform eugenics. Old-style eugenicists overemphasized heredity to the almost total exclusion of the environment, exhibited a simplistic understanding of genetics, not to mention race and class biases, and had a strong preference for conservative politics. Reform eugenicists, by contrast, had a more sophisticated understanding of genetics and evolutionary theory, especially with respect to the role of the environment, as well as an awareness of the fallacies of race and class bias, and tended to be politically liberal to radical.

Diane Paul and Elazar Barkan agree with Allen but emphasize how porous and changing the boundary between "mainline" and "reform" eugenics was. For example, Huxley emphasized the importance of genetic diversity in evolution and was, for his time and station, politically left. Paul notes that his student H. J. Muller was even more radical in his political leanings but emphasized the culling effect of natural selection. Although Muller did not think that selection would produce an "ideal man" (or woman), he did think that natural selection would constantly cut down on the amount of genetic diversity in a species. Barkan does not want Huxley to slip too easily off the pin upon which historians have mounted him for inspection. Although Huxley was uncomfortable about it, he held during the course of his lifetime various racist beliefs and attitudes. For example, his fear of the population explosion was based not on numbers alone but on the composition of those peoples who were increasing most rapidly.

In his contribution, Daniel Kevles chronicles Huxley's success as a popularizer. In his popular writings Huxley championed social causes as much as he brought science to a wider audience. He was a feminist of sorts, endorsing divorce and birth control. Although at times he may have been patronizing in his attitudes toward other peoples, he actively opposed the racist views of the Nazis. But what Huxley enjoyed most was bringing his love of the living world to a wider audience. D. L. LeMahieu, however, reminds us of how small Huxley's audience actually was. The most popular journal in which he published sold only about 50,000 copies per issue, most of his books sold fewer than 5000 copies, and the sort of radio program to which he contributed attracted an audience too small to measure statistically, probably less than one or two percent of the listeners. The chief exception was "The Brains Trust," which drew almost 30 percent of the listening public at its height at the end of World War II, and Huxley was its most popular participant. Huxley did help to popularize science among educated intellectuals, but he left the great mass of Britons untouched.

A recurrent issue in the collection under review and in the larger literature on Julian Huxley is the extent to which he was a genuine scientist as distinct from a popularizer and statesman of science. Another is how much of Huxley's fame stemmed from his accomplishments and how much from his name. As Churchill shows, Huxley continued to publish on animal behavior throughout his life in addition to producing a constant stream of more popular works, but his work in experimental embryology all but ceased in 1939 and was replaced by contributions to evolutionary biology. Even those tapered off after the publication of his most influential work, *Evolution, the Modern Synthesis*, in 1942, but in 1942 Huxley was 55, an age at which many scientists begin to slow down. Certainly polls indicating that the general public considered Huxley to be among the five best brains in Britain, ahead of Ernest Rutherford and Bertrand Russell, did not help his reputation among his fellow scientists. As is usually the case, Huxley's popular success detracted from his professional reputation. His name both helped and hurt him. It certainly opened doors, but living up to such an illustrious name also placed a heavy strain on him, a strain that periodically got too much for him.



"Cartoon of Julian Huxley dated 1946." [From *If I Am to Be Remembered;* Huxley Archives, Woodson Research Center, Rice University]

In general, the collection put together by Waters and Van Helden is history of science at its best. My only complaint is that periodically I detected a slight whiff of Whiggism. None of the authors is especially guilty of reading present-day science back into Huxley's work or criticizing him for not holding the scientific views that we now do, but on occasion authors seem not only to note Huxley's positions on social and moral issues but to condemn him for holding them. But isn't racism wrong regardless of what racists might think? But isn't the sun in the middle of the solar system regardless of what geocentrists might think? As Olby remarks, "If we are going to judge Huxley, let us do so in terms of [his] generation and not our own."

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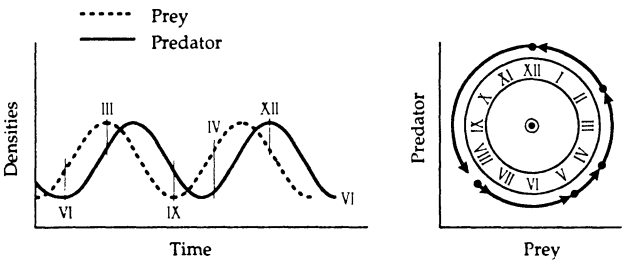
Matters of Scale

Toward a Unified Ecology. T. F. H. ALLEN and THOMAS W. HOEKSTRA. Columbia University Press, New York, 1992. xiv, 384 pp., illus. $45 or £50; paper, $28 or £20. Complexity in Ecological Systems Series.

Ecology is complicated business. At one level, myriads of plants, animals, and microbes are involved in fixing carbon and cycling hundreds of nutrients and other chemicals through dozens of pathways. These are ecosystem (with a little *e*) processes. Understanding the stoichiometry of these processes does not require a detailed knowledge of the species that participate in them, and, indeed, ecosystem studies can become intractable when individual species are considered. But ecology involves more than ecosystem processes, and species *are* important at these other levels of investigation. When species are added to an ecosystem, an Ecosystem (big *E*) emerges and an orders-of-magnitude jump in complexity occurs. An investigator confronting an Ecosystem is obligated to understand ecosystem processes, the processes that are occurring in scores of different populations, and a multitude of interpopulation interactions—all simultaneously.

Reducing Ecosystem complexity into something intelligible is clearly a daunting task. Ecologists have largely attempted to do this by creating subdisciplines that concentrate on small pieces of the big picture. Thus basic ecology has split along aquatic and terrestrial and plant and animal lines; these in turn have fragmented further into organismal, population, community, and ecosystem ecology, each with its own paradigms and styles of investigation. An even wider gulf has developed between basic and ap-



"A graph of prey and predator over time oscillates, the line for the predator lagging behind that of the prey. Plotting prey numbers against predator numbers, the trajectory of prey/predator relationships follows a roughly circular pattern. Once around the circle brings the prey and predator densities back to their original values." [From *Toward a Unified Ecology*]

plied ecology, with only sporadic information flow between the two, and applied ecology has divided into forestry, range conservation, fish and wildlife management, and so on. If ecology were only an academic exercise, the world could probably live with these divisions; but it is now evident that a comprehensive understanding of Ecosystems and an intelligent application of that understanding to their management are crucial to the future of the human condition.

Clearly, unifying ecology is a worthy goal, and Allen and Hoekstra make a brave attempt to do so. First they devote a number of chapters to demonstrating that organisms, populations, communities, ecosystems, landscapes, and biomes do not fall into a rank-order hierarchical system. Hierarchy implies upper-level control over lower-level processes, and ecological events that occur at supposedly higher levels, such as ecosystems, may or may not control events at community or population levels. Nevertheless, the authors show that these subdivisions each do provide useful ways of looking at parts of the big picture. Studying a piece of land as an ecosystem may involve taking a different point of view from that required for studying it as a community, but each is a valid perspective.

What then are ecology's unifying principles—if they exist at all? Allen and Hoekstra suggest that such principles lie in a thorough understanding of scales and constraints. The matter of scale is critical since important ecological phenomena occur at scales ranging from microliters to the entire biosphere. However, up-scaling is not a simple matter; when a change in scale occurs, the system can undergo a chaotic flip to a completely different set of constraints. When that happens, a different set of explanatory principles is usually required. Some levels of investigation scale up rather easily; for example, populations often can be studied at scales of kilometers or tens of kilometers without the need to consider a new set of constraints. On the other hand, different species in a community occupy their environments on different scales, and interspecies interactions on the scale of square kilometers very likely require quite different explanatory principles from those that occur in tenth-hectare study plots.

Allen and Hoekstra's book is full of new insights and perspectives that are quite likely to titillate a pure researcher, and it would be particularly useful as a focus for an advanced graduate seminar in a theoretically inclined department. However, I doubt if it will effect the desired confluence of ecology's pure and applied subdivisions. A forest scientist contemplating the potential impacts of clear-cutting most of a mountain range will find little inspiration in hierarchy theory, fuzzy sets, and strange attractors. Unfortunately, the monumental bridge that will link these conceptual devices to management actions is not to be found here.

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Exsanguinators

The Biology of Mosquitoes. Vol. 1, Development, Nutrition, and Reproduction. A. N. CLEMENTS. Chapman and Hall, New York, 1992. xxii, 509 pp., illus. $99.50 or £69.

Mosquitoes are a problem with which few of us lack personal experience. Their continuing global importance as vectors of parasites and viruses motivates research on these blood-sucking insects, and mosquito research over the past 100 years has yielded many concepts integral to disease control and biomedical research in general. Now mosquito biologists are increasingly spanning the molecular and the population levels to explore mosquito-pathogen systems.

At the heart of the research effort is a realization that solutions to persistent vector-borne disease problems require a solid understanding of vector biology. In 1963 A. N. Clements gave us a classic on the subject in *The Physiology of Mosquitoes*. Now after 30 years, a lag he concedes is akin to the longer generation time of periodic cicadas, he produces another comprehensive treatise on mosquitoes that provides a backdrop for this revolution, painstakingly synthesizing a diverse and vast literature into an understandable account of modern-day mosquito biology. Invariably, new questions and research directions emerge from his critical repackaging of important findings from the primary literature.

Clements stays focused on basic biology and leads the reader directly to the heart of each topic covered. An introductory chapter contains useful background information on the mosquito life cycle and highlights how research on mosquito biology is a keystone for understanding and controlling mosquito-borne diseases. Mostly from the viewpoint of a physiologist Clements addresses complex relationships among parameters such as structural morphology, development, reproduction, immunology, and behavior to illustrate mechanisms critical to the organism. For example, his treatment of genetics provides insights into how mosquito geneticists approach this subject from both a classic and a molecular viewpoint. Each of the book's 23 chapters details a specific aspect of mosquito biology by providing research updates within the context of earlier knowledge.

Clements strives to present an overall picture by collating information from studies of diverse taxonomic groups of mosquitoes. At the same time, he considers how species differ and what this means in terms of vector competence. This is important because much of what is known from studies of the "white mouse" workhorse mosquito, *Aedes aegypti*, cannot be generalized to all groups of mosquitoes, especially the malaria vectors in the genus *Anopheles*. Many research groups are now therefore focusing exclusively on *Anopheles gambiae*, the most important African malaria vector (See Zheng *et al.*, *Science* **261**, 605 [1993]). Additionally, interesting examples illustrate how efforts to delineate basic vector-pathogen relationships are now at the forefront of mosquito research.

Many of us working today on mosquito-borne diseases have not had the benefit of formal training in entomology and mosquito biology and stand to benefit greatly by consulting Clements's treatment of relevant topics. His presentations are supplemented by primary data and informative illustrations, and it is rare to find major publications not cited (there are 54 pages of references). In fact, I found many references of old that are normally overlooked today.

Much technical detail regarding experimental designs is presented. Indeed, many of the standard and newer techniques will be of interest to a wide range of biologists working on other Diptera, other invertebrate systems, and microorganisms. This comprehensive review draws upon diverse subject matter. For example, the very first reference cited deals with the "fatal exsanguination of cattle attributed to an attack of