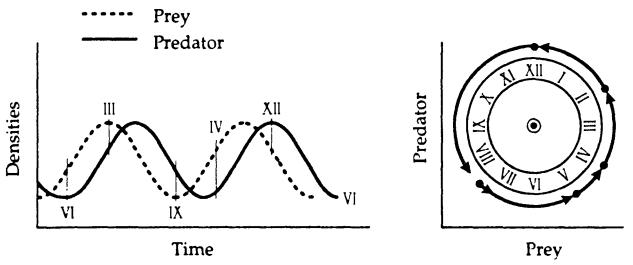

"A graph of prey and predator over time oscillates, the line for the predator lagging behind that of the prey. Plotting prey numbers against predator numbers, the trajectory of prey/predator relationships follows a roughly circular pattern. Once around the circle brings the prey and predator densities 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

Vignettes: Minority Malaise

In graduate school I was expected to have ideas, express them, write them down, and—horrors—defend them. How does one do that? If you defend them, some hotshot white male is there to tear your arguments to bits. What manner of discourse is this? Many women, especially older minority students, had this problem. We thought that tearing apart arguments was rude at best and cruel at worst.

—*Elisabeth J. Johnson*

When I first came to New Haven to teach at Yale, I was truly surprised by the marked class divisions between black folks—students and professors—who identify with Yale and those black folks who work at Yale or in surrounding communities. . . . I soon learned that the black folks who spoke on the street were likely to be part of the black community and those who carefully shifted their glance were likely to be associated with Yale.

—*Bell Hooks*

From Michelle M. Takarczyk and Elizabeth A. Fay, Eds., *Working-Class Women in the Academy: Laborers in the Knowledge Factory* (University of Massachusetts Press)

salt marsh mosquitoes." Other not so well-known published accounts deal with the healing of gut wounds in mosquitoes, abdominal pulses of newly emerged mosquitoes, causes of male incompatibility, and even the effects of decapitation. You will also find instruction on how to give your mosquitoes enemas, regulate their diets, and even record their biting electronically. Literally, there is something for everyone.

This volume will long serve as a guide for everyone dealing with mosquitoes and other Diptera of medical and veterinary importance. On its own it stands as a tribute to Clements's dedication and astute scholarship. The eagerly awaited second volume will presumably address further issues in mosquito behavior and ecology.

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Markers of Disease

Molecular Epidemiology. Principles and Practices. PAUL A. SCHULTE and FREDERICA P. PERERA, Eds. Academic Press, San Diego, CA, 1993. xx, 588 pp., illus. $80 or £61.

In the present century chronic disease supplanted infectious disease as the primary cause of morbidity and mortality in the developed world. With this transition the field of epidemiology expanded its focus to include the study of chronic diseases. The era of subspecialization of epidemiologic research had commenced. The many subdisciplines that have since emerged include clinical, genetic, occupational, psychiatric, cardiovascular, and cancer epidemiology.

The title of this book suggests the addition of yet another subspecialty to the list: "molecular epidemiology." Paul Schulte, one of the editors of the volume, defines the term as the use of biologic markers (or biomarkers), which "generally include biochemical, molecular, genetic, immunologic, or physiologic signals of events in biologic systems," in epidemiologic research. In their preface the editors seem to side with those who view "molecular epidemiology" as "an exciting phrase that conveys the potential for incorporating biologic markers, especially ones depicting events at the genetic or molecular level, into epidemiology" and against those who argue that "there is nothing new in molecular epidemiology" or even that "such reductionist approaches are antithetical to public health." Despite the controversy, the term is here to stay. A brief search of Medline revealed 161 articles published in the last three years with "molecular epidemiology" in the title. With *Molecular Epidemiology* Schulte and Perera have provided a basic guide to the "hybrid discipline of molecular epidemiology." The book is an excellent review of the crucial issues related to the incorporation of new markers of exposure, disease, or susceptibility into epidemiologic investigations.

The book is designed for both laboratory-oriented and population-oriented scientists. It will be particularly valuable to the epidemiologist unfamiliar with the terminology and procedures of molecular biology. Part 1, General Principles, contains clear and concise chapters on the techniques and principles of molecular biology, with definitions of key terms. The chapters addressing issues of quality control, technical variability, pharmacokinetic modeling, and the banking of biologic specimens constitute an excellent reference for all investigators who use biologic markers in their research. It is refreshing to see a chapter on interpretation and communication of epidemiologic data, a matter that, although often overlooked, is of critical importance.

Part 1 is not quite as strong in its presentation of epidemiologic principles for the nonepidemiologist and could have been made more helpful to the laboratory scientist by the more explicit definition of epidemiologic terms and by a fuller explanation of key concepts. For example, in their chapter on validation Schulte and Perera suggest that the most valuable indicator of whether a biologic marker is valid is its predictive value, or the proportion of people studied who have a particular disease (true positives) among all the people who have the marker (true positives and false positives). Since predictive value, although related to the validity of the measurement, is, as the authors note, also dependent on the prevalence of the condition in the population studied, it is not generally used as a measure of validity, which pertains to sensitivity and specificity. In addition, the concepts of content and construct validity, approaches derived from psychometrics that apply to measurements that cannot be directly confirmed by physical means, require more development than the authors give. The laboratory scientist requiring an introduction to the principles of epidemiology is thus encouraged to consult additional works. On the positive side, Schulte and Perera are right to emphasize the potential of biomarkers for lessening the possibility of exposure misclassification, a problem that plagues epidemiologic research, and the chapters on design considerations and risk assessment are very effective.

Part 2, Practical Applications, reviews the application of molecular biology to the study of specific organ system diseases, including cancer and cardiovascular, neurologic, and musculoskeletal disorders. In an epilogue, Rothman puts the use of biomarkers in the context of current epidemiologic research: "At present, and in the foreseeable future, epidemiology will use questionnaires, medical records, environmental monitoring data, and biomarkers in a complementary fashion to achieve its overall goal: to understand the determinants of human disease and to use that information to control disease."