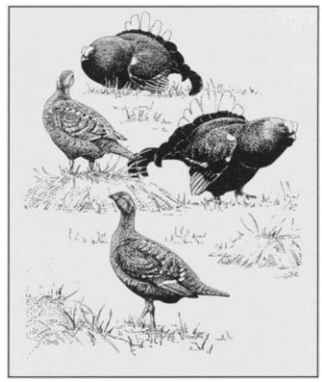
BOOK REVIEWS

Mating Arenas

Leks. JACOB HÖGLUND and RAUNO V. ALATALO. Princeton University Press, Princeton, NJ, 1995. xiv, 249 pp., illus. $49.50 or £40; paper, $24.95 or £18.95. Monographs in Behavior and Ecology.

Leks are among the greatest wonders of the natural world. These aggregations of displaying male birds, mammals, and (by some definitions) insects, apparently existing solely as mating arenas where females come, mate with one or more highly popular males, and leave having obtained nothing more than sperm to fertilize their offspring, have captivated naturalists for centuries. Why should hundreds of grouse cluster every spring on a barren icy meadow, with populations often occupying the same display grounds for decades? If males supply only sperm, what differences among them motivate female choice so extreme that a single male can fertilize 90 percent of the offspring produced? Given that such extreme choice occurs, how can any genetic variation in fitness remain after generations of selection?

Höglund and Alatalo, experts in avian behavior and sexual selection, attempt to answer these questions and to place lekking systems in a broad context of sexual selection theory. They first struggle to define lek mating systems, a simple task for classic species such as sage grouse or Uganda kob, but more problematic in the case of taxa such as crickets and frogs, in which male display sans paternal care is the norm but clustering is not tight and the resources females require are unclear. The authors arrive at a broad and useful definition that includes many of these latter cases, but for the remainder of the book they have difficulty incorporating insects and amphibians into theories about the evolution of mating aggregations or the operation of female choice on leks. This difficulty may reflect a shortcoming in the study of leks and perhaps other issues in behavioral ecology: empirical research is only uneasily wed to theoretical predictions, and despite numerous elaborate models experimental tests remain rare and observations insufficient to discriminate among hypotheses. Indeed, given the attention lavished on lekking species since the last century, I found it disheartening how few questions can be definitively answered even for representative systems.



"Black grouse (*Tetrao tetrix*) females sample males by repeated visits to their territories and finally mate with one." [From *Leks*; drawing by Dafila Scott]

The authors emphasize the need to integrate theory with practice, a synthesis that is nowhere more evident than in their own work with black grouse. They combine ingenious manipulations of male feather ornaments with meticulous observations of display and copulation success (documented to closely reflect paternity). Here, too, however, the results are often disappointing; few cues in males explain the high degree of mating skew observed, although more vigorous males tend to be successful. I particularly enjoyed the descriptions of experiments using stuffed grouse dummies to elicit copulations from displaying males and test the response of real females in the area. It turns out that although females are attracted to apparent success (males copulate readily with the fake females), they do not ultimately mate with the male given the dummy. Whether this indicates a failure of the female copying hypothesis to explain mating skew or merely suggests that female grouse are not as stupid as male grouse is unclear.

"Ruffs (*Philomachus pugnax*) are unique among birds in that males come in two morphs, probably genetically determined: satellites and residents (van Rhijn 1991). These morphs behave differently. Residents defend lek territories, whereas satellites engage in short-term associations within resident territories. Both can have access to females." [From *Leks*; drawing by Dafila Scott]

Like other researchers, Höglund and Alatalo divide major questions about leks into two parts: why do males aggregate, and how do females choose? Several models have been proposed to answer the first question, including the suggestion that female movement patterns lead to areas where groups of males are likely to achieve higher per capita copulation success than single males (the "hotspot" idea), the idea that attractive males ("hotshots") are parasitized by less attractive males clustering near them, and a relatively new idea, the black hole model, in which females bounce from male territory to male territory like billiard balls until they are free from harassment and then mate at random. The authors dismiss the hotshot model, but I found the last notion at least as implausible, given the absence of random mating in virtually every vertebrate species in which it has been carefully looked for.

As for why females choose, Höglund and Alatalo point out that we may have been too hasty in assuming that females receive nothing from lekking males besides their genes and suggest that direct benefits have not been ruled out by careful research. Most studies of morphological variation in displaying males reveal few differences that could account for the high degree of skew in mating success. In some species, females will follow males experimentally moved to new positions on the lek, whereas in others territory location is critical and females continue to mate with replacements of popular individuals. Perhaps some answers may be found in the period before lek formation, when selection might take place among males to determine who can make the competitive grade in the first place. Little is known about a crucial element, the relative fitness of the offspring of females mating with different males. Although the ease of observing leks has fostered much research, behavior off the lek is extremely difficult to follow, making tests of pre-lek activity and offspring fitness daunting.

Reading this book, I was reminded of a rather gloomy assessment by Krebs and Myers (*Adv. Ecol. Res.* 8, 268 [1974]) of a problem in ecology that has similarly eluded definitive conclusions, the cycling of rodent populations: "This lack of understanding may have three explanations: (1) these small rodents are poor subjects in which to study population ecology; (2) ecologists working on these animals have been particularly inept; or (3) our current views on population control may be incomplete.

Each of these explanations may be supported by a survey of the literature on this problem." Though I do not think such pessimism is warranted in the study of leks, I hope researchers will follow the thoughtful suggestions for future research given in the final chapter of this book and provide new insights for the next edition.

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Visual Perception

Foundations of Vision. BRIAN A. WANDELL. Sinauer, Sunderland, MA, 1995. xvi, 476 pp., illus. $45.95 or £29.95.

We see wonderfully well and without obvious effort, yet vision is arguably the most difficult task the brain faces. In *Foundations of Vision* Brian Wandell has done a fine job of explaining both the complexities of the problem and the state of our current knowledge. Viewed from afar, the cover of Wandell's book displays a picture of an eye, an appropriate subject. But as you approach, the eye is increasingly camouflaged by the hundreds of separate tiny images from which it is constructed. The small component pictures (illustrations from the book) are monochrome images of different colors and contrasts. At the near distance required to resolve their individual characteristics, the great eye itself virtually disappears. This clever design is a useful metaphor for the visual system. When we examine the visual mechanism closely, although we understand much about its component parts, we fail to fathom the way in which they fit together to produce the whole of our complex visual perception.

Wandell divides his consideration of the visual system into three parts. The first describes the optics of the eye, the retinal photoreceptors and their responses, and the color matching that is so well explained by reference to this level. The second section treats what Wandell refers to as representation, including information about analysis in the neural retina and the visual cortex, basic facts about behavioral pattern sensitivity, and a discussion of multiresolution image representations. Here he introduces computational models related to human vision, presenting both the underlying ideas and some of the algorithms that are used. The third section of Wandell's book considers the most difficult problem of all, namely, how we interpret the information that is present in the visual representation. Color, motion, and depth are discussed in some detail, and there are interesting short descriptions of the strange perceptual phenomena associated with certain neurological abnormalities and of ever popular visual illusions. The book concludes with a series of useful appendixes describing shift-invariant linear systems, display calibration, classification, signal estimation, motion-flow-field calculation, and sampling and aliasing.

Foundations of Vision is unusual in combining competent treatments of the basic physiology and psychophysics of vision with a lucid presentation of ideas from computational vision, all with the ultimate goal of understanding high-level visual perception. It will be of particular value to students because it presents a broad range of fundamental data and ideas and because it demonstrates how to compute solutions to many standard problems. But Wandell's new book is not just for students; it is a well-written, carefully crafted discussion of the problems of vision and the current state of our understanding. It has much to offer everyone who wonders how this most remarkable of all senses works.

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Also Noteworthy

Atoms, Bombs, and Eskimo Kisses. A Memoir of Father and Son. CLAUDIO G. SEGRÈ. Viking Penguin, New York, 1995. xiv, 287 pp. + plates.

The Nobel Prize–winning physicist Emilio Segrè gave an account of his own life in the posthumously published *A Mind Always in Motion* (University of California Press, 1993; reviewed in *Science* **263**, 996 [1993]). In the present book Segrè's only son (now himself deceased) gives an account of his growing up with such a father. The experience as he describes it was not an easy one. Transported in infancy from Italy to the United States, Claudio was required to negotiate his way between his family's persistent conviction of European cultural superiority and the danger of being perceived as "not one of us" by his new compatriots. Admiring his father, he was conscious of himself as "Son of Superman," alternately feeling eclipsed by and relishing the position. Academically he was beset by a "joyless desire to achieve" and only seldom gained the praise or sympathy he longed for from his exacting and often sarcastic father. But he discovered the delights of hot dogs, comic books, and baseball and forged ahead on his own by choosing the reputedly "Red" Reed College over his family's preferred Berkeley. After graduation, in search of work to which he could "be as devoted . . . as my father was to physics," he spent some years as a journalist before ultimately making a creditable academic career as a historian, along the way establishing an apparently satisfactory family life of his own. The book ends with an account of his relations with his father as an adult, including a disappointing attempt at a therapeutic confrontation.

Katherine Livingston

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Books Received

Critical Success Factors in Biomedical Research and Pharmaceutical Innovation. S. W. F. Omta. Kluwer, Norwell, MA, 1995. xii, 294 pp., illus. $124.50 or £79 or Dfl. 175.

The Cure of Childhood Leukemia. Into the Age of Miracles. John Laszlo. Rutgers University Press, New Brunswick, NJ, 1995. xiv, 289 pp. $29.95.

The Most Beautiful Molecule. The Discovery of the Buckyball. Hugh Aldersey-Williams. Wiley, New York, 1995. x, 340 pp., illus. $24.95.

The Most Complex Machine. A Survey of Computers and Computing. David J. Eck. Peters, Wellesley, MA, 1995. xii, 445 pp., illus. $49.95.

Polyamines. Regulation and Molecular Interaction. Robert A. Casero, Ed. Springer-Verlag, New York, and Landes, Austin, TX, 1995 (distributor, CRC Press, Boca Raton, FL). x, 236 pp., illus. $89. Molecular Biology Intelligence Unit.

Population Dynamics. New Approaches and Synthesis. Naomi Cappuccino and Peter W. Price, Eds. Academic Press, San Diego, 1995. xxii, 429 pp., illus. $74.95.

Population Production and Regulation in the Sea. A Fisheries Perspective. David Cushing. Cambridge University Press, New York, 1995. xii, 354 pp., illus. $69.95.

Reinventing Biology. Respect for Life and the Creation of Knowledge. Lynda Birke and Ruth Hubbard, Eds. Indiana University Press, Bloomington, 1995. xviii, 291 pp. $35; paper, $15.95. Race, Gender, and Science.

Semiconductor Optics. C. F. Klingshirn. Springer-Verlag, New York, 1995. xviii, 490 pp., illus. $54.50.

Set Theory. On the Structure of the Real Line. Tomek Bartoszyński and Haim Judah. Peters, Wellesley, MA., 1995. xii, 546 pp., illus. $69.95.

Shafarevich Maps and Automorphic Forms. János Kollár. Princeton University Press, Princeton, NJ, 1995. x, 201 pp. $37.50 or £29.50. M. B. Porter Lectures.

Shapes and Shells in Nuclear Structure. Sven Gösta Nilsson and Ingemar Ragnarsson. Cambridge University Press, New York, 1995. xiv, 408 pp., illus. $89.95.

She Does Math! Real-Life Problems from Women on the Job. Marla Parker, Ed. Mathematical Association of America, Washington, DC, 1995. xvi, 253 pp., illus. Paper, $24. Classroom Resource Materials.

Signal Transduction Mechanisms in Cancer. Hans H. Grunicke. Springer, New York, and Landes, Austin, TX, 1995 (distributor, CRC Press, Boca Raton, FL). xiv, 148 pp., illus. $79. Molecular Biology Intelligence Unit.

The Sixth Extinction. Patterns of Life and the Future of Humankind. Richard Leakey and Roger Lewin. Doubleday, New York, 1995. xii, 271 pp., illus., + plates. $24.95 or $C34.95.

Solid-State Imaging with Charge-Coupled Devices. Albert J. P. Theuwissen. Kluwer, Norwell, MA, 1995. xxviii, 388 pp., illus. $192 or £124 or Dfl. 295. Solid-State Science and Technology Library, vol. 1.

The Story of Astronomy. Lloyd Motz and Jefferson Hane Weaver. Plenum, New York, 1995. x, 387 pp., illus. $28.95.

Structure in Protein Chemistry. Jack Kyte. Garland, New York, 1995. x, 606 pp., illus. $62.