an astounding lapse that will put off serious scientific readers. Wolfram's Web site (*14*) includes "relevant books," but this list is no substitute.

To benefit from the book, one must get past these issues without becoming too angry and take most of the claims with a large grain of salt. Wolfram's discussions and speculations will interest many people in a wide variety of fields, but they do not constitute a new kind of science.

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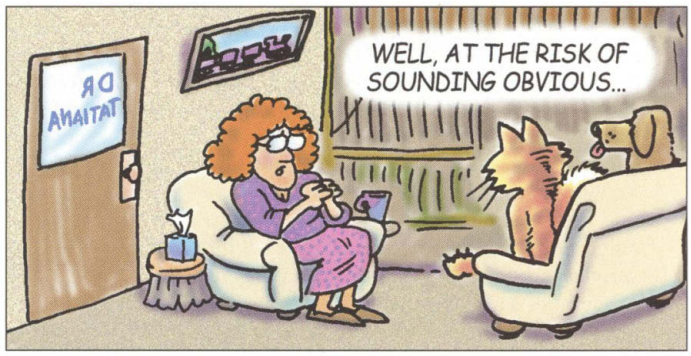
BOOKS: EVOLUTION

Explanations for the Birds and the Bees

Paul Harvey

If I were an intellectually challenged adult male gorilla who stumbled across an adult male chimpanzee, I should in all likelihood be at a loss to explain my comparatively tiny testicles. Fortunately, my angst might be eased by consulting Dr. Tatiana, the agony aunt, who would point out that large testicles are characteristic of those primates and other mammalian species in which the female often mates with more than one male during a given estrus. Large testicles produce more sperm, thereby providing more tickets in the sperm competition lottery. Female gorillas mate only with the group's silverback who, in the absence of sperm competition from other males, needs to provide just enough sperm to ensure that fertilization is successful. The promiscuous female chimpanzee, on the other hand, has the sperm from different males competing for access to her eggs, so those males have evolved the capacity to produce inordinate quantities of the stuff.

Dr. Tatiana is the brainchild of Olivia Judson, whose doctoral studies were supervised by the late W. D. Hamilton. She wanted to describe to her audience our current understanding of the evolutionary biology of sex. The topic is manifold, wondrous, and characterized by diversity: Why do some organisms have sexual reproduction whereas others do not? Why do different species have different numbers of sexes? What determines whether individuals are single-sexed or hermaphrodite? Why do some species usually have imbalanced sex ratios while others do not? Why is sex sometimes determined genetically and sometimes environmentally? What are the causes and consequences of the different mating systems seen in the natural world? Over the years the variety has been described and the problems of explaining it have been solved, to varying degrees. Many of the major contributions came from biologists like Darwin who became familiar with the natural history of many, many species and were then able to make comparisons to explain the differences.



Familiarity with natural history is equivalent to becoming intimate with private lives, except that the former lacks the taboo of anthropomorphism. Some of the best evolutionary biologists work by attempting to identify themselves with the species they study: "What would I do if?" is often useful shorthand for "What would natural selection produce under particular circumstances?" Of course there can be dangers in this way of thinking, which is why formal models often reveal logical pitfalls. But, even then, the results of a logical modeling process need to be described verbally. Judson has gone the whole hog by employing anthropomorphism to its extremes, in the assurance that most of the work she describes has been backed by evolutionary models. Through the device of having organisms describe their situations (and predicaments) to her, she is able to enter a dialog that uses individual case studies to illustrate general principles. This technique draws in the reader to a witty, racy, informed, entertaining, and instructive read.

There will be opposition to Judson's approach. Some will argue that anthropomorphism on this level is unjustified and leads inevitably to inaccuracies. Who cannot feel for the plight of the green spoon worm (*Bonellia viridis*) that just inhaled her "husband"? But, then again, in what sense was the male a husband before being inhaled? Only after being inhaled does the male start to fertilize the female's eggs. This example leads Dr. Tatiana to a description of environmental sex determination in the spoon worm: lone larvae mature into large females and larvae that subsequently develop near a female become male. In a carefully crafted discourse that follows, she explains why and when sex is environmentally versus genetically determined.

It would be wrong to think about *Sex Advice to All Creation* as merely a collection of anecdotes followed by descriptions of general principles. Instead, the book is a developing text, meaning that it should be read from the beginning because answers to some questions require familiarity with earlier chapters. For those who want to check the facts for themselves or to delve more deeply into the problems that Judson tackles, notes at the end of the book cleverly reference the original research papers used in its construction. The bottom line is that the book actually works. Like Richard Dawkins's *Selfish Gene* (Oxford University Press, Oxford, 1976), it uses unabashed anthropomorphism to create scenarios with which the open-minded reader can identify. Also like Dawkins, Judson is a gifted writer, and her book helps further understanding.

Dr. Tatiana's Sex Advice to All Creation
by Olivia Judson

Chatto and Windus, London, 2002. 317 pp. £16.99. ISBN 0-7011-6925-7. Metropolitan, New York, 2002. 319 pp. $24, C$34.95. ISBN 0-8050-6331-5.

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