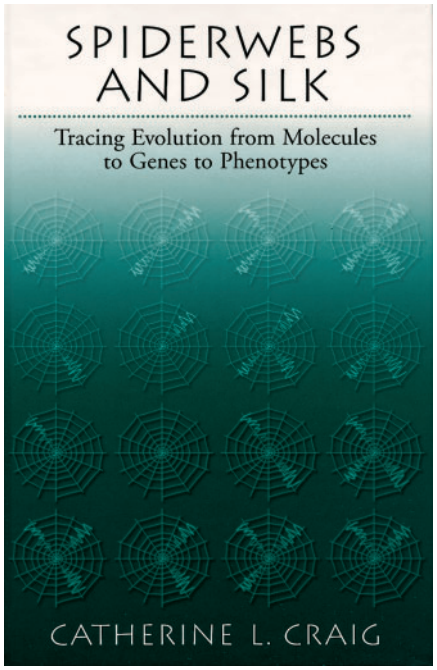
Book Review

SILK SPINNERS



Spiderwebs and Silk – Tracing Evolution From Molecules to Genes to Phenotypes

Catherine L. Craig

Oxford University Press (2003)
pp. 256 ISBN 0195129164 (hbk)
£37.50 (hbk)

Spiders offer experimental opportunities to researchers from a wide array of disciplines: physicists and biochemists are interested in the physical properties of the silk strands all spiders spin, ecologists find them useful in examining diverse problems, from predator–prey interactions to life history, and evolutionary biologists find them ideal for studying speciation and the evolution of mating behavior. Catherine Craig has, in this slim volume, set out to explore the interaction between the web-building spider, the silk it produces and the prey it captures. In this endeavor, she has collected concepts from an extremely diverse array of disciplines, ranging from physical biochemistry to insect neurophysiology to evolutionary ecology. Sadly, the attempt to draw together so many aspects of spider biology and their remarkable web structures, while laudable, is poorly executed and left this reader frustrated.

The first chapter is an overview of silk protein structure and a phylogenetic analysis of the evolution of silk and silk-spinning in insects and spiders. Interestingly, the other silk-producing arachnids, mites and pseudoscorpions, are not mentioned. The next two chapters present the genetics and mechanics of silk production, with a good review of the literature and some novel data from Craig's research with C. Riekel. Unfortunately, there are some instances where hypotheses, such as the existence of mutational 'hotspots', are reported factually. The purported hotspots do indeed have the same amino acid sequence as hotspots documented for some mammalian species, but the data that would allow the author to state unequivocally that these sequences in spiders are mutational hot spots are currently lacking. There is also an implicit assumption that the existence of such hot spots is evolutionarily advantageous. Such an assumption would be exceedingly difficult to test in the silk system because no spider silk genes have yet been sequenced that lack the purported hot spot.

In chapters four, five and six, Craig reviews her own ground-breaking work with spider web visibility, and *Drosophila* and bee visual capacities and learning. Unfortunately, there is very little mention made of any alternative hypotheses or work by other researchers except the background work on insect neurophysiology that forms the framework for Craig's own research, and nearly all of the data presented she has published elsewhere. The presentation of these studies would leave the reader with the mistaken belief that no alternative hypotheses have ever been presented. For example, there has been much debate about the function of web decorations but none of these other hypotheses are discussed. Additionally, there is evidence that they function differently in different species of web-building spiders, and her failure to mention this is an example of a tendency to generalize to all insect prey and web-building spiders despite the fact that the majority of the research presented is with bees and orb-web spinning spiders.

Chapters seven and eight may be the weakest in the book. Chapter seven is a discussion of the possible physiological costs of silk production, reprinted from a published article (as is Chapter 2), but it still presented several problems to this reader. Chief among them is the use of ATP as a measure of cost of silk production with no mention whatsoever of the unit of silk. Are *Nephila* building webs at a cost of 1416 ATP per microgram, molecule, or web of silk? And without the

unit of measure for the silk, it is simply impossible to draw comparisons among spiders or between spiders and insects. Another serious problem is the assumption that, if an amino acid can be synthesized by the organism, it is being synthesized. This seems unlikely, as the author herself states that *Escherichia coli* do not synthesize amino acids if they can obtain sufficient amounts from the environment, and the same likely holds for spiders. Therefore, the estimates of the cost of the silk to spiders are all probably overestimates. Chapter eight discusses the evolutionary cost that silk spinning may present to spiders by assuming that the absence of eusociality, where a few individuals reproduce and most individuals are workers or soldiers, is an indication that spiders have reached an evolutionary dead-end. It is an interesting concept, and worth further consideration. However, the presentation of the physiological data for spiders are again biased towards her own unpublished data, and it is arguable that eusociality is not necessarily the pinnacle of evolution in animal systems.

The final chapter of the book, outlining topics for future research, presents some interesting ideas. Like these topics, the book had great potential in its inception because Craig has gathered together diverse questions that that can be considered simultaneously in spiders due to their unique biology. Unfortunately, a tendency to rely very heavily upon her own work, sometimes to the exclusion of others' publications, a tendency to phrase hypotheses as facts, and a tendency to generalize from a few species to all 'insects' or 'web-building spiders' undermines her goal. These flaws could leave a naive reader with the mistaken impression that far more is known about these topics than is actually the case. Had she been more inclusive of the work of others, and had the editors worked more judiciously with the prose and content, the resulting book could have been very influential. In spite of these flaws, the book should stimulate more research in spider evolutionary ecology by highlighting the characteristics of these organisms as study systems. Certainly those who study spiders will want to read it and consider some of the issues she has raised.

doi:10.1242/jeb.01341

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Published by The Company of Biologists 2004