

## **The Birds And The Bees, From The Flower's Point Of View**

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fyng such a framework would entail revisions so radical as to either be unpalatable to proponents of ID creationism or render a completely neutered (and thus harmless) version of ID creationism. ID creationists must either argue that the designer is accessible by naturalistic means or reject methodological naturalism altogether. Sarkar has effectively taken just what ID creationists identify as being distinctive of their work and rendered it unscientific—all the while rejecting a hard line of demarcation. Creationists may object that excluding the possibility of the supernatural directing evolution is itself a roadblock to progress in science—if they were to be so forthright in front of school boards and responsible media, then Sarkar will have accomplished his goal.

Although Sarkar's book overall is extremely well written and carefully rendered, I found some shortcomings. If his goal is to reach an interested lay public, a primer on assigning probabilities would be helpful. This is especially the case given how much of Sarkar's criticism of Dembski turns on the incoherence of trying to assign probabilities without a reference class. These are technical arguments, and more help should be offered to the reader. Sarkar can also get a bit carried away in rhetorical flourish, producing fuel for the fire. Describing Alfred Wallace's panselectionism as "heresy," for example, plays into the ID creationist ploy to characterize evolutionary theory simply as Darwinism, and is all too easily exploited or misunderstood. That this occurs a page after Sarkar (rightfully) argues, "ID creationists misrepresent the practice of evolutionary biology when they present it as Darwinism, as if it were a doctrine based on a prophet like their own theologies of revelation," is that much more striking (p. 29).

I would strongly recommend *Doubting Darwin? Creationist Designs on Evolution* to anyone interested in why biologists find ID creationism objectionable. It would make a wonderful textbook for an undergraduate course in either biology or philosophy, and could also be effectively used as a jumping-

off point into a deeper exploration of a host of topics. My copy will be close at hand on my bookshelf when ID creationists present themselves at my door.

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### THE BIRDS AND THE BEES, FROM THE FLOWER'S POINT OF VIEW

**Understanding Flowers and Flowering: An Integrated Approach.** Beverly Glover. Oxford University Press, New York, 2007. 256 pp., illus. \$75.00 (ISBN 9780198565963 paper).

*Understanding Flowers and Flowering* has the ambitious goal of unifying molecular genetic and ecological viewpoints on floral production, development, and morphology—and it largely succeeds in that aim. Author Beverly Glover, of the University of Cambridge, is a specialist in floral color and epidermal cell morphology, and therefore has particular insight into aspects of floral biology that link ecology with genetics. The book covers topics ranging from angiosperm evolution to floral genetics to the ecological interactions of pollinators and floral form. As might be expected, some sections are stronger than others, but on the whole, this work fills a considerable gap among available texts by integrating evolutionary, ecological, and developmental genetic materials.

The 19 chapters are logically divided into three sections that can be described generally as evolution, developmental genetics, and ecology. The first section is perhaps the weakest (it is also the shortest), highlighting several questionable or out-of-date hypotheses and results. Among these, the most prob-

lematic is the assertion that the "mostly male" hypothesis is the "currently favored" model for the evolution of the hermaphroditic floral axis. This hypothesis holds that an important gene for promoting floral meristem identity, called *LEAFY*, was duplicated in the ancestor of all seed plants (angiosperms and gymnosperms). The resulting two types of *LEAFY* evolved sex-specific functions—one primarily controlling male reproductive identity, and the other, female. These two flavors of *LEAFY* function are posited still to be present in extant gymnosperms, whereas in angiosperms, only the "male" *LEAFY* function persists. The explanation for this condition is that somehow the genes responsible for promoting ovule development came under the control of the male *LEAFY* in the ancestor of angiosperms, producing ectopic ovules on some male reproductive organs that ultimately evolved into carpels.

Although this hypothesis represented an important transition in models of angiosperm evolution by invoking simple changes in gene expression as potential mechanisms for evolutionary change, it cannot be considered viable at this point because substantial contradictory data also exist (i.e., the two gymnosperm *LEAFY* homologs are not, in fact, male and female specific). Of much greater importance are the homeotic models for flower evolution, which Glover references in subsequent chapters but incorrectly suggests are equivalent to "mostly male." Aside from this point, I particularly missed the presence of any kind of angiosperm phylogeny figure, even a simplified one that glosses over the controversial points. This absence is also felt in later chapters that, to the author's credit, do an admirable job of including data from taxa other than the standard *Arabidopsis*. At least one angiosperm phylogeny would have been useful to help readers orient themselves in an evolutionary context when these different taxa are discussed.

The second section encompasses the developmental genetics of flowering time and floral development from a relatively broad perspective, with some consideration of the evolution of these

genetic pathways. This section begins with a useful introduction to *Arabidopsis* biology and genetic manipulation as well as to the often confusing terminology used in flowering time control. Glover defines three major pathways—autonomous, photoperiodic, and vernalization—which feed into the floral pathway integrators that actually promote flowering. In this regard, Glover does not do herself any favors by using atypical terminology when discussing the flowering-repressor gene *FLC* (*FLOWERING LOCUS C*), included as part of the “autonomous inhibition” pathway. The odd point here is the use of the term “autonomous” in relation to *FLC*. There is also a well-characterized floral induction pathway that is more commonly referred to simply as the “autonomous” pathway. These autonomous loci act through several different genetic mechanisms to deactivate the floral repressor *FLC* and thereby allow flowering to occur. This is the first time I have seen *FLC* termed an “autonomous inhibitor,” and I can understand Glover’s logic, but, as a rule, *FLC* is discussed in the literature as a component of the vernalization pathway.

One can always quibble about terminology, but I found the use of autonomous inhibition versus autonomous induction to be tricky in two regards. First, readers have to pay very close attention to catch which pathway is being discussed at any particular time (not necessarily a bad thing), and second—and more problematically—it may lead to confusion when readers go to the primary literature and do not see the same usage. This being said, the complexities of flowering time control in *Arabidopsis* make it one of the hardest subjects to explain clearly. Glover has achieved that quite well, and the data covered are very up to date, which will extend the shelf life of this text.

The latter part of the molecular genetic section focuses on the genetic control of floral meristem and floral organ identity. This subject is the one area that has been thoroughly covered in many other texts and literature reviews, so it is hard to add much that is new, but Glover does an excellent job of explain-

ing the work from first principles. In particular, she gives full coverage to the fact that the A-class component of the ABC model of floral organ identity, which is often considered essential to the development of sepals, does not actually appear to be well conserved. This point often gets short shrift in other reviews, but it is very important for students to grasp as early as possible.



The last section, covering variation in floral form, represents the most integrative material. What is the ecological value of zygomorphy (bilateral floral symmetry), and how is it genetically generated? What are the biochemical, genetic, and morphological bases for floral color, and how do the components interact with floral ecology? These questions are among the best-addressed points in this section and are very useful for students coming from both sides of the genetics/ecology divide. (The first half of the section could benefit from labeled illustrations of the genetic models, and the figures throughout the book are of variable quality.) The second half of the section focuses more on evolutionary- and ecological-minded questions concerning the role of pollination interactions in plant fitness. In particular, Glover takes on some of the controversy concerning “pollinator syndromes,” and she presents both sides evenhandedly.

*Flowers and Flowering* is a well-written text that would well serve undergraduates, early graduate students, or anyone with a solid biology background who is interested in floral biology. Although I found some points to criticize, I would still recommend the book, especially for those from an ecology per-

spective who want to learn more about floral genetics. I do think that further integration is needed among the disciplines of evolution, genetics, and ecology—both in this text and in others to follow—but this work will initiate that important process.

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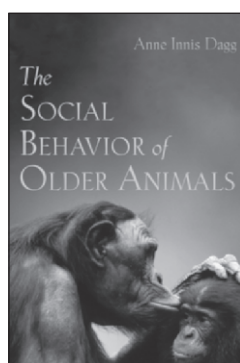
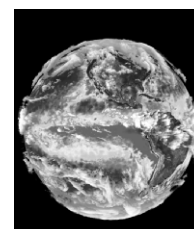
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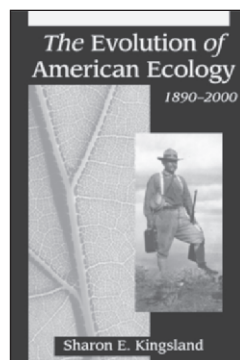
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