

So Long, It's Been Good to Know You

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So Long, It's Been Good to Know You

The Ecology and Behavior of Amphibians. Kentwood D. Wells. University of Chicago Press, Chicago, 2007. 1148 pp., illus. \$75.00 (ISBN 9780226893341 cloth).

Having recently encountered the absurd criterion of whether a book will fit in a backpack as the first cut in a judgment of its worth, with size inversely proportional to value, I am both personally and professionally pleased to note that this new book written by Kent Wells will not fit in an ordinary backpack. Nor for that matter will it accommodate the schemata of narrow minds, short attention spans, or least publishable units (more on this below).

This is a book about the diversity of amphibian life and the ecological and behavioral features that have made amphibians successful components of global terrestrial and freshwater aquatic ecosystems. There are more than 6000 extant species of amphibians, and nearly everything you need to know about these animals is included in this volume. Kentwood D. Wells, a professor in the Department of Ecology and Evolutionary Biology at the University of Connecticut, traces his book's pedigree back to G. K. Noble's *The Biology of the Amphibia* (1931) and through Duellman and Trueb's *Biology of Amphibians* (1986) and Heatwole's *Amphibian Biology* series (1999–present). To this list I would add Stebbins and Cohen's *A Natural History of Amphibians* (1995).

Throughout the book Wells emphasizes variation. He points out that because modern amphibians consist of families at least 50 million to 100 million years old, they are as divergent as horses are from opossums, bats, and anteaters. He challenges the “uncritical use of... animals as model organisms, based on the assumption that [amphibians] chosen mainly for their suitability [for the] laboratory... are representative of amphibians as a whole.” And where there are differences of opinion, out of con-

cern for fair play he recognizes all sides. Considering the evolutionary origin of amphibians, Wells writes: “We can only speculate about the selective pressures that led a group of fishes to emerge onto land.... Some authors have argued that the [selective force was] unexploited food resources in the emerging terrestrial communities and the absence of large predators.... Others have suggested [the requirement to leave low dissolved oxygen conditions in] warm, swampy environments.... Another theory is that... periodic drought favor[ed] the ability to leave drying pools to seek out other aquatic habitats” (p. 3).

Authors take heart: you may have thought not many people noticed that neat little paper you published in that midlevel journal, but Kent Wells did, and it's included in this book.

Where there are problems, such as with the paraphyly of the anuran (frog and toad) families Hylidae, Lepidodactylidae, and Ranidae, he acknowledges the situation, suggests patience, and offers direction: “these families eventually will be divided into smaller families that are monophyletic” (p. 15). When considering Wells's words, I'm reminded of the compliment that legendary biologist Ed Ricketts paid to W. K. Fisher about one of his biogeographic papers. Ricketts wrote that it was “the work of a man who has too much integrity to make things fit for convenience what won't fit in fact” (Rodger 2006). And when Wells writes about the new and “radically revised” phylogeny of amphibians recently proposed by Daryl Frost and colleagues (2006), he notes the value of this new thinking, but then adds, “It seemed neither possible nor desirable [at this late date] to incorporate these changes into

the book” (p. 2). We feel a little bad about this both for him and for us, because we want Kent Wells to be able to incorporate this new thinking, and we know that how he thinks about this issue will, to some extent, determine how we think about it.

Chapters are organized around biological themes, and Wells begins each with a quote, usually from a centuries-old source, that is quirky, naïve, or quaint, and often hostile. (My favorites include “These foul and loathsome animals,” “Amphibians are a defeated group,” “These hideous and disgusting reptiles,” and “Amphibia... remain slaves of their surroundings.”) These words make us smile but also give perspective on how far we've come in our understanding of “these fine beasts.” In each chapter, Wells provides a clear history of the topic, including citations of nearly all of the relevant literature. (Authors take heart: you may have thought not many people noticed that neat little paper you published in that midlevel journal, but Kent Wells did, and it's included in this book.) As mentioned above, Wells takes an even-handed, level-headed approach to nearly every topic considered, and in many cases suggests directions for future research.

Some chapters are books unto themselves. For example, chapter 1 begins with general characteristics of living amphibians. Wells then considers the origin and evolution of amphibians, morphological evolution, paedomorphosis, genome size, and the phylogeny and classification of anurans, urodeles (salamanders), and caecilians. Each of the phylogeny and classification sections includes lengthy synopses of each component family, followed by topics such as morphological evolution and ecology, habitat associations, body size, sensory systems, locomotion, body plans associated with burrowing, arboreal dwelling, gliding, and the evolution of lunglessness. The first chapter alone is worth the price of the book.

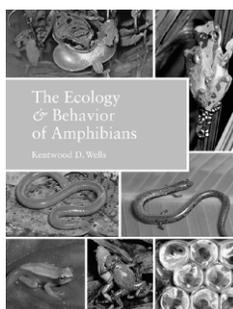
In the chapters addressing physiology, Wells pays attention to ecological and life history differences. For example, in addressing water relations (chapter 2), he regards ground-dwelling, arboreal, and burrowing species separately. When considering temperature relations (chapter 3), he addresses life-history stages separately and includes an extensive section on freeze tolerance. In the chapters on behaviors, he emphasizes species differences. For example, addressing movements and orientation (chapter 6), he presents separate, lengthy tables first on movement distances, then on home-range sizes for salamanders and anurans. Considering anuran vocal communication (chapter 7), he offers a text appropriate for a short course in neural systems and behavior.

The numerous photographs accompanying chapters on reproduction (chapter 10) and parental care (chapter 11) demonstrate differences in mating, egg-mass shape, nests, egg guarding, brood pouches, and egg and tadpole transport. The reader is left with a conscious impression of variation in these traits, and the data shown in the many tables and figures reinforce this understanding. The chapters on ecology and behavior of larvae (chapter 12) and complex life cycles and metamorphosis (chapter 13) continue Wells's emphasis on variation as he addresses the morphology, physiology, ecology, and behavior of larval life histories and their trajectories. Chapters on predators (14) and communities (15) reinforce the notion that amphibians occupy midlevel trophic positions in most ecosystems (i.e., one ecological role of amphibians is to transfer insect biomass into avian and mammal biomass—that is, these amphibians are meant to eat and be eaten).

Wells provides figures demonstrating mortality rates, survivorship, and longevity. His first table in chapter 14 is an internal reference to other sections in the book where predation is shown to influence specific behaviors or ecological factors. In chapter 15, Wells provides a conceptual framework for amphibian community studies that defines spatial scale, species composition, processes

that structure communities, and global and regional patterns. He then addresses communities of adult anurans, terrestrial salamanders, pond-dwelling salamanders, and tadpoles.

Because of how Wells sets up the first 15 chapters of his book—with theme and variations, and a stunning attention to species-specific detail—his last chapter (16) has something that almost no other argument for amphibian conservation has: the implicit notion that if a large percentage of amphibian species become extinct, what the earth loses forever are big chunks of the biology just described. In this chapter, all known causes of amphibian declines are addressed, and there is a large section on the relatively new phenomenon of chytridiomycosis and emerging infectious diseases.



So, the question everyone posits when they contemplate this book (and one that, as a neurobiologist, I naturally gravitate to) is: how can one person know all this stuff? The answer, of course, is they just do. To paraphrase Norman Maclean, there is something in them that's not in the rest of us. Ted Parker's brain knew 4000 species of Neotropical birds by their song alone; Al Gentry's brain could recognize 6000 species of Neotropical woody plants (one sixth of the world's woody plant species) on sight in the field. When Parker and Gentry were killed in a 1993 plane crash in Ecuador, these skills were gone and could not be replaced. (Perhaps by teams of people and technology, yes, but not at that time by individuals with the same aptitude.) Add to this list of exceptional biological talent the ability of Kent Wells's brain to synthesize literature.

Any book is a direct extension of its author. In *The Ecology and Behavior of Amphibians*, the University of Chicago Press notes in its description that Wells's book synthesizes 70 years of research on amphibian biology, and this is true. It is also true that "the reports of biologists are the measure, not of the science, but of the men themselves" (Steinbeck and Ricketts 1941, p. 73). As we contemplate the future and the growing challenges to the survival of amphibian diversity (and therefore to amphibian biology), let us not forget that while individual papers, or series of papers, give us our knowledge, it is uniquely talented people like Kent Wells, with that rare ability to fully assimilate large numbers of facts—measured, I guess, in clusters called backpack units—who give us, in their own inimitable way, our understanding.

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**NOT SO INNOCENT:
METHODOLOGY AND
METAPHYSICS OF EVOLUTION**

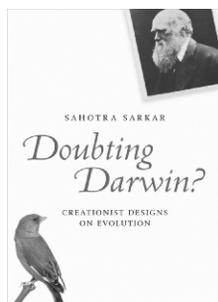
Doubting Darwin? Creationist Designs on Evolution. Sahotra Sarkar. Blackwell Publishing, Malden, MA, 2007. 232 pp., illus. \$64.95 (ISBN 9781405154901 cloth).

Sahotra Sarkar has set a difficult task for himself: to assess intelligent design (ID) creationism as a science without consideration of political motivations. What makes this task so difficult is that ID creationism is predominantly politically motivated, and it is just those motivations that explain, in large part, why ID creationism is such lousy science and lousy philosophy. Sarkar, a professor of philosophy and integrative biology at the University of Texas, is well suited for the job. Technically sound in both philosophy of science and evolutionary theory, he also appreciates the social responsibility of his position. Indeed, Sarkar cut his philosophical teeth visiting southern African refugee camps in the Frontline States in the early 1980s to lecture on and debate political and economic philosophy in the struggle against apartheid. He is not afraid to wade into a charged political atmosphere.

The power of the ID creationist arguments is not that they are convincing, coherent, or compelling; it is that they are presented with a veneer of complexity that is taken as a sign of authority—namely, scientific authority. Dismantling these arguments requires a certain level of technical proficiency, but it is not altogether effective. The risk of providing ID creationists with the cover of legitimacy is often greater than any payoff would be in confronting the arguments directly. It is, after all, legitimacy that they are typically after. Politically, it can be more valuable simply to air your ideas in debate without much regard as to how such debates play out. Nonetheless, exposing the absurdity of the seemingly technical ID creationist claims is a vital component

in the push back against creationism. For as much as what is at stake concerns a political or ideological debate, it must be underwritten by good science.

Sarkar accepts the ID creationist gambit for the sake of argument, taking seriously the claim that ID creationism should be considered *on scientific grounds* as a credible scientific alternative to evolutionary theory. He is even gracious enough to provide an argument for this where the ID creationists have not, by providing historical examples of cases where new theories replacing old ones entailed major shifts in our metaphysical assumptions (e.g., Newton's mechanics required acceptance of action-at-a-distance). Drawing on these examples, Sarkar identifies



criteria by which to judge such proposed adoptions and then proceeds to demonstrate why ID creationism fails badly by every measure. He includes a useful history of conceptual debates within evolutionary theory, culminating in a nice encapsulation of the modern framework of evolutionary theory and current controversies. This is coupled with technically sound dismantlings of ID creationist arguments concerning design, complexity, and information. My favorite chapter title makes for a nice rejoinder: “Complexity Is Complicated” (chapter 6).

Sarkar argues that the adoption of ID creationism would include the acceptance of a worldview that is radically different from our current scientific theories, namely, the rejection of methodological naturalism—the claim that scientific inquiry is limited to those facts accessible by naturalistic methods (i.e., through logic and our senses). A metaphysical strain of naturalism

beyond the epistemological claim asserts that the world *consists of* only what we can experience through naturalistic methods. A common line of argument

By demanding a broadly naturalistic methodological framework, Sarkar establishes criteria that ID creationism will not meet.

proffered by ID creationism critics is that these two lines of reasoning are independent; the former does not entail the latter. (Sarkar cites Michael Ruse as an example.) Sarkar rejects this characterization of metaphysical naturalism, instead agreeing with the 19th-century physicist and philosopher of science Pierre Duhem, believing that “science is never innocent of metaphysics.”

At first glance, it may seem that this characterization of naturalism plays right into ID creationist hands by acknowledging that accepting evolutionary theory does carry metaphysical weight. Yet Sarkar's characterization carries both greater and fewer commitments than many ID creationists and critics suppose. Yes, one must make certain metaphysical commitments in accepting methodological naturalism and evolutionary theory, but they are not as broad as those characterized by Ruse. We are merely to accept the metaphysics implicit in the theory: biological variation arises by chance, natural selection is lawlike in operation, design in nature is not teleological, and other general principles of physical science, including the principle that all such commitments are revisable in light of experience. These commitments are simply silent regarding what might exist beyond the scope of methodological naturalism; however, what is included (the natural) or excluded (the supernatural) from that scope is itself revisable.

Strategically, this defense of naturalism is very clever. By demanding a broadly naturalistic methodological framework, Sarkar establishes criteria that ID creationism will not meet. Satis-

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.

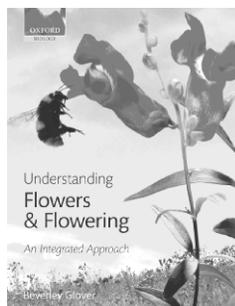
The second section encompasses the developmental genetics of flowering time and floral development from a relatively broad perspective, with some consideration of the evolution of these

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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NEW TITLES

Bears: A Brief History. Bernd Brunner. Trans. Lori Lantz. Yale University Press, New Haven, CT, 2007. 272 pp., illus. \$15.00 (ISBN 9780300143126 paper).

CO₂ Rising: The World’s Greatest Environmental Challenge. Tyler Volk. MIT Press, Cambridge, MA, 2008. 223 pp., illus. \$22.95 (ISBN 9780262220835 cloth).

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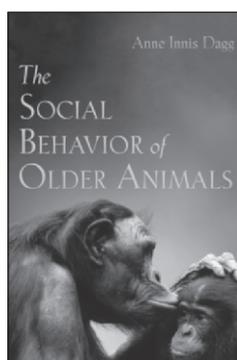
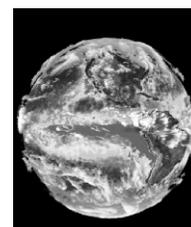
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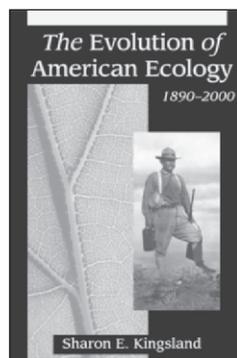
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