Agriculture's Ethical Horizon
Robert L. Zimdahl
Academic Press, Boston,
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Roughly 6.5 billion people inhabit the earth, but over 1 billion people regularly go hungry. This food shortfall poses an ethical dilemma for agriculture. On one hand, agriculture may be obligated ethically to increase production so that an additional billion people have adequate food. However, achieving such an increase with current agricultural practices has real potential to ravage the resource bases of soil, water, and clean air, and thereby jeopardize agriculture's ability to maintain even current production levels.

Agriculture's Ethical Horizon grapples with this dilemma. It argues that agricultural productivity has been the quintessential value of agriculture that has trumped other concerns such as sustainability, environmental preservation, and social justice (e.g., fair commodity prices, welfare of migrant farm laborers). Increasing world population demands greater productivity, but *Agriculture's Ethical Horizon* argues that the prevailing production ethic is insufficient to address the myriad issues that 21st-century agriculture faces. Modern practices bent on ever-greater production per acre have created externalities such as soil erosion, pesticide resistance, and groundwater depletion, with woefully inadequate attention about their long-term consequences. Social policies and economies of scale favor ever-larger farms, resulting in loss of family farms and dwindling of rural communities. A new, more encompassing ethic is needed to guide agriculture that places other values on par with production.

Agriculture's Ethical Horizon was written primarily for the agricultural science community, and it calls for agricultural scientists to actively question and re-shape values underlying modern production agriculture. *Agriculture's Ethical Horizon* is not primarily a philosophical text, but Zimdahl outfits readers for the discussion with an exploration of scientific and experiential truths, considerations of "is vs. ought" arguments behind agricultural research, and an introduction to ethical theories for non-philosophers (chapters 1, 2 and 4, respectively).

Having laid the philosophical groundwork, Zimdahl then tackles various issues in modern agriculture, such as approaches to weed control (parts of chapters 3, 6 and 7), sustainability (chapter 7, parts of chapter 9 and others), and biotechnology (chapter 8). It is especially difficult to stay current in the debate over a topic like biotechnology, but Zimdahl does a good job of framing the issues surrounding it up to 2006. *Agriculture's Ethical Horizon* intentionally omits issues relevant to agriculture such as animal ethics and livestock welfare, urbanization and loss of agricultural land, and farming for biofuels. Chapter 9's title of "How to Proceed" is misleading in that it largely continues to point out deficiencies in current production systems, rather than proposing concrete ways to advance the ethics of modern production agriculture.

One of the strengths of *Agriculture's Ethical Horizon* is that it encourages agricultural scientists not to focus solely on how they do science, but to think more about why. Zimdahl argues that most agricultural scientists genuinely try to avoid subjectivity and strive to find objective truth by confining their endeavors strictly to hypothesis testing. As agricultural ethicist Paul Thompson notes in the foreword, this is largely an outcome of the strong influences of positivism and philosopher Karl Popper's notion that science advances by falsification of hypotheses. Zimdahl argues cogently that scientists have consequently not adequately reflected upon values that drive decisions about what hypotheses in agricultural science are deemed worthy of testing and often do not give ample consideration to the implications of their science. *Agriculture's Ethical Horizon* urges agricultural scientists to look beyond strict hypothesis testing, recognize the role and importance of subjectivity in determining which hypotheses are tested, and engage in ethical debates about agriculture today. This discussion is facilitated by numerous citations of prominent scientists and ethicists in the current production debate.

Agriculture's Ethical Horizon often couples criticism of the prevailing production ethic in agriculture with criticism of the utilitarian philosophy that supposedly underlies it, but linkage between the two is not made clear and criticism of utilitarianism may be misplaced. In short, utilitarianism posits that the best outcome is the one that produces the greatest good for the greatest number of people. So, one could argue that an agricultural ethic that values productivity above other values fails to maximize good among people and resources and is actually a poor reflection of utilitarianism. The challenge to agriculture still lies in promoting an ethic that maximizes good, but utilitarianism might actually be a candidate to use as a guiding philosophy. Alternative ethical theories to utilitarianism could have received greater consideration in the book. But beyond an overview of some ethical theories in chapter 4, and an occasional reference to ecocentric ethics, the potential utility of alternative theories in building an improved agricultural ethic received hardly any discussion, and it would have been appropriate if *Agriculture's Ethical Horizon* had presented their pros and cons.

Another weakness of *Agriculture's Ethical Horizon* is its oversimplification in seemingly laying all the blame on production agriculture. In contrast, many argue that agriculture already produces enough food to feed the world, but food is not distributed equitably. Thus, irrespective of agricultural production considerations, there are economic and political dimensions to the larger issue of feeding the world that are not adequately acknowledged in the book. Moreover, while

agricultural scientists debate ethical and practical issues about how to best supply the world's food, there is also need to address the demand side of the food equation and perhaps the thorny problem of human population management. Although issues such as materialism, consumerism, and population growth may have been beyond the scope of *Agriculture's Ethical Horizon*, the book should have at least acknowledged their driving influence in the demand for greater agricultural production.

The book generally reads well, but editorial deficiencies and some redundancies are apparent. The text suffers from many punctuation errors (especially a lack of commas), and there are inconsistencies in the format of excerpted works. Sentences are often verbose and in passive voice, and the font is challengingly small. Some of these sentences repeat earlier statements in the paragraph, or in previous sections of the book.

Agriculture's Ethical Horizon is timely in kindling the debate about ethics, or perhaps its lack of consideration, in modern agricultural production. Readers will be stimulated to pick up the discussion where *Agriculture's Ethical Horizon* has left off, but they will need to fill in what it has left out of the debate.

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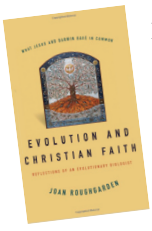
Evolution and Christian Faith: Reflections of an Evolutionary Biologist
Joan Roughgarden
Island Press, Washington
2006; 155 pgs
ISBN I-59726-098-3
Price: $15.95 (hardcover)



I admit that curiosity drove me to review a book on evolution and religious faith. After all, the book is subtitled "Reflections of an Evolutionary Biologist," albeit one with some rather unorthodox and almost universally rejected criticism of evolutionary theory (much of it directed at my own field of sexual selection). However, despite the warning signs (my e-search of science journals had turned up no reviews of this 2006 tome), I naïvely thought I might see a reasonable discussion of the science-religion interface, perhaps of the sort espoused by other evolutionary thinkers such as M. Ruse (2005) and especially S. J. Gould in his 1999 "non-overlap" argument that science and religion cover separate but distinct "magisteria." My interest was piqued on page 3, as I was about to "understand today's collision between science and Christian faith," but dismay set in with Chapter 2, when I was instructed to turn to *Genesis* in the Bible (King James Version) to seek out some biology. Roughgarden's chapters (11 aimed at Christians and one for evolutionary biologists) present a bizarre fusion of science and religion. The author actually gleans from *Genesis* that "from the beginning" God created genetic diversity. Then she argues that Jesus in the Gospels used natural selection and random mutation metaphors in his teaching. This is pure biblical literalism that belongs on the list of misguided conclusions arrived at by other literalists – e.g. our planet must be flat because the phrase "the ends of the Earth" is in the Bible (p. 30).

The purpose of this review is to warn biologists not to waste money or time on this weird mixture of research and revelation. The single chapter directed at researchers ("To Do List for Theorists") is a stream of consciousness with the awfully precise statement that current evolutionary biology is 10% incorrect. The chapter has some poor writing; as a case in point: "Many species, perhaps even most fall between the extremes where the individual is everything, like moths, to where the individual is nothing, like ants. Instead breeding in most species relies on a biological infrastructure provided by the animal's social system."

I should note that the book does have a few good bits. The chapters directed at Christians include a primer of basic evolutionary biology (from the 90% the author deems to be correct) and has an agreeable critique of ideas about Intelligent Design. The frustration that Roughgarden must feel when she reads yet another incarnation of intelligent design/creationism that ignores reasoned responses from scientists matches my frustration when reading yet another version of Roughgarden's rant that sexual selection is "the only part of Darwin's work that is . . . seriously incorrect" (p. 103). Originally proposed in her 2004 book, another lengthy discussion of the supposed weak science surrounding sexual selection emerged in Roughgarden (2007), and a less strident version (in a refereed journal) appears in Roughgarden et al. (2006). All of these published arguments are selective in their citations and have precious little in the way of reasonable response to her critics (some 50 of these are listed by Kavanagh (ed). 2006). Her views reveal a strong bias influenced by religious indoctrination and "personal trials." I will not respond here, save for one brief moan. My studies on insects with reversed sex (mating) roles (part of the literature ignored by her publications) have explained why sexual selection and sexual differences vary so greatly. To Roughgarden, however, the very existence of these reversals means that "sexual selection . . . doesn't square up with the facts" (p. 107). For the most recent response to this, in a well-reasoned and detailed critique of Roughgarden on sexual selection and gender/sexuality issues (including Joan Roughgarden's biases), I highly recommend Dickemann's (2008) review of Roughgarden (2004). In conclusion, biologists should avoid *Evolution and Christian Faith*. Even the one positive aspect—arguments against intelligent design—is better presented elsewhere and does not outweigh the inherent problems in this tract.

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The Bees of the World 2nd ed.
Michener, C. D.
2007, 992 pages
Johns Hopkins Univ. Press. Baltimore, MD
0-8018-8573-6
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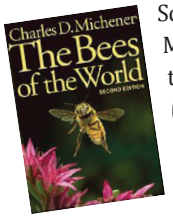

Scarcely seven years after Charles Michener published his first edition of *The Bees of the World* (2000) to great acclaim, garnering 5-star reviews in top scientific journals including *Nature* and *Science* and an R. R. Hawkins Award from the American Association of Publishers for the top scholarly reference work of the year, a second edition (2007) is on the shelves. In the first masterwork, Michener guaranteed that a single reference would contain all essential knowledge of bees (Apiformes), much of it accumulated over nearly seven decades of his own collected work and that of generations of bee students trained directly or indirectly under his tutelage at the University of Kansas. Within 913 pages, he summarized the existing knowledge of bee taxonomy, phylogeny, and classification, along with chapters that briefly summarized fossil bees, historical biogeography, nesting biology, floral relationships, and ideas about social evolution.

That only seven years have passed since the first edition is testament to the vigorous ongoing research on bees. The new edition is as beautifully produced as the first, contains all of the many original chapters (several slightly re-titled) and an additional 40 pages that include color plates of fossil bees and updates on new genera, subgenera, and species, summarized in an updated Table 16-1 in Chapter 16. There are 278 new references added to the literature citations. These updates exemplify how taxonomy is always changing, as it should in an active field, with the number of recognized genera increasing from 425 to 443 and the total described species increasing by 1,200 from 16,325 to 17,533. At this rate, everything else holding constant, it will take only 1,600 years for bees to catch up with the beetles!

The majority of the 121 chapters comprise keys to subfamilies, genera, and subgenera of each of the seven families, including valuable discussions of the biology and anatomy of each group. For experts interested in one or more of the seven families comprising Apiformes, look for revisionary changes in the Colletidae, including the addition of three new tribes in the Colletinae and loss (due to synonymy) of two tribes in Xeromelissinae. Andrenidae, particularly the subfamily Andreninae, has increased significantly (20%) with the addition of ~300 species. Of the two subfamilies of Halictidae, Halictinae has undergone considerable revision within the genus *Halictus*, with the construction of three new subgenera and a reduction from 88 to 36 recognized species in the subgenus *Seladonia*.

Through no fault of the author, it is unfortunate that at the time the new edition was being reworked, some comprehensive family level and tribal phylogenies were under construction. As a result, the higher classification of bees shown in Michener's Table 16-1 does not represent the current knowledge. For instance, a recently inferred phylogeny of bee families by Danforth et al. (2006) strongly supports the hypothesis that Melittidae comprises a paraphyletic basal assemblage of three lineages. The Danforth et al. phylogeny is included in Chap. 20 of the new edition (Family Level Phylogeny and the Proto-Bee) but Melittidae is nevertheless treated as a single family in his higher classification of bees. Among the corbiculate Apidae, a comprehensive molecular phylogeny of the tribe Bombini (genus *Bombus*) was published recently (Cameron et al. 2007) and from this, the classification of bumble bees was simplified (Williams et al. 2008) to recognize only 15 of the original 38 subgenera listed by Michener in Table 16-1. Narrowly missing inclusion of this simplified classification in the 2nd edition is somewhat of an irony because of all the taxa Michener considered grossly over-divided, it was the bumble bees. A molecular analysis of the corbiculate tribe Meliponini (stingless bees) was also published recently (Rasmussen and Cameron 2007; Michener cites this in an Addenda). This study and subsequent work revealed that the large genus *Trigona* is not monophyletic but instead comprises a polyphyletic group of two distantly related clades in the Old and New Worlds. As currently classified in Michener, however, *Trigona* is retained as a single broadly distributed genus. Ongoing phylogenetic research on all the families will undoubtedly lead to other significant changes in our understanding of bee relationships and evolution.

Another finding that narrowly missed the 2nd edition, although it made it into the Addenda, is the discovery of the exciting new Cretaceous age fossil, *Melittosphex burmensis* (Poinar and Danforth 2006), which links bees directly to the apoid wasps. *Melittosphex burmensis* (~100 mya) has characters of both bees and apoid wasps, but is considered an extinct bee or beelike lineage more closely related to the extant bees than is Crabronidae, considered up to that time the sister group (Poinar and Danforth 2006). The fossil therefore lends strong support to phylogenetic hypotheses that indicate bees arose as a monophyletic group from within the apoid wasps sometime during the mid-Cretaceous.

If one has the first edition, it will be an economic decision as to whether the new edition is worth the purchase. Libraries should definitely obtain an updated version. For those melittologists and pollination ecologists that do not have a copy, this new edition is a must-have. However, be warned that this is not a book that will assist the urban gardener to identify a bee to species from a photograph (one citizen scientist who purchased the book was unhappy about this) — the mass alone would discourage all but a weightlifter from hefting this volume around in the field. Please check your local field guides and state keys for species identification. The availability of such local references is crucial at a time when some of our local pollinators are disappearing or undergoing severe range reductions. Encouraging people to learn their local wild bee fauna (and flora) will help foster their survival and reproduction. In this regard, *The Bees of the World* plays an important role in educating individuals about the number and diversity of bees on this planet, distilling the knowledge of their biology and biodiversity into a single unified work. This alone is a great tribute to the author, who has spent most of a lifetime devoted to unveiling the mysteries of these flower-tending creatures.

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What Bugged the Dinosaurs: Insects, Disease, and Death in the Cretaceous
George Poinar, Jr. and Roberta Poinar.
Princeton University Press, Princeton, NJ
2008; 264 pp.
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Price $30 (hard cover)

Modern vertebrate populations aren't unique in being plagued by insects, parasites, and viruses. The discoveries by George and Roberta Poinar of developmental stages of protozoa and an "ancient malarial organism" preserved in the guts of insects fossilized in amber confirmed that these disease-causing organisms were also important components of paleoecosystems. These revelations are products of years of dedicated work and form the fundaments of the Poinars' argument in *What Bugged the Dinosaurs?*, a book that attempts to support a significant role for insects and diseases in the extinction of the non-avian dinosaurs at the boundary between the Cretaceous and Paleogene periods. This extinction hypothesis is thought-provoking, and the book contains fascinating photographs of amber fossils, but ultimately the authors' thesis is weakly supported.

Three amber localities [Lebanon (~130 Ma); Myanmar (~100 Ma); and Alberta, Canada (~75Ma)] provide the insect fossils that the authors use to build their argument. Largely omitted from the book are major Cretaceous deposits with abundant insect records, including Liaoning Province (limestone, China, ~130 Ma); New Jersey (amber, USA, ~100 Ma); and Santana (limestone, Brazil, ~100Ma). Given the importance of amber specimens for our knowledge of extinct arthropods and for the Poinar's thesis, a review of the process of amber fossilization would have been a welcome addition to the early chapters of the book.

The Poinars portray insects and dinosaurs in adversarial terms—dinosaurs "would have been locked in a life-or-death struggle with them for survival" (p. 5)—and they use this antagonistic relationship to develop the hypothesis that insects and the diseases they vectored were important causative agents for the mass extinction of dinosaurs. The authors develop their case by presenting evidence that Cretaceous invertebrates had three major negative impacts on dinosaur populations: as competitors for food plant resources, as parasites, and as vectors for disease.

Evidence for dinosaur-insect competition for food is presented in an extensive list of major Cretaceous plants and insect herbivores that may have been associated with them, as indicated by their presence in contemporaneous amber pieces. A more thorough review of dinosaur and insect co-occurrence in the fossil record would have added strength to this argument. The Poinars use seven chapters to address their numerous discoveries of parasitic arthropods and the disease-causing organisms they may have vectored to dinosaurs. These discoveries are vividly described and include interesting and easy-to-read biological accounts of their modern counterparts. For example, *Paleoleishmania*, the polyhedra associated with polyhedrosis viruses, was discovered in the guts of sandflies preserved in Burmese amber.

Unfortunately, the association of insect, plant, virus and dinosaur fossils does not provide compelling evidence for the extinction hypotheses laid out by the authors. While present-day insect populations also compete for food resources with herbivores, modern habitats, such as the Serengeti (Tanzania and Kenya), support high levels of invertebrate diversity *and* large numbers of herbivorous mammals. The authors argue that because blood cells found in the protozoan-infected sandflies are consistent with "reptilian" blood cells and the dominant "reptiles" at the time were dinosaurs, then the newly-discovered disease agents likely plagued the dinosaurs. They cite the work of Robert Desowitz, who "suggested that an epidemic of reptilian kala azar [a type of leishmaniasis] transmitted by sandflies could have caused the extinction of the dinosaurs" (p. 201) and they indicate that the identification of these protozoa provides the "smoking gun" that Desowitz lacked. It would be benighted to claim that dinosaurs did not suffer from such infectious diseases and parasites but, while the identification of these preserved pathogens is fascinating science, the associative reasoning presented by the Poinars falls short of providing a convincing causative agent for mass extinction.

The dinosaur information presented in "*What bugged the dinosaurs?*" is largely inaccurate. The taxonomy is particularly confused, with genera elevated to families (e.g. "dryosaurids," p. 29), incorrect common names used (e.g. "ceratopsids," p. 29), and nonexistent taxonomic entities (e.g. "coelurids," p. 31). Some of the ecological roles attributed to dinosaurs are also in error or based on outdated information. For example, the text makes references to now-debunked ideas, such as tail-dragging sauropods (p. 47), and gliding (but not flying) pterosaurs (p. 44).

Important concepts in dinosaur paleobiology are expounded in the book that are either unsupported (no references provided) or contradict existing research. Dinosaurs are characterized as "the ultimate K-strategists" (p. 191), yet they actually epitomize the opposite by laying large numbers of eggs, exhibiting fast growth to adulthood, retaining long life spans, and in some cases exhibiting extended parental care. Given that biting insects are essential to the book's hypothesis, the statement that "dinosaur skin was surprisingly thin and … very similar to that found on… Gila monsters" (p. 107) is particularly troubling. While illustrations of the *surface* of some dinosaur skin are shown, this critical point has no citations to support it and the fossilized skin of some dinosaurs has been shown to be quite thick.

After conceding that dinosaurian populations would have been weakened by environmental factors such as the Deccan Traps eruptions in India, lowering sea levels, and the impact at Chicxulub, the authors conclude that we "cannot discount the probability that diseases, especially those vectored by miniscule insects, played an important role in exterminating the dinosaurs," (p. 202) – a considerable diminution of their

Book Reviews (*continued on page 205*)