Environmental Philosophy: From Theory to Practice.

Author: Norton, Bryan G.

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University of Bath, objected respectfully that DNA itself encodes information but is also tangible.

The case studies are informative and generally well crafted. The innovations they discuss are clearly distinguishable, but many are also clearly complementary, making the discussions of the potential for misuse and the susceptibility to governance quite similar in multiple chapters. The contributors' modal judgment would suggest that these innovations could indeed be used maliciously. A terrorist group, however ambitious, would find the presented innovations far beyond its abilities without a cooperating or sponsoring state or corporation; more familiar devices would have to do, and—sad to say—they do plenty. An advanced state, or an otherwise backward state determined to advance in biological or chemical weaponry, might succeed over time.

Of the innovations reviewed in the book, several are exceptionally intriguing and worrisome. Combinatorial chemistry with HTS (chapter 5) ordinarily discards products excessively toxic to humans; laboratory warriors would save these very products for further development. Synthetic biology using standard parts (chapter 9), once called *BioBricks*, may allow the fabrication of useful or dreadful organisms, but useless or simply dead organisms would be its more typical creations. Immunological modulation of intended victims through gene insertions into pathogen genomes (chapter 12) has been an all-too-real prospect since late in the last century, and an analysis of this hazard still presents no critical control point more promising than professional honor—a decidedly nontechnical and extraregulatory global asset. Chemical microprocess devices (chapter 16), which channel fine streams of reagents into tiny precatalyzed reaction chambers and then convey products to the next reaction points or to terminal collection, are becoming standard in chemical industries, including pharmaceuticals and plastics. Large-scale production requires large numbers of these microprocess devices; small-scale production requires small numbers. A specific chemical, such as one used in chemical munitions, could be produced in useful quantities in a very small space and would not present to remote sensors any signature suggesting a chemical weapons plant or even a *chemical* plant.

Malice certainly is no prerequisite for reckless endangerment or even for misadventure. However, biosafety risks are not much discussed in the book. Environmental damage, intended or unintended, is likewise barely mentioned. In a lucid discussion of RNA interference, Matthew Metz notes that "a wide variety of invertebrates, fungi, and plants employ RNA interference as a mechanism for innate cellular immunity against viruses" (p. 210) but leaves these nonhuman life forms to their own devices as the discussion turns to "ethnic weapons" (p. 214), whose development would require a genocidal purpose in a consistently committed and scientifically adept sovereign government willing to waste a lot of money. Mark Wheelis, formerly a lecturer in biology at the University of California, Davis, is a contributor eminently qualified to assess microbial risks to agriculture, but here he has written a chapter about the use and misuse of LSD by the US Army and the Central Intelligence Agency (chapter 20). Jonathan D. Moreno, a professor of medical ethics and the history and sociology of science at the University of Pennsylvania, might have analyzed the motivations for misuse and professionalism's role as a misuse preventive, but he has written instead about transcranial magnetic stimulation (chapter 15), a purportedly therapeutic innovation that in clinical testing, barely—if ever—beats placebo and that owes its Food and Drug Administration approval more to advocacy than to evidence.

Innovation, Dual Use, and Security was brought to completion under extraordinary circumstances. Quibbles aside, it is stuffed with fascinating information interpreted by people who know their chosen subjects. It is well written, well edited, and even well copy edited. I have seen no better book on this subject.

ROBERT HUNT SPRINKLE
Robert Hunt Sprinkle (sprinkle@umd.edu) is associate professor of public policy in the School of Public Policy at the University of Maryland, in College Park.

ENVIRONMENTAL PHILOSOPHY: A FRESH PERSPECTIVE

Environmental Philosophy: From Theory to Practice. Sahotra Sarkar. Wiley-Blackwell, 2012. 224 pp., illus. $34.95 (ISBN 9780470671825 paper).

My opinion of the academic field in which I work is that it was accidentally named *environmental ethics* rather than *environmental philosophy*. I came to this field from the philosophy of science and epistemology, rather than from an ethics background, but I have never had a problem maintaining a dialogue with environmental ethicists, because most of them engage with empirical science—especially ecology. I have never found a shortage of issues and principles to discuss and argue with them. The difference in labels has never seemed intellectually important to me. Furthermore, I know of few books with *environmental philosophy* in the title, whereas my shelf of books on environmental ethics, after several expansions, has spilled out into piles on my floor. I have been jogged out of my complacency, however, by a new book—*Environmental Philosophy: From Theory to Practice.*

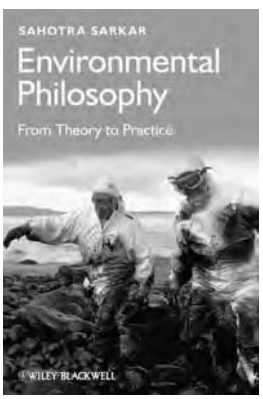
From the specific topics covered to the overall perspective taken, Sahotra Sarkar's book is startling to me—as I expect it will be for others with at least a passing interest in environmental ethics and environmental values. In some subject areas, the overlap with environmental ethics is obvious, as in "Ethics for the environment" (chapter 3) and "From ethics

to policy" (chapter 4). But even in these chapters, Sarkar's approach differs from most work in environmental ethics by embedding sections such as "Natural value" and "Intrinsic value" in a broader purpose of developing a philosophy of conservation biology. He discusses these topics, well worn in environmental ethics, as a practitioner who is looking for tools with which to solve real-world conservation problems. Although he examines the arguments for attributing intrinsic value to natural objects, he is as interested in assessing the usefulness of a theory when applied to conservation action as he is in determining the truth within the theoretical claims of environmental ethicists. Sarkar's fieldwork with scientists and conservation activists (he participates in the application of algorithms for choosing land reserves at the lowest cost, both in dollars and in terms of ecosystem disturbance) provides him with a rich foundation on which to evaluate ethical concepts as tools for practitioners.

This practical perspective serves to focus Sarkar's attention more narrowly on species and higher taxa when he discusses intrinsic value in nature. Whereas most environmental ethicists focus on a general question ("Do any nonhuman entities have intrinsic value?") Sarkar focuses on only those categories that "are central to biodiversity" (p. 47). Because he writes from the perspective of a practitioner as well as that of a philosopher of biology, he focuses on the units of nature that conservation biologists actually try to protect. He discusses the hypothesis that species in particular might have intrinsic value, evaluating it for practical value in building support for the goals and activities of actual conservationists. He concludes, "Intrinsic value arguments did not get us as far as we may have hoped toward a satisfactory environmental ethic, at least if the latter is to include an ethic for biodiversity conservation" (p. 55).

Sarkar also corrects a widespread misapprehension that anthropocentrists cannot believe in "noninstrumental" values in nature or find them appealing. He cites the idea of the *transformational power* of experiences with wilderness: "Attempts to attribute intrinsic value to rocks, mountains, rivers, etc., may be no more than attempts to recognize their transformative power beyond demand values…" (p. 59).

Once Sarkar moves past his discussion of values to emphasize the philosophical questions and problems that confront conservation biologists in the field (especially in their communication with other disciplines and with the public and policymakers), his work diverges even further from typical treatments of environmental ethics. Sarkar recognizes that some of the most important and difficult philosophical problems related to environmental protection are conceptual (What do we mean by key terms like *biodiversity*?) and epistemological (How can we prescribe actions to preserve biodiversity, given that the term can be defined using only proxy variables?).



In *Environmental Philosophy*, as in his other publications, Sarkar speaks as an advocate for systematic conservation planning (SCP), and he surveys key concepts necessary to support better decisionmaking regarding the choice of which areas to protect. This approach, which originated in Australia, has been used successfully in other countries, including South Africa. Employing a broadly adaptive approach to management, he describes SCP as providing algorithms for the design of *conservation area networks*, "which are sets of areas protected for management for biological conservation" (p. 99). SCP pursues three goals: The first—representation—involves protection of those units of biodiversity included in the accepted definition of the term; the second—persistence—relates to an assurance of the likelihood that those units continue into the future; and the third—economy—implies that the protection of biodiversity will be achieved through means that are comparatively inexpensive in costs and in the area of land required.

Including economy as a goal and a constraint is, of course, a very practical approach to conservation decisionmaking but is not usually taken by those with a philosophical interest. However, Sarkar demonstrates the utility of a key concept called *complementarity* by applying it as an alternative to richness (i.e., species count) and using it as a measure of biodiversity. In making choices based on complementarity, one evaluates various plans to add protected areas according to how much each new area contributes to the protection of previously unprotected elements. These judgments are embodied in an algorithm that ranks these conservation area networks according to their ability to protect more of the conservation-targeted elements of biodiversity.

Seeking concepts that are both epistemologically effective and ethically reasonable, Sarkar discusses the ideas of biodiversity and conservation in chapter 5, recognizing that these terms convey a certain level of protection. He continues with his promise to clarify concepts in subsequent chapters. In chapter 7, "Sustainability," Sarkar first cautions about how we define this term and goes on to argue that *weak sustainability*, which he equates with economic sustainability, fails to provide sufficiently robust goals for a protective environmental policy. He then contrasts this with

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strong sustainability (i.e., specifying what should be protected in nature) and variations thereof, through which he accepts economic sustainability as necessary but supplements it with independent criteria articulated outside the sustainability framework. He also cites ecological resilience as an independent conservation principle, but this has been embraced by most strong-sustainability theorists as a noneconomic aspect of sustainability.

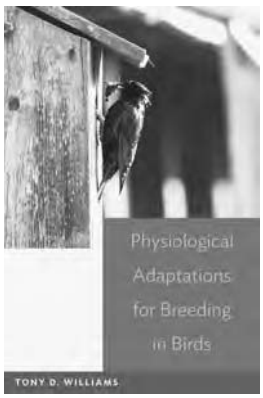
In chapter 8 ("Justice and equity"), the discussion is strongly weighted toward concerns that environmental problems, and even environmental solutions, may fall heavily on the most vulnerable parties affected. The topics in this chapter include responsibility for climate change, environmental racism, social and political ecology, and ecofeminism. Sarkar asks, "Where does this leave us?" in a short, final chapter and closes with a "take-home message for environmental activists that the future they envision can only be achieved if natural values are embedded into the cultural fabric of a region" (p. 199).

BRYAN G. NORTON
Bryan G. Norton (bnorton@gatech.edu) is a distinguished professor in the School of Public Policy at the Georgia Institute of Technology in Atlanta. He is the author of Sustainability: A Philosophy of Adaptive Ecosystem Management *(University of Chicago Press).*

WHAT DO WE REALLY KNOW ABOUT AVIAN REPRODUCTION?

Physiological Adaptations for Breeding in Birds. Tony D. Williams. Princeton University Press, 2012. 368 pp., illus. $69.50 (ISBN 9780691139821 cloth).

The title *Physiological Adaptations for Breeding in Birds* will prompt readers with a background in ecology and evolution to recall David Lack's highly influential 1968 book *Ecological Adaptations for Breeding in Birds*, in which he provided many of the theoretical foundations for modern evolutionary ecology. Lack's focus on the ecological and environmental factors influencing the numbers of chicks raised by free-living birds deliberately excluded any considerations of physiological adaptations. In this new book, Tony D. Williams, professor of biological sciences at Simon Fraser University, examines how more recent knowledge of physiological and energetic mechanisms can be applied to the fundamental questions that Lack raised almost 50 years ago to explain individual phenotypic variation in reproductive life-history traits.



Physiological Adaptations reflects the recent awareness of a need for avian reproduction research to become more integrative and multidisciplinary. Historically, evolutionary and ecological approaches have tended to lack consideration of mechanistic constraints. However, physiological approaches have generally not taken into account how the evolutionary selection of mechanisms interacts with the environment to influence lifetime reproductive success. Williams has been a pioneer of integrating physiology with ecology and evolution in the study of avian reproduction. With his education in the United Kingdom and graduate work on the endocrine mechanisms underlying avian seasonal breeding, Williams undertook postgraduate work in the South Atlantic, with the British Antarctic Survey, during which he developed an interest in the ecological and behavioral aspects of penguin biology. His research in Canada is now focused on egg formation and laying in birds. Williams played an influential role in the international E-BIRD network (not to be confused with the similarly named eBird program), which ran between 2004 and 2008, with the aim of bringing ecologists and endocrinologists together to stimulate collaborative work. As he acknowledges, this project provided an important intellectual stimulus for writing the book.

The evolutionary emphasis of *Physiological Adaptations* is apparent in the organization of its chapters into the key reproductive life-history traits of the timing of breeding, egg size and quality, clutch size, incubation, and parental care. A further chapter considers the tradeoffs and carryover effects of reproduction on other life-history stages. Williams uses a consistent structure within each chapter, considering for each trait the extent of its variation in an evolutionary context before addressing the physiological and energetic mechanisms that may contribute to that variation. He places an emphasis on female reproduction, arguing that the life-history traits having the greatest influence on lifetime reproductive success are ultimately determined by a female's decision on when to lay her eggs and how much to invest in them. For this reason, a primer is given in an early chapter on the physiological control of egg production.

The tandem focus on both the physiology underlying individual trait variation and the physiology of female reproduction is a continuous narrative throughout the book. A consequence, however, is that *Physiological Adaptations* does not provide a comprehensive treatment of avian reproduction. Readers would need to look elsewhere for an overview of male reproductive physiology equivalent to the one Williams gives for females. He also offers limited coverage of social

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