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Dissecting Ghosts?

Soul Made Flesh: The Discovery of the Brain—and How It Changed the World. Carl Zimmer. Free Press, New York, 2004. 384 pp., illus. $26.00 (ISBN 0743230388 cloth).

The end of the world is imminent, spiraling out of control to unavoidable disaster. Loudest are the radical fundamentalists, intolerant, bigoted, deaf to all arguments beyond their narrow ken. It is a time of profound anti-intellectualism, yet, paradoxically, science is in a ferment of creativity. Long-cherished ideas are thrown on furious pyres, leaving worthless ashes to be trampled by careless crowds or blown by meaningless winds. Philosophers no longer discuss abstract precepts in cloistered calm, but engage with the world, questioning every principle, ripping up every foundation. Even the Academy is not immune; the cry goes up to reform radically, once and for all, the ancient universities.

I could, of course, be speaking of today. In fact I am referring to 17th-century England, a country tumbling from the autocracy of the Tudors to the prevarication of the Stuarts, with an interregnum that began with the beheading of a brave but foolish king and ended with the posthumous decapitation of a brave but failed tyrant. The scene of *Soul Made Flesh* is principally Oxford, and from its shadows of ancient colleges and modern slums step forth both familiar men, notably Christopher Wren, Robert Boyle and William Harvey, and those now poorly remembered, especially Thomas Willis. This was a time of turmoil, of uncertain prospects, when political stars plunged—sometimes to the executioner's block—or soared to heights of aristocratic excess. The defining years of the English Civil Wars might have resembled a bad-tempered picnic compared with the savagery of the religious wars on the adjacent European mainland, but for England they were the single greatest disaster since the annihilation of the Saxon kingdom 600 years earlier. Add disease, culminating in the Great Plague of 1665, and a ferocious criminal system, not to mention a millenniarian spirit of religious zealotry, and one goes some way toward appreciating the backdrop of Carl Zimmer's engrossing account of how mechanism replaced spirit, and how the soul was finally banished to the stuff of dreams, or at least so it appears.

Zimmer's book has many virtues, unsurprisingly given the author's established reputation as a science writer. The first virtue is that *Soul Made Flesh* is a wonderful read. Carrying the narrative at a brisk pace, it avoids the tendentious word-spinning of much science writing, where the reader is either left gasping for intellectual oxygen or peering through a fog of verbiage. A second virtue is a sympathy for the time in question and the people caught up in a historical process of which they could have little inkling as to its destination. If only that perspective were more common. So too Zimmer is adept at bringing together the luminaries and other actors of the time: Hobbes on his recalcitrant horse, Wren deftly vivisecting a dog, and Anne Greene mysteriously returning to life after hanging. (Readers of Iain Pears's fine novel *An*

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Instance of the Fingerpost [Penguin, 1999] will be interested to compare the two books' portrayal of an Oxford far removed from its ongoing Disneyfication and the revival—or was it resurrection?—of the hanged Greene [renamed Sarah Blundy by Pears].)

Zimmer's book has, however, a very definite purpose: It aims to add one more rung to the ladder that, or so it is widely thought, lifts humanity from the miasmic lowlands of superstition and credulity to the shining uplands of rationality. It is a ladder that defines the Enlightenment, but it has the doom of disenchantment, draining the world not only of magic but also of meaning. From our privileged perspective, the path away from the dictates of Galen and Aristotle, and toward the identification of the brain as the seat of mentality, was painfully crooked as investigators heeded the siren calls of Paracelsus and van Helmont, with their empathetic world of alchemy and mysterious forces that were more easily conjured in cabbalistic scribbling than in the retorts and furnaces of their early laboratories. But the result seems inevitable. In essence, the material world was victorious, hinging on the emergence of a mechanistic paradigm. Spurred on by the materialist manifestos of Hobbes, the Oxford scientists approached the human frame with metaphorical screwdrivers and wrenches. As the levers, pistons, and pumps of the body were identified, so the soul evaporated. To Hobbes, there could be no alternative, and he it was who helped prise open the doors to our modern world (and all its attendant horrors). Perhaps, however, we should remember how Boyle insisted that to understand matter gave no explanation of how "the fabric of the Universe" came to be as it is, what determines its utter contingency. Yet, as Zimmer notes, Boyle was worried. If the deepest secrets of the world were revealed, where might the whole process end?

Despite Zimmer's empathy with the denizens of the 17th century, it is clear where his sympathies lie. The alchemist Paracelsus was wrong, but Boyle's notion that "experiments could reveal some of God's language" (p. 135) appealed to another forlorn hope. Zimmer's account is also triumphalist as he catapults the reader from the mire of 17th-century England to the clinical austerity of the modern laboratory, where powerful magnets and computers combine to reveal the brain's cartography, where mind is revealed in (and reduced to) flashing lights. Observing, however, is not necessarily equivalent to understanding. To know that one part of my brain "lights up" when I think of a stiff gin-and-tonic, and another when I write this review, is certainly fascinating. But are we any closer to understanding what makes us sentient?

Zimmer observes that when the hanged Greene returned to life, by whatever route, she began again her gallows-side speech, but otherwise all memory of her terrible ordeal had fled. To say on this basis that memory is mechanical surely misses the point. Think of those memories that surface after decades of absence, returning with an eerie vividness.

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The simple fact is that we are still as far as ever from understanding how the mush of neurons actually creates and recalls our reality. Even when all parts of the brain are mapped to the *n*th degree, there is no prospect in sight that mind itself will emerge from the neural shadows. The question is simply different.

So too with the apparently nebulous soul. To talk of banishing it really misses the point, because it presupposes a medieval outlook that was never worth defending. As the philosopher Stephen Clark reminds us, the classic parody of medieval thought, about how many angels can dance on the head of a pin, is answered, "Just as many as they please." Angels, just in case you had forgotten, are, as Clark writes, "immaterial intellects [that] do not occupy space to the exclusion of any such intellectual substance." In an analogous way, the same applies to the brain and the soul. The former remains concrete but deeply mysterious, the latter elusive but deeply familiar.

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COMPLEXITY, LIKE BEAUTY, MAY LIE IN THE EYE OF THE BEHOLDER

Animal Social Complexity: Intelligence, Culture, and Individualized Societies. Frans B. M. de Waal and Peter L. Tyack, eds. Harvard University Press, Cambridge, MA, 2003. 640 pp., illus. $49.95 (ISBN 0674009290 cloth).

This multiauthored volume is derived from a "two-tiered" conference that took place in Chicago in August 2000. Part of the conference was concerned with social complexity and intelligence in animals, and part was a "celebration of 40 years of research by Jane Goodall and her group at Gombe." The resulting symposium volume has all the strengths and weaknesses common to the genre. On the one hand, it is stronger than some symposium collections both in the excellence of its contributors and in the intrinsic interest of the material discussed. On the other hand, it includes little in the way of new theory, and the loosely defined themes that serve to organize the volume result in breadth rather than depth of coverage of most issues.

The stated goal of the editors, Frans B. M. de Waal and Peter L. Tyack, in bringing together this diverse collection of essays is to explore some of the many forms of social and behavioral complexity in animals. De Waal is director of the Living Links Center at the Yerkes National Primate Research Center and Charles Howard Candler Professor of Primate Behavior in the Department of Psychology at Emory University; he is the author of several highly visible books on primate social behavior. Tyack is senior scientist and Walter A. and Hope Noyes Smith Chair in the Biology Department of the Woods Hole Oceanographic Institute and an expert on dolphin communications. Together they bring a formidable expertise to the symposium volume they have edited.

The book is divided into five sections, each with a brief introduction provided by one of the editors: "Life History and Brain Evolution," "Evolution of Cooperative Strategies," "Social Cognition," "Communication," and "Cultural Transmission." An interesting and largely successful idea is the inclusion of 11 brief "case studies," written mostly by relatively junior investigators, that complement the 18 lengthier reviews provided by more senior authors.

The chapters themselves provide readable, concise summaries of important, though familiar, research on the social behavior of mammals, including hyenas (Drea and Frank), elephants (Payne), and dolphins (Wells, Tyack), and on the traditions and culture of chimpanzees (Boesch, Matsuzawa, Nishida, McGrew), cetaceans (Whitehead), and cowbirds (West et al.). There are also chapters on social knowledge and communication in primates (Seyfarth and Cheney, de Waal), cetaceans (Schusterman et al.), parrots (Bradbury), and bats (Wilkinson). Chapters by Creel and Sands on the relative social stress experienced by subordinate and dominant animals and by van Hooff and Preuschoft on the evolution of laughter and smiling, however, seem somewhat out of place.

Animal Social Complexity is largely concerned with primates and carnivores. However, it includes material on a few less charismatic and less cognitively sophisticated creatures that also live in social groups whose members respond to one another as individuals. This comparative material provides a forceful reminder that life in societies, even societies in which individuals are recognized and responded to differently, and the emergence of traditions in animals may not require particularly complex cognitive processes. Indeed, a surprise to me, given the book's subtitle, was the general lack of support provided by the authors for the "Machiavellian intelligence" hypothesis (Byrne and Whiten 1988), which suggests that the evolution of higher cognitive abilities has been driven by the need for animals living in social groups to compete, cooperate, deceive, and so on.

In the book's opening chapter, van Schaik and Deaner provide comparative analyses of potential correlates of brain size and find that, across mammalian orders other than bats, a slow life history rather than a complex social life predicts increased encephalization. Wilkinson's analysis later in the book suggests that in bats, the outliers in van Schaik and Deaner's broader analysis, group stability is more important than colony size, mating behavior, or echolocation in shaping neocortical volume. Three excellent contributions on spotted hyenas provide ample evidence that a social life comparable in complexity to that of many primates is possible without primate levels of encephalization. These discussions of hyena social life also provide an interesting counterpoint to de Waal's insistence on the "exquisite" social knowledge and "remarkable social complexity of primates" (p. 237).

In their brief general introduction to the volume, the editors suggest that social complexity, intelligence, and culture are somehow interrelated, though they acknowledge that all three terms are dif-

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ficult to define and that correlations among them remain obscure. As Seyfarth and Cheney discuss briefly in introducing their chapter on the structure of social knowledge in monkeys, "the same bit of behavior can be explained equally well in many different ways—some cognitively complex, others less so" (p. 208). Or, as Engh and Holekamp put the matter in discussing the relative intelligence of hyenas and cercopithecine monkeys, "although coordinated hunting behaviors in hyenas and other carnivores appear to require complex mental processes, these behaviors can be explained more easily with a few simple rules of thumb" (p. 152). The contrast with Boesch's description of a chimpanzee hunting red colobus monkeys—the chimpanzee "not only anticipated the action of the prey, but also the effect the action of other chimpanzees would have on future movements of the colobus" (p. 101)—is striking. The implicit tension between simple and complex explanations of behavior is apparent throughout the book and serves as a reminder that relatively rich or lean styles of explanation may offer as much insight into an author's cognitive style as into the minds of the animals whose behavior is being discussed. Whatever your own preferred approach, you will find both congenial and irritating contributions in de Waal and Tyack's volume.

The section on cultural transmission is perhaps the most strongly biased toward rich interpretations of data, with four of five chapters considering, to a greater or lesser extent, the largely semantic and anthropocentric issue of whether chimpanzees or whales should be considered bearers of culture. Only one chapter in the section is devoted to analyses of behavioral processes supporting the social transmission of behavior and traditions in animals.

Evidence of differences in the behavioral repertoires of chimpanzees living in different areas in Africa is surely convincing, and Nishida's chapter adds to the catalogue. However, we still know almost nothing about how such differences in behavior develop in natural circumstances. The field experiments that Matsuzawa describes suggest that appropriate developmental studies may be possible in the wild, and the chapter by West and colleagues describes the type of analysis of traditions in birds that may, in time, become available for primate traditions. Once such research is under way, we can look forward to less concern with semantic issues in the "culture wars" that McGrew discusses in a chapter that is both erudite and amusing.

Some 40 years ago, when I was a graduate student, my classmates and I took it for granted that the more intrinsically interesting the animal, the less interesting the available data. The contributors to *Animal Social Complexity* make clear that we have come a long way in intervening decades. Extended field studies of chimpanzees, dolphins, elephants, and hyenas (and of other primates, cetaceans, and large carnivores, both social and solitary) have provided a wealth of descriptive data and the beginnings of an understanding of how these enthralling animals function in a complex and challenging social world. However, considerably more progress seems to have been made in describing and analyzing social complexity than in understanding the cognitive processes underlying social life. This may be because long-term, systematic observation of the behavior of members of a social group can result in much progress in understanding social life, whereas observation alone seldom provides equally convincing insight into cognitive processes.

Animal Social Complexity provides readable, concise reviews of a wealth of material concerning animals living in individualized societies. At the same time, the collection makes evident the challenges still to be overcome in developing a full understanding of the relationships (if any) between life in complex social groups, the evolution of intelligence, and the emergence of culture. Professionals will probably want to look at

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more extended treatments of the many issues addressed in *Animal Social Complexity* rather than these relatively brief, data-free presentations, concise and readable though many may be. The volume could, however, serve as a useful starting point for a senior undergraduate or graduate seminar, providing useful introductions to relevant literature that students could consult in preparing oral or written presentations.

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Reference cited

Byrne R, Whiten A, eds. 1988. Machiavellian Intelligence: Social Expertise and the Evolution of Intellect in Monkeys, Apes, and Humans. Oxford (United Kingdom): Clarendon Press.

NOURISHING HUMANS WITHOUT DIMINISHING NATURE

World Agriculture and the Environment: A Commodity-by-Commodity Guide to Impacts and Practices. Jason Clay. Island Press, Washington, DC, 2004. 568 pp., illus. $35.00 (ISBN 1559633700 paper).

Jason Clay, vice president of World Wildlife Fund's Center for Conservation Innovation and one of the first purveyors of "green marketing," brings to *World Agriculture and the Environment* decades of agricultural experience, beginning with working the family farm in Missouri. He has synthesized into this accessible reader an impressive volume of facts, figures, and trends on the state of world agriculture and its myriad environmental impacts.

Unlike the reams of statistics aggregated in national or United Nations Food and Agriculture Organization reports, the numbers for each of the 21 commodities covered in Clay's work are woven into a narrative that captures significant patterns. Two trenchant chapters cover "agricultural trends and realities" and "agriculture and the environment." These are followed by chapters on separate commodities, each of which begins with a map of the geographical areas of production; "fast facts" on production and international trade; the key countries that produce, export, and import the commodity; and a summary of major environmental impacts and the potential for improvement. Clay examines in some detail the main threats that each commodity poses to the environment and the overall global trends that shape these threats. He also presents a detailed discussion of best management practices (BMPs), both tried-and-true ones and new approaches, that could boost production while minimizing ecological losses.

The book can be read from multiple perspectives. For example, Clay examines eight categories of threats and impacts—habitat conversion, invasive species, agrochemicals, soil erosion, wastes, water, fire, and greenhouse gas (GHG) emissions; he then presents innovative policy recommendations—some market based, some that operate through regulatory enforcement—for addressing them.

Habitat conversion, especially of intact ecosystems with globally significant biodiversity, is covered quite well. Several striking insights run through many of the commodity assessments:

- Habitat conversion can occur regardless of whether the commodity price increases, decreases, or remains stagnant.
- A commodity's scale of production in terms of hectares under cultivation may not always be the most meaningful indicator of biodiversity threat and impact.
- Advances in biotechnology (both classical and transgenic) continue to overcome one agricultural constraint after another, enabling expansion of production into habitats previously inhibited by some limiting factor.
- Agricultural subsidies promote habitat conversion. Ironically, though, the reduction of the Organization for Economic Cooperation and Development's domestic manipulation of consumer prices and of its provision of producer subsidies (which totaled over $300 billion in 2001) could also accelerate conversion of some of the planet's most biologically rich habitats in developing countries. (Such conversion can be avoided, however, by the use of mechanisms I discuss below.)

All of these factors combine with other trends to pose ever-present threats that lead to broadscale fragmentation, degradation, and destruction of intact ecosystems. These other trends include an annual increase in human population great enough to people Mexico; as incomes rise, growth in the percentage of protein derived from animals, a shift that demands even more agricultural land; conversion of natural resources in developing countries to alleviate mass poverty and foster economic expansion; a rising rate of consumption of land-based commodities globally; and a steady decline in the quality and productivity of soils.

Clay's most important BMP and policy recommendations to combat such threats concern land zoning: Areas of high biodiversity and habitats important for maintenance of ecosystem services should be set aside, he maintains. Not only does such zoning need to be done at the landscape or ecosystem level, he says, but it is essential to identify minimal-size, viable forest fragments of biological significance within commodity operations.

"Farming with nature," an idea long ignored by large-scale, high-input monoculture systems, is attracting greater attention. The concept ranges from connecting fragmented patches into ecological corridors for sustaining viable populations of endangered species (e.g., Sumatran rhinoceroses in unplanted areas of oil palm plantations) to using multicrop systems with ecologically based

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pest-management strategies (e.g., shade-grown coffee and cocoa).

Regenerating degraded and abandoned lands is another critical recommendation for slowing deforestation, which averaged 15 million hectares per annum over the past decade. One-fourth of the world's agricultural land area is degraded, much of it capable of being revitalized for production. Brazil offers a case in point. Sixty million hectares are currently under production in that country, with another million hectares of forests being converted into agricultural lands each year. Meanwhile, 80 million hectares of land lie abandoned or degraded. Yet degraded pasture can be converted into productive soybean–corn–cotton rotations within six years using no-till practices that augment the soil's organic matter. The degraded land is valued at $500 or less per hectare, while land for soybeans is worth $2000 per hectare. Reclaiming degraded land can boost producer assets by up to $300 per hectare per annum over the six years it takes for regeneration, increasing the value of the degraded land *more* than the net value of the soybeans or other crops produced on it.

As Clay notes, "if even 15 percent could be reclaimed for agricultural use, Brazil's current rate of agricultural expansion could be sustained for twenty years without needing to clear a single hectare of natural habitat. If productivity is increased on each hectare, then the rate of expansion of cultivated land could be slowed even more and total production would still increase."

World agriculture is responsible for a sizable fraction of GHG emissions, the major constituent of which is carbon dioxide (CO_2). Clay identifies climate mitigation projects for protecting and restoring land carbon as potential sources of income to fund many of the BMPs and land zoning policies. According to the Intergovernmental Panel on Climate Change, the equivalent of 360 billion tons of CO_2 could be captured in the next five decades through prevention of deforestation, restoration of fragmented landscapes, and agricultural and forestry sequestration. Although this amount is only 10 percent of the total reduction in GHG emissions that may be needed this century to stabilize atmospheric concentrations, it represents a potential income of many hundreds of billions of dollars for these climate mitigation services, which could simultaneously bring biodiversity benefits and help transform impoverished rural communities into ones with sustainable livelihoods. For example, Brazilian scientists have proposed a national cap on Amazonian tropical deforestation, which averaged 2 million hectares per year over the past decade. If the national loss were then further reduced, say, 10 percent below the cap, or 200,000 hectares per year, this would prevent the release of more than 50 million tons of CO_2. These saved tons could then be sold to countries and corporations that need to reduce their CO_2 emissions, accruing revenues in excess of $150 million per year (at current low prices of $3 per ton of CO_2).

Storing carbon is but one among several environmental services that, Clay argues, provide important societal benefits and economic value. Others are maintaining watershed quality and quantity, protecting biodiversity, and preventing soil erosion. Payments to farmers to help sustain and restore these services, Clay says, are justifiable.

Is it reasonable to think that in times of shrinking government budgets and rising national debts such new funds will be forthcoming? Clay answers affirmatively, proposing that some of the hundreds of billions of dollars per year of production, export, input, credit, and infrastructure subsidies be shifted into paying for environmental services "beneficial to all members of society, both for this generation as well as for future ones." The rest of the subsidies and other market barriers should then be phased out.



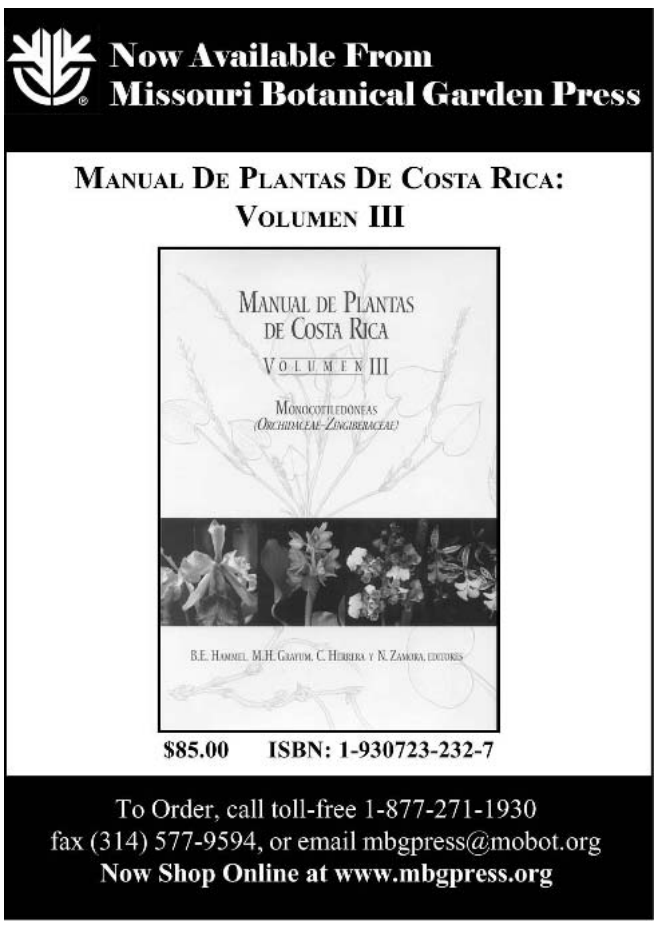
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Clay acknowledges that the political clout of producers and the legitimate need of society to ensure adequate food and fiber supplies pose formidable barriers to eliminating subsidies in the near term. Such inertia, however, is being challenged by a worldwide counter-trend to remove market-distorting policies.

A large part of *World Agriculture and the Environment* focuses on BMPs that improve farm operations, reduce ecological impacts, and increase biodiversity benefits, thereby achieving monetary savings and productivity gains. Clay makes three key recommendations: (1) Promote socially responsible and equity-based BMPs (e.g., worker incentive programs, employee stock option plans); (2) make BMPs the basis for regulatory structures and permitting systems; and (3) base investment, insurance, and purchase screens on BMPs. He also discusses the current shortcomings of "eco-labels" and calls for improvement of certification systems.

Overall, Clay's commodity-by-commodity guide is a rich reference worthy of inclusion in any library, and it will inspire readers to delve more deeply into this provocative and important topic. The book certainly deserves a wide readership, given that agriculture's overall impact on the planet's ecosystems is greater than that of any other human activity.

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UNCERTAINTIES IN RIVER RESTORATION

Strategies for Restoring River Ecosystems: Sources of Variability and Uncertainty in Natural and Managed Systems. Robert C. Wissmar and Peter A. Bisson, eds. American Fisheries Society, Bethesda, MD, 2003. 283 pp., illus. $69.00 (ISBN 1888569468 paper).

In a special issue of *BioScience* in 1995 entitled "Ecology of Large Rivers," Johnson and colleagues (1995) pointed out in their introductory article that a number of useful concepts had been developed to understand the interactions between physical and biological factors in large river systems. They also highlighted the fact that these concepts failed to recognize the importance of nested scales of interactions, both spatial and temporal, between large-scale processes (such as climate change and tectonic factors) and smaller-scale processes (such as intraspecies and river flow–species interactions). The authors additionally stated that "better methods and tools are needed...to predict a river's physical and biological characteristics along its length." The authors were absolutely right on both counts, and that issue of *BioScience* was for me an important landmark in the promotion of more holistic and connected thinking about what we might aspire to achieve in river restoration and how we could approach it.

Of course, it is now clear that predicting physical and biological characteristics along a river's length is not just difficult—it is, in absolute terms, impossible. And yet predictability is exactly what river restorers would like. The reason predictability will remain the elusive Holy Grail is the subject of this very timely volume edited by Robert Wissmar and Peter Bisson. In *Strategies for Restoring River Ecosystems*, a series of well-edited chapters run the gamut, from sources of variability in climate change and all its knock-on effects into hydrological and geomorphological patterns, through sources of variability in riparian and

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aquatic ecosystems, to uncertainties in watershed assessment techniques and watershed decisionmaking approaches. By the end of the book it becomes clear that variability, uncertainty, and unpredictabilty are in fact the hallmarks of river systems and, by extension, of any river restoration initiative.

The book is divided into two sections: The first deals with sources of variability in river ecosystems and the second with uncertainty in developing restoration strategies. The stated aims of the editors were to understand these two areas in order to design robust and more predictable restoration projects and outcomes.

I found chapter 2 on sources of climate variability in river ecosystems (by Edmonds et al.) of great interest. It contains well-judged levels of information from across the huge bodies of knowledge about natural and human drivers of global-scale climate variability, streamflow patterns, and the implications for river restoration. It emphasizes the importance of understanding river flows over short and long time scales, of renaturalizing flows, and of reconnecting river channels and floodplains to ameliorate changes caused by climate variability. I would have liked more discussion on how returning natural variability to river systems would ameliorate the effects of climate change on river systems, because this is a crucial argument in river restoration.

This chapter also points out that assessing climate change impacts at the local scale requires "downscaling" from global climate system models to finer resolutions (such as tributary watersheds), a process that at present has low confidence levels. On the other hand, also difficult is "upscaling" from the reasonably predictable river flow–species interactions in riparian ecosystems that are used to excellent effect in designing planned releases for restoring regeneration in riparian plant communities (e.g., Rood et al. 2003) to predictions of the extent, connectivity, and distribution of riparian ecosystems necessary to maintain viable metapopulations.

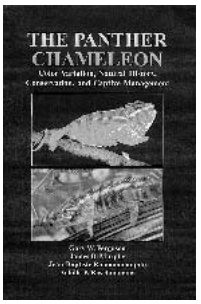
These are among the themes picked up in chapter 5 by Wissmar and colleagues, and they mirror parallel ideas in chapter 3, by Montgomery and Bolton, concerning the difficulties of predicting geomorphological change at different hierarchical levels of landscape study. It becomes clear that the range of likely responses to change at each spatial and temporal scale is much more predictable than the exact location at which those responses might manifest themselves. Being able to predict the type of response, but not its location, is not ideal for river restoration initiatives that are confined to one site and are therefore not systemic.

In chapter 4, Hauer and colleagues criticize local-scale restoration approaches exactly because such approaches do not take into account the linkages at nested spatial and temporal scales that need to be addressed in restoration methods. This chapter goes on to provide a useful account of sources of natural and human variation at a landscape scale, covering a wide range of natural processes.

A final chapter in the first half of the book covers sources of variability in aquatic ecosystems (chapter 6, by Bilby et al.). There is an emphasis here, as in chapter 5, on the integral part that natural disturbance processes play in the functioning of aquatic and riparian ecosystems. Both chapters include discussion of "recovery" and the resilience of ecosystems to natural (and often considerable) variations in, for example, river flows, sediment loads, and channel mobility. The message is clear: Restoration efforts must return variability to river systems if a diverse and mobile mosaic of habitats is to be returned to their aquatic and terrestrial components.

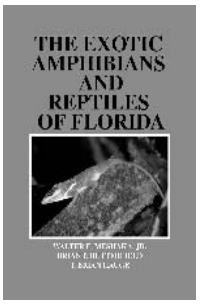
In the second half of the book is a particularly enjoyable chapter (chapter 9) by Anderson and colleagues on different decisionmaking approaches to watershed restoration. The authors appear to include a psychologist, a mathematician, and two ecologists, making for a provoca-

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tive discussion of the social contexts in which decisions are made and the advantages and disadvantages of different decisionmaking approaches. Here, as in chapter 7 (Reisenbichler et al.) on genetic concepts and uncertainties in restoring fish populations and in chapter 10, which is a specific case study about the Columbia River Basin, the recovery of fish populations is a strong driver for river and watershed restoration.

The emphasis on watershed restoration rather than local-scale restoration is the subject of chapter 8 (Pess et al.), but the authors also explain why local-scale initiatives often prevail over landscape-scale approaches. It describes the difficulties of dealing with land ownership, legal and funding issues, socioeconomic objectives, and regulatory obligations, among others, and roots the reader firmly in the realities of river and watershed restoration.

The final chapter, written by the editors, does a good job of summarizing many of the main themes of the book through the use of some useful diagrams. Appreciating variability in river systems is a vital precursor to being realistic in our expectations of the range of possible restoration outcomes. Far from being daunted by the realization that we cannot easily predict those outcomes, we should perhaps open our minds to accept their endless and changing variety.

If the book had too much information about fisheries for my personal interest, this can be forgiven: It was published by the American Fisheries Society. What I found disappointing was the complete lack of comparisons with sites outside North America. Nonetheless, the editors should take credit for a thought-provoking volume that greatly adds to the sophistication of our thinking on river restoration.

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References cited

Johnson BL, Richardson WB, Naimo TJ. 1995. Past, present and future concepts in large river ecology. BioScience 45: 134–141.

Rood SB, et al. 2003. Flows for floodplain forests: A successful riparian restoration. BioScience 53: 647–656.

AN ALL-ENCOMPASSING APPROACH TO THE TOPIC OF ECOTOXICOLOGY

Fundamentals of Ecotoxicology. 2nd ed. Michael C. Newman and Michael A. Unger. Lewis Publishers, Boca Raton, FL, 2003. 458 pp., illus. $59.95 (ISBN 1566705983 cloth).

Michael Newman, a professor at the Virginia Institute of Marine Sciences at the College of William and Mary, has revised his previous edition of this book with the assistance of his colleague Michael Unger, a research associate professor at the same institution. Like the first edition, this is a readable, comprehensive text for graduate students and for advanced undergraduates who have the requisite chemical and biological background. It is also a good general reference. The authors take an all-encompassing approach to the topic of ecotoxicology, covering all levels of biological organization from the molecular level to the global. The definition of the field, as used in this book, includes molecular and cellular studies, though some would argue that *eco*toxicology ought to have an ecological focus. (The term has certainly been misused in some places—I have seen collections of articles that focused almost entirely on subcellular effects, but were defined as "ecotoxicology" research because they dealt with fish rather than humans or their rodent surrogates.) Human health considerations, while a secondary consideration, also appear in this book, interwoven with the ecological effects of toxic chemicals.

There are 15 chapters, each with suggested additional readings. A number of people besides the authors have contributed to this volume. All the chapters and some chapter subheadings are introduced with appropriate quotations, sometimes from ecotoxicologists, but also from noted people from other areas of life, including Thoreau, Teasdale, Ibsen, and Descartes. Each chapter contains vignettes written by experts in the particular field under discussion, which give more details and explanations of the topics.

The introduction offers background on the historical incidents spurring the development of this relatively new integrative science: the Minamata mercury tragedy in Japan, DDT in wildlife, oil spills, hazardous wastes, acid rain, and more. It includes a vignette by John Cairns, a father of the field, discussing the emergence and future of ecotoxicology. Cairns encourages a broad view, advocating a multidimensional research strategy that emphasizes ecosystem complexity, dynamics, resilience, and interconnectedness, and he decries the role of funding for "contract" research of limited scope, which hinders the development of visionary long-term projects.

The chapter that follows the introduction covers the different classes of inorganic and organic environmental contaminants of concern (including nutrients) and their chemistry, sources, fates, and cycling in the terrestrial, freshwater, and marine ecosystems. I was glad to see coverage of nutrients and eutrophication issues, which are often omitted in this kind of book because they are not "toxic chemicals." The text also covers radionuclides, which also are frequently left out of books on environmental toxicology.

The next several chapters discuss bioaccumulation. These chapters cover uptake, transformation, and elimination (the processes responsible for bioaccumulation) and include kinetics and models of contaminant accumulation. A chapter on bioavailability includes the characteristics of a chemical, an organism, and its environment that can affect the chemical's bioavailability. The last of the chapters on bioaccumulation deals with the transfer of contaminants in the food chain. The vignette in this chapter, by Bryan and Jagoe, gives an in-depth treatment of the dietary exposure of fish-eating birds to mercury. This sequence of chapters is appropriate and logical.

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The chapters on bioaccumulation are followed by several others on toxicant effects at different levels of biological organization, from the molecular level to cellular, organismal, population, community, ecosystem, landscape, and global levels. Overall, plants are not given enough space in these chapters, despite the fair amount of research that has been done on them and despite their obvious importance in the biosphere.

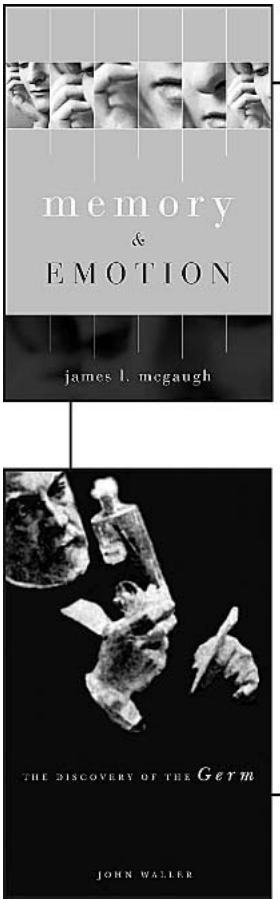
The molecular chapter covers topics such as detoxification pathways, metallothioneins, stress proteins, DNA damage, and enzyme dysfunction; Roesijadi, one of the foremost experts on metallothioneins, contributes a very informative vignette.

The chapter on cells, tissues, and organs covers histopathology, damage to chromosomes, and carcinogenesis and shows how these effects link to effects at higher levels of organization. A vignette by McBee covers the topic of chromosome damage in greater detail, while one by Vogelbein deals with liver carcinogenesis in fish—these two authors are leading researchers in their respective fields.

The chapter on sublethal toxic effects on individual organisms deals with growth, development, reproduction, physiology, and behavior. The vignette by Schultz on environmental estrogens gives insight into why the field of endocrine disruption is such a hot topic these days. I particularly liked the vignette by Sandheinrich on behavior, which is a sensitive indicator and a type of effect that clearly links to higher (population and community) and lower (biochemical and cellular) levels of organization.

The chapter on acute and chronic toxic effects on individuals (lethality) covers the various types of toxicity tests and models that are still in use for most regulatory purposes. These tests, which are relatively inexpensive and easy to perform, are the basis for numerical water quality criteria under the Clean Water Act. They are also used extensively in ecological risk assessment procedures. The regulatory side of the field has a lot of catching up to do to be in synchrony with the state of the science, which started out with a "kill 'em and count 'em" approach that sadly still prevails in the regulatory realm. There is considerable doubt about the applicability of such short-term lethal toxicity tests, performed on selected standard species, to environmental impacts in the real world.

The next chapter covers the effects of toxicity on populations, demographic approaches, and epidemiology. These topics, which are clearly relevant to organisms in the field, put the "eco" into "ecotoxicology." The chapter's introductory quote from Barnthouse and colleagues says it clearly: "There is an enormous disparity between the types of data available for assessment and the



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types of responses of ultimate interest. The toxicological data usually have been obtained from short-term toxicity tests performed using standard protocols and test species. In contrast, the effects of concern to ecologists performing assessments are those of long-term exposures on the persistence, abundance, and/or production of populations" (p. 203). This chapter also covers changes to population genetic structure involving the acquisition (evolution) of tolerance to contaminants, and it includes a vignette by Grant on industrial melanism.

The chapter on community- and ecosystem-level effects of toxicity deals with the types of interactions between and among species that may be affected by contaminants (e.g., predator–prey interactions, competition), with measures of changes in communities, with study designs such as micro- and mesocosms, and with the use of community indices (species richness, evenness, and diversity) for field assessments. The vignette by Karr on indices of biological integrity is informative and interesting.

The chapter on effects at the landscape to global levels includes the topics of acid rain, ozone depletion by chlorofluorocarbons, global transport of persistent organic pollutants, and global warming. This fairly short chapter could have been developed further—the issues it covers have great importance because they are global in nature.

The chapters on risk assessment focus on the basic frameworks for human and ecological risk assessment and include a vignette from Suter, a leading expert in the field.

After a concluding chapter, there are study questions for each chapter and a number of other appendices, including regulatory aspects of the field. There are brief descriptions of US and European laws and regulations dealing with toxic substances. Only one paragraph is devoted to each major US law: the National Environmental Policy Act; the Clean Air Act; the Clean Water Act; the Safe Drinking Water Act; the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substances Control Act; the Marine Protection Research and Sanctuaries Act; the Resource Conservation and Recovery Act; and the Comprehensive Environmental Response, Compensation, and Liability Act (or Superfund). I would have liked to have seen a bit more description of these laws and of how toxicity tests or risk assessments are used in the regulations associated with them, because in many ways they have driven the development of the field of environmental toxicology. One might argue that without these laws and the funding derived from them, the science in this field might have become more sophisticated more rapidly. Since we are still saddled with LC_{50} tests, scientists who might otherwise be involved in advancing our knowledge of sublethal effects, mechanisms, or the big picture of long-term ecological effects are involved in these less intellectually challenging efforts. Another appendix contains equations for the estimation of contaminant exposure. There are abundant references, a long glossary, footnotes, and illustrations.

Fundamentals of Ecotoxicology provides a broad overview of the field and, like its predecessor, should be of great use to both students and practitioners. The vignettes are a clever and enjoyable addition to a well-written and well-organized presentation of a complex field. A quibble, however: The vignettes are printed in somewhat smaller type than the rest of the chapters and might be skipped over by some readers. This would be most unfortunate, because they are major assets of this new edition.

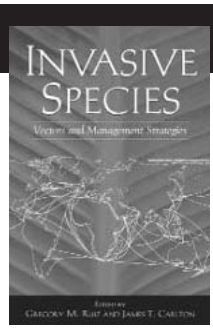
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