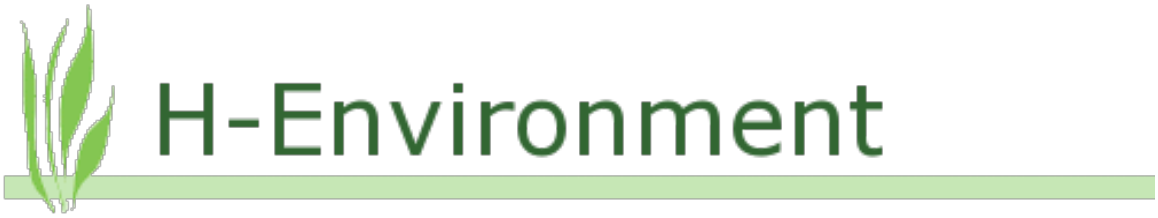
Environment & Society Portal

H-Environment

Full citation: Hamblin, Jacob D. (ed.), Roundtable Review of *Evolutionary History: Uniting History and Biology to Understand Life on Earth* by Edmund Russell. *H-Environment Roundtable Reviews* 2, no. 3 (May 2012) http://www.environmentandsociety.org/node/3645.



H-Environment Roundtable Reviews

Volume 2, No. 3 (2012)
www.h-net.org/~environ/roundtables
Publication date: May 15, 2012

Roundtable Review Editor:
Jacob Darwin Hamblin

Edmund Russell, Evolutionary History: Uniting History and Biology to Understand Life on Earth (New York: Cambridge University Press, 2011). ISBN-13: 9780521745093. Paper. 230 pp.

Stable URL: http://www.h-net.org/~environ/roundtables/env-roundtable-2-3.pdf

Contents

Introduction by Jacob Darwin Hamblin, Oregon State University

One of the consequences of the educational system in the United States and Europe (perhaps elsewhere too) is that, at an early age, children make decisions about whether they are good at math and science or good at the humanities. They choose a side. Commentators have harped upon the great divide for many years, from today's debates about the importance of the STEM fields, on back to the post-*Sputnik* "two cultures" conversation launched by C. P. Snow, and earlier in time to Charles Babbage's *Reflections on the Decline of Science in England*.[1] There are many permutations of it in the "science wars" and "culture wars." Those of us who research and write history for a living know that this socialization process has an enormous effect on how we tell the story of the past. After all, didn't most historians decide long ago that they were "humanities" people rather than "science" people? Who can deny that the topics we choose reflect our values, interests, experiences, and education? Historians of science and environmental historians are among those who make forays into the process of integrating the humanities and sciences, often armed only with the knowledge that it is folly to tell the story of the past while ignoring the natural world, including biological processes in humans, animals, and plants.

And yet there are many social pitfalls to uniting history and science, particularly biology. Change to organisms over time—evolution—remains a controversial subject among millions of non-scientists, particularly in the United States. Complaining about teaching evolution in schools is a time-honored tradition, as are demands to give "creation science" equal time. Occasional discomfort with "revisionist" history notwithstanding, historians have not seen their entire discipline under siege in the way that evolutionary biologists have. If historians embrace biological science and attempt to tell the story of the past—even the recent past—through that lens, is there a major storm on the horizon?

Edmund Russell has thrown caution to the wind by adopting a view of history that draws unflinchingly upon the lessons of evolutionary biology. He provided a taster on this approach in a prize-winning essay in 2003 that argued for a much closer connection between historical and biological research.[2] In ***Evolutionary History: Uniting History and Biology to Understand Life on Earth***, he provides more than a story about deep time, which one might expect from a story about evolution. Instead, Russell employs the notion of coevolution of plants, animals, and

[1] Debates about STEM can be found on numerous blogs. An example of a widely re-posted one is Cathy N. Davidson, Paula Barker Duffy, and Martha Wagner Weinberg, "Why STEM is Not Enough (and We Still Need the Humanities)," *Washington Post* (5 Mar 2012), http://www.washingtonpost.com/blogs/answer-sheet/post/why-stem-is-not-enough-and-we-still-need-the-humanities/2012/03/04/gIQAniScrR_blog.html. Accessed on May 10, 2012. See also C. P. Snow, The Two Cultures and A Second Look (New York: Cambridge University Press, 1963); Charles Babbage, *Reflections on the Decline of Science in England, and on Some of its Causes* (London: B. Fellowes, 1830).

[2] Edmund Russell, "Evolutionary History: Prospectus for a New Field," *Environmental History* 8 (2003), 204-228.

microorganisms to explain the causes and consequences of a broad range of events. These include the activities of daily life, such as picking up dog feces and using hand sanitizer, to episodes of enormous historical import, such as the natural causes of the Industrial Revolution. Throughout, Russell wants to convince us that evolution is everywhere, happening all the time, and that humans have played an enormous role—conscious or not—in shaping evolutionary processes. He also hopes to encourage scholars to incorporate evolution into their own historical work.

With such a provocative premise, I was delighted to solicit comments from four scholars, all of whom already have engaged in some way with the relationships between humans and other species in their work. **Joseph E. Taylor III** has written about reasons for the decline in fish populations over long periods of time, and has pointed out the futility of certain fisheries policies in keeping these populations robust and thriving. In *Making Salmon*, Taylor pointed out a long-standing attitude that humans could "make" salmon in a way that served human needs, finding ways to propagate them anew rather than enforcing measures of conservation or avoiding habitat destruction.[3]

Anita Guerrini also has written about human intervention in animals' lives, but in a slightly different vein: as subjects in scientific experimentation. Many of the fundamental ideas of human biology—such as William Harvey's seventeenth-century conception that blood circulates throughout the body—came from gruesome vivisections of animals, including dogs. Even blood transfusions from animals to humans were attempted in those years, under the short-lived premise that animals produced purer, more wholesome blood. In Guerrini's work we can see the scientific, cultural, and moral dimensions of the interactions between humans and other species.[4]

Also concerned with the fate of animals, but on a much larger scale, is **Mark V. Barrow, Jr.** His *Nature's Ghosts* examined those species whose evolutionary paths halted abruptly, or are at risk of doing so.[5] Part environmental history and part history of science, Barrow's research assesses the extinction idea itself, from the controversial fossil investigations of Georges Cuvier to the twentieth-century debates about wildlife protection. Barrow invites us to consider the causes and consequences of human-induced changes to, or even complete destruction of, other species.

Julianne Lutz Warren shares with Edmund Russell a desire to see more ecology in history—and in fact she wants to see it in other domains as well. She has been

---

[3] Joseph E. Taylor III, *Making Salmon: An Environmental History of the Northwest Fisheries Crisis* (Seattle: Univesity of Washington Press, 1999).

[4] Anita Guerrini, "The Ethics of Animal Experimentation in Seventeenth Century England," *Journal of the History of Ideas* 50:3 (1989), 391-407. See also Anita Guerrini, *Experimenting with Humans and Animals: From Galen to Animal Rights* (Baltimore: Johns Hopkins University Press, 2003).

[5] Mark V. Barrow, Jr., *Nature's Ghosts: Confronting Extinction from the Age of Jefferson to the Age of Ecology* (Chicago: University of Chicago Press, 2009).

critical of writers who fail to incorporate nature, and has been outspoken about the need to bring the natural world into political discourse, beyond token references to "green" politics or particular environmental issues. Also, her *Aldo Leopold's Odyssey* (writing as Julianne Lutz Newton) examines the change in Leopold's worldview from a resource-minded conservationist to an ecology-minded philosopher concerned with the role of all species. There may be a parallel here to the kind of worldview change urged by Edmund Russell among historians—to writing about the past with all living things in mind.[6]

Before turning to the first set of comments, I would like to pause here and thank all the roundtable participants for taking part. In addition, I would like to remind readers that as an open-access forum, *H-Environment Roundtable Reviews* is available to scholars and non-scholars alike, around the world, free of charge. Please circulate.

[6] Julianne Lutz Newton, Eric T. Freyfogle, and William C. Sullivan, "Land, Ecology, and Democracy: A Twenty-first Century View," *Politics and the Life Sciences* 25:1/2 (2006), 42-56. Julianne Lutz Newton, *Aldo Leopold's Odyssey: Rediscovering the Author of A Sand County Almanac* (New York: Island Press, 2006).

Comments by Joseph E. Taylor III, Simon Fraser University

Welcome to the Jungle, or Why Paul Crutzen is Shortsighted

At one level Edmund Russell's *Evolutionary History* is utterly conservative. Russell's examination of "the ways populations of human beings and other species have shaped each other's traits over time and the significance of those changes for all those populations" (5) carries on a tradition at least as old as James Malin of studying, as Richard White put it, "the reciprocal influences of environmental and social change."[7] Contained within Russell's agenda, however, is a rather radical implication. In marrying biology's Modern Synthesis to history's concern for social and cultural contexts, Russell complicates "the sense many of us have that evolution is something that happens 'out there' – well away from us in time, well away from us in space, well away from us as a species, and certainly well away from us as individuals" (5). This is, in short, about *anthropogenic evolution*. Yet in implicating humans in biological change, *Evolutionary History* speaks to the idea of the Anthropocene in a way that methodologically undermines the narrow focus on CO_2 emissions for understanding the ecological history of industrialization. Stories about animals, pathogens, and plants instead reveal temporally deep and globally expansive processes of biological, ecological, and social transformation. As epochs go, there is no pristine *before* when it comes to the Anthropocene; evolutionary history reveals turtles all the way down.

Evolutionary History begins as a primer on theory and language. Early chapters carry readers through a lexicon of concepts, drawing out meanings and limitations of terms. Russell begins with the familiar, if opaque, idea of *selection*, illustrating how it has been effected through varied mechanisms and degrees of intentionality. The history of hunting and fishing reveal how humans shaped phenotypes in ways that either aided or undermined their interests but always, and this is Russell's key point, altered species. Human interactions with African elephants, bighorn sheep, bison, and salmonids help explain in clear and nuanced prose the biological meanings of *unconscious selection*, *sexual selection*, and *extinction*. Such lessons underscore Russell's point that humans "have played the role of the alpha and omega of evolutionary forces" (29). In similar fashion stories about bacteria, coca, and dogs introduce additional evolutionary forces ranging from intimate acts to ageless domestication to faceless states and corporations. As Russell quips, "Anthropogenic evolution, thy forces are legion" (53). They are also ancient and pervasive. *Evolutionary History* thus extends significantly the hybridity timeline, further complicating an already deeply problematic depiction of nature as a world apart.[8]

---

[7] Richard White, "American Environmental History: The Development of a New Historical Field," *Pacific Historical Review* 54 (August 1985), 300.

[8] William M. Denevan, "The Pristine Myth: The Landscape of the Americas in 1492," *Annals of the Association of American Geographers* 83 (September 1992), 369-85; William Cronon, "The Trouble with Wilderness, Or, Getting Back to the Wrong Nature," *Environmental History* 1 (January 1996), 7-28;

Of all the species featured in this book, cotton turns out to offer the most versatile and persuasive stories. In the chapter "Intentional Evolution," Russell traces the history of industrial manipulations to cotton. Much of this will be familiar, at least in its general structure, to anyone concerned with biotechnology.[9] Russell's contribution is thus less in its details than in how he mobilizes them as didactics for technical concepts central to the Modern Synthesis's emphasis on selection and variation. The implications hang fire for a chapter before erupting in "Evolution of the Industrial Revolution." This chapter puts environmental history into a compelling dialog with the history of technology. As Russell notes, most histories of the industrial revolution have privileged English agency and technological or organizational innovation. Cotton is a given, yet as Russell shows, the nature and history of *Gossypium barbadense* and *g. hirsutum* complicate our view of industrialism. "Amerindians, New World cottons, and anthropogenic evolution in the Americas" (104) turn out to have been critical factors in the revolution. Russell's argument is subtle, nuanced, and surprisingly straightforward when he reveals that textile manufacturers at the time were in fact obsessed with these very issues.

By the end we are back at the start, scrambling through literal and figurative jungles and reexamining the earliest interactions among humans and nature to grasp more fully the biological warp and weft of things like the industrial revolution.[10] It is hardly that rising CO_2 levels are historically irrelevant, but in the wake of this book they seem more of an arbitrary metric, a key story but hardly the only or eclipsing one. Nor am I the only one given pause by the implications of the past. Although ecologist Eugene Stoermer and chemist Paul Crutzen insist that the late eighteenth century represents a geological Rubicon, this is not a consensus viewpoint even among geologists.[11] Researchers working on anthropogenic fire and early extinctions place the threshold for climatic change as far back as thirteen millennia, at which point the Anthropocene is synchronous with the Holocene.[12] What Russell does in addition is give us stories that have the effect of illustrating how the continental drift of the Anthropocene is tied to the genetic drift of *Gossypium* and other evolutionary processes. Even recent environmental issues are bound up with the longue durée. The human imprint just gets older and older, and, as a result, the Anthropocene seems more like an environmentalist expression of Modernity—an

---

Richard White, "From Wilderness to Hybrid Landscapes: The Cultural Turn in Environmental History," *The Historian* 66 (September 2004): 557-64.

[9] For a similar, if more superficial, treatment see Steve Striffler, *Chicken: The Dangerous Transformation of America's Favorite Food* (New Haven: Yale University Press, 2005).

[10] For a fascinating discussion of fire and human evolution see Richard Wrangham, *Catching Fire: How Cooking Made Us Human* (New York: Basic Books, 2009).

[11] For eighteenth century see Paul J. Crutzen and Will Steffen, "How Long Have We Been in the Anthropocene Era?" *Climatic Change* 61 (December 2003), 251-57.

[12] William F. Ruddiman, "The Anthropogenic Greenhouse Era began Thousands of Years Ago," *Climatic Change* 61 (December 2003), 261-93; Christopher E. Doughty, Adam Wolf, and Christopher B. Field, "Biophysical Feedbacks between the Pleistocene Megafauna Extinction and Climate: The First Human-Induced Global Warming?" *Geophysical Research Letters* 37 (7 August 2010), L15703.

insight about the pace and scope of atmospheric change—than a precise geological marker.

One of the most admirable things about this admirable book is its patient instruction of how historians can incorporate evolutionary concepts in research. Russell presents terminology in careful, clear prose, and the range of tools and examples make this relevant to scholars working on Neolithic cultures or the twenty-first century. As in almost all writing on evolution, however, there are occasional slips of prose. Russell tries to avoid the problematic language of Darwinian and Lamarckian frameworks, but there are a couple passages where intentionality seeps in, where animals "have altered their traits" (43) and species act "for short-term gain" (69). These are hardly fatal flaws, and as ecocritic Michael Cohen points out, the tendency toward anthropomorphism is endemic in writing about evolution and especially *adaptation*.[13] The slips are rare. Russell mostly hews to a conservative style that preserves the contextual and contingent nature of nature undergoing change. Conversely, there are curious omissions of standard ideas. Russell does not discuss *microevolution* and *macroevolution*, two terms that have been around since the 1900s, were central to Theodosius Dobzhansky's articulation of the Modern Synthesis, and remained prominent in Jonathan Weiner's Pulitzer-winning *The Beak of the Finch*.[14] Nor does Russell try to unpack the language of genes and genomics, which have commandeered the evolutionary biology in recent decades and, as Evelyn Fox Keller notes, substantially changed the vector of research and thinking.[15] Obviously no book can do it all, so it is worth repeating that *Evolutionary History* does plenty in its brief, highly-readable 161 pages, and Russell has effectively followed through on his 2003 prospectus for a new field.[16] Evolutionary History is in play.

---

[13] Michael P. Cohen: "Evolutionary Works and Texts: Reading Dobzhansky in an Age of Genomics," *Configurations* 18 (Winter 2010), 99.

[14] Theodosius Dobzhansky, *Genetics and the Origins of Species* (New York: Columbia University Press 1937); Jonathan Weiner, *The Beak of the Finch* (New York: Vintage, 1995).

[15] Evelyn Fox Keller, *Century of the Gene* (Cambridge, Mass.: Harvard University Press, 2000), 5-10.

[16] Edmund P. Russell, "Evolutionary History: Prospectus for a New Field," *Environmental History* 8 (April 2003), 204-28.

Comments by Anita Guerrini, Oregon State University

In *Evolutionary History,* Edmund Russell offers a primer on evolutionary theory for historians, and a research agenda for a new way of doing history. Evolutionary history, as Russell defines it, focuses on human impacts on the evolution of other species, as well as the co-evolution, the reciprocal impacts, on both humans and non-humans. Another recent contribution to this field, Daniel Lord Smail's *On Deep History and the Brain* (2008), focused on the evolution of the human brain and the arbitrary divide between "history" and "prehistory." Russell in contrast offers a more general introduction to this new field, which has relevance particularly for environmental historians but also, as he convincingly demonstrates, for other kinds of history as well. To some readers, particularly historians of science, some of his explanations may seem elementary. But even those who think they know what evolution is and how it works will find much that is new in this work, and Russell's admirably clear exposition and exemplary organization makes even the most arcane concepts comprehensible.

The first chapters of the book offer a tutorial in evolutionary theory for historians. Russell's focus is on the role humans have played in shaping the evolution of both humans and non-human species. He does not argue for biological determinism; rather, he suggests that adding evolution as a factor to the usual mix of historical forces – social, cultural, intellectual, political – can yield new, illuminating and at times surprising results. Chapter 2 offers, in 11 pages, a clear and concise account of what evolution is and the most important ways in which it works, from Darwin to epigenetics. Russell lays particular emphasis on the distinction between natural and artificial selection; he notes that the latter term is unsatisfactory for a number of reasons, and prefers the term "anthropogenic" or "human-induced" evolution, which neither separates humans from the rest of nature nor minimizes their impacts. The glossary of terms offered at the end of the book is also very helpful for novices in the field, and the endnotes (there is no bibliography) give evidence of a very wide range of sources from both science and history..

The next several chapters deal with specific evolutionary concepts, with a wide range of examples from across history. Russell uses such varied examples as bison, elephants, salmon, and bacteria to illustrate the varied evolutionary effects of humans on natural populations. These effects can take place surprisingly quickly; for example, because of overharvesting of large fish, whitefish evolved to grow more slowly between 1940 and 1970. Even faster is the evolution of insects resistant to insecticides; faster still do bacteria evolve resistance to antibiotics.

Russell points out that human-induced changes that we think of as being primarily ecological – such as alterations of the landscape – can also lead to evolutionary changes. He recounts the familiar story of the color evolution of peppered moths. As the Industrial Revolution took hold in northern England and coal burning prevailed, dark-colored moths came to predominate over light-colored ones, which

were more visible to predatory birds against the coal-blackened tree trunks. The progress of the Industrial Revolution could indeed be tracked by the proportion of dark to light moths in an area. But Russell then tells the epilogue to this story: as coal usage declined in the late twentieth century, so too did the numbers of dark-colored moths.

Russell realizes that such an account only tells half of the story: evolution cannot explain why coal became popular, or why its use declined. But it provides an excellent example of what he calls "inadvertent evolution," the cascade of effects that can result from human actions. Climate change provides another example with even broader impacts.

Human domestication of plants and animals provided by far the most important mechanism for evolutionary changes, but Russell argues that much domestication was unconscious. Using the example of the evolution of dogs into wolves, he portrays domestication as a two-way street, with wolves and humans each acting in their own self-interest. His chapter on the co-evolution of humans and other species is to my mind the best in the book, using co-evolution as a way to examine more general reciprocal environmental impacts.

Unlike animals, domesticated plants are a result of intentional breeding by humans who select for particular desired characteristics. With human help, cotton evolved from a small short-fibered plant to one with large bolls that yielded desirable long fibers. Cotton provides Russell with a case history in how evolutionary history can substantially revise an oft-told story – in this case, the rise of the Industrial Revolution. He makes a convincing case that the evolutionary development of new varieties of cotton, aided by human intervention, played a major role in the origins of the Industrial Revolution. It would not have happened when and where it did without changes in the cotton genome of New World cotton that led to longer fibers that could be spun by machines. Moreover, the slave trade, particularly the famous triangular trade out of Liverpool, allowed New World cotton to be produced and imported into England, making the slave trade itself both a cause and an effect of industrialization.

Only toward the end of the book does Russell directly address the relationship between evolutionary history and environmental history. He expresses surprise that until quite recently this relationship was basically non-existent, even though both fields deal with people and their environments. Surmising that this lack of attention to evolution may simply be owing to ignorance of the science, he also speculates that sociobiology and evolutionary psychology may have turned some historians off from looking at evolutionary history. I would have liked to have seen more attention to these issues: Russell raises them but does not pursue them, and this chapter seems more hortatory than constructive. The book closes with two charts that give examples of how social forces have shaped evolution and how evolution has shaped society. I found these too schematic to be more than

suggestive, but they do give an idea of the range of applicability of evolutionary history.

Russell packs a lot into less than 200 pages of text, and at times no more than glances at a particular topic before moving on to another. Nonetheless, his book opens new territory for exploration for historians from a number of fields, not least of which is environmental history. It deserves a wide readership.

Comments by Mark V. Barrow, Virginia Tech

It's time for historians to take biology much more seriously. Or so Edmund Russell argues in a manifesto that seems to vaguely echo environmental historians' repeated attempts to persuade their historical colleagues to take the natural world as much more than a stable backdrop against which human actors enact their lives. Russell acknowledges that environmental historians have long relied on the science of ecology—a field of biology that studies the relationship between organisms and their environments—as a source of tools, data, and conceptual frameworks for exploring the role and place of nature in human society. Think, for example, of Donald Worster's first book, *Nature's Economy* (1977), which offers a sweeping history of ecological ideas; the first chapter in *Changes in the Land* (1983), where William Cronon introduces a field that he refers to as "ecological history"; or Alfred Crosby's *Ecological Imperialism: The Biological Expansion of Europe, 900-1900* (1986), which argues that interactions between plants, animals, and pathogens facilitated European colonization of territories in the temperate zone. Or consider how ecological terms like "carrying capacity," "ecosystems," and "food webs," routinely appear in environmental history discourse. Indeed, Russell's recent search of the Environmental History Bibliography maintained by the Forest History Society scored more than 3,500 hits for the term "ecology" and its variants in a database that includes more than 40,000 entries.

What Russell really wants, though, is for historians to take the field of biological evolution more seriously. More than 150 years after Charles Darwin published *The Origin of Species* (1859), a landmark book that soon convinced most educated Westerners of the reality of evolution in nature, few historians have yet to grapple with the implications of seeing the world in more Darwinian terms. Even environmental historians, an interdisciplinary lot of scholars who often lean on the sciences in their work, rarely explore the role evolution has played in the interactions between humans and nature over time. A search of the Environmental History Bibliography, the same database that generated thousands of hits for variants of the word "ecology," revealed a meager seventeen entries that "used evolution as an analytical tool," and most of the authors of these publications were from fields "other than environmental history" (145).

Why the lack of engagement with a scientific theory that has not only revolutionized but also unified biology over the last century or so? Russell offers two plausible explanations for understanding this neglect. First, historians often have little formal training in evolutionary biology, so their understanding of the field is often quite rudimentary. Like the broader reading public, most historians associate evolution with speciation occurring over eons of time through the mechanism of natural selection, a conceptualization that makes it hard to see the idea's relevance to the relatively narrow period of recorded human history. Contemporary biologists, however, tend to think about evolution in terms of changes in traits within

populations over generations and have come to embrace many causes of evolution beyond natural selection, both of which open up the possibility of seeing history in evolutionary terms. Part of historians' neglect may also be politically motivated, Russell conjectures. Over the last three decades or so, science study scholars have revealed the myriad ways social Darwinists, eugenicists, and more recently, sociobiologists have relied on evolutionary arguments to make deeply troubling claims about the nature of human behavior and the limits of human potential. Most historians find the biological determinism inherent in such arguments both unconvincing and unpalatable. As Russell notes, however, there is an irony in historians' continued suspicion of evolutionary theory since biologists now tend to emphasize "the roles of genetic variation, chance, environment, and historical contingency in creating the world we inhabit" (149). This prominence of chance and contingency is remarkably similar to most historians' understanding of how historical change occurs.

Ultimately what Russell is calling for is sustained attention to a specific kind of evolution—anthropogenic evolution, that is, evolutionary change driven by human actions. According to the book's abstract "Human beings have become probably the most powerful species shaping evolution today, and human-caused evolution in populations of other species has probably been the most important force in shaping human history" (i). These are bold claims indeed. Following a brief introduction, chapters 2-8 examine how "people have shaped the evolution of other species" (4) through hunting and fishing, eradication campaigns, environmental modifications, domestication, and other means. One particularly compelling example is the evolution of wolves into dogs, one of a long series of domestications of wild animals and plants that set in motion the far-reaching Agricultural Revolution about 10,000 years or so ago. The last chapter in this section argues that humans have not only transformed the populations of other species but have also been transformed by them in an intricate dance known as coevolution. Not just genetic traits, like skin color and lactose intolerance, have been shaped through this reciprocal process, but also cultural traits, like selective harvesting of larger or smaller fish or the creation and use of new antibiotics. Because human culture can evolve rapidly, while human biology cannot, "coevolution between people and other species involves human cultural change more often than human genetic change" (100).

The full payoff for Russell's approach comes in chapter 9, when he reinterprets the Industrial Revolution through the lens of evolutionary history. Here he traces how anthropogenic selection of four species of cotton—two in the Old World and two in the New World—produced longer fibers, and how the arrival of these long fiber cottons from the New World in the eighteenth century seems to have "catalyzed the Industrial Revolution" in England (104). When British manufacturers used shorter fibers, the cotton industry relied exclusively on hand spinners to make thread and hand weavers to make cloth, while the introduction of longer New World fibers produced thread strong enough to withstand processing by machines. In short, Russell argues, biological innovation through the coevolution of plants and

Amerindians in the New World created the preconditions that made mechanical innovation—and the Industrial Revolution—possible.

The final two chapters examine the implications of evolutionary history for the history of technology and environmental history, two fields that Russell has successfully straddled throughout his career. Traditionally historians of technology have focused on the study of machinery and other tools made from inert matter. Russell argues, however, that it's useful to begin thinking about organisms that humans have modified through anthropogenic evolution as living technologies, or "biotechnologies" in the most literal sense, and thus open to analysis using ideas and approaches from the history of technology. The potential fit of evolutionary history with environmental history seems even stronger. Although environmental historians have generally neglected evolution, they study the interactions between people and their environments across time, so the "relevance of evolutionary history seems clear" (145). But what Russell ultimately wants is for evolutionary history not to be subsumed within one of these pre-existing scholarly endeavors, but to stand as a field unto itself. In the conclusion, he briefly explores how evolutionary history can "enhance other fields. . .including those as disparate and perhaps as surprising as the history of politics and the history of art" (150).

Although written in an accessible, homespun style, complete with a useful glossary, this is a conceptually rich book that gives readers much to ponder. I'm not entirely convinced that evolutionary history deserves to be a historical field of its own, but I do think it offers an approach that can further illuminate the myriad ways that the human and natural worlds interpenetrate one another. It also reminds us to always be on the lookout for multiple (and in the case of coevolution, multidirectional) lines of causation rather than simplistic answers to the questions of how and why of historical change take place.

I am curious, though, about why this book is appearing now. Certainly Russell's personal trajectory has played a key role in his decision to make the pitch to launch evolutionary history. He notes in the preface that the seed for the book was a lecture he heard in an ecology class during his first semester of graduate school. There his professor mentioned that the effectiveness of agricultural pesticides often decreases with time. The explanation for this phenomenon, known as resistance, is Darwinian: insect populations exhibit a great deal of variation, and some individuals possess particular behavioral or physiological traits that allow them to survive exposure to toxic chemicals, while those that do not perish. The surviving insects are able to reproduce, passing on their favorable traits to the next generation, and as long as the pesticide is used, resistant forms will represent an ever-larger percentage of the total population. Russell also repeatedly references his grandfather, whose death in a hospital was apparently at least partially the result of exposure to a pathogenic bacteria that had developed resistance to the antibiotics in use at the time. Russell's interest in the phenomenon of resistance is also quite apparent in his first book *War and Nature: Fighting Humans and Insects from World*

War II to Silent Spring, which is a fascinating look at how chemical warfare and pest control intersected in the twentieth century to create the modern pesticide industry.

But for *Evolutionary History* to gain the wider traction it deserves, certainly more than Russell's own personal fascination with the topic is necessary. There is some evidence that the time is ripe for the acceptance of his ideas. Certainly at least since the publication of Bill McKibben's *The End of Nature* (1989), there has been a greater appreciation for the role of anthropogenic change of all sorts, especially climate change. At the same time, it's hard to find a newspaper these days without a report of a new outbreak of MRSA or some other drug resistant disease, and we are constantly being warned to limit the use of antibiotics and some hand soaps that are fostering an epidemic of bacterial resistance. There is also a small but growing body of historical studies—from Harriet Ritvo, Deborah Fitzgerald, Jack Kloppenberg, John Perkins, and others—that illuminate the absorbing history of agricultural breeding, one of the prime examples of anthropogenic evolution that Russell explores. At the same time, as I read *Evolutionary History*, I couldn't help be reminded of Michael Pollan's *Botany of Desire*, an eloquent exploration of the coevolution of plants and humans. In short, I am convinced that Russell is not only on to something of lasting value here but also that his argument is coming at a time where it has the potential to be widely read and widely appreciated.

Comments by Julianne Lutz Warren, New York University

The Dogged Arrow and Expanding the Circle of Life

"We are born trapped in our own selfish skins," writes *New Yorker* author Adam Gopnik in his recent essay "Dog Story." Perhaps gradually "we open our eyes to the rings of existence around us."[17] Early on and with relative ease we encircle those nearby—lovers, parents, and children. It is often less comfortable to look beyond to notice those with whom we are less intimate—who seem farther away in space, in time, or in degree of relatedness. Dogs, though they are separated from us by species boundaries, for many of us have entered the circle of attention, if not care. In probing possible reasons for this Gopnik refers to one of the many interesting stories told in the new, provocative and involved book *Evolutionary History* by Edmund Russell about "the ways populations of human beings and other species have shaped each other's traits over time and the significance of those changes for all those populations" (5)—an updated tale of "why" wolves became dogs.

On the one hand is the longer-standing "master breeder hypothesis," Russell explains. This theory suggests that people foresaw the usefulness of tame wolves and purposely set about mating animals with desired traits to each other, applying (in Darwinian terms) "methodical selection." Russell finds this idea far-fetched largely because he disbelieves that people could have imagined dogs from wolves. Based on a combination of recent scientific work and speculation, on the other hand is the view that Russell favors. This theory, which might be called the "domestication partners" (70) hypothesis, proposes that dogs were domesticated via "unconscious selection" (another Darwinian term, Russell stresses). According to this theory, humans did not actually have a breeding plan. Rather, the inherited consequences of many short-term decisions—for example, to tolerate gentler wolves nearby and to kill more aggressive ones—accumulated over time—perhaps 15,000 years or so—with an eventual dramatic evolutionary effect. Moreover, in a sense, wolves may have domesticated themselves by learning how to use humans as sources for scavenging food. Calmer dogs, in this case, more successfully gleaned extra nutrition. These types thus were more likely to survive and have pups and thus passed on more of their genes—signaling fewer alarm hormones and fear neurotransmitters--to future generations creating an increasingly tame population. Mutations resulted in some dogs having more "desirable" traits than others, which people "by accident or on purpose" further encouraged into various breeds (66).

The choice of whether one or the other of the theories Russell discusses—master breeder or domestication partners—may be more or less right, Gopnik points out, is more than academic. If the newer story about unplanned wolf domestication turns out to be the more strongly supported one, Gopnik writes, "then the line between

[17] Adam Gopnik. "Dog Story." *The New Yorker* August 8, 2011: 46-53, 53.

artificial and natural selection seems far less solid, and the role of man at the center less fixed."[18] Perhaps, then, there is no center or there are multiple centers and we discover that many or perhaps all life forms matter. With regard to a boundary line between human and natural, Russell himself carefully chooses not to use the term "artificial selection" because, he says, "its job is to separate human beings from all other actors (which we usually call *nature*)" (13). Artificial means ""opposed to natural,'" he explains, and so using the term would falsely affirm our "nature-mastering" self-image and thus our actions and influences as fundamentally different from what's in the rest of the world (13). Charles Darwin, writes Russell, "wanted to blow down the walls separating the human from the natural" (15). Russell intends his book to follow in Darwinian tradition so we may assume that he too is interested in blowing down such walls and perhaps even aiding an escape out of our "selfish skins." Furthermore, Russell is concerned that human-induced evolution not be mistaken as "artificial" in the sense of *"false* and *feigned"* (13). Human effects, he explains, are not "imitation evolution." "Human-shaped" or "human-induced" organisms are, he argues, no less real and important than those of other species. To head off such confusions between what may be human and natural and between what may be real and fake, rather than "artificial," Russell prefers the term "anthropogenic evolution" (14) to encompass any selective "changes in inherited traits or genes of populations over generations" that involve humans methodically or unconsciously (16).

And it is not only the new historic tale of dogs evolving into being that may erase a supposed boundary between artificial and natural, decentering us. Additionally, we may need to credit unconscious anthropogenic evolution, Russell argues, for the entire agricultural revolution, dependent as it was on a similar process of domestication of a host of plants and animals—from chickpeas to cotton and olive trees to horses and rabbits. That is to say, he writes, the modern civilization that has unfolded over the past ten thousand or so years from the "most radical transformation in human history" began by accident as opposed to human intention (60). Moreover, this transformation of our environment has circled around to further change inherited human population traits over time, too (89). For example, northern Europeans eating an agrarian diet lacking in vitamin D evolved light skin—a characteristic allowing their bodies to sequester more of this nutrient from the spare sunlight (89)."Do you feel the arrow in the heart of our self-image?" Russell asks. If civilization is founded on evolutionary accident and co-evolutionary forces and not human invention then we cannot think of ourselves strictly as the nature-mastering species that makes plans and carries them out (60), he suggests.

Furthermore, Russell unfurls his own research on the evolutionary history of Old World and New World domesticated cottons and expands his possibly humanity-humbling argument further. He suggests that unconscious selection by Amerindians in the New World led to the evolution of long-fibered varieties there. These varieties were the necessary precondition for the invention of spinning and weaving

[18] Gopnik, "Dog Story," 49.

machines in England. That is, credit for the rise of the English textile industry goes to biological innovation interacting with the accumulation of short-term human decisions, not to the foresight of human genius as the "spark." Moreover, if the cotton industry was not only a leading sector, but caused the Industrial Revolution, as some other historians argue, then unconscious anthropogenic evolution of this plant ignited that entire 18th-19th transformation (103). Albeit, the happening was mixed with an ample measure of a pre-existing fairly stable British cultural bias toward using discoveries for generating better material lives and more wealth quickly. (Or else why notice and possess the longer-fibered kind of cotton at all? Or, why not, once found, use it to weave higher quality fabric by hand that craftspeople in some local places in India had been doing with their sparer long-fibered varieties?)

But if believing that the agricultural and industrial revolutions began as accidents in which humans were merely unconsciously involved and also consequentially altered themselves sends an arrow through the heart of our self-reliant self-image, then some recent stories of intentional selection, it seems, may do the opposite. Like Virgil's Aeneas—helped by the power of his goddess-mother Venus—we may slide the arrow right back out, regain our god-like confidence, and get on with our at least centuries-old task of consciously expanding human empire. There is another way to think about boundary lines, centers, and circles. Rather than coming to see ourselves increasingly as one of many other species, we can imagine ourselves becoming de-centered by expanding into the whole circle—that is, literally engulfing the world. In this case, perhaps you could say that humans as selves have become "globaled." Following this way of thinking seems, too, to make the line less solid between "anthropogenic" and "natural selection." The latter is a term, Russell points out, which Darwin employed to help 19th century readers understand that the then-familiar intentional processes of domestic breeding also took place all around them even outside of human activities. These very same processes, in fact, had also evolved and were continually shaping our own species. But if the whole world is now becoming molded by *Homo sapiens* presence—whether we meant it to be so or not—and if we are no less "natural" than any other being or process, then why would there be a need for any adjective to describe "evolution?" This is not a new argument, of course. Nor is it one that Russell is necessarily making. It just seems possible to do so working within the tensions of the ideas he presents.

At any rate, human culture is included in Russell's broad purview of anthropogenic evolution. He chooses a recent anthropological definition of culture as generally "*ideas about how to do things"* (95). And, he says, culture may be thought of in terms of units of inheritance named "memes" by evolutionary biologist Richard Dawkin's. Memes and genes, then, may interact resulting in evolution. For example, U.S. government subsidized corn syrup and wide-spread obesity are cultural factors shaping selective environments of human gut bacteria; industrial-economic goals and burning the coal conveniently underfoot and then not burning it in England changed the surroundings of peppered moths and thus their cryptic coloring and perhaps predator-prey relations; and global climate change influencing the timing of

seasons and thus phenological events in populations of Californian wild mustard, Spanish fruit flies and Canadian squirrels with largely unknown rippling consequences. Climate change, which Russell could give much greater emphasis, is also driving extinction of up to a third of the world's species, gravely diminishing genetic and every other scale of biodiversity. These provide examples of unconscious culture-gene interactions resulting in evolution at personal, regional, and global scales (explained in a chapter that Russell somewhat misleadingly titles "Altering Environments," which actually focuses on species we tend not to notice because they are not directly useful or harmful to us). Then, too, culture-gene evolution may also be methodical or goal-oriented, Russell explains, including intentional breeding—the more recent efforts to produce cotton plants adapted to the hot, dry American Southwest, for instance—and a host of "new biotechnology" (75) techniques. These latter include genetic engineering, which alters the target organisms' genetic variation—on which evolution relies—and thus, in Russell's scheme, is rightly sheltered under the umbrella of evolutionary history. An example is the story of "why" unconsciously domesticated cottons eventually became "transgenic" (79). Indeed this is a story, and many others like it, that needs telling.

But genetic engineering, as Russell admits, is different from intentional breeding not only in degree of human control over evolutionary processes, but in kind. It is, he writes, a technique for "outdoing evolution" (75). Humans move genes from one species to another—for example, from bacteria to a cotton plant, or even from one kingdom to another, such as from a firefly to a tobacco plant. People are thereby linking organisms that could never mate without our intervention, creating novel combinations that depend on us for reproduction and survival. Surely with genetic engineering—intentionally penetrating, breaking, and transforming genetic codes—we have gone even further than thinking of ourselves as god-like "master breeders." We can see ourselves employing these techniques not only as god-like, but as actual gods. "For the first time, God has competition," wrote the editors of *Nature* in 2007, with regard to newly emerging biotechnologies. They could make it possible "to supplant the world created by Darwinian evolution with one created by us."[19] In which case, indeed, we would have become, if not gods, then very nature itself. Perhaps then we have ended nature, as climate change author and activist Bill McKibben has argued,[20] and have also lost ourselves in the process—a deep-seated fear of many today, according to historian of technology Helga Nowotony.[21] Anthropogenic climate change already has altered the environments shaping the evolution of all of Earth's life, including our own, of course. Russell, unsettlingly, appears to take the continuing rise of genetic engineering, paired with that of industrialization, as inevitable matters of course. Assuming humans continue in this direction, assuming, that is, that the walls between human and natural selection are further blown down in this way, then not only are we *not* escaping our selfish skins.

---

[19] Michael Specter. "Life of its Own." *The New Yorker* September 28, 2009: 56-,
[20] Bill McKibben. *The End of Nature*. (New York: Random House, 1989).
[21] Helga Nowotony. *Insatiable Curiosity: Innovation in a Fragile Future*. (Cambridge, MA: MIT Press, 2008)

Rather, as long-standing, inevitable, and as far as we know unalterable a process as evolution is (100), we are indeed swallowing it and everything else into them.

If we are doing so, we are doing so by the powers of humanity's uniquely evolved capacity for symbolic consciousness.[22] Recently, scientists and humanists have been explaining in more detail the ways our envisioning uses of language and metaphor influence the ways we treat the world of life and the consequences.[23] As the co-authors of another new book titled *Journey of the Universe*, Brian Swimme and Mary Evelyn Tucker point out, thinking in engineering terms and thinking of "nature" (potentially including even ourselves) in such terms "is natural to us, because we ourselves use our hands to manipulate matter and our brains to work out a plan of action." We do so all the more because we live now in a world permeated by machine systems. But, they write, to use such images "for nature's creativity diminishes the insights into life that Charles Darwin bequeathed to us."[24] Environmental historians, ecologists, and other environmental thinkers have also long shown us that doing so leads humans to act in ways that degrade Earth's self-renewing, life-generating capacities.[25]

Yet Russell, in his admirable zeal for cross-fertilization between evolutionary history and the history of technology, often recommends the use of such limiting engineering mental images (though he also shows how "evolutionary physicians" have veered away from them [149]). These are implicit with an unrealistic view of nature as consisting of potentially inexhaustible natural resources that are severable from each other and can and should be manipulated in accordance with human plans—namely ongoing, albeit evolving, industrialization. This occurs at the scale of DNA, for example, where stretches of it within humans (i.e., implicitly part of nature) regulate the operations of genes turning on and off, which "are like the people (managers) who decide whether to put other people (employees) in a given factory to work" (92). "Imagine," too, Russell writes in reference to what may be the deeper changes in canid genomes accompanying domestication, "a fox's body as a factory" with genes as "workers" and traits as products (64-65). Thinking of organisms as factories meshes easily with Russell's argument that domesticated plants and animals are biotechnologies, blurring the line between what is a machine and what is a living being. A guard dog, for example, is a "biological artifact" (135). While perhaps the dog is not strictly a machine, it is still a tool, just as an alarm

---

[22] Brian Swimme and Mary Evelyn Tucker. *Journey of the Universe.* (New Haven: Yale University Press, 2011).
[23] Brendon Larson. *Metaphors for Environmental Sustainability: Redefining Our Relationship with Nature*. (New Haven: Yale University Press, 2011).
[24] Swimme and Tucker, *Journey of the Universe,* 52.
[25] For example see, Aldo Leopold. *A Sand County Almanac*. (New York: Oxford University Press, 1949); Donald Worster. *Dust Bowl.* (New York: Oxford University Press, 1979); Terry Tempest Williams. *Refuge.* (New York: Vintage Books, 1992); Julianne Warren. *Aldo Leopold's Odyssey*. (Washington, D.C.: Island Press/Shearwater Books, 2006); David Montgomery. "Is Agriculture Eroding Civilization's Foundation?" (2007) *GSA Today* 17(10): 4-9; Bill McKibben. *Eaarth*.(New York: Times Books, 2010); Anthony Barnosky, et al. "Has the Earth's 6th Mass Extinction Already Arrived?" *Nature* 471: 51-57.

system is, Russell says. They both were unconsciously or intentionally "shaped by humans to serve human ends" (135) and, in this case, also have the same purpose.

The machine is not merely in the garden, says Russell, turning Leo Marx's famous phrase inside out, the "garden is in the machine" (135). But what does this mean exactly? It seems to mean, in Russell's scheme, intentionally adapting living beings to an increasingly techno-industrialized world, further drawing them into our globaled selves. To this end, Russell recommends that, inspired by the frameworks of historians of technology, evolutionary historians may helpfully analyze plant and animal breeding as technological innovation. Perhaps they might discover that biotechnologies are better suited (i.e. are more efficient and cost effective) to industrialization than machines because they contain their own means of production. Indeed they are also the product. It may be that, looking back, Russell suggests, historians of the future might see multiple forms of biotechnology as the second wave of industrialization, supplanting non-living machines with living ones. An agricultural scientist puts it this way: hogs need to be modified so as not to use "'poor machinery to put the raw product [feed] through'" (136). Russell leaves us to imagine an assembly line that is also the product and the workers. Imagine a corn plant, a pig, a chicken, a whole farm each as a factory or complex of factories, he says, converting raw materials into products—the flesh of themselves. If it turns out that we have this second wave—would this revolution be an intentional one on our parts? Do degrees of intentionality of evolutionary involvement result in different ramifications in terms of human responsibility for intended and non-intended consequences?

Perhaps the tension in Russell's work—pulling between unconscious human-partnership with the rest of nature and ongoing domination of it—in *Environmental History* is intentional. Perhaps on the other hand it is at least a partly unplanned manifestation of what Nowotony describes as a key cultural resource and characteristic of modernity—ambivalence—potentially giving rise to creativity and innovation (14). At the same time, Nowotony raises a key question for our times: "if not everything that is scientifically possible can or should be realized, what criteria of selection should be applied…?" (17) She points out that Darwin himself considering how to weave together his public concept of "natural selection" once said: "How odd it is that anyone should not see that all observations must be made for or against some view if it is to be of any service!" (45). To better understand how to innovate under today's increasingly uncertain conditions (116-117) and how to address present controversies, society needs, writes Nowontony, "a normative foundation, a basic consensus (which is hard to achieve), as well as legal and political regulations and their implementation" (161). Will "evolutionary history" argue for or against particular views of proper human relationships within the world? I would like to contend for a view in which humans are neither the center nor the whole, but are co-equal members of Earth's community. In an interdependent world it is only in this way that there is any chance that both our selfish and unselfish interests can be met. In the interest of such a view I find that

there are a few vying insights that could use more emphasis in Russell's stimulating work and in the work of those who follow after it:

1. There are other ways to define culture than so generally as "ideas about doing things." Defining it differently may shift the framework of understanding meme-gene interactions. Indeed, the root of the word "culture" means "to worship." The term was first tied to working with the land itself. Following in this etymological tradition, the 20th century ecologist and conservation-thinker Aldo Leopold defined culture as "our understanding of the land and its life."[26] This is closer to environmental historian Donald Worster's definition of "culture as an adaptation," as Russell points out in passing near the end of his book, and as "'a mental response to opportunities to pressures posed by the natural environment'" (146). As humans re-shape the world, they reshape selective pressures and potentially their mental responses to it thus returning to influence the world and so on. Our understandings, though, tend to change faster than do our biologically inherited traits as both Russell (100) and Leopold point out. Leopold believed that such different rates meant that until the moral and prudential necessity of expanding humanity's circle of care to include all of life became instinct people needed a conscious land ethic. A land ethic would help us envision human relationships that promote the health of nature as an ecological and evolutionary whole with ourselves as humble members of it.[27] Russell voices moral concern over deterministic misuses of evolutionary and historical ideas, particularly where eugenics and racism are concerned (101) but does not much extend that concern to environmental justice or the mutual well-being of all evolving life forms. He leaves the morality of environmentalism largely in the hands of "environmentalists and environmental historians." This group, he says, also tends to focus on "community, ecosystem, and population ecology" (147-148), incorporating study of a multitude of interrelationships.

2. While helpfully urging environmental historians to build more bridges between ecological understandings and evolutionary ones, Russell himself in other ways tends to underemphasize the relationship between them, inclining to distinguish them from one another (142). In his book Russell does refer to complex ecological interrelationships, for example, bringing in the concept of food webs with regard to "indirect" influences that human activities may have on other organisms (49). But, generally, when Russell references "ecology," it is with a fairly limited view (e.g., having to do with "population size and habitat" [26]). A line between evolution and ecology, whoever may be drawing it, however, is an artificial one. It was by observing the inter-relationships among organisms that Darwin could discern the mechanisms of evolutionary transformations. Moreover, the German polymath, Ernst Haeckel, defined the new term "oecology" in 1869 as inseparable from Darwinian understandings. The new science was, in his words, "the body of knowledge concerning the economy of nature [*Naturhaushalt*],…in a word, ecology

[26] Aldo Leopold. "The Role of Wildlife in a Liberal Education." *Transactions of the Seventh North American Wildife Conference*, 1942: 485-489, 485.
[27] Leopold, *A Sand County Almanac*, 202-203.

is the study of all those complex interrelations referred to by Darwin as the condition of the struggle for existence."[28] Leopold more recently recommended thinking of evolution and ecology at right angles to each other. If ecology is in the here and now, evolution happens continually along the "arrow of time,"[29] connecting into a long story all the unfolding "heres and nows" to the deep past and deep future, not to mention potentially nailing humanity in the heart.

3. Russell vitally emphasizes the proximity of evolution in time and space: "Evolution is ordinary, not exceptional. It happens all around (and inside) every one of us—you, me, and the dog next door—every day. We rarely notice it, but it shapes our lives continually" (5). Noticeable evolutionary changes can take place in matters of days to years. This is true particularly in the cases of small-bodied, quickly reproducing, and generalist organisms—whether that may be within the bacterial community of our guts or on our hands or a plant, insect, or rodent population in a field or forest. Yet, as Russell acknowledges, all shorter-term evolutionary changes take place not only within the context of *Homo sapiens* decadal generations to thousands-of-years' history, but within that of evolution's billions-of-years' time scale (100). Indeed evolution's own long history inclines Russell "to accept evolution as inevitable" (100) whatever roles humans may play in its unfolding dramas. It thus seems best, he writes, for us not to try to find ways to halt it, but to adapt to it. Indeed, this is a vital point. And yet here again Russell could go farther in connecting anthropogenic evolution to wider contexts. While evolution may happen relatively quickly, often its changes are slow and local within dynamic, but long-established communities.

Recent widespread human changes to nature are rapidly outpacing the capacity of many organisms embedded in long-term co-evolutionary interrelationships to adapt to what we in the "Anthropocene" (49) are doing. It is difficult predict who will be the winners and losers as the future unfolds. Russell, employing the words of evolutionary biologist Douglas Futuyama, points out near the end of his book that evolution contains an "element of historical contingency" (149). Like other fields of history, Russell says, evolutionary science may help explain how past happenings developed along certain pathways instead of others into the properties of "living systems" today, arguing against determinism of various sorts. One thing that science has shown us, though, with multiple strands of supportive evidence, is that evolutionary processes accumulating changes over billions of years of "here and now" have exhibited ongoing patterns—adding up to increasingly more diverse, more complex, and more intricately interdependent life on Earth. That growing

---

[28] Ernst Haeckel. Inaugural lecture at the University of Jena, Germany, 1869 quoted in W.C. Allee, et al. *Principles of Animal Ecology.* (Philadelphia: Saunders, 1949). According to R.C. Stauffer. "Ecology in the Long Manuscript Version of Darwin's *Origin of Species* and Linnaeus' *Oeconomy of Nature." Proceedings, American Philosophical Society* (1960) 101(2): 235-241, Paul Oesher in"The Word 'Ecology.'" *Science* (1959) 129:992 points out that Henry David Thoreau used the term "ecology" in a letter dated January 1, 1858.

[29] Ilya Prigogine. *The End of Certainty: Time Chaos, and the New Laws of Nature.* New York: The Free Press, 1996.

ecological intricacy of life has connected Earth's uniquely life-sustaining atmosphere with the fertility of its soils over time to enhance its "capacity for self-renewal" or, in other words, its "health."[30] This reality is awe-inspiring, if not respect-instilling. In contrast, the new reality that humans have brought is the opposite—a rapid widespread diminishment in diversity, fertility, and health. Looking forward from as recently as 200,000 years ago when our species emerged, who could have predicted this? What does the future potentially hold and which path(s) might be best to take? How will evolutionary history help modern humans align with the deep history of evolution's ways, which scientific evidence shows promote flourishing life?

4. Finally, in the last pages of his book, Russell explains that a colleague of his recommended that he "slice through the Gordian knot of terminology." Rather than calling "evolutionary history" a subfield or research program of environmental history or something else, Russell's friend recommended that he simply distinguish it as a "*field.*" It may be that for the sake of creativity scholars interested in the evolutionary relationships between humans and other species over time could benefit from separate spaces to creatively develop. On the other hand, Russell, in his bold efforts to show how various fields of history and evolutionary biology may interact, neglects how all of them and every other besides might work together to better understand the world and orient ourselves within it to the mutual benefit of all. Members of all disciplines—anyone concerned about the possibilities of thriving lives—need to better conceive and work toward mutually agreed upon ideas of a good future grounded in the unfurling realities of the past and the uncertainties unfolding out of the present.[31]

In the real world, for billions of years, evolution has involved dynamic relationships among waters, rocks, soils, atmosphere, the sun's energy, plants, and animals, with humans coming along late in the game. Because the world is so interconnected, Leopold came to understand that it is not divisible into fields of study. He came, too, to believe that ecology—the science of interrelationships—was likely the "fusion point of sciences and all the land uses."[32] Ecology, he believed, could help us "learn more and more about the whole biotic landscape"[33] in ways helpful to aligning with an authentically hopeful future full of healthy life. Ecology can help us see in front of our eyes the consequences of the processes of evolution--interdependency. If we realize this, our circle of caring, moreover of love, may naturally grow to embrace all life—right here, right now. Leopold went so far as to say that ecology is "superior to evolution as a window from which to view the world."[34] Russell helps us to re-think that claim, showing us that evolution has been under-appreciated as a point of view. Ultimately, however, I am unconvinced that "evolutionary history" is best developed

[30] See, for example, Leopold, *A Sand County Almanac*, 221.
[31] Julianne Lutz Warren. "Urgent: Dreams" *Journal of Environmental Studies and Sciences*. Forthcoming, 2011.
[32] Aldo Leopold. "A Biotic View of Land." *Journal of Forestry* (1939) 37 (9): 727-730, 30.
[33] Aldo Leopold. "The Round River: A Parable." Pages 158-165) in Luna Leopold (ed.) *Round River: From the Journals of Aldo Leopold*. (New York: Oxford University Press, 1993), 159.
[34] Leopold, "Wildlife in a Liberal Education," 489.

as a separate field. Rather, I find myself wishing that environmental historians would take the lead in further developing evolutionary ideas connected with ecological understandings. Furthermore, I wish that all historians, all people, in fact, would come to understand that their work is inseparable from the real soil and water, chlorophyll and sunlight, flesh and blood world.

Finally, in his musings about dogs, Gopnik suggests that from wolves they may well have "first emerged…as the dream companion of a child"[35]—of some adults, too, I can personally attest—who simply wanted them around for petting. If our dreams can come true because our hearts are thus open, perhaps with or without a piercing arrow we have always known that we are not alone at the top of the world nor have we ever wanted to be. Then, too, perhaps our imaginations have a larger capacity than we tend to realize. If we can envision fireflies in tobacco perhaps well-supplied with evolutionary and ecological and a host of other understandings we can also picture a healthy world of intertwining communities where factories, for instance, are redesigned as water-purifying organisms and fuel-driven machine-made cars developed into "nutrivehicles"[36]; industrial farms become "perennial polycultures";[37] and desert oases inhabited by people consequentially grow to be more biologically diverse.[38] Might it be that modern humans can now choose to evolve into beings that benefit Earth's evolving capacities for self-renewal?

[35] Gopnik, "Dog Story," 49.
[36] William McDonough and Michael Braungart. *Cradle to Cradle.* (New York: North Point Press, 2002).
[37] Wes Jackson. *Consulting the Genius of the Place: An Ecological Approach to a New Agriculture*. (Counterpoint, 2011).
[38] Gary Paul Nabhan. *The Desert Smells Like Rain.* (Tucson: The University of Arizona Press, 1982).

Author's Response by Edmund Russell, University of Virginia

My thanks go to Jacob Hamblin for assigning *Evolutionary History* to four superb scholars and to the reviewers for reading the book closely, writing thoughtful reviews, and saying many kind things.

My goal for this book was to spark discussion about the role of evolution in human history, rather than to have the last word on the topic, so it is gratifying to see two patterns in the reviews. First, the reviewers seem to agree with my main point that anthropogenic evolution has been an important and understudied aspect of history. Second, the reviewers' mainly call for extensions of the ideas in the book rather than for their revision. No author could ask for more. I will focus the rest of this essay on topics that reviewers identified for elaboration.

I like Joseph Taylor's suggestion that *Evolutionary History* broadens our thinking about the Anthropocene, the proposed term for the geological era dominated by human activity. Prominent advocates of this term have used carbon dioxide levels as the primary index of human impact on the earth. This index has led some researchers to identify the Industrial Revolution as initiating the Anthropocene because it sparked heavy use of fossil fuels. Other researchers have argued that the Agricultural Revolution increased levels of greenhouse gases much earlier, so the beginning of the Anthropocene should be located thousands, rather than hundreds, of years ago. Carbon dioxide is not the only measure of human impact. Geologists have the privilege of naming geological periods, so perhaps it is not surprising that some have suggested that human impact on the pedosphere (the soil layer between the earth's outermost rocky layer and the atmosphere) provides another measure. This measure, too, suggests that the rise of agriculture initiated a new geological era because plowing, planting, and erosion had a measurable impact on soil traits.

Anthropogenic evolution (human-influenced change in inherited traits of populations of organisms) could be another measure of impact. Trait changes of organisms under domestication, which archaeologists have documented, show the past impact of people on the world around them. Using anthropogenic evolution as the yardstick could reinforce dating the Anthropocene to the Agricultural Revolution and its spate of domestication events. I do not know the degree of change geologists consider necessary to divide one period from another, and I have not tried to quantify the scale of anthropogenic evolution over time, so I am not prepared at the moment to stake a specific claim using this measure. But Taylor's suggestion is fruitful. It would be valuable to try to measure the rate of anthropogenic evolution in the past and see what changes in the rates might tell us about the scale of human impact. I will return to the theme of the rate of anthropogenic evolution below when discussing Mark Barrow's review.

Taylor wonders why the book does not use the terms *microevolution* and *macroevolution*. For readers unfamiliar with these terms, let me supply definitions from Douglas Futuyma's textbook in evolutionary biology. *Microevolution* is a "vague term for slight, short-term evolutionary changes within species." *Macroevolution* is a "vague term for the evolution of great phenotypic changes, usually great enough to allocate the changed lineage and its descendants to a distinct genus or higher taxon."[39] Futuyma's references to vagueness tell us something about the dicey status of these terms within evolutionary biology. I included *microevolution* and *macroevolution* in the manuscript of the book, but an evolutionary biologist who reviewed it recommended removing them. He pointed out that the terms imply a difference between evolutionary processes that result in small changes in populations and those that result in large changes. The process is the same in both cases, he emphasized, so it is better to refer to all evolution as evolution. This criticism made sense, so I removed the terms.

Taylor suggests that I do not "try to unpack the language of genes and genomics," which have had a big impact on evolutionary thinking. I am not sure I follow Taylor's point for *genes*. Pages 11-12 discuss the modern synthesis of evolutionary biology with genetics, several places in the text discuss genes and genetics, and the glossary defines *genes* and four terms beginning with *genetic*. Taylor is probably right about *genomics*. I do not remember using the term. I wrote this book primarily for historians and aimed to reduce the number of biological terms to a minimum. Before including a biological term, I asked myself whether it would help or hinder a general reader's understanding of my arguments. I have been reflecting on *genomics* since reading Taylor's review, and I am uncertain how the term would have clarified an argument in the book. But it is a good sign that Taylor thinks it would. I hope that many scholars will see topics or ideas that could have been in the book but are not, and I hope they will research them. *Evolutionary History* has little to say about pigs, one of the more important domestic animals, so it was great to see Sam White publish a superb essay on the evolutionary history of this species.[40]

Mark Barrow is "not entirely convinced that evolutionary history deserves to be a historical field of its own." Fair enough. I am not entirely convinced, either. In recent presentations, I have tended to refer to evolutionary history as a research program (a term also suggested in the book). I have no plans to try to found a journal or create a new professional society devoted to evolutionary history. Instead, I hope to see this approach thrive within existing fields, especially environmental history and the history of technology. My dream is to see it infiltrate unlikely fields, too, such as art history and the history of leisure (for hints about how it could, please see the discussion of elephant evolution in the book). In many ways such infiltration would mark the extension of environmental history (with

[39] Douglas Futuyma, *Evolutionary Biology*, Third Edition (Sunderland, Mass.: Sinauer Associates, 1998), glossary (unpaginated).
[40] Sam White, "From Globalized Pig Breeds to Capitalist Pigs: A Study in Animal Cultures and Evolutionary History," *Environmental History* 16 (2011): 94-120.

evolutionary history an approach within it) to other fields, and this outcome would make me very happy.

Barrow's musing on the timing of *Evolutionary History* is intriguing. My volume does resemble Michael Pollan's *Botany of Desire* and other popular books in spirit. Newspapers do carry reports about unhappy results of evolution (such as pathogens resistant to multiple antibiotics). Books and reports of the sort Barrow mentions influenced my thinking, so more than coincidence is at work.

The broader question, and the one I think Barrow is really posing, is why so many people are talking about evolution now. I have a hypothesis: because anthropogenic evolution is accelerating. It is accelerating partly through intentional efforts, such as breeding and genetic engineering. And it is accelerating because of accidental effects. The more we change the earth's ecology, the more populations of organisms adapt to the changes (or, if the change is too great, they go extinct). I suspect that the rate of anthropogenic evolution correlates with the rate of economic change. Here we return to the scale question raised in Joseph Taylor's review. One of the challenges evolutionary historians could take up is determining the scale and speed of anthropogenic evolution in various periods of the past and seeing to what extent they form predictable patterns.

Anita Guerrini would like to see more discussion of the reasons that historians have paid little attention to evolution as a force in history. In the book, I suggest that one reason might be a lack of knowledge about biology. This lack is understandable. History departments do not require courses in biology, and some historians feel (as I did) that they do not have a knack for science. To solve this problem, *Evolutionary History* includes a section describing some low-risk ways for historians to learn biology. I meant this section as an invitation to do something I have found fun and valuable. I have learned, however, that it may have sounded like a demand. At presentations, a couple historians have asked why they cannot collaborate with biologists rather than mastering the science themselves. This roundtable gives me a chance to clarify that I did not mean to slight collaboration. It is a great idea (I am doing so on a project now). I do think evolutionary historians need to master basic concepts and terms from evolutionary biology in order to understand and communicate with collaborators, but forming research groups to pair complementary skills would be an effective way to do evolutionary history.

Julianne Lutz Warren's review is the most wide-ranging and philosophical of the four. I cannot address all the points she raises, so let me focus on what seems the review's heart: "the tension in Russell's work—pulling between unconscious human-partnership with the rest of nature and ongoing domination of it." In replying, I think it would be helpful to distinguish descriptive from normative goals.

Evolutionary History was intended to be descriptive more than normative. From this perspective, I see less of a tension than Warren might. *Evolutionary History* describes people both as part of the community of species and as an especially

powerful member of the community. One of my favorite examples of partnership is that about ten percent of the cells inside the volume we call our bodies are human. Ninety percent of the cells belong to other species, primarily bacteria in our gut. Without these mutualists, we would be unable to digest food and would die. Domestication has also created partnerships with populations of other species. Domestication has traditionally been seen as a process through which people mastered other species, but I have come to see it as the development of a relationship with reciprocal obligations. Domestication places demands on human beings for certain kinds of behaviors, so domesticating populations of other species requires also domesticating ourselves. A coevolutionary framework, the focus of one of the chapters of the book, provides a useful framework for understanding how and why people have developed partnerships with populations of other species.

At the same time, the book describes the impact of human beings on the rest of nature as growing over time. Many environmental historians have documented a similar pattern, though primarily using ecological yardsticks (impacts on the distribution and abundance of species). The focus in *Evolutionary History* is to highlight the evolutionary mechanisms and consequences of this increasing scale of impact.

The book also shows that, because of evolution, human beings have found some conquests to be temporary. Pathogens and insects have evolved resistance to antibiotics and pesticides, setting off coevolutionary arms races between traits of human populations (introductions of new technologies) and traits of non-human populations (genes that confer resistance). So evolutionary history has the ability to challenge our hubris in believing we have truly conquered the rest of nature.

Is there a contradiction between describing people as partners, as conquerors, and as conquerors with Achilles heels? I do not think so. The differences are largely a matter of degree of impact (all species have an impact on their surroundings, at minimum by ingesting food and taking up space, even when they seem more like partners than dominators of an ecosystem), so I see a continuum more than separate roles. The degree of impact has varied in time and space, and I am comfortable trying to document a range of degrees.

Although the book is not meant to be primarily normative, I did take a stance on misuse of biology for social purposes. Among other things, I wanted to show that genetics and evolutionary biology counter, rather than support, beliefs underpinning social evils such as racism. Many people believe there is some genetic basis for dividing people into races, and racists have used this belief to argue that some races are innately superior to others. But genetics offers no basic for racial divisions. The vast majority of genes are identical among human beings. Differences in traits shade into each other with no clear lines. Traits vary independently of each other. So races are social constructs, not biological realities. The argument for treating all people with equal dignity has nothing to do with real

or imagined genetic differences among populations. It is that we are all human beings.

Warren wishes the book had tackled a different project, which is to propound a specific normative stance on human relations with the rest of nature: "a view in which humans are neither the center nor the whole, but are co-equal members of Earth's community. In an interdependent world it is only in this way that there is any chance that both our selfish and unselfish interests can be met." While I agree with this sentiment, and agree that scholars should be writing about these issues, I disagree that every work of history should be normatively prescriptive. Doing so makes it all too easy to slam earlier generations of people for not living up to today's standards of behavior, which runs counter to the goal of understanding people in their context.

Although largely beyond the scope of my book, Warren's normative concern about relations between people and other species is important. Should we see ourselves as part of nature or as its conqueror? The idea that we should take a humble, wise approach to nature is common among environmental historians, including me, so I will not belabor the idea here.

I find it less obvious that trying to conquer parts of nature is necessarily evil. My view grows largely out of experience as a volunteer in the rural Philippines. I frequently saw funeral corteges with coffins a few feet long. The children in the coffins died from preventable diseases. I contracted two nasty, sometimes lethal diseases—typhoid fever and amoebic dysentery—and can report that having them is no fun at all. Antibiotics helped cure and prevent me from transmitting these diseases to other people. When I returned to the United States after drinking boiled water for two years, I turned on the tap in my parents' house and watched the water run for about twenty minutes while saying over and over to myself in wonderment, "I can drink this water and it will not make me sick." I have two daughters. Both have survived to their teenage years, and they have not suffered from typhoid, cholera, typhus, pertussis, smallpox, or mumps. Clean water and vaccinations helped them to do so.

My point is twofold. First, it is easy for those of us who have benefited from the conquest of nature to take the benefits for granted and focus only on the abuses. I had taken clean water and good health for granted for 22 years, and in that time had often seen nature in romantic terms. Hard experience taught me otherwise. After I returned to the US, I saw scrawled on a young man's backpack, "Take care of nature, and nature will take care of you." I chuckled and said to myself, "I bet that guy never had typhoid fever." Second, I believe that saving human lives is good. I am glad to have survived diseases that have killed many other people, and I am glad my daughters both survived childhood. I am glad that I am not transmitting typhoid or amoebic dysentery to other people. I honor the people who have made possible these and other improvements in human health. I believe their work has been morally good.

So, whereas Warren seems to see partnership and conquest as mutually exclusive and morally incompatible (she asserts that "only in" embracing partnership can we succeed), I see a continuum of effects and an ethical dilemma in which we are choosing between competing goods. As with other ethical dilemmas, a good solution requires hard thinking, tradeoffs, and creativity. I doubt this and other forms of ambivalence are unique traits of modernity. I suspect people have been making decisions about tradeoffs as long as they have had the ability to do so. My hope, shared with other environmental historians, is that understanding the consequences and tradeoffs of actions in the past can help us make better decisions about the future.

About the Contributors

Mark V. Barrow, Jr. is Professor and Chair of the History Department at Virginia Tech. He earned a Ph.D. from Harvard University in 1992, and is the author of *Nature's Ghosts: Confronting Extinction from the Age of Jefferson to the Age of Ecology* (Chicago, 2009). Aside from his continuing research on attitudes toward human-induced extinction, he is writing a cultural history of the American alligator.

Anita Guerrini is Horning Professor in the Humanities and Professor of History at Oregon State University. Her books include *Experimenting with Humans and Animals: From Galen to Animal Rights* (Johns Hopkins, 2003), and *Obesity and Depression in the Enlightenment: the Life and Times of George Cheyne* (Oklahoma, 2000). Currently she is writing a book, *The Courtiers' Anatomists*, about animals, anatomy, and natural history in the Paris of Louis XIV. She also is researching the role of history in ecological restoration, particularly through a study of the ecological history of a wetland in Santa Barbara, California.

Jacob Darwin Hamblin is Director of Graduate Studies in the School of History, Philosophy, and Religion at Oregon State University. He is the author of *Oceanographers and the Cold War* (University of Washington Press, 2005) and *Poison in the Well: Radioactive Waste in the Oceans at the Dawn of the Nuclear Age* (Rutgers, 2008).

Edmund Russell is Professor of Science, Technology and Society, and Professor of History at the University of Virginia. He is the author of *War and Nature: Fighting Humans and Insects with Chemicals from World War I to Silent Spring* (Cambridge, 2001). He won the 2003 Leopold-Hidy Prize for best article in the journal *Environmental History*, for "Evolutionary History: Prospectus for a New Field," *Environmental History* 8 (2003), 204-228. To follow up on his book *Evolutionary History*, he is currently working on a book titled *Gambling on Evolution: The Coevolution of English Culture with Fierce, Fleet, and Fancy Dogs*.

Joseph E. Taylor III is Canada Research Chair and Professor in History and Geography at Simon Fraser University. He is the author of *Making Salmon: An Environmental History of the Northwest Fisheries Crisis* (Washington, 1999) and *Pilgrims of the Vertical: Yosemite Rock Climbers and Nature at Risk* (Harvard, 2010). *Making Salmon* won the 1999 George Perkins Marsh Prize for best book in environmental history.

Julianne Lutz Warren is Master Teacher in the Liberal Studies Program at New York University. Her published writings include *Aldo Leopold's Odyssey* (Island Press/Shearwater Books, 2008). She currently is pursuing two projects, one about the relationship between hope and uncertainty in the Anthropocene, and another on the consequences of extinct birdsongs.