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A Place for Tigers

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Source: BioScience, 58(10) : 990-991

Published By: American Institute of Biological Sciences

URL: https://doi.org/10.1641/B581014

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In the Light of Evolution

Evolution. Nicholas H. Barton, Derek E. G. Briggs, Jonathan A. Eisen, David B. Goldstein, and Nipam H. Patel. Cold Spring Harbor, Woodbury, NY, 2007. 833 pp., illus. $100.00 (ISBN 9780879696849 cloth).

In his autobiographical book *Naturalist,* E. O. Wilson wrote that "in the 1950s and 1960s the molecular revolution had begun to run through biology like a flash flood" (Wilson 2006, p. 219). Today, something of the reverse is happening with the techniques and approaches developed by evolutionists permeating molecular biology. For example, phylogenetic analysis plays a critical role in tracing the origins of antibiotic resistance (Dantas et al. 2008), the predictive power of population genetics has assisted in discouraging the evolution of pesticide resistance in genetically engineered crops (Rausher 2001), and the rise of molecular taxonomy has vastly increased our awareness of microbial species diversity (Giovannoni and Sting 2005). In the past, this synergy has come awkwardly, perhaps because of a difference in scientific cultures.

The new text *Evolution* aims to provide students with the fruits of both molecular and evolutionary scientific cultures early in their careers, with the goal of making evolutionary biology more "accessible" to molecular biology students. The book masterfully covers the field of evolutionary biology from a multicultural perspective through the collaborative writings of a population geneticist, paleontologist, microbiologist, human geneticist, and developmental biologist. Like none before it, this book should successfully introduce evolutionary biology to the present generation of students while drawing appropriate connections to molecular foundations, concepts, and the potential for new, integrative directions.

In some ways, *Evolution* is suitable for any student new to the subject of evolutionary biology. The book is organized into four sections: an overview, the origin and diversification of life, evolutionary processes, and human evolution. The overview combines the history of evolutionary biology with the history of molecular biology. Here are found accounts of evolutionary thought before Darwin, events that influenced Darwin's life, the development of (and opposition to) his ideas, and the integration of multiple perspectives generating the "evolutionary synthesis" in the mid-1900s. Also sketched are the historical circumstances before the birth of molecular biology; the events leading up to the discovery of the structure of DNA; and the technical advances enabling the study of DNA, RNA, proteins, and their relationship to one another and to the evolutionary process.

The frequent comparison of failed and successful theories simultaneously conveys the excitement of discovery and the fallibility of human effort at the cutting edge of biological science.

These chapters are paired and integrated, setting the stage for an extensive summary and interpretation of evidence for evolution and the remainder of the book.

In the meaty midsections of the book, students are presented with the two fundamental aspects of evolutionary biology—pattern (emphasizing current knowledge and theories on the origins of life, deep history, and the origins of phylogenetic diversity) and process (emphasizing the mechanisms of population change). While molecular perspectives are given throughout, the excitement of recent genomic and proteomic advances fortunately do not upstage a clear articulation of the pillars of evolutionary process such as mutation, genetic drift, population structure, and selection. In fact, these subjects enjoy a spectacular and detailed delivery. Considerable attention is also given to phylogeny; "tree-thinking" and diversity (especially microbial diversity); the nature, quantification, and study of genetic variation; the origin of species; the evolution of phenotypic novelty; and, in the final section, human evolution. In addition, the text offers refreshing organizational perspectives on newly consolidated subjects such as "evo-devo" (evolution and development), "cooperation and conflict," and the evolution of genetic systems. Particularly astute analyses center on the role of optimization and constraints, evolutionarily stable strategies, and maintained polymorphisms, bringing together different traditions in evolutionary biology.

The overall treatment is quite thorough, with clear writing and engaging illustrations and photographs. At 833 pages, the book is an intense introduction to evolutionary biology, and students who are serious about digesting the material in this text will gain an impressive perspective on the subject. In other ways, *Evolution* will not be suitable for some courses. The genetic sophistication and integration of molecular concepts immediately bumps the discussion up to a more advanced level and could easily overwhelm beginning university students. Prior exposure to genetics and molecular biology is critical; without it, the pace through the text will surely be slow.

Given that the text operates on a relatively advanced level, students will find the extensive Web support to be exceptionally valuable for more in-depth coverage of particular topics (this resource is currently under construction, however). Fully referenced versions of the printed chapters are also available on the supporting Web site, but the conspicuous lack of references in the main text is unfortunate because students may not want to revisit material they have already read in the text. Hence,

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many students will remain ignorant of the link to the primary literature, and miss the associated message that the growth of scientific knowledge is an active process carried out by real people.

Despite this shortcoming, the authors do help students relate to the growth of scientific knowledge through considerable discussions of theories that have failed the test of time and scientific experimentation. Thus, on the positive side, the frequent comparison of failed and successful theories simultaneously conveys the excitement of discovery and the fallibility of human effort at the cutting edge of biological science.

Although I do not want to diminish the many excellent features of this book, the authors appear to have missed an opportunity in the treatment of the evolution of behavior. This is especially disappointing because behavioral evolutionary biology ("evo-bevo," if you will) is an exciting and rapidly growing field, fed by molecular advances in areas such as chronobiology (Tauber and Kyriacou 2008) and social evolution (Robinson et al. 2005), among many others. To be fair, some behavioral topics are covered in various sections, but a consolidated treatment would better serve students, as is done in at least one of the other major evolution textbooks. The evolution of behavior lends itself well to an integrated approach across levels from the molecular to the phylogenetic, in part because of the influence of behaviorists such as Nikolaas Tinbergen. Evo-bevo—evolution and behavior—would juxtapose nicely with evo-devo, as there is intense interest in the molecular, developmental, and physiological aspects of behavior, as well as in the origins, diversity, and evolutionary causes of behavior. Behaviorists are often exposed to different cultures in biology, and behavioral genomicists appear to show no particular allegiance to any level of study, yielding optimal conditions for discovery. Students drawn to the evolution of behavior would benefit tremendously from the subject matter of this book, and the evolution of behavior certainly would seem a natural extension of the current array of topics covered.

By integrating molecular biology and evolutionary biology, the authors exploit a relatively unfilled niche for evolution texts. Smaller works exist in this area, but they cannot compare with this monumental effort to convey the current state of a burgeoning field. Thankfully, the authors devote ample attention to the pillars of evolutionary biology while making evolutionary biology more interesting to molecularly minded students, thereby spreading Dobzhansky's message that "nothing makes sense except in the light of evolution."

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doi:10.1641/B581012
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A LONG AND FORKING ROAD

Human Evolution: Trails from the Past. Camilo J. Cela-Conde and Francisco J. Ayala. Oxford University Press, New York, 2007. 432 pp., illus. $69.95 (ISBN 9780198567806 paper).

Take a philosopher of science with a long-standing interest in human evolution, team him up with an eminent geneticist and evolutionary biologist, and you might legitimately expect that the resulting textbook would be a little bit different from the typical offering in paleoanthropology, a science that is unusually and frustratingly hidebound. Indeed, you might even pick up such a book anticipating a refreshing new perspective on the traditional story of human evolution—but you may find your hopes dashed if that book happens to be Camilo J. Cela-Conde and Francisco J. Ayala's *Human Evolution: Trails from the Past,* a translated work that updates and enlarges upon their *Senderos de la Evolución Humana,* first published in Spanish in 2001. On the other hand, if your expectation of these authors had been simply that they would do a thorough and professional job of reviewing the paleo- anthropological literature, and present that review clearly and literately, you would find yourself well satisfied. Cela-Conde and Ayala have produced a remarkably comprehensive overviewof the hominid fossil and artifactual records, and their presentation contains more than a perfunctory nod to history—something that is crucial in this particular arena, since most current interpretations of our fossil past are comprehensible only as modifications of earlier views.

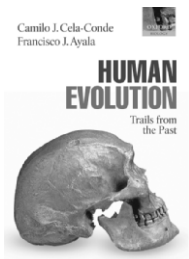
The volume opens with an oddly truncated chapter titled, "Evolution, Genetics, and Systematics." The authors' brisk review of evolutionary concepts essentially ends with the establishment of the evolutionary synthesis circa 1950: the short section on "the second half of the twentieth century" dives straight into the molecules, with nary a nod to punctuated equilibria, hierarchy theory, and all that stemmed therefrom. This omission alerts the reader to the fact that process will get generally short shrift as the book proceeds. But this is not the case with pattern. Cela-Conde and Ayala are scrupulous in paying due attention to the basics of species, systematics, and cladistics, and provide as useful a short review of these areas as can be found anywhere. Nonetheless, even though there is much that is forward-looking in this discussion, there are also nostalgic elements, as in the authors' enthusiasm for Ernst Mayr's "adaptive" concept of the genus.

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From this point on we are in the midst of the hominid fossil record, pausing only for a quick consideration of humanity's place among the living primates. The opening survey of primate evolution is simultaneously compact and comprehensive. Due consideration is given to a whole variety of viewpoints, and numerous text boxes provide lively vignettes dealing both with historical interpretation and with current controversies. The same applies to the remainder of the book, in which individual chapters deal with the earliest hominins (the authors seem to equate these with the tribe Hominini) and the origins of bipedal locomotion; with the South and East African australopiths, plus *Homo habilis*; with other "early *Homo*" and the East African "robusts," plus *Kenyanthropus*; with the subsequent radiation of *Homo* species and their spread around the world (opting for a "*Homo erectus* grade" as the most useful device for avoiding awkward systematic choices); with the "evolutionary characteristics" of the "erectus grade," including consideration of the archaeological record and of the earliest émigrés out of Africa; and with the "late Pleistocene transition," where the multi-regional hypothesis is broached and never quite dispatched, tough choices are once more avoided (this time by resorting to the "archaic *Homo sapiens*" concept), and there appears one of the best summaries available of the molecular evidence bearing on modern human origins and distinctiveness.

A final chapter on "the uniqueness of being human" considers cultural evidence for human cognition during the later Paleolithic. Again, the discussion is detailed and ecumenical, ranging eventually into questions of primate communication, of language, and even, very trendily, of moral sense. This is indeed where the philosophical and genetics backgrounds of the authors interact most profitably, and no matter where you may stand on the matter of whether moral codes are the specific product of a process of "cultural evolution," you will find this discussion a stimulating one.

Partly because of the sheer amount of ground it covers, everyone will find a trove of details to quibble with in *Human Evolution.* Still, that does not detract from the great strength of the book as a teaching (and learning) resource, which lies in its almost journalistic striving to represent or at least to reference all points of view, not to mention all major fossils. And while it is a bit frustrating not to have the slightest idea



about where the authors might come down on most issues, the meticulous attention their book pays to the literature makes *Human Evolution: Trails From the Past* useful not only as a text (in both advanced undergraduate and graduate classes) but also as a starting point for classroom discussion—no matter what the teacher's personal perspective may be on the issue at hand.

So while I am personally a little disappointed not to find more attitude between its covers, many will find that absence a positive, or at least a helpful, attribute. What's more, while the authors make few concessions to readers, they never write down to them, making the book, for the most part, a pleasure to read. The illustrations are numerous, varied, and well chosen, if a little small and on occasion muddy; and the English version is bang up to date. Price apart, this book is an attractive selection as a primary text in any human evolution course—whatever your own shade of opinion.

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doi:10.1641/B581013
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A PLACE FOR TIGERS

Life in the Valley of Death: The Fight to Save Tigers in a Land of Guns, Gold, and Greed. Alan Rabinowitz. Island Press, Washington, DC, 2007. 248 pp., illus. $25.95 (ISBN 9781597261296 cloth).

From his perch as executive director of science and exploration at the Wildlife Conservation Society, Alan Rabinowitz traveled to remote areas in Asia and the American tropics for two decades. His mission: conservation of large cats. His formula: find remote areas large enough to support a viable population of his target large cat, jaguar or tiger; obtain a political buy-in at the highest levels of government for his vision of the conservation landscape; build the managerial capacity to manage these large areas; raise the funds to support all of the above; and then move on.

Rabinowitz has reported to his constituents in *Jaguar: One Man's Struggle to Establish the World's First Jaguar Reserve, Chasing the Dragon's Tail: The Struggle to Save Thailand's Wild Cats,* and *Beyond the Last Village: A Journey of Discovery in Asian's Forbidden Wilderness.* In *Life in the Valley of Death,* he continues this tradition, reporting on his fight to fashion a 22,000-square-kilometer tiger conservation landscape: the Hukawng Valley Tiger Reserve in northern Myanmar.

To an earlier generation of Westerners, the isolated Hukawng Valley—nicknamed "Valley of Death" because thousands of refugees died there while fleeing advancing Japanese forces in 1942—was notorious World War II turf. When the Japanese forces choked off the 1130-kilometer Burma Road to Kunming, China, isolating Chaing Kai-shek's army, "Vinegar Joe" Stilwell resolved to reestablish the connection by retaking the Burma Road and connecting it with a new road, 770 kilometers long, leading from the Ledo railhead in Assam, India, and transecting the Hukawng Valley.

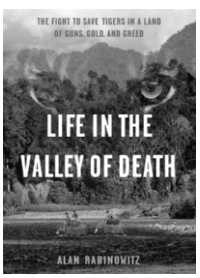
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Rabinowitz tells intertwining stories, as in his earlier books. He recounts the fragile state of wild tigers in this age of globalization and exploding Asian economies. He narrates his "discovery" of the Hukawng Valley and describes how he convinced Myanmar's ruling generals that this denuded landscape pocked with exhausted gold mines could serve a larger purpose in the country's future. He outlines his vision, or what he calls "the question of balance," in designing tiger conservation landscapes that meet the needs of tigers while also persuading the people who live there that, by agreeing to the conservation landscape, sufficient incentives will be created to make it in their best interest to become supporters and protectors of tigers rather than their killers. Through it all, Rabinowitz relates his personal life struggles in startlingly intimate detail, detracting from the focus on tiger conservation in an area seldom seen by outsiders.

The 1997 rangewide assessment of tiger distribution identified extreme northern Myanmar as a priority survey area because not enough was known about it to classify it otherwise. With his first expedition to the Hukawng Valley in 1999, Rabinowitz was smitten: "I have seen no other areas of this size anywhere in Asia in such pristine condition and with much of its wildlife seemingly intact" (p. 52). His survey teams had determined that tigers in Myanmar had been nearly extirpated, and the Hukawng was the best—the only—place where tigers could recover, if they were afforded protection.

Myanmar's director of wildlife, Khin Maung Zaw, and his staff established the 6500-square-kilometer Hukawng Valley Wildlife Sanctuary. They saw a larger, if more challenging, opportunity knocking, however, and so asked Rabinowitz for his help in presenting a bold plan to the minister of forestry for creating a tiger reserve that would encompass the entire valley. Forestry Minister Aung Phone agreed to the plan: "We must do whatever we have to in order to save tigers in my country. The Hukawng Valley is a big place, and there are many other interest[s] there. We will not move any people and you will have to work with them so that they benefit from the scheme as well."

Minister Aung Phone was wise. People who live with tigers ultimately determine the cats' fate. They must see the tiger as a living asset if they are to coexist. This is experienced in few areas today, for several reasons: Tigers occupy only 7 percent of their historical range, and tiger-occupied areas have shrunk by 40 percent in the last decade. Protected areas are rarely large enough to ensure their survival. Tigers are an enforcement-dependent species, and protected areas with porous borders are seldom able to effectively prevent tiger poaching, which is driven by a growing demand for tiger parts from increasingly affluent East Asian markets. In practice, enforcement is weak, and poachers and traders are seldom brought to justice.



The best way forward for Myanmar's few remaining tigers lies in landscape-level conservation that combines protected areas for forests and wildlife with national and local development activities that improve people's lives. Rabinowitz realizes this. He describes the rapid changes in the economy of the valley he and his colleagues must confront. For example, a bridge was built to improve access. An advertising campaign launched by the Ministry of Mines induced 50,000 gold miners to come to the Hukawng Valley to get rich. Miners have to eat, so local hunting for wildlife intensified, draining the valley of the large mammalian prey that tigers need. Tiger poaching intensified. Timber and other resources were used to support the gold mining, and rivers became polluted from the mercury in the gold mining tailings. Rabinowitz saw that conservation results could be achieved only through the head of military intelligence, General Khin Nyunt, to whom he wrote, unbeknownst to his colleagues in the Forestry Ministry. Those colleagues were not pleased when military intelligence agents came knocking on their doors "requesting" files.

With General Khin Nyunt's approval, the Forest Minister signed the decree establishing the 22,000-square-kilometer Hukawng Valley Tiger Reserve in March 2004. The Kachin Independent Army (KIA), whose territory is located in the valley, was not pleased that they were not fully consulted in the declaration process—and the KIA is the regional force with the capability to control poaching of tigers and prey—yet after a stakeholders meeting, the KIA agreed to participate. Such meetings in which stakeholders gather to discuss joint management of large areas had not been the norm in Myanmar's recent history.

Meanwhile, Rabinowitz, never idle, proposed adding contiguous protected areas totaling 31,000 square kilometers in all, nearly the size of Maryland, to comprise Myanmar's Northern Forest Complex. Working with his forest department colleagues and with some significant support from the very top of the government, Rabinowitz in less than a decade turned an area recognized as one needing to be surveyed in 1997 into the largest complex of protected areas in South or East Asia. The question that remains is, can and will this complex be sustained now that Rabinowitz has moved on to other interests?

In conservation, there is no finish line, because political criteria change. Rabinowitz is philosophical about it: "The Hukawng Valley Tiger Reserve is like a living organism, needing to be watched over, nurtured, protected, and guided" (p. 195).

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doi:10.1641/B581014
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