

Evolution: The Story of Life

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Origin—Reznick preserves the crucial elements of each chapter's arguments while passing over others perhaps less important, or redundant. He also does an admirable job presenting the historical aspects of Darwin's arguments through a modern take on these issues, though in places I would have liked a fuller discussion of points where Darwin missed the mark. For example, although Reznick nicely explains Darwin's "divergence of character" process, in my opinion he misses an opportunity to emphasize how Darwin's overreliance on this competition-driven model of divergence led him astray. This represents one of the important areas where modern evolutionary biologists would disagree with Darwin; his divergence of character model led him to downplay the role of isolation in speciation and embrace an essentially sympatric speciation model in continental areas, consistent with the observation that most species are found in continental areas (as opposed to islands), where competition is fiercest.

Reznick discusses how Darwin combined a Lyellian model of cyclical changes in land elevation to postulate periods where continental areas were broken up into archipelagoes, thereby incorporating isolation and allopatry into his model of species formation. But this fascinating aspect of Darwin's thinking is worth even deeper exploration, I think. Explicit discussion of isolation by Darwin came as late as 1869 in the *Origin's* fifth edition, apparently prompted by criticism leveled by the German naturalist Moritz Wagner. Wagner wrote Darwin in 1868, arguing that isolation is necessary for the formation of new species—what Wagner called his "separation theory." Darwin cited Wagner in the fifth edition, but even then stated that he could "by no means agree with this naturalist, that migration and isolation are necessary for the formation of new species." Wagner was not satisfied, and proclaimed in books and articles that it was he and not Darwin who had discovered the true mechanism of the origin of species. Darwin was not amused. This episode, which also

involved a related criticism by engineer Fleeming Jenkin, is one reason that Ernst Mayr criticized Darwin's divergence of character model and considered it a failed theory, which Reznick mentions in a somewhat different context. The full story is illuminating, and provides an opportunity to explore how and why biologists today differ with Darwin.

There are a few other areas where I felt that a fuller exploration and contrast with today's thinking would have been instructive, but this is a minor criticism. In all, I found Reznick's treatment of the relation of historical to current thinking deft and effective. We see this to especially good effect in the concluding two chapters of Reznick's book, the penultimate chapter treating Darwin's chapter, "Recapitulation and Conclusion" (which is entertainingly presented as a case argued before a jury), and the final chapter, in which Reznick expands upon the lines of evidence Darwin marshaled from diverse disciplines in the second half of the *Origin* (Darwin's consilience argument). Reznick looks to the pieces of the evidentiary puzzle that were missing or limited in Darwin's day and fills these gaps with an abundance of well-chosen examples that have come to light in the ensuing post-*Origin* century. The "eyewitnesses" then missing and now found include a detailed quantitative and empirical understanding of the action of natural selection, the speciation process, "deep time" and Earth processes, heredity, and the ever-growing panoply of transitional fossils. Reznick concludes this chapter with a discussion of human origins and evolution, a topic only hinted at in *Origin* itself but treated by Darwin 12 years later in *The Descent of Man*.

David Reznick succeeds in producing a highly engaging and informative "interpretive guide" to the original *On the Origin of Species* with an approach that will prove quite useful in different ways to different groups of readers. Those who have read Darwin but perhaps lack knowledge of contemporary evolutionary biology will find the case studies, examples,

and discussion of modern context highly instructive; modern biologists will gain much insight into the state of evolutionary thinking at its genesis, à la Darwin. But as illuminating as Reznick's "translation" of Darwin's epochal work is in its own right, it is not a substitute for reading Darwin himself. Rather, this book should be viewed as an invitation. I join Reznick in hoping that his interpretive guide will inspire readers to pick up the *Origin* and enjoy Darwin with a whole new level of comprehension and appreciation.

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LIFE, ILLUSTRATED

Evolution: The Story of Life. Douglas Palmer. University of California Press, 2009. 374 pp., illus. \$39.95 (ISBN 9780520255111 cloth).

We have seen a flurry of books about evolution in the wake of 2009's Darwinian anniversary year, and *Evolution: The Story of Life* may be the last of the major tomes. The recent focus on Darwin and on evolution has presented a wonderful opportunity for scientists and educators to take these core ideas to the public, although it isn't clear whether the excitement of the Darwin celebrations has shifted

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the balance of public opinion one iota. Perhaps all the books, television programs, lectures, and exhibitions have been consumed by thoughtful



people who need little convincing. But the naysayers remain comfortable in their views, blissfully uninformed and untouched by all this work.

Evolution: The Story of Life is not presented as a polemic in favor of evolution but is simply a statement of what we know. The subtitle positions the book: It is more a survey of the history and phylogeny of life than an introduction to modern evolutionary theory. In fact, of its 374 pages, only 2 cover natural selection, and there is little on lab- and fieldwork in genetics, genomics, variation, speciation, selection, development, or related themes. But no reader would be misled when glancing through the book—the core is the series of 100 stunning, double-page spreads representing key fossil deposits.

The preliminary pages about evolution, systematics, Darwin, fossils, and the dating of rocks are much as one would expect, with all the broad materials required for the beginner, and striking photographs and historical images—some of them unfamiliar, some used many times before in similar books. A hint of debate and controversy is presented here and there, but not a great deal, which I regret.

The history of life, as documented in 100 fossil localities, is the core of the book: 200 pages of often highly original presentation. Inevitably, about half the chosen locations are familiar from numerous previous books, but it is much to the credit of author and

artist that they have included newer ones, such as the lower Cambrian Chengjiang Biota of China, with its remarkable early animals, including putative fishes; the upper Devonian of Ellesmere Island, Canada, and *Tiktaalik*, the limbed tetrapod-like fish; and the lower Cretaceous Jehol biota from China with its spectacular feathered dinosaurs. There is even a feature on the Pleistocene of Flores Island, Indonesia, and the small hominid reported in 2003. Aficionados of such books will recognize the old favorites, such as Ediacara, Rhynie, the Texas redbeds, and Rancho la Brea. However, the images are original and beautifully composed, and the supporting text and images show that the author and artist have read the literature right up to date.

Each chosen episode in the history of life is represented by a large color painting that combines a detailed depiction of the environment, with appropriate landscapes and flora, and with a number of key animals in the foreground. We are so familiar with such images that we may take them for granted. However, having worked on such projects, I am aware of the endless discussion and negotiation behind each piece of artwork. The artist sketches a layout, the writer checks the relative sizes of the plants and animals. A further layout is produced, and artist and writer must consider the poses and behaviors represented: Did this fossil plant look more like a bush or a tree (the fossils are usually isolated leaves and stem fragments)? Did this animal stand on all fours or on its hind legs? Could it climb? Did it eat from the ground or higher? The backgrounds matter as well, combining sometimes scattered and scrappy information about topography, sedimentary facies, and evidence of the era's climate.

The supporting text for each spread is broken into boxes representing location, age, environment, geology, and preservation of the fossils. There are photographs of two fossils and a detail of one of them, and the brief texts and captions explain the history

of paleontological work, current views, and the evidence for the environments and organisms depicted. The text on each site is brief, and so in its terseness we read only fleetingly of the discoveries themselves. Sometimes a date is given to assure readers there is much current research activity, but there is little of the discussions and debates on current interpretations of the new fossils and their places in the evolutionary tree.

The next 50 pages cover the “tree of life” by means of numerous cladograms, starting with the most general and working down through the hierarchies to different extents. I’m not sure how useful these rather detailed evolutionary trees are, however. Although thorough, correct, and complete, they are presented with such dense labeling and small print that the key elements cannot be understood at a glance. The primary genetic and morphological evidence for key branching points—the fundamental basis of the trees—is not given, but of course that information is generally highly technical.

Further listings in the remaining 70 pages of the book are similarly thorough and represent a huge amount of work by the author, but I am uncertain of their role. There is a gazetteer of all the fossil localities, which for each site gives one or more references to the literature, as well as one or more relevant Web sites. I would have preferred to see this information incorporated into the main spreads, to save splitting the accounts. Finally, there is a “species list,” followed by an alphabetical list of the major clades referred to in the earlier text (e.g., Actinopterygii, Afrotheria, Agnatha, etc.), each with a short account and outline of the systematic subdivisions. All of these listings cross-refer, but I am not sure how many readers will take the time to leaf backward and forward through the book. The old-fashioned narrative approach might have worked better, where the text develops the story of geological time and the major clades in sequence.

There are three, four-page fold-outs—one on the Cambrian Explosion,

the time between 535 million and 510 million years ago when animals radiated rapidly in the sea; one on mass extinctions with a focus on the most recent one, 65 million years ago when the dinosaurs died out; and one on the geological timeline with a “story-board” sequence of all 100 paintings in a single spread.

The incorporation of such a huge amount of work by author and artist is astonishing. This book is up to date and includes an outline of current paleontological and systematic knowledge, all of it accurate and correct so far as I can see. I’m sure it will sell in large numbers, but I’m not sure that it will *captivate* its readers. This is not entirely the fault of the author; the problem is driven by the tyranny of the two-page spread, where the artwork is key and the text has to fit into small spaces in the periphery. Trade books such as this one are designed and managed closely by the publisher, and the author has to write an exact number of words to fill each panel. (The other kind of book, the old-fashioned narrative, allows the author to lead and to tell a story, and the artwork is secondary and used only when necessary and in the appropriate style to qualify and explain the text.)

The outcome of the two-page spread can be a book that is beautiful to behold but not engaging to read. In normal writing mode, an author may dash off a wonderful explanation of the debates about whether the Burgess Shale animals belong to modern groups or represent an explosion of “experimental” body plans, as Steve Gould argued. Or the account of the Jehol Biota in China might be enhanced by a word picture of the landscape today—enormous expanses of rolling hills on which every inch has been brought into cultivation, and where millions of farmers till the fields, and plow up exquisite fossils every day. However, if the word limit is exceeded in the double-page-spread mode, the text is edited back to basics and much color is lost.

Much current work in paleobiology is ingenious and smart—working out

how ancient organisms lived, discerning patterns of evolution, interpreting ancient environments and ecosystems from subtle clues in the rocks, and investigating the origins of evolutionary novelties that drive diversification. It would have been wonderful to read more about *how* we know what we know. That is what grips the reader, and these are the details of human endeavor and ingenuity that turned most people onto science when they were young.

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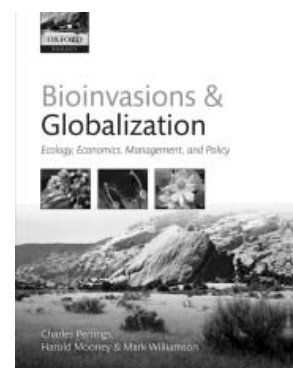
BIOLOGICAL INVASIONS AND SOCIETY’S RESPONSE

Bioinvasions and Globalization: Ecology, Economics, Management, and Policy. Charles Perrings, Harold Mooney, and Mark Williamson, eds. Oxford University Press, 2010. 288 pp., illus. \$70.00 (ISBN 9780199560165 paper).

Bioinvasions and Globalization: Ecology, Economics, Management, and Policy, edited by Charles Perrings, Harold Mooney, and Mark Williamson (three of the most prominent researchers, authors, and leaders in the field of invasion science over the past 25 years), sets out an ambitious agenda, proposing to “explore the current state-of-the-art in the social and ecological science of invasive species and draw out the implications for the national and international regulation of the problem.” The book targets graduate students and professionals in the fields of ecology, invasion biology, conservation biology, and environmental economics. It consists of 16 chapters written by a total of

36 authors, representing nine countries and five continents. Examples and case studies from diverse regions of the world constitute one of the strengths of the book.

There are many other aspects of this book that I liked as well. One is the book’s emphasis on invasive pathogens, particularly human pathogens and pathogens affecting food production (livestock and crops). During the past 30 years, invasion science has focused considerable attention on the ecological effects of invasive species. This is consistent with some of the early definitions of invasive species that emphasized habitat and biodiversity impacts; for example, the definition of invasive species by the Convention on Biological Diversity: “those alien species which threaten ecosystems, habitats, or species.” Although humans, farm animals, and crops are species too, invasion biologists have focused mostly on the effects of invasive species on wild native species. Clearly, invasive pathogens



are not the only nonnative species causing serious harm, but as a group, they do pose the greatest threat to human well-being, and it is time that this be generally acknowledged. By highlighting this point, *Bioinvasions and Globalization* makes a very important contribution to the field of invasion science.

As exhibited by several of the book’s chapters, the field of invasion science has matured considerably over

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