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book review

A 100 million year love affair with American plants

A Natural History of the New World, by Alan Graham

2010, The University of Chicago Press, 408 pp. ISBN: 9780226306797 / 9780226306803

Price: \$110 (Hardback) / \$40 (Paperback); <http://www.press.uchicago.edu/>

I teach a class called “The Ecosystems of California”, and my students always ask the question: “Will global climate change cause trouble for California’s plant communities?” I find it impossible to give a short response, not because I doubt the grave predictions about future warming, but because many of California’s species have a long history in North America, and have already lived through ten glaciation cycles, including the recent extinction of the Pleistocene megafauna (which must have wrought major ecosystem change). Some species are old enough to have endured the massive cooling and drying that changed North America from the mostly frost-free and drought-free continent that it once was in the Eocene. On the other hand, even if non-anthropogenic climate change has offered little more than an evolutionary bump in the road when examined from a 50 million year perspective, contemporary human-mediated disruptions may be catastrophically destabilizing to ecosystems and human civilization in the short term. Thus, answering how the biota will respond to current climate changes and disturbances requires an understanding of the magnitude of the changes that have already occurred and Alan Graham’s new book provides exactly this context.

A Natural History of the New World represents a wonderful synthesis of Alan Graham’s voluminous career studying the American flora. This narrative includes detailed descriptions of plant communities of the Americas, and includes a comprehensive review of paleobotanical evidence and interpretations regarding how changes in floras have coincided with global climate changes and geological events in different biogeographic regions of the Americas over the past 100 million years.

The book opens with a very long description of all of the different biomes and vegetation types in the Americas, starting with the North Pole and

ending with Tierra del Fuego. My favorite chapter, by far, is Chapter 3, which succinctly gives the best and clearest description I have ever read of the tools used to put dates on past events. I very much enjoyed these lucid explanations of how global sea levels are reconstructed, how reversals of the earth’s magnetic field are detected, and how radiometric dating works. I will definitely use this in my undergraduate teaching. The next chapter describes the techniques that paleobotanists use to identify micro and macrofossils and also how macrofossil assemblages are used to estimate past climates. Here, I was disappointed that the explanation of leaf-margin analysis did not include any discussion of Peter Wilf and students’ work of why serrated leaf margins may be correlated with colder climates (Wilf 1997, Royer and Wilf 2006).

Graham then divides the past 100 million years into four sections: the Middle Cretaceous through the Early Eocene, the Middle Eocene through the Early Miocene, the Middle Miocene through the Pliocene, and the Pleistocene and Quaternary, to discuss how the major climatic and tectonic events have impacted the evolution and assembly of plant communities, and how and when (and why) those assemblages begin to approach recognizably modern forms. I greatly enjoyed these sections, as they provide a great review of the paleobotanical research for each time period broken down by geographic area – a synthesis of time and place that is often very difficult to piece together from other books and articles which give a more local or taxon-specific focus. The book is very well referenced throughout, a great service for readers who want to follow up on more details about particular regions and paleobotanical studies. It is indeed striking how few paleobotanical studies are published for tropical areas, and botanically megadiverse, important areas like the Amazon basin have only very few well-studied sites over large stretches of time

from the late Eocene to the middle Miocene. This middle section of the book I find to be the most valuable, because besides Graham's own monographic work in separate volumes, I can think of no other source that reviews all of the vegetational sequence over such a large time scale for the entire Americas. Willis and McElwain's (2002) *The Evolution of Plants* comes to mind, but their book is global in scope and does not provide nearly the same amount of detail regarding the fossil evidence.

My main quibble with this book is that I think it could have been organized and edited much better. The opening descriptions in Chapter 2 of the vegetation communities from pole to pole contain too many anecdotes covering completely different periods of time. The majority of this chapter as well as the "pole-to-pole" synthesis (Chapter 10) should have been integrated into Chapters 5-8, so that the reader could have learned about the changes in vegetation in one temporal sequence. There are also quite a few errors that should have been caught by an editor (p. 195: flying foxes are not related to lemurs, p. 223: *Pelluceria* actually lives on both the Pacific and Caribbean coasts in Central America (Roth and Grijalva 1991), p. 236: the Sierra Nevada achieved close to its current height by 12 million years ago (Mulch et al. 2008). Also I found the numerous historical asides and personal anecdotes distracting (although to be fair I should acknowledge here that my graduate student had the reverse reaction and really enjoyed these parts). The many links given to webpages and quotations of other people's work is a nice attempt to be comprehensive within the format of a paperback book, but I would have preferred that the author stay on topic. I say this because Alan Graham has a deep knowledge and understanding of how different plant communities have existed in the Americas – and which major geologic and climatic events were the most important in shaping American ecosys-

tems, and the many tangents detract from the main narrative.

I would recommend this book for anyone seriously interested in plant biogeography, ecology or evolution who wants to gain a better perspective on the historical events that have shaped current biotas. Considering the large amount of attention paid to global climate change recently by environmentalists, the media, and policy makers, it is critical to be able to consider changes in plant communities within the larger context of global climate change over the past 100 million years. To this end, I think that this book makes an extremely valuable contribution.

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