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**The Monkey's Voyage: How Improbable Journeys Shaped the History of Life.** — By Alan de Queiroz. New York: Basic Books, 2014. 360 pp. ISBN 978-0-465-02051-5, \$27.99, £18.99, €19.99 (hardback); ISBN 978-0-465-06976-7 (e-book).

As a scientist, I literally grew up with the cladistic paradigm. The history of cladistics is usually presented as taking place solely in New York and London (e.g., Williams and Knapp 2010; Hamilton 2014), but contributions did come from elsewhere (e.g., Whiffin and Bierner 1972). I was first taught systematics in 1978 in Australia, by the person who seems to have published the first cladistic analysis of any endemic Australian biota (Carolin 1977). So, to me cladistics was “normal science,” and it took me some years to find out what people had done before they invented cladistics (and phenetics).

This means that I watched cladistics rise to prominence in systematics during the late 1970s and early 1980s, and then fade away again a decade later. I also watched vicariance biogeography replace the previous “just so” stories of historical biogeography (as distinct from ecological biogeography). I was actually taught historical biogeography as a hypothesis testing activity, which went like this: (i) first construct a cladogram of the taxa, (ii) then convert this to an area cladogram, and (iii) if this matches the “known” history of vicariance events for the areas then stop, otherwise invoke a hypothesis of long-distance dispersal. This approach was based on the idea that vicariance hypotheses could be directly tested by reference to a cladogram, whereas there was no direct test of dispersal hypotheses. Vicariance was the null hypothesis to be tested, and dispersal was the alternative that was never tested directly.

This approach appeared to be common among the other austral biologists, although many of them seemed to be expecting that they would detect vicariance related to the breakup of Gondwanaland, rather than detecting dispersal. In this respect, over the past few decades one can trace an interesting trend regarding the perceived historical biogeography of the southern land masses. For example, the biogeographic distribution of the Southern Beeches (*Nothofagus*) shows a decade-by-decade change in perceived explanation, from “primarily vicariance” (Humphries 1981) to “possibly not vicariance” (Linder and Crisp 1995) and on to “mostly dispersal” (Cook and Crisp 2005). Similarly, Weston and Crisp (1996) considered that long-distance dispersal had almost no role in establishing transoceanic relationships in the southern hemisphere plant family Proteaceae, whereas a decade later Barker et al. (2007) concluded the exact opposite.

However, there were a number of hard-core Cladists (“big C” cladists, to distinguish them) who sometimes

seemed to reject dispersal as being unscientific, even as an alternative hypothesis. These people form the center-piece around which Alan de Queiroz builds his new book *The Monkey's Voyage*. This book is basically an exposition of the trend that I have just described for historical biogeography, from “just-so” stories about dispersal and land bridges, to vicariance-only explanations based on the break-up of Pangaea, and then on to a world in which long-distance dispersal is considered to be a common feature.

This is an engaging book that makes interesting reading, and I can recommend it to anyone who wants to learn about biogeography and its relationship to vicariance and dispersal. The book is written for the general public, as well as for biologists who do not necessarily work in biogeography. The book pretty much assumes that you know nothing about historical biogeography, and slowly introduces you to the topic, providing enough of the technical background for any interested reader to follow the various narrative and logical threads. So, for a specialist it may seem to take a long time to present each point and arrive at a conclusion, but hopefully there are enough new pieces of information along the way to keep them interested as well.

The central thesis of the book is that much of the work done in the name of vicariance biogeography was an unnecessary side-track in the study of historical biogeography. All along, there has been ample evidence of the importance of long-distance dispersal, and molecular data have finally provided the evidence to make that fact clear to all concerned. This thesis is not a return to the “good old days,” but is instead presented as a step forward, where evidence for dispersal is derived from rejecting the hypothesis of vicariance.

There are basically three types of evidence presented, related to the current geographical distribution of particular organisms: (i) organisms endemic to islands that have never been connected to the mainland, but whose closest relatives are on the nearest continent (e.g., the amphibians of São Tomé and Príncipe); (ii) organisms on islands whose closest relatives are on the nearest continent, but where the island itself has historically been connected to a different continent (e.g., the biota of the Falkland Islands); and (iii) organisms whose fossil-dated molecular phylogenetic history is more recent than the geological break-up of the land areas they inhabit (i.e., their phylogenetic history does not match the geological history). De Queiroz provides detailed discussion of dozens of such examples, both well-known and not so well-known, although you will read about New Zealand more often than about anywhere else. However, the dispersal of the New World monkeys from Africa across the Atlantic to South America provides the example referred to in the book's title. (Kistler

et al. (2014) provide another recent example of this dispersal, involving the bottle gourd, one of the most cross-culturally ubiquitous crops.)

The book focuses on people as much as it does on the biota that the people were studying. The people are named, their scientific work is presented (with their data and conclusions), and their personalities are discussed, along with their motives and intellectual failings (particularly those of Leon Croizat, Michael Heads, Colin Patterson, and Gary Nelson). That is, the book tells a story as well as a history. This is usually seen as a Good Thing when writing for the general public, but it leads to a sense of unease if you actually lived through the history yourself (and know the people).

For example, *Nothofagus* is a case study in this book, but the simple story I mentioned above is not told by the author, because Chris Humphries is eliminated from de Queiroz' history of vicariance biogeography. This is odd because, as well as providing one of the prime early examples of cladistic biogeography, Chris also co-authored the first specialist textbook on the subject (Humphries and Parenti 1986). Perhaps Chris did not foam at the mouth quite enough for the author's rhetorical purpose; because that is the story as told by de Queiroz in his book, that the hardcore Cladists were a bunch of rabid hounds baying at the cowering personae of the dispersalist school. De Queiroz's preferred approach in his book is a simple one: the Cladists were blindly dogmatic about their new paradigm and its relationship to biogeography, and they are now receiving their come-uppance at the hands of the New Dispersalists.

This pedagogic approach may produce a good story for the general public, who like an exciting narrative about human conflicts, but as a history it is sadly incomplete. For example, Gary Nelson is certainly hard-nosed and dogmatic, but he is also quite a nice guy and a pretty sharp thinker. De Queiroz focuses on the former pair while failing to note the latter pair, so that his story comes across as being about the goodies (Dispersalists) and the baddies (Cladists). History is not that simple, fortunately (for an alternative view of the history, see Ebach 2014).

De Queiroz also takes most second-hand stories at face value, which might not always be wise. To take just one example, in his various histories of the origin of the polymerase chain reaction technique, Kary Mullis presented himself as being a romantic maverick (especially in Mullis 1998), rather than being part of a team all of whom made essential contributions, which is how his colleagues saw it (see the discussions in Rabinow 1996 and Fore et al. 2006). Moreover, not all of the participants agree with the cladistics history written by Hull (1988), fascinating though that story is. Not unexpectedly, the recent reviews of de Queiroz' book in the popular press have focused on his anecdotes as much as on his scientific message.

Finally, given that the target audience is non-specialists, the book takes a sometimes uncritical look at its subject. As I noted, the evidence for long-distance

dispersal actually comes from rejection of the null hypothesis of vicariance. In practice, this is most often because the dichotomous branching of the taxa is estimated to be too recent to match the vicariant history of the lands on which they occur. This means that the crucial evidence is the dating of the nodes in the molecular phylogenies. Indeed, the recurrent theme of the book is that it is the switch from morphology to molecules that destroyed the Cladistic paradigm for biogeography. A critical look at the data, then, would involve questioning the molecular dating procedure. For example, if the true dates of the branches are older than the current estimates, then the evidence begins to melt away. De Queiroz makes only a half-hearted attempt to address this issue.

A more critical view of dating suggests two potential sources of under-estimation of divergence ages. First, people tend to use the arithmetic mean for the divergence estimates, whereas the data are likely to be log-normally distributed, in which case the geometric mean provides a better date estimate (Morrison 2008). Second, all of the phylogenies have been based on a tree model, which excludes the possibility of historical hybridization and introgression events. These reticulation events will hamper any attempt to identify the original divergence events, and will lead to under-estimates of the associated dates. In this regard, it is interesting to note that one of de Queiroz' prime examples involves the fact that many animal phylogenies match the break-up of Gondwana, whereas many of the plant phylogenies show divergence dates that are too recent. If hybridization is more common among plants than animals (Arnold 1997) then this pattern is easily explained.

Don't get me wrong, I like this book; but we cannot ignore the book's limitations—this is a story not a history. It is a fascinating story, and one that is told sufficiently well and in enough detail for the educated public to both understand it and be fascinated by it. At the end of the book most of you will have enjoyed your journey. This is what a book is all about; but history itself usually isn't like that.

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