MacFadden, B. J. 1993. **Fossil horses: systematics, paleobiology, and evolution of the family Equidae.** Cambridge University Press. ISBN: 0-521-34041-1.

The history of the horse is perhaps the most familiar example of evolution. Practically every textbook and popular book on evolution recycles the familiar diagrams showing the transformation from "eohippus" to *Equus*. As a number of scientists (e.g., Gould, 1987) have pointed out, however, this overused (and misused) example is based on diagrams which are over a century old, and reflect orthogenetic concepts which were rejected early in this century. Sadly, this oversimplification of a complex story is copied again and again, probably because most textbook and trade book authors have no access to (or interest in) the primary literature that would set them straight.

Thanks to Bruce MacFadden's new book, there are no more excuses for recycling outdated concepts. Indeed, MacFadden devotes an entire chapter on the history of this case study and how it was influenced by turn-of-the-century orthogenetic concepts. He also shows that by the time of Matthew's (1930) and Stirton's (1940) research, the "bushiness" of horse phylogeny was beginning to emerge, and the non-linear pattern was clear in Simpson's (1951) classic book on horses. Surprisingly, after the publication of Simpson's book, another forty years passed before another equally comprehensive examination of the horses reached book form.

Part of that delay was a necessary consequence of an explosion of horse research in the last generation, triggered by the immense collection of fossil horses in the Frick Collection of the American Museum of Natural History (which did not become available for study until the 1970s). Another important impetus was the adoption of cladistic methods by vertebrate paleontologists, which forced them to re-examine many of their assumptions about phylogeny. MacFadden describes how this new information has changed many of the conventional ideas about horse evolution. Horse phylogenies are bushier than ever before, with many more static, long-lived lineages overlapping in time; many paraphyletic taxa (such as "*Merychippus*," the ultimate "wastebasket" genus if there ever was one) are gradually being broken up. Other changes, such as revisions of the numerical time scale, have made many of the old statements about rates of horse evolution obsolete. MacFadden devotes entire chapters to new ideas about the time scale (which have already become outdated with the new $^{40}Ar/^{39}Ar$ dating), to biogeography and vicariance, and to systematics and their effects on understanding horse relationships.

There are also chapters on evolutionary rates and trends, functional morphology, paleoecology and community evolution – "paleobiology" topics that are seldom discussed in a trade book. In this respect, the book is much more comprehensive than Simpson's. Unfortunately, the high level of discussion makes the book a bit too advanced for most trade book readers. For example, MacFadden only briefly discusses the goals and methodology of cladistics, and then refers the reader elsewhere. The average person would not be able to make sense of this. Yet the book is not a technical monograph, either. The details of horse systematics and anatomy are only briefly discussed, mostly in the context of reviewing the major new developments and controversies. Although the cover copy claims that "anyone

with an interest in vertebrate paleontology, evolutionary biology, or general natural history will find this an absorbing and challenging book," the publishers are a bit optimistic. Clearly, the book is written for an audience of professional biologists and paleontologists, and possibly for advanced undergraduates and graduate students.

MacFadden is one of the primary contributors to our modern understanding of Miocene horses, so these sections are clearly the strongest. Given his preference for cladistic methods, however, it is surprising that he retains several paraphyletic groups, such as "Hyracotheriinae" and "Anchtherlinae" and the abominable "Condylarthra," when they are not useful to his discussion (or hardly mentioned again). MacFadden and his colleagues have demonstrated that most species of "*Merychippus*" are clearly referable to different derived lineages of Miocene horses. In this context, it is also a bit disappointing that they have not yet renamed all these taxa. For example, MacFadden (Fig. 8.6, p. 177) shows that "*Merychippus*" *republicanus* is the sister-taxon of *Pseudhipparion* – why not change it to *P. republicanus*?

Given the broad scope of this book, it was inevitable that a few errors would creep in. For example, MacFadden (p. 92) reviews Hooker's (1989) work on European *Hyracotherium*, which demonstrates that the type species of the genus, *H. leporinum*, is a palaeothere, not a horse. MacFadden apparently misunderstood this, and thus fails to realize that there is a good reason why another name (not "*Eohippus*") is required for the early Eocene horses of North America. Similarly, on pages 87–88, he expresses surprise that Prothero and Schoch (1989) placed the arsinoitheres as closest sister-taxa of the perissodactyls. If he had read that work closer, however, he would have realized that we were forced to do so because *Radinskya* (which is clearly the closest sister-taxon of perissodactyls – McKenna et al., 1989) was placed in the arsinoitheres by those authors for lack of a better place. Since that time, Court (1990) has shown that arsinoitheres are closer to proboscideans, so the ordinal affinities of *Radinskya* is still an open question. MacFadden does not clearly convey the recent discovery that the earliest perissodactyls, arsinoitheres, and proboscideans (exemplified by *Phenacolophus*, *Radinskya* and *Minchenella* from the late Paleocene of China) are so close in morphology that such ordinal distinctions are problematic. What does emerge from all the new research is that phenacodontid "condylarths" are *not* the closest sister-group of horses, a point which MacFadden is reluctant to accept, but which most recent research (e.g., Thewissen, 1990) has clearly demonstrated.

These are minor quibbles, however. By and large, the book is a solid piece of scholarship, covering all the important aspects of the topic with competence and concision. With such a book available, textbooks should stop recycling nineteenth-century diagrams and catch up with the twentieth century – before the twenty-first century begins!

References

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