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Book Review

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Functional Morphology of the Miocene

Hominoid Foot

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A widely applied approach to the functional morphology of the locomotor skeleton is to establish a correlation between gross locomotor categories and sets of morphological characters. This approach does not explain the causal relationships among variables. The proportions and shapes of the bones are determined by the mechanical stresses acting upon them. A prerequisite for deducing locomotor behavior from morphology is the knowledge of the interface between the behavior and the mechanical stresses typical for it. Parts of the locomotor apparatus can be utilized in a similar way in the context of various movements. It is in a way disappointing for the paleontologist that different locomotor behaviors may lead to a similar stress pattern, in which cases there exists no clear relationship between one locomotor 'category' and one certain morphology. In addition, primate locomotor behavior tends to be variable; only frequently used behaviors that also go along with forces above a certain (up to now unknown) level seem to determine skeletal morphology.

The author is aware of these problems and devotes a long section of the book to define positional and locomotor categories and to characterize them with respect to the functions of the foot. He starts from Rose's classification of positional behavior and includes the available kinesiological, myological and force data on the foot. By doing so, he reduces the 8 categories of Rose to 4 categories that cover all actions of the foot of higher primates: climbing, suspension, running and human bipedalism.

Only a part of these functional considerations find their way into the central section of the book, an

osteological comparison and functional interpretation of the foot bones of recent and fossil primates. The modern sample comprises Cebidae, Cercopithecidae, Hylobatidae, Pongidae and Homo, on the whole 297 specimens in the range of body sizes observed among the fossils. The about 80 fossil specimens represent a very comprehensive sample of Miocene hominoids from African, Asian and European sites. The author has taken 96 measurements on the bones of the foot; only about 70 are included in this study, mainly in the form of indices. He compares these indices one by one in easily understandable drawings.

Multivariate statistics are not applied. All individual features are discussed with respect to their functional meaning. The one-by-one comparison and discussion make this section hard to read, especially as a number of characters do not discriminate between functional categories and are also not interpretable in terms of foot function. The number of 'good'

measurements is therefore further reduced. A selection before starting to measure by considering the usefulness of measurements for deducing foot function (based on the aforementioned section!) would probably have been less time-consuming – for the reader and for the author as well. Langdon arrives at a list of morphological characters that can be correlated with differences in positional behavior and foot use, and he also offers convincing functional explanations for many of these differences.

The fossils give a less clear picture. Variation is high, which is no surprise considering the time span and geographical range of the material. The author's statement that 'the diversity of Miocene hominoids is only beginning to be appreciated' (p. 163) is fully justified. However, the range of variation is smaller than that of living catarrhines, which is mainly due to the absence of fast-running and leaping adaptations that are the monkey specializations in the fossil record. It is difficult to trace the specimens through the diagrams indicating, for every single character, their position relative to the modern forms, but it seems that they mostly represent a mixture of traits unlike the patterns found in living anthropoids. The final loco-

Book Review

227

motor categorization of the fossils is inevitably somewhat vague. Proconsul exhibits features adaptive for quadrupedal walking as well as for climbing. Pliopithecus and Dendropithecus are characterized by features indicating a more suspensory role of the foot in locomotion. The 'ramapithecids' present a rather un-specific morphology that clearly indicates only the importance of arboreal climbing in their locomotor repertoire, with Sivapithecus not (yet) showing any specialization pointing in the direction of Pongo. Indications of orthograde or semi-orthograde postures are not present in the record of fossil foot bones, there is no evidence of a vertically clinging and leaping forerunner.

In a short, final chapter, Langdon outlines the evolution of catarrhine positional behavior based on pedal morphology and function. From a generalized arboreal quadruped (Propliopithecidae, Proconsul), he derives 3 evolutionary lines: one with a more climbing and suspensory mode of locomotion (Pliopithecus, Dendropithecus), which has no modern descendants; a second one into the monkey-like locomotion, which up to now is not documented in the fossil record; and a third one via a more climbing form (Sivapithecus), leading to modern apes and man.

Information from other parts of the locomotor skeleton and/or other studies in the field is discussed in the introductory chapter in a review of the excessive literature on the locomotor adaptations of Miocene hominoids. It demonstrates that the author's results are in agreement with other evidence. Conflicting views are presented, but the criteria for favoring one opinion over another sometimes remain unclear in the shortness of this presentation.

The book is informative and impressive in its very comprehensive analysis of recent and fossil foot bones. It offers a number of original functional explanations of differences in pedal morphology between hominoids and cercopithecids. The lack of a multi-variate analysis with this bulk of data is to be regretted. The text is printed single-spaced, which requires eagle eyes and a lot of concentration from the reader. The photographs of fossil hominoid foot bones are not very informative and sometimes seem to be out of focus. The overall quality of the production is not high with regard to the rather high price, but the increasing difficulties of publishing monographs in a time favoring short (and short-lived) papers have to be considered.

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