things, and settling for rehabilitative narrative technology, has been one of physical anthropology's persistent problems. Doing it on purpose does not constitute a solution.

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## A Missing Link

**Eugène Dubois and the Ape-Man from Java.** The History of the First "Missing Link" and Its Discoverer. BERT THEUNISSEN. Kluwer, Norwell, MA, 1988. xii, 216 pp., illus. $49. Translated from the Dutch edition (Amsterdam, 1985).

Evolutionists have not always recognized the crucial importance of fossils in the reconstruction of our evolutionary past. In the *Origin of Species* (1859) Darwin admitted that the fossil record was meager and relied instead on indirect evidence from embryology, comparative anatomy, and plant and animal breeding. Of course, hardly any important human fossils were then known—in fact only one, the first Neanderthal, discovered in 1856. Yet, throughout the 19th century, as more and more Neanderthal and other Ice Age fossils were discovered, evolutionists still failed to cite them in support of their position. Why?

One reason was scientific "racism." Darwin and his contemporaries exaggerated racial differences so much that fossils like Neanderthals appeared no more primitive than Africans or Australian aborigines. Another reason was the long-held doctrine that Caucasians originated in Asia and could not possibly be descended from prehistoric inhabitants of Europe. Because the main arguments for (and against) evolution were not based on fossils, hardly any 19th-century evolutionists even bothered to look for "missing links." An outstanding exception was Eugène Dubois (1858–1940).

Dubois was a Dutch army surgeon who believed in Darwinism and journeyed to the Far East to find human fossils to prove it. After years of searching, he found them in a river bank in central Java in 1891–92. What he found was a well-preserved fossilized molar, skullcap, and femur presenting a mixture of apelike and human traits. The femur looked fully human, indicating that it belonged to someone who walked upright, and the skullcap resembled a gibbon's, with a brain too large for an ape yet too small for a human being. To Dubois, these fossils showed clearly that in the transition from early ape to human being walking on two feet had been the beginning. He called his

Eugène Dubois's reconstruction of *Pithecanthropus* for the World Exhibition in Paris, 1900. [From *Eugène Dubois and the Ape-Man from Java*; Dubois Collection, Rijksmuseum van Naturlijke Historie, Leiden]

find *Pithecanthropus erectus*, the erect ape-man from Java. Anthropologists today have changed the name to *Homo erectus*, but they still accept Dubois's basic interpretation. It is fair to say that Dubois discovered the first true missing link.

Despite Dubois's importance, historians of science have until now written relatively little about him. The following curious story, based largely on hearsay, has been retold in anthropology textbooks: *Pithecanthropus* created an immediate scientific controversy; Dubois defended his interpretation against countless critics; then, about 1900, he took himself and his bones into seclusion; finally, 25 years later, just as other scientists were converting to his view, he resurfaced to announce that he had changed his mind and now considered *Pithecanthropus* to be an ape. Bert Theunissen's new book shows that this story is neither complete nor completely true.

*Eugène Dubois and the Ape-Man from Java* is a translation of the author's doctoral dissertation. It is not a thorough biography, or even a scientific biography. Rather it is a carefully researched account of Dubois's adventure with his missing link. According to Theunissen, Dubois was a true pioneer in recognizing the importance of fossils. This was his lasting contribution to science, along with the impetus he gave to others to think the same way. Theunissen provides a good background to Dubois's Javanese finds and analyzes all the scientific arguments about them. The most exciting part of his book, however, is its surprising account of Dubois's later life. Though Dubois did in fact remove himself from the debate about *Pithecanthropus*, Theunissen reveals that he never really changed his mind about its status as a missing link but merely exaggerated its apelike traits to distinguish it from other fossils being discovered at the time. Meanwhile he was engaged in ingenious research on the allometric relation between brain and body weight in mammals, research that confirmed his belief that *Pithecanthropus*'s brain size was halfway between that of apes and human beings. This research eventually led him away from the gradualist Darwinian model of evolution to a saltationist model like that of punctuated equilibrium. Ironically, he ended up defending his missing link on non-Darwinian grounds.

*Eugène Dubois and the Ape-Man from Java* does not tell us everything we might want to know about its subjects, but it does place them in clear historical perspective and correct misinformation about them that has been around for a long time. Its contribution to the historiography of anthropology is overdue.

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## Ape Affinities

**Orang-utan Biology.** JEFFREY H. SCHWARTZ, Ed. Oxford University Press, New York, 1988. x, 383 pp., illus. $79.95.

In the late 19th century, as the notion of the relatedness of humans and great apes gained acceptance, anatomists searched among the higher primates for "man's" closest relative. For a time, when Asia was the focus of interest in human paleontology, some scientists, such as Ernst Haeckel, believed that the Asian orangutan (genus *Pongo*) was the extant ape most closely related to our own species. Others did not agree. Charles Sonntag, in addition to suggesting that orangutans were "heavy in build, ugly in appearance and sluggish in habits," marshaled comparative anatomical evidence that suggested that African apes and humans shared a common ancestor at a time that postdated the divergence of *Pongo*. The following year (1925) *Australopithecus* was discovered and the search for the fossil evidence of human evolution shifted to Africa.

In 1984 Jeffrey Schwartz sought to restore the notion of an orangutan-human clade. *Orang-utan Biology* is a follow-up that was prompted by his interest in the phyloge-

Bornean orangutan, fist-walking on wet cage floor. As they walk "terrestrial orang-utans variably place their hands in fisted, palmigrade, and modified palmigrade postures." Subjects also vary with respect to inversion and eversion of feet, and it has been "noted that Sumatran orang-utans are more likely than Bornean orang-utans to approximate plantigrade foot postures." [From R. H. Tuttle and G. W. Cortright, "Positional behavior, adaptive complexes, and evolution," in *Orang-utan Biology*]

netic affinity of *Pongo*. The topics covered in this volume include taxonomy, behavior, ecology, reproductive biology, neuroanatomy, ontogeny, and craniofacial, dental, and postcranial anatomy. The weight of the evidence presented does not support an orangutan-human clade, nor does it vindicate Schwartz's claim that the orangutan is our closest living relative among the extant apes.

The book begins with overviews of orangutan taxonomy, behavior, and ecology. Although much in this section is found in earlier publications by the authors, the chapters on the comparative biology of Bornean and Sumatran orangutans and on their behavioral ecology by Courtenay *et al.* and by Rodman, respectively, are worthwhile reviews. Marks provides a review of his work and that of others on molecular and genetic perspectives on orangutan phylogeny. He concludes that humans and African apes share a common ancestor subsequent to the divergence of the orangutan (although the precise relationships within the African ape-human clade are ambiguous).

Orangutan odontology is discussed by Swindler and Olshan and by Swarts. Swindler and Olshan treat the subject of variability in tooth morphometrics and find no support for the proposal that the molar size-sequence ($M_2 > M_3$) and other dental traits in orangutans indicate a close relationship with humans. Swarts, on the other hand, suggests, on the basis of an analysis of the deciduous premolars of *Pongo*, that orangutans and humans do exhibit a special affinity.

Cranial morphology is discussed by Shea, by Brown and Ward, by Röhrer-Ertl, and by Winkler *et al.* Shea documents the extreme retroflexion (airorhynchy) of the orangutan face, as do Brown and Ward. Whereas Shea believes that airorhynchy may be primitive for hominoids, Brown and Ward believe that retroflexion of the face in *Pongo* and *Sivapithecus* is a shared, derived feature of that clade that dates to 12 million years ago. All authors agree that the craniofacial evidence does not support an orangutan-human clade.

The contributions on postcranial and locomotor anatomy are more uneven in quality than those on the skull and dentition. Morbeck and Zihlman report on the body composition and limb proportions of orangutans, but most of their contribution is based on relative weights of muscle, bone, and skin in the limb segments of two captive orangutans (one male, one female). The goals of the work are puzzling and the method would appear fatally flawed, since it is well documented that the adult weights of captive orangutans average more than twice those of free-ranging individuals. Jungers and Hartman address the question of how orangutan limbs achieve their proportions via ontogenetic scaling. Although functional correlates of skeletal growth emerge from this comparative analysis, the notion of an orangutan-human clade receives no support from multivariate growth trajectories of the locomotor skeleton. Rose provides an excellent account of hand and foot anatomy that further underscores the unusual locomotor anatomy of *Pongo* and the adaptations of orangutan cheiridia for life in the trees. Rose insightfully notes a number of salient features indicative of arboreality, but he, as well as Morbeck and Zihlman, mistakenly refers to a "double-locking" mechanism in orangutan fingers (a feature first suggested by Napier in 1960). In fact the presumed anatomical basis of the "double-locking mechanism," namely a relatively long manual proximal phalanx that exceeds the combined length of the middle and distal phalanges and allows the fingertip to be tucked into the crease between the metacarpophalangeal joint, does not exist. Though Rose finds no orangutan specializations in the earliest presumptive orangutan fossils (that is, *Sivapithecus*) from the Miocene of Pakistan, it appears to this observer that at least one fossil finger bone (GSP 17154) from the Nagri Formation, attributed to *Sivapithecus*, has a decidedly orangutan morphology.

Other chapters in *Orang-utan Biology* deal with reproductive physiology and endocrinology, neuroanatomy, and myology. These substantial contributions do not, for the most part, address directly the question of orangutan phylogeny. The ones that do fail to persuade the reader that orangutans are our closest living relatives. Despite the absence of support for the editor's hypothesis, *Orang-utan Biology* enhances our understanding of this rare and remarkable great ape. The volume further underscores the need for continued research on captive and wild orangutans (and other apes) if the goals of paleoanthropology include a better understanding of human phylogeny and behavioral pathways in human evolution.

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## *Cercopithecus* and Company

**A Primate Radiation**. Evolutionary Biology of the African Guenons. ANNIE GAUTIER-HION, FRANÇOIS BOURLIÈRE, JEAN-PIERRE GAUTIER, and JONATHAN KINGDON, Eds. Cambridge University Press, New York, 1988. viii, 567 pp., illus., + plates. $120.

The Old World monkeys are the most taxonomically diverse superfamily of living primates, with some 90 to 100 species. A few of these are well known from field studies, mainly the ones that tend to spend a good deal of time on the ground, in the open, where they are easy to study. But it is in the forest, especially the tropical rain forest, that the major diversity lies; and it is only rather recently that the most speciose genus of all, *Cercopithecus*, has really begun to become as well known as *Papio* or *Macaca*. This genus and its closest relatives are the topic of this book; and it is hardly surprising that it has become, in effect, a textbook on the comparative method in primatololgy.

It should not be thought that the book is entirely about field studies: it is, as the title makes clear, about the radiation (evolutionary diversification) of the guenons. So the first section includes papers on fossils, paleoenvironment, distribution, and basic taxonomy. Perhaps the key paper in this section is by Lernould on classification, which brings out the taxonomic problems, and so highlights the inherent evolutionary interest of the group. There are, to begin with, four major taxonomic groupings: three supposedly monotypic (*Allenopithecus*, *Miopithecus*, *Erythrocebus*) and one highly speciose (*Cercopithecus*). Are they all full genera, or only subgenera of *Cercopithecus*? Lernould has them as subgenera; authors of some other chapters disagree. Within *Cercopithecus* proper, how many species? Lernould lists 25 but admits that it is impossible to be decisive, not only because two new species (*C. salongo*, *C. solatus*) have been added within the last dozen years and more may yet turn