THEORY AND TECHNOLOGY IN THE FUTURE OF PALEOANTHROPOLOGY

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In his great book *The Descent of Man and Selection in Relation to Sex* (Darwin, 1871), Charles Darwin wrote much of the agenda that paleoanthropology has followed over the past century and a half. In that work Darwin was largely concerned with establishing the biological unity of mankind (sexual selection was an adduced explanation that seems to have taken on a life of its own as work on the book progressed, see Desmond and Moore, 2009) as a riposte to those advocates of slavery who had distorted his evolutionary notions to suggest that the various human geographical varieties had descended from different species of ape. At the same time Darwin gave a detailed argument for humankind's descent from an "ape-like progenitor" that had lived in the continent of Africa, and he was essentially the first to suggest in an organized fashion that the study of living primates would yield valuable perspectives on the characteristics and lifestyles of humankind's ancient ancestors. Possibly less productively, he provided the historical as well as the theoretical underpinnings for the seductive reductionisms of today's evolutionary psychology by suggesting that "in the distant future Psychology will be based on a new foundation, that of the necessary acquirement of each mental power and capacity by gradation" (1871: 488).

Darwin always thought of himself as a geologist, and his nascent ideas on evolution (specifically on the replacement of faunas) had been hugely influenced by his early discoveries in South America of fossil glyptodonts, giant extinct relatives of the extant armadillos (Eldredge 2005). Nonetheless, throughout his career, this man of wide-ranging curiosities remained resolutely mute on the subject of actual human fossils. He was ready to speculate in theory about the nature of ancient human precursors; but he was reluctant in the extreme to embroil himself with the tangible physical record. There are many potential reasons for this reluctance (Tattersall 2009a); but the fact remains that by the time Darwin published *The Descent of Man*, the first fossil of an extinct hominid to come to proper scientific attention (namely, the Feldhofer Cave partial skeleton from the Neander

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Thal in Germany) had already been the source of enormous and highly public disputation in English scientific circles for an entire decade. Yet in the *Descent* the only mention of this key specimen, the holotype of *Homo neanderthalensis*, was a single offhand comment to the effect that it showed that even ancient human crania could be "capacious."

My main purpose in drawing attention to this historical situation is to show that, from the very beginnings of paleoanthropology as an evolutionary science, there has been a very distinct gulf between theory and its practical applications in the tangible world. Indeed, the study of the human fossil record was virtually theory-free (at least in terms of respectable evolutionary theory) right until the middle of the twentieth century (Tattersall 1995, 2009b). Perhaps this was due principally to the fact that, following its foundations in geology and comparative anatomy, the field had rapidly become the province of human anatomists whose focus was on one particular species, and who thus did not require mechanisms to explain diversity.

Whatever the case, paleoanthropology has traditionally been an importer rather than an exporter of evolutionary theory. And the first coherent body of theory it imported was the Evolutionary Synthesis, to which the field capitulated around mid-century following the publication of an enormously influential contribution by the ornithologist Ernst Mayr (1950), himself one of the original architects of the Synthesis.

The Synthesis itself was a highly reductionist construct which, by the time it was absorbed into paleoanthropology, had reduced virtually all evolutionary phenomena to gradual gene frequency changes within lineages, under the guiding hand of natural selection. And the hominid phylogeny Mayr proposed was a supremely linear one. He condensed a plethora of recognized hominid species and genera to a mere three species: *Homo transvaalensis* (the ancient "australopiths"), *Homo erectus*, and *Homo sapiens* (including the Neanderthals). Subsequent finds forced even Mayr to recognize modestly higher diversity than this, but his basic outlook continues to dominate the paleoanthropological mindset today. Even with the huge hominid fossil record now to hand, a record that is eloquently witness to a level of diversity that is as wide as is to be found in any other successful mammalian family, paleoanthropologists remain reluctant to recognize more than a strict minimum of taxa. This is true at the species level but even more so at that of the genus, where the entire hominid fossil record (ignoring early and poorly known forms such as *Sahelanthropus, Orrorin, Ardipithecus and Kenyanthropus*) is crammed into a mere two or three genera: *Australopithecus* (plus perhaps *Paranthropus*) and *Homo*.

It is clear by now that, rather than having been a singleminded unilinear slog from primitiveness to perfection, the evolution of the hominid family

has witnessed a huge amount of evolutionary experimentation. New hominid species have routinely been tossed out on to the ecological stage, to flourish or perish in competition with each other and with other members of the biota in a constantly changing world. And if sense is ever to be made of the great diversity of hominid fossils now known, paleoanthropologists are going to have to recognize more taxa than most of them are willing to do at present, and to acknowledge the fundamental reality that systematics is much more than a mere clerical "argument about names." This has become particularly the case over the past two or three decades, during which cladistic notions have managed to penetrate into their science—at least to the extent that most paleoanthropologists would now accept that the only defensible criterion for the recognition of suprraspecific taxa is ancestry. And while avoiding paraphyletic taxa does not mean that every node on the cladogram of hominid relationships should be dignified with a nomen, it does require that more taxa be recognized than most paleoanthropologists are currently willing to contemplate.

The conclusion has to be, then, that paleoanthropology needs a paradigm shift, away from the linearist mindset that has dominated for sixty years, and toward a concept that embraces diversity. There is quite clearly a limit to the degree to which "taxon-creep" can cope with the morphological diversity that is becoming ever more evident in the hominid fossil record. And consequently a new systematic framework is required. To achieve such a framework will require a change in mindset, thus emphasizing the "conceptual elaboration" side of the balance to which this forum of *Ludus Vitalis* is devoted.

Ironically, perhaps, this may ultimately be achieved through developments on the technical side. The penetration of quantitative cladistic methodologies into paleoanthropology means that taxa will have to be recognized and, even more importantly, characterized in terms of character states. This will make the need for new taxa more evident. What is more, history has shown that new conclusions are more easily absorbed when they are arrived at through the discovery of new fossils, or of new methods of analysis. For example, there was relatively little resistance when Meave Leakey and colleagues (Leakey, et al. 2001) named the new genus *Kenyanthropus* from distinctive but poorly preserved material from a little-known time zone. Had she tried to rename something already described (including in isolation the KNM-ER 1470 cranium she also referred to her new genus), the reaction would almost certainly have been different.

Similarly, for almost a quarter of a century (Tattersall 1986) I have been trying to convince my colleagues that the Neanderthals merit an identity of their own, as the species *Homo neanderthalensis* (rather than dismissal as *Homo sapiens neanderthalensis*, an unsuccessful and by implication inferior

subspecies of our own species). Progress was slow until 2004, when Katerina Harvati and colleagues used advanced three-dimensional geometric morphometric techniques to show that the Neanderthals fell morphometrically outside any reasonably-defined variability envelope of *Homo sapiens* (Harvati, et al. 2004). This coup de grâce followed closely on the heels of an elegant analysis of computed tomography data on Neanderthals showing that the latter had very distinctly different cranial developmental trajectories from *Homo sapiens* (Ponce de Leon, et al. 2001). Add to this the demonstration soon after, using high-resolution CT scanning (Smith, et al. 2007), that the Neanderthals had an accelerated (primitive) dental development schedule compared to *Homo sapiens*, and the case for separate identity for the Neanderthals is now accepted by most workers, forced primarily by high-tech analyses of a kind not available until recently.

The conclusion must be, then, that technological advances and conceptual ones are currently proceeding hand in hand in paleoanthropology, the former compelling needed changes in the latter. The future, then, is not in one or the other; instead, it is in both, acting in synergy.

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