BU Discussion: Origins of *Homo* and access to fossils (Adam Van Arsdale)

Evolutionary origins are inherently complicated topics. Speciation, particularly in organisms as complex as higher primates, is unlikely to occur as a simple process, or manifest itself as such in the fossil record. Correctly identifying the combination of derived traits that might represent a trajectory of novel evolutionary change and evidence of reproductive isolation requires both a theoretical framework through which to addresses hypotheses of evolutionary relationships and a rich fossil assemblage with both geographic and temporal variation. The latter requires an immense amount of coordinated work among field specialists, including geologists, archaeologists, taphonomists, paleontologists and paleoanthropologists. Developing the theoretical framework requires some consideration of the action of evolutionary forces in the context of known understandings of the biology, behavior and ecological niche of ancestral and descendent taxa. Understanding the origin of our genus, *Homo*, therefore requires a consideration of a large assemblage of fossils spanning significant parts of the Old World as well as a theoretical examination of evolutionary scenarios that might give rise to *Homo* from an australopithecine past.

Recent fossil discoveries from the Georgian Lower Paleolithic site of Dmanisi and the South African site of Malapa promise to greatly aid in our understanding of the origin and early evolution of the genus *Homo*. Both sites offer a remarkably well-preserved assemblage of materials, including materials that have surprised us because of some combination of their location, the dates associated with them, or the combination of features they display.

The fossils from the Lower Paleolithic site of Dmanisi, Georgia, almost certainly do not represent the earliest members of our genus in the fossil record. However, I will argue that they do present us with the earliest evidence of a complete and novel evolutionary niche that characterizes Pleistocene *Homo*. The site itself is on a basaltic promontory in the foothills of the Lesser Caucasus, about 75 km southwest of Tbilisi. The areas that have produced the vast majority of the hominin fossil materials, blocks I and II, are characterized by a complicated microstratigraphic sequence, likely shaped by the underlying topography of the Masavera basalt and complex, layered erosional features that transect the area. For our purposes here, it is sufficient to say that all of the hominins recovered to date come from a single, rapidly deposited stratigraphic layer, referred to as the B1 horizon. While the Masavera basalt and lowest *in situ* ash deposits at the site have been dated to just older than 1.8 Ma (40Ar/39Ar), no direct date exists for the B-layer sediments. However, the A-level and B-level ashes are distinguished on the basis of their magnetic polarity, the former displaying normal polarities while the latter display reverse polarities. With the Olduvai-Matuyama reversal event placed at 1.77 Ma, the rapid depositional signals of the B-layer suggest that all of the hominin fossils come from a relatively narrowly circumscribed window of about 1.77-1.75 Ma. This date places Dmanisi in the middle, in terms of age, of the rich fossil sequences from the East African rift valley from places like the Turkana Basin and Olduvai Gorge. It also makes the site just slightly younger than published estimates for the Malapa material from South Africa.
The Dmanisi hominin sample currently consists of the partial remains of at least six individuals, including several individuals with multiple, well-preserved skeletal elements. At present, the hominin sample includes a particularly well-represented assemblage of cranio-dental material. Initial analyses of the cranio-dental remains have struggled with the combination of seemingly Homo habilis-like primitive features and more derived Homo erectus-like features, referring to the material as representative of basal Homo erectus. Additionally, the fossils display an intriguing combination of features characteristically associated with Lower Pleistocene Asian Homo erectus samples as well as features characteristic of early African Homo erectus. As such, the sample appears to occupy not just a transitional evolutionary location on the cusp of the Habilines and Erectines, but also a biogeographically intermediate position between Asian and African samples. Rather than focus on the details of this taxonomic debate, I would like to consider broader ideas on what distinguishes the Dmanisi sample as a whole, what it suggests about the evolution of Homo at this time period, and what it might suggest about the pattern of human evolution that follows throughout the Pleistocene.

While commentaries on the material have emphasized the relatively small cranial capacity and body size of the Dmanisi individuals, such statements are perhaps misleading when the remains are considered in the larger picture of the early evolution of Homo. Taken together, the package of traits observed in the Dmanisi hominin sample suggest a significant shift to a broader and more dynamically flexible adaptive niche in Homo relative to the australopithecines. Although not of the size estimated for the Nariokotome specimen, the Dmanisi post-cranial remains, with an average estimated stature of ~155 cm, suggest an adult size within the lower range of contemporary humans and above most estimates for australopithecines. In addition to larger body size, the major details of the Dmanisi post-cranial remains are consistent with patterns of locomotion observed in contemporary humans. Nor do the Dmanisi hominins, with an average cranial capacity between 650-700cc, possess the large brain of early African Erectines like ER-3733 or ER-3883. However, in both absolute and relative terms, the Dmanisi specimens have larger cranial capacities than the australopithecines. More enigmatically, the 3444 individual from Dmanisi is the earliest edentulous specimen from the hominin fossil record. While edentulous specimens are not unheard of in museum primate collections, the Dmanisi specimen at least gives some hint as to potential cultural or technological innovations associated with increased survivorship. The Dmanisi remains are found in the context of a basic Oldowan tool industry with some, albeit limited, evidence of primary access to faunal carcasses. Finally, Dmanisi is, of course, well outside of Africa. This is true not just in a literal sense, but more significantly in the faunal signal from Dmanisi, which is considerably different from contemporary African sites like Olduvai Beds I and II. Dmanisi is not just out of Africa, it is not Africa, and likely presented the hominins living there with different ecological challenges.

Two points are worth highlighting about the above features of the Dmanisi hominins. First, all of the traits are consistent with an expansion of the evolutionary
niche occupied by hominins. The increased prioritization of technologically and cognitively driven plasticity, coupled with a body more efficiently designed for longer-range movement, set up the expansion of these hominins out of Africa. Second, all of these features are representative of gradual trends observed across the human lineage throughout the Pleistocene. Body size, adult survivorship, and the exploitation of novel environments are all traits that, although they are seen at Dmanisi in a limited fashion, continue to increase throughout the Pleistocene. The challenge in taxonomically placing the Georgian remains between Habiline and Erectine, African and Asian samples, reflects not necessarily a short-coming in our data, but the reality of an expanding niche with complicated patterns of long-term genetic isolation between geographically and technologically divergent lineages. What Dmanisi suggests is that the package of traits which might be considered characteristic of classic Homo erectus, and which signal the major trends that characterize fossil Homo throughout the Pleistocene, consolidated early in the evolution of the genus Homo. At the center of this new adaptive niche is a technology-mediated interaction between hominins and their adaptive landscape, presumably driven by an increasing cognitively-specialized, social hominin.

The new fossils from Malapa make for an interesting comparison with Dmanisi and for questions about the origin and early evolution of Homo. In particular, the Malapa remains preserve a surprising combination of traits. If the evolutionary niche that consolidates around the genus Homo in the Lower Pleistocene is predicated primarily on a cognitively and technologically driven adaptive flexibility, the newly designated Australopithecus sediba material does not appear to show the full suite of characteristics necessary for such a transition. Like Dmanisi, the A. sediba remains appear to preserve a strongly reduced masticatory apparatus relative to earlier australopiths. While no stone tools have been published with the fossils, the first appearance of stone tools increasingly appears to be an australopithecine innovation, perhaps suggestive of a dietary/ecological shift and accounting for the reduced masticatory structure in A. sediba. The post-cranial remains of A. sediba also suggest retention of a more primitive set of locomotor traits than those observed at Dmanisi and in later Homo. Given their close association in time, the A. sediba remains may represent a contemporary, albeit more primitive off-shoot of the lineage that gave rise to Homo, preserving only a partial set of derived features, without the consolidated broadly adapted niche seen in Homo. The Malapa material also presents another opportunity to critically examine what set of features we use to define the genus Homo. Additional research on these important fossils will certainly aid in our understanding of their significance in the origin of Homo and Plio-Pleistocene hominin evolution.

Our understanding of the origin of Homo, like all questions of the fossil record, is predicated on access to primary data – the fossils themselves. Paleoanthropology is, and likely will remain, in many ways, a low-information science. The fossil record is an important representation of past life on the planet. As such, when considering the production of scientific knowledge in paleoanthropology, we should expect to be wrong with some frequency. New discoveries add potentially significant and
unexpected additions to our dataset (Dmanisi and Malapa serving as nice examples of this), which may very rightfully topple old understandings of the fossil record. This is not a bad thing, and indeed, is characteristic of scientific practice at its best within the field. Neither does it relegate paleoanthropology to being a fringe science.

While paleoanthropology is a low-information science, it also is blessed with a unique diversity in the kinds of data it engages. We are privileged not just to have a fossil record, but also a record of material culture extending more than 2.5 million years into the past, thanks to courtesy of the human tendency to create durable trash. We have an increasingly well-studied picture of human genomic diversity. We have a record of past environmental and climatic changes at varying scales of time and geography. We have a comparative perspective on behavior and morphology from our evolutionary cousins. And finally, we have extensive knowledge about the complex activities that we, as humans, regularly engage in. The diversity of data relevant to questions of human evolution gives paleoanthropology the ability to operate within a rich, hypothesis-testing framework: one in which paleoanthropology can generate empirically driven and logically coherent hypotheses associated with predictions across a wide variety of data sources. This also allows paleoanthropology to occupy a unique position between the theoretical traditions of macro- and micro-evolutionary studies.

In this rich array of data, fossils sit at the center. Access to fossils is essential to paleoanthropology fulfilling its potential as a rich generator of knowledge and theory about the pattern and evolutionary processes associated with human evolution. Several divergent interests and realities need to be considered in the context of fossil access. First, there is the balance between privileging those individuals whose labor and research have gone into primary efforts of fossil discovery, preparation and publication. This interest must be offset by the need, in the interest of science, to make such discoveries accessible to relevant researchers, including those with potentially contrary scientific views. Paleoanthropology cannot operate as a proper science without valuing such access.

Second, and perhaps more fundamentally challenging, is the reality that the location of much of the human fossil record and the most highly-developed and resource-rich institutions devoted to their study, do not share great overlap. Problems of one-sided academic extraction abound in paleoanthropology. From my own field experiences in Kenya and Georgia, both countries with a proud, but socio-politically limited, scientific history, I have witnessed some of the ways in which fossils take on value relevant to questions of access. Without going into great detail here, in addition to their obvious scientific value, fossils have cultural, institutional, political and monetary value. As a discipline, paleoanthropology can do a better job of trying to bridge the gap between the priorities imposed by our profession – publication, grants, and promotion – and ethical best practices in fossil research. Field research that seeks way to benefit all of the vested parties is rarely consistent with a “publish or perish” ethos, but instead takes careful planning and the long-term development of cooperative, collaborative relationships.