Orgnac 3: New Perspectives on an Old Site and Directions for Future Research

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A critical goal of current paleoanthropological research is to clarify "the muddle in the middle," (Isaac 1975), that is, the poorly resolved record of the behavioral and biological evolution of Middle Pleistocene (MP) hominin populations in Europe that included Neanderthals and their ancestors. Orgnac 3 (OR3) in southeastern France is especially well suited to addressing the paleoecological, behavioral, and morphological changes that were taking place during the MP, though it has received relatively little attention. We will introduce the site to a wider audience, summarize the previous results, offer some new views that they suggest, and propose directions for future research. A review of previous work and the inferences it allows show that OR3 remains relatively misunderstood and understudied. We will show that the OR3 archaeological deposits most likely date to OIS 11, 10, 9, and 8, rather than just to OIS 9 and 8, putting the initial occupation of the site ~100,000 years earlier than previously accepted. This bears directly on when Levallois technology appeared in Europe, as OR3 is one of the few early sites to reveal its development. The shorter chronology was based on Uranium-series dates from post-depositionally altered travertine samples, and contradicts biochronological and sedimentological chronologies. The fossil fauna most likely represents a combination of both carnivore and hominin activity and not simply hominin hunting and butchering. The hominin remains have not been photographed, described in detail, or assigned to a taxon. The site itself, of which only ~12% of the currently known deposit has been excavated, has been left in a state of disrepair and, despite having a building and a fence protecting it, has been frequently vandalized by intruders over the last 20 years. We hope that continuing research at OR3 will help clarify the "muddle" in our understanding of hominin evolution during the MP.

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References Cited:

Isaac, G.L. 1975 Sorting out the muddle in the middle: an anthropologist's post-conference appraisal. In: Butzer, K.W., Isaac, G.L. (eds) *After the Australopithecines*. Mouton de Gruyter, The Hague, pp. 875–888.

Occlusal Fingerprint Analysis in Early Hominid Molars and its Meaning for Dietary Reconstruction

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The morphology of teeth has always been essential for research on phylogeny, diet, and palaeoenvironment. Occlusal wear patterns, which develop during the processing of food, are an important aspect for the understanding of the functional morphology of teeth, as these structures provide direct evidence for an individual's diet. However, the complexity of the configuration of these facets has been a challenge in dental research. The Occlusal Fingerprint Analysis (OFA) applied in this study provides a mean to quantify and compare these wear patterns. By measuring the dip direction and the inclination angle of every facet on a tooth, we generated a 3D occlusal compass. This compass enabled us to get a clear picture of an individual's dental wear. Lower molars of *Australopithecus afarensis* from the three Ethiopian sites of Hadar, Omo, and Maka were surface scanned and the resulting 3D models were analysed using the software package PolyWorks®. Our preliminary results indicate that this early hominid sample is extremely uniform, independent of wear stage, geological age and place of discovery. These results are remarkable considering the wide range of habitat reconstructions for the investigated sites, covering open woodland and grassland to rather closed vegetation.

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3D Digitization of the Excavation Site of a Fossil Hominid (StW 573 / "Little Foot," Sterkfontein, South Africa)

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During more than 10 years of careful excavation, Ron Clarke and his colleagues exposed a virtually complete skeleton of *Australo-*

pithecus (StW 573, nicknamed "Little Foot") at Sterkfontein in South Africa. It is estimated to be around 3 million years old. This is somewhat older than recently published U-Pb dates for the skeleton, which, in fact, date a younger flowstone that filled gaps created by subsidence of the breccias containing the skeleton. This specimen is exceptional in its completeness and represents a second species of *Australopithecus* to *A. africanus*, for which Sterkfontein is well known. Most of the elements of the skeleton are undistorted and preserve anatomical association. However, a few anatomical parts show crushing, fragmentation, scattering, and disarticulation, caused by collapse of portions of the deposit. It has been important to record the details of the skeleton's position and any displacement within the strata so that the orientation and location of the bony elements are carefully archived prior to removal of the bones from the cave. For this purpose, we scanned the excavation site with two 3D laser scanners. High resolution 3D models also provide a memory of the geological context to assist interpretation of the skeleton in relation to the detailed stratigraphy. With the 3D digital models, it will be possible to come back to an interactive and non-interpretative view of the context. We used a Konica-Minolta VIVID 910 scanner which is widely used in industrial metrology and a NextEngine HD scanner which is a low-cost desktop device used to digitize small archaeological objects. Post-processing of the 3D views consists in a pipeline of computer graphics procedures: selection of 3D views, global registration, fusion, and simplification, "beautifying" the resulting 3D reconstruction and rendering. One author used only open-source software whereas another author combined the functionalities of several commercial softwares.

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The ESRF Virtual Database: A New Resource for Paleoanthropologists

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Paleoanthropological studies increasingly employ micro-computed tomography (micro-CT) for studies of skeletal anatomy and development. This non-destructive method allows precise quantification of internal structures and three-dimensional morphology at increasingly finer resolutions. For example, recent micro-CT studies of the primate dentition have provided insights into enamel thickness, enamel-dentine junction shape, root and pulp morphology, and developing tooth calcification. However, limited access to requisite scanning equipment and fossil material has prohibited widespread study of these characters. Although there have been discussions about making hominin data accessible (Weber 2001; Delson et al. 2007), the only fossil that is available for free and with open access is the Skhul V scan (on the Harvard University Peabody Museum website), and just a few scans are available for a nominal fee (e.g., NESPOS Society, University of Vienna's Digital Archive of Fossil Hominids). Recently, the European Synchrotron Radiation Facility (ESRF) created a free open access online database from micro-CT studies performed at the ESRF (<http://paleo.esrf.eu>). We are currently working to upload synchrotron micro-CT scans employed in publications on hominin dental remains (Smith et al. 2006, 2009, 2010), and other material scanned at the ESRF in collaboration with numerous scholars and repositories (who may retain copyrights). The ESRF is committed to the long-term maintenance of this database as a means of increasing global research infrastructure and promoting awareness of synchrotron imaging. Given the recent publication of newly discovered fossil insects in opaque amber (e.g., Lak et al. 2008), digital data may even represent the primary evidence of new species in some cases. Moreover, virtual models of skeletal remains may serve as a mean of safekeeping fossils, can be used to produce scaled replicas, and reduce the need for repeated measurements on actual fossils. By making these data available we also hope to promote more open scholarly exchange.

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References Cited:

Delson, E., Harcourt-Smith, W.E.H., Frost, S.R., and Norris, C. 2007. Databases, data access, and data sharing in paleoanthropology: first steps. *Evolutionary Anthropolgy* 16, 161–163.

Lak, M., Néraudeau, D., Nel, A., Cloetens, P., Perrichot, V., and Tafforeau, P. 2008. Phase contrast X-ray synchrotron imaging: opening access to fossil inclusions in opaque amber. *Microscopy and Microanalysis* 14, 251–259.

Smith, T.M., Olejniczak, A.J., Tafforeau, P., Reid, D.J., Grine, F.E., and Hublin, J.-J. 2006. Molar crown thickness, volume, and development in South African Middle Stone Age humans. S. Afri. J. Sci. 102, 513–517.

Smith, T.M., Olejniczak, A.J., Kupczik, K., Lazzari, V., Vos, J., Kullmer, O., Schrenk, F., Hublin, J.-J., Jacob, T., and Tafforeau, P. 2009. Taxonomic assessment of the Trinil molars using non-destructive 3D structural and developmental analysis. *PaleoAnthropolgy* 2009, 117–129.

Smith, T.M., Tafforeau, P., Reid, D.J., Pouech, J., Lazzari, V., Zermeno, J.P., Guatelli-Steinberg, D., Olejniczak, A.J., Hoffman, A., Radovčić, J., Masrour, M., Toussaint, M., Stringer, C., Hublin, J-J. 2010. Dental evidence for ontogenetic differences between modern humans and Neanderthals. *Proceedings of the National Academy of Sciences USA* 107, 20923—20928.

Weber, G. 2001. Virtual anthropology (VA): a call for glasnost in paleoanthropology. *The Anatomical Record* 265, 193–201.

Carnivore Ecomorphology in Plio-Pleistocene East Asia and East Africa: Implications for Hominins

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Hominins interacted with the carnivore guild by scavenging carcasses and competing with carnivores for those carcasses. Feeding adaptations and body mass are among the traits that differentiate members of the carnivore guild and influence the outcome of interspecific competition. Early Pleistocene hominins colonizing East Asia would have encountered different species of predators. Obtaining animal resources would have been important at higher latitudes due to seasonal differences in plant availability. Here, Plio-Pleistocene