Paleosol Carbonate and Pollen Evidence for Deforestation and Cooling in South Asia Caused by the Toba Super-Eruption: Implications for Human Evolution

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The eruption of Toba, Sumatra, ~73,000 years ago was the largest explosive eruption of the past two million years. Its impacts on global and regional climate and on human evolution remain controversial. Ash from the Toba eruption crops out as channel-fill and lake basin deposits across peninsular India, and is present in marine sediment cores from the Indian Ocean, the Arabian Sea and the East China Sea. Ice core records show that this eruption marks a six-year-long volcanic winter, and the abrupt onset of an 1,800-year-long period of the coldest temperatures of the last 125,000 years. We present results of two independent lines of inquiry into the impact of this eruption and instant ice age on ecosystems in India and Sumatra. Pollen grains extracted from samples collected immediately beneath and above the Toba ash in two marine cores, one west of Sumatra, the other in the Bay of Bengal, show reduction of tree cover and cooling followed by prolonged drought after the eruption. Stable carbon isotopes of fossil soil carbonates directly beneath and above the Toba ash from three sites in the Son and Narmada valleys of central India show forests before the eruption and open or wooded grassland ecosystems after the eruption. Our results show that the Toba eruption was followed by more than a millennium of drier and cooler climate, with deforestation of some terrestrial ecosystems in South Asia. We hypothesise that other tropical ecosystems may also have been affected. Recent genetic bottlenecks and population subdivisions in humans and other species, and extinctions of several SE Asian mammals, may have been initiated by this event. The genetic structure of modern humans, the course of modern human behavioral evolution, and dispersals out of Africa may have been influenced by the environmental impact of the Toba eruption.

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Survey and Exploration of Cave Sediments in Southeastern Ethiopia: Preliminary Results

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Modern humans likely originated in East Africa, possibly in Ethiopia, between 190–60 ka, but the MSA-LSA archaeological record in Ethiopia remains poorly known. More well-stratified and well-preserved sites are greatly needed. Southeast Ethiopia has many rock shelters and caves from its Middle-Late Jurassic limestone successions; these sites have great potential for preserving rich archaeological deposits including fauna. Previous investigations in this area located many caves and shelters, but primarily focused on the region's rich rock-art. We formed the Southeastern Ethiopia Survey Project to identify cave or shelter deposits containing MSA and/or LSA remains, revisit sites identified by previous researchers, and document known and new rock-art sites. During the first field season (June-July 2007), we visited more than two dozen caves, rock-shelters, and open-air sites. MSA lithics (points, scrapers, and Levallois cores) were documented in five caves or rock-shelters and one open-air site. LSA tools occurred at nine caves or shelters. One site contained both MSA and LSA tools in stratigraphic succession, raising the possibility of a continuous occupation. Many MSA and LSA sites had associated fauna, although preservation varied considerably. In both periods, chert and obsidian make up a substantial portion of the lithic assemblages. Rock art was documented from 15 caves and shelters. Pastoral themes predominate. The art comprises all stages and phases of Cervicek's classification of the "Ethiopian - Arabian" style. One cave site, Goda Dessa, features rare paintings of wild fauna in black pigment and depictions of domestic animals in red and white pigments, some superimposed on earlier compositions. Sadly, much of the art is threatened; at the previously described site of Goda Wenji (Goda Ondji), the art has been destroyed by graffiti. In future seasons, we will explore additional areas, perform sedimentological and geochronological investigations, and conduct test excavations in four promising sites.

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New Discoveries From the Ysterfontein 1 Middle Stone Age Rockshelter, South Africa

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Excavations at the Ysterfontein 1 Rockshelter are yielding a rich record of Middle Stone Age (MSA) coastal ecology. We present an update of our continuing research. The site is located on the western coast of South Africa, ~70km NNW of Cape Town, in an environmental zone very different from the southern coast, where MSA ecology has been previously best documented. The rockshelter's base is ~7m above current mean-sea-level and ~40m from the current coastline, and the site preserves 3.8m of stratified sandy deposits. The lower 2m comprises dense stratified shell middens in association with stacked hearths, stone artifacts, worked ochre, and animal bones. Denticulates are a common feature among the artifacts; and some fine examples of convergent denticulates are unique. No elements suggesting the Howieson's Poort or Still Bay variants of the MSA have been found at the site. The fauna resembles other Western Cape coastal MSA sites with bovids, seals, seabirds, and heavy emphasis on a limited range of shellfish, particularly black mussels and limpets. Edible-sized fish are absent, and limpets and tortoises are large. The uppermost 1–1.5m layers of the site contain more ephemeral material, including occasional stone artifacts, numerous animal bones, abundant ostrich eggshell, and traces of large and small burrowing animals. AMS-radiocarbon and optically stimulated luminescence dating combined with knowledge of local bathymetry and changing sea levels help constrain the age of the deposits to MIS 5. Future comparisons with the long sequence at Diepkloof rockshelter, ~100km north of Ysterfontein, may help to further bracket the chronology. Ysterfontein 1 contributes to our understanding of the range of variation in MSA ecology and will allow us to test models of human behavioral evolution on the western and southern coasts of South Africa.

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Results of Excavations at Le Gros Roc, Charente-Maritime, France

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The Paleolithic occupation of a hillside with cave formations at Le Gros Roc, Charente-Maritime, France, occurred about 10km from Saint-Césaire, where a late Neandertal skeleton was found in a Castelperronian level (Leveque and Vandermeersch 1980). Testing of a newly discovered cavity at Le Gros Roc was accomplished by Western State College of Colorado field school students in 1997, 1998, and 1999; these soundings uncovered a large cavern that was found to contain the same chronostratigraphy as Saint-Césaire. In 2001, excavations revealed diagnostic artifacts in Level 4, including Châtelperron knives; the technology of stone reduction is typical of the Castelperronian. Many unretouched blades, carinated endscrapers, foliate unifacial scrapers, burins, and backed pieces were found, all in excellent condition, along with faunal remains. At the base of the Castelperronian level, evidence of *in situ* burning suggested the presence of a hearth. Analysis has pointed to the presence of a workshop with specialized blade production. The Castelperronian remains at Le Gros Roc represent a very different context from the Castelperronian at Saint-Césaire, which was a domestic context (Backer 1994). Blade production and caching behavior at Le Groc Roc evidently reflect a specialized, logistical function, involving planned hunting and butchery of animals attracted to the permanent springs at this location. The idea that this behavior was part of the annual round of the late Neandertals in the immediate area, rather than limited to anatomically modern humans' subsistence-settlement repertoire, is discussed.

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High Resolution Paleoclimate and Paleoenvironment from 92–55ka from Pinnacle Point, South Africa

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A central goal of the SACP4 project is the construction of a multi-proxy high resolution and continuous paleoclimate and paleoenvironmental record for the MSA along the South African coast. Speleothems provide one of the best terrestrial records because they can be precisely dated with u-series techniques and studied for shifting d18O and d13C that can be used as proxies for changing climates and environments. Here we present the first high resolution speleothem sequence (Crevice Cave, Pinnacle Point) for the period between 92-55ka for the southern hemisphere, a time when the MSA displays significant technological variation and material culture complexity, including the Still Bay and Howiesons Poort lithic variants. A high sea level cut the cave into a fault breccia cemented into a shear plane in the Table Mountain Sandstone (TMS). The fossil shelly dunes and calcrete that overly the TMS supply the calcium carbonate for the formation of speleothems from the time the caves were sealed. Optically stimulated luminescence ages (OSL) joined to petrographic analysis show the cave was partially closed (~120 ka) and then sealed (~92 ka) by dunes, a pattern consistent with PP13B and other Pinnacle Point localities. A high resolution isotopic record of the speleothems show d18O fluctuations ranging from -6.0‰ to -2.0‰ and d13C from -12.0‰ to -7.0‰. d13C fluctuations reflect changes between periods with domination of C3 fynbos vegetation to periods with some invasion or replacement by C4 vegetation. There are several long d13C - d18O cycles lasting 4,000 to 9,000 years, interrupted by short, several hundred to thousand year events that our high precision approach reveals. We document numerous major cold/dry and warm/wet events, and discuss their significance for understanding several major questions about the MSA.

Paleodietary Analysis of Medium-Sized Cervids in 'Ubeidiya, Israel: Evidence for Mediterranean Oak Woodland Habitat in the Early Pleistocene of the Jordan Valley and its Bearing on Climatic Hypotheses of 'Out of Africa I'

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The impetus for hominin dispersal from Africa in the early Pleistocene is attributed to grassland expansion into higher latitudes. Although it is suggested that hominins inhabited Mediterranean ecosystems as well, it is unclear if hominins preferentially inhabited woodlands or grasslands within this biome. The Levantine Lower Paleolithic site of 'Ubeidiya, Israel, is one of the earliest hominin sites out of Africa. Its chronological and geographic position makes it an excellent case study to test hypotheses regarding 'Out of Africa I.' It is hypothesized that if 'Ubeidiya was situated within a grassland environment, ungulates retrieved from the site will have a higher proportion of graze in their diet compared to ungulates from woodland habitats. Novel predictive equations were developed for percent graze, browse, and fruit in the diet based on mesowear variables (Fortelius and Solounias 2000). Mesowear data were retrieved from *Psuedodama* sp. (Cervidae, Artiodactyla) populations from two 'Ubeidiya strata and applied to the prediction equations. For comparison, populations of *Dama mesopotamica* from Mediterranean sub-habitats were similarly analyzed: Ohalo II (23ka BP) in the Jordan Valley (Mediterranean grassland) and late Pleistocene and modern populations from Mount Carmel (evergreen Kermes oak woodland). Results indicate no significant shift in the diet of 'Ubeidiya deer between strata with a high percent of browse (ca. 80%) in cervid diet. The populations are indistinguishable from the late Pleistocene and modern Mount Carmel fallow deer populations but differ significantly from fallow deer in Ohalo II, which have an increased proportion of graze in their diet (ca. 45%). These results support reconstructions of the region as woodland and are inconsistent with the view of extended grassland habitats in 'Ubeidiya during this time period. Intrinsic factors may have contributed to the success of hominins in higher latitudes and the drive for the dispersal from Africa.

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A Continuous Archaeological Sequence from MIS 3 to 5: Preliminary Results From the Middle Stone Age Deposits at Pinnacle Point Site 5-6, Mossel Bay, Southern Cape, South Africa

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The MSA of southern Africa is critical to developing models of the origins of modern humans and modern human behavior. As a result there is a growing need for more continuous and well-dated archaeological sequences from this time period. Ongoing research at PP5-6 will significantly refine knowledge about the MSA sequence along the southern African coast, due to advanced field methodology, the depth of deposits, and an intensive dating protocol. PP5-6 is a rockshelter in the quartzitic cliffs at Pinnacle Point near Mossel Bay, South Africa. Three seasons of excavation at PP5-6 have been conducted as part of the South African Coastal Palaeoclimate,

Palaeoecology, Palaeoenivronment, Palaeoanthropolgy Project (SACP4), an ongoing interdisciplinary research program. At least 12 meters of deposit exist at this site, and a continuous 7 meter section of stratified MSA deposit spanning MIS 3–5 has been excavated to date. The base of PP5-6 has several meters of deposit with lenses of shell and anthropogenic burning transitioning to a series of sandy and ashy layers with fine-grained lithics contemporary with the Still Bay. Howieson's Poort deposits occur further up the section with characteristic backed geometric blade segments on fine-grained raw material. OSL dates provide constraints on these sedimentary and technological shifts. Pinnacle Point has numerous caves and rockshelters including PP9 (A–C), 13A, and 13B which all provide shorter MSA occupations spanning MIS 5–6. PP5-6 provides a continuous set of deposits that will expand the time range covered at Pinnacle Point. The sequence at PP5-6, in conjunction with the other excavated sequences at Pinnacle Point, stands to be one of the longer continuous sequences for the MSA in southern Africa. When combined with the SACP4 high resolution speleothem isotopic sequence, PP5-6 will significantly contribute to our understanding of the relationship between modern human evolution and changing environments.

The Ma'in Site Complex: Middle Paleolithic Lithic Procurement on the Madaba Plateau, Northern Jordan

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Neanderthals and early anatomically modern humans may have coexisted in the Levant for a prolonged period employing similar Middle Paleolithic technologies (Grün et al. 2005; Hovers 2006; Shea 2006). To assist understanding this phenomenon, the Ma'in Paleolithic Project is modeling Middle and Early Upper Paleolithic land-use and resource exploitation on the East side of the Rift Valley, an ecologically diverse area that differs from the better-known Levantine coast. Here we summarize two seasons of research at the Ma'in Site Complex near Madaba, Jordan. This locality includes two flint-bearing limestone ridges surrounded by Pleistocene soils. Excavations, systematic surface collection aided by GPS technology, and GIS analysis of artifact locations revealed hominin presence from the Lower Paleolithic through the entire Middle Paleolithic and may include an early stage of the transition to the Upper Paleolithic. Surprisingly, the Upper Paleolithic proper is not present, and the only later material is Chalcolithic. Stratigraphic information, the spatial distribution of both core types and sizes, and patterns of patination have permitted a reconstruction of the Middle Paleolithic technological sequence. This differs from the "classic" coastal sequence (Levallois blades to large flakes to smaller flakes and broad points), and also from most Jordanian Middle Paleolithic assemblages, which are strongly blade-based (Bar-Yosef 1998; Henry 2003). Instead, the Ma'in Middle Paleolithic is primarily Levallois flake-based throughout the sequence, although blades (more common earlier in the sequence) and points are also present. The one temporal trend is a reduction in the size of Levallois products over time. In the possible transitional MP-UP industry, faceted platform flake cores are replaced by plain platform cores producing small irregular blades. This differs from other MP-UP transitions in the Levant (Bar-Yosef 2000). An open-air Middle Paleolithic campsite adjacent to the flint source is described, and new OSL dates for these assemblages are summarized.

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ESR Dating of Spring and Paleolake Deposits near Kharga, Western Desert, Egypt

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Located in Egypt's hyperarid Western Desert, Kharga Oasis today receives ~0.7mm/y precipitation, but suffers >2m/y evaporation,

ensuring that naturally standing water occurs rarely. Along the nearby Libyan Escarpment's edge, springs deposited tufa that dammed small lakes and ponds, ranging from 1–5m^2 to 4.5km^2 in area, and then trapped calcarous silts. The Pleistocene tufas yield Paleolithic artifacts. Freshwater molluscs in the interbedded tufas and lacustrine silts indicate abundant fresh water to support the hominids, a diverse fauna, and locally lush vegetation. Dating these deposits helps to delimit the pluvial periods that enabled hominids to occupy the eastern Sahara. At Wadi el-Midauwara, a tufa terrace complex covering ~25km^2 accumulated during at least four different pluvial events. Upper Acheulian, terminal Earlier Stone Age, Middle Stone Age, Aterian, Epipaleolithic, and Neolithic artifacts, as well as limestone and chert nodules eroded from the local limestone, dot the gravel lags flooring small basins and blowouts within the tufa complex terraces. Electron spin resonance (ESR) can date aragonitic mollusc shells ranging from 5ka to >2Ma. From Midauwara, ten *Melanoides tuberculata* samples were dated by standard ESR analysis. Although more accurate modelling for the time-averaged cosmic dose rate would improve their accuracy, the preliminary ESR dates suggest that the area experienced at least three distinct humid episodes: In surface samples from deflated pans, snails dating to ~9ka hint at ponds in earliest Oxygen Isotope Stage 1 (OIS 1), although no early Holocene tufa has been found yet. From 125±5 to 100±8ka, during OIS 5c-5e, a lake and several ponds in the tufa terrace complex supplied water to the area. In the Earliest Pleistocene or Latest Pliocene, at 2.0± 0.3Ma, snails and standing fresh ponds or lakes existed.

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Variability in Acheulian Technology at Elandsfontein, South Africa

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The variation in Acheulian large cutting tool forms has been the subject of much interest in many parts of the Old World. Although there is much variation across Acheulian sites, the modalities of shape within assemblages suggest that Acheulian technology represents a distinct change from the earlier part of the Paleolithic archaeological record. Many different hypotheses have been developed to explain these modalities. Recently, the variation in South African Acheulian technology has been suggested to be the product of socially generated constructs. While all models of Acheulian technological variation incorporate some aspect of the raw material variability, this attribute is rarely investigated in detail. Here we incorporate an extensive study of raw material sources in the Saldanha-Langebaan area of the South African Western Cape and apply this to the Middle Pleistocene Acheulian assemblage at Elandsfontein. Stone used for the manufacture of Acheulian large cutting tools at Elandsfontein vary not only in initial form but also in specific qualities of the raw materials. Data suggest that distinct technological strategies were implemented on different raw materials. These strategies are found in the large cutting tools as well as the associated detached pieces. Transport decisions and intensity of reduction may have also influenced the resultant assemblage of Acheulian forms. Our results suggest that diversity in Acheulian technological form allow the investigation of a range of aspects of Middle Pleistocene behavior but only when these assemblages are studied relative to a detailed understanding of the context of raw material variability. Broader scale studies of the evolution of human behavior in stone tool technology must incorporate proximate causes of variation before higher order hypotheses can be addressed.

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First Documentation of Heat Treatment of Silcrete in the Howieson's Poort and Still Bay Middle Stone Age Industries, Southern Cape, South Africa

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The Howieson's Poort (HP) and Still Bay (SB) Middle Stone Age (MSA) lithic Industries in southern Africa are important for the understanding of early modern human behavior as there are no instances of similarly sophisticated bladelet and biface technology, respectively, in Eurasia until the Upper Paleolithic. Both these industries include tools that have been argued to show an increase in standardization, craftsmanship, and production time. The blade dominated HP, and bifacial points of the SB, usually occur in conjunction with an increased reliance on fine-grained raw materials, predominately silcrete, at MSA sites in the southern Cape. Through an intensive experimental replication study of HP blades and SB bifaces, we have found that silcrete in its raw quarried form is difficult to knap, and HP and SB bladelets and bifaces are nearly impossible to knap. After heat treatment, however, the raw material is significantly more workable and both bladelets and bifaces are easy to knap. Experimental replication and laboratory analysis of heated and unheated silcrete from both modern and archaeological contexts support the argument that early modern humans processed at least some of their lithic materials with fire prior to initiating formal tool production. Heat treatment demands a sophisticated knowledge and control of fire that signals an elevation of human engineering. This has obvious implications not only for the spread of bifacial and blade technology across central and northern Africa, but also indicates that by ~70ka, early modern humans had advanced fire technology and the cognitive ability to conceptualize an abstract core reduction process involving advanced planning.

New Insights on Hunting Behavior During the Howiesons Poort: Faunal and Lithic Evidence From Sibudu Cave (KwaZulu-Natal, South Africa)

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In this paper, we integrate faunal and lithic data from Sibudu Cave to examine the evidence for variability in hunting behavior within a single substage of the MSA-the Howiesons Poort (HP). Although dates for the HP layers at Sibudu are not yet available, ages for the Still Bay and post-HP industries confine the possible range to somewhere between ~73 and 60ka. Three stratigraphic units have been identified within the Howiesons Poort-from oldest to youngest, these are Pinkish Grey Sand (PGS), Grey Sand (comprised of layers GS I and II), and Grey Rocky (GR I and II). Taken as a whole, the HP fauna is dominated by species that prefer closed (particularly forested) environments; the assemblage also shows a heavy focus on small bovids. However, there is evidence for significant variability within the HP- the youngest layers show a higher proportion of species that prefer more open habitats, and there are significant shifts in the representation of the various bovid size classes over time. In exploring whether these changes may have been linked or otherwise related to changes in hunting technology, we examined a particular class of backed tools-the segments-as these have been subjected to detailed use-trace, micro-residue and quantitative metric analyses. Although use-trace analysis indicates that most segments were hafted and that the tools likely served as inserts for hunting weapons, the stratigraphic divisions within the HP appear to coincide with marked changes in the way that segments were made, hafted, and used. In addition to significant variation in raw material type and segment length/breadth over time, evidence also indicates shifts in hafting configuration and in the material to which the segments were hafted. The implications of this variability to our understanding of human hunting behavior during the HP will be discussed.

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Results From the Re-Excavations at Vogelherd Cave, Swabian Jura, Germany

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In the summer and fall of 1931, Gustav Riek directed excavations at the Paleolithic site of Vogelherd in the Swabian Jura of southwestern Germany. This excavation produced finds from the Middle and Upper Paleolithic, and is best know for its rich deposits dating to the Aurignacian. Riek's dig emptied the cave entirely of Pleistocene deposits. Starting in 2005 a team of archaeologists from the University of Tübingen began large scale excavations in the backdirt produced by the fieldwork of 1931. In three field seasons the team has re-excavated ca. 160m^3 of the backdirt and through careful waterscreening has recovered important finds, which were overlooked during the original research at the site. We report on new results from Vogelherd, including the discovery of important lithic and faunal remains, Aurignacian artworks, possible fragments of a bone flute, personal ornaments, human bones, and other finds that help us to better understand the importance of this famous site.

Between the Caves: Survey and Open Air Paleolithic Sites in the French Midi-Pyrénées

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Since 1993, we have been carrying out survey in the Central French Pyrénées, and have recovered more than 5,000 Paleolithic artifacts from several hundred locations. We have used petrographic analyses of flint sources to connect some of the cave sites with flint sources and open air sites, especially linking the important Magdalenian cave site of Enlène with open air flint sources and an open air site. We have put in test trenches at a variety of open air locations attributable to both the Mousterian and Upper Paleolithic. Survey materials have included Mousterian materials that are surprisingly Levallois and also attributable to at least two different eras, based on differential patination of the lithics. In 2006 and 2007 we began excavations at what is arguably the first intact Upper Paleolithic open air site—Peyre Blanque—of some artifactual and contextual significance in the region, and it appears as if it is also the first site with materials that can be attributed to the very early Middle Magdalenian, in a region with important Magdalenian cave sites. This poster will present information on the Between the Caves project, with particular focus on the regional and inter-regional implications of the Peyre Blanque (Ariège) site.

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New Strontium Isotope Evidence for Hominin Residence and Ranging in the Sterkfontein Valley, South Africa

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Strontium isotopes ($^{87}Sr/^{86}Sr$) often are used in archaeology and paleontology to assess residence or migration. An early study in Sterkfontein Valley (Sillen et al. 1998) suggested little spatial resolution of biologically available $^{87}Sr/^{86}Sr$ across diverse geological substrates, other than riparian versus grassland distinctions. Therefore, it was concluded that $^{87}Sr/^{86}Sr$ isotopes could not be used to establish foraging ranges of hominins or other taxa. However, that study was severely limited by sample size, where nine of the ten geological zones were represented by a single plant. We now have new background data for $^{87}Sr/^{86}Sr$ variation across the landscape from plants, animals, soils, and rocks, from 40 sampling sites across 12 geological substrates within a 20km radius of the Sterkfontein and Swartkrans fossil caves. $^{87}Sr/^{86}Sr$ of plants and animals from each geological substrate cluster closely, and are significantly different between sites on different substrates. These data demonstrate that $^{87}Sr/^{86}Sr$ can be used to infer landscape-scale movements of animals. Following our earlier pilot study of $^{87}Sr/^{86}Sr$ in hominin tooth enamel, we have applied high resolution laser ablation MC-ICP-MS to teeth of modern and fossil fauna, and 10 *Australopithecus africanus* and *Paranthropus robustus* individuals. This method leaves minimal damage, is precise and consistent as shown by 15 paired comparisons with standard solution-chemistry methods, and allows for intra-tooth sampling. The range in $^{87}Sr/^{86}Sr$ for 35 fossil specimens (0.719 to 0.747) closely resembles that for modern fauna (0.720 to 0.751). Among the hominin fossils, intra-tooth variability is low for all specimens, suggesting little movement between substrates during the period of tooth mineralization. However, $^{87}Sr/^{86}Sr$ levels vary between individuals—values for males (as determined by overall tooth size) are consistent with a local origin, while values for some females indicate that they were resident in an area >5km away from the fossil caves during tooth mineralization.

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A Whole-Body Analysis of Neanderthal Thermoregulation

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The unique limb proportions of the Neanderthals are widely thought to represent an adaptation to low temperatures. However, the studies that underpin this hypothesis have dealt with the regions of the Neanderthal body separately rather than as part of a whole body. As such, there is reason to question their accuracy. Here we report the results of a study that investigated Neanderthal thermoregulation using a whole-body approach. First, we used published data to create a segmented model of a Neanderthal. Next, we estimated 3D segment displacement values for the Neanderthal by scaling values recorded for a sample of modern humans walking at 1.2m/s. Thereafter, we used the segment proportion and 3D segment displacement values for the Neanderthal to estimate its heat balance and the segment specific contributions to total heat loss when ambient temperature is between 20ºC and 35ºC. Lastly, the estimates of heat balance and segment specific contributions to total heat loss were compared with those for the aforementioned sample of modern humans. Our results do not support the hypothesis that Neanderthal limb proportions were adaptations to low temperatures. Although Neanderthals would have consistently lost absolutely and relatively less heat than modern humans, this is not attributable to their limb proportions. We found that only the Neanderthal's arms consistently lost relatively less heat than those of the modern humans, and this was true only of the upper arm and the hand, not the lower arm. The Neanderthal head, neck, and trunk heat loss were not consistently lower than those of the modern humans, and the Neanderthal legs would in fact have contributed relatively more to total heat loss than those of the modern humans.

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Middle Paleolithic Settlement in Arabia: First Evidence From a Complex of Stratified Archaeological Sites in Western Yemen

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Located in the southwestern part of the Arabian peninsula and facing the African shore of the Red Sea, the Tihama coastal plain is considered to be one of the most favourable areas to yield evidence of faunal and human exchanges between Africa and Asia. However, the dearth of dated and stratified sites in this coastal region is a considerable obstacle for existing Out of Africa models of early modern human expansion. Since 2005, the Paleo-Tihama project has developed a field program in central Tihama (western Yemen) which led to the discovery of a Middle Palaeolithic locality of major prehistoric, chrono-stratigraphic, and environmental value. The site of Shi'bat Dihya 1 (SD1) is situated at the interface of the coastal foothills (ca. 60km from the Red Sea littoral) and the highland western escarpment, in the Wadi Surdud sedimentary basin where several other Pleistocene stratified sequences have been identified through survey. SD1 is characterized by a dense archaeological deposit which yields a rich lithic assemblage and occasional faunal remains, which include Equidae (*Equus hemionus*) and Bovidae. The lithic artifacts were produced on the spot from locally available lava cobbles, with a marked preference for fine-grained rhyolites. The end-products of this knapping sequence are Levallois flakes (the majority are triangular in shape) and elongated blades. The preliminary radiometric (OSL) dates indicate an age of 80-70ky (OIS 5a–4). This date is consistent with the arid and open environment suggested by the carbon stable signature of the sediment and by the phytolith analyses carried out. The SD1 lithic and faunal record do not show any clear affinity with contemporaneous eastern African Middle Stone Age sequences. Instead it is more likely to be related to the western Asian prehistoric record, an alternative often disregarded by existing models of human evolution and expansion out of Africa.

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Eland, Buffalo, and Wild Pigs: Were Middle Stone Age Humans Ineffective Hunters?

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Patterns of faunal exploitation play a central role in debates concerning the behavioral modernity of Middle Stone Age (MSA) humans. MSA foragers are often portrayed as less effective hunters than their Later Stone Age (LSA) successors on the basis of relative species abundances from southern African ungulate assemblages. Specifically, MSA hunters are said to focus on docile eland while avoiding more aggressive prey, particularly buffalo and wild pigs. To evaluate these arguments and compare patterns of large game exploitation, I present a quantitative examination of 51 MSA and 98 LSA ungulate assemblages from southern Africa to show that: (1) eland, buffalo, and wild pigs are equally abundant in the MSA and LSA, (2) large ungulates are more common in the MSA than in the LSA, (3) with respect to ungulate exploitation, MSA diet breadth may have exceeded LSA diet breadth, and (4) ungulate assemblage evenness is equivalent in the MSA and LSA. With few exceptions, these broad patterns, which sample a range of geographic and environmental contexts, are supported by an environmentally controlled comparison of Middle and Later Stone Age faunas that accumulated under interglacial conditions along the southern African coastline. Thus, the argument that MSA hunters avoided dangerous and aggressive prey is not supported by the empirical record. When interpreted within a foraging theory framework, the data suggest that MSA hunters enjoyed increased meat yields due to more frequent encounter rates with large prey. These results need not imply cognitive differences, but are consistent with an increase in human populations from the Middle to Later Stone Age, which resulted in diminished abundances of large ungulates.

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Interglacial Neandertals at Neumark-Nord (Germany)

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Neandertals have traditionally been depicted as a "cold adapted" Pleistocene species, but studies performed over the last two decades have demonstrated beyond any doubt that Neandertals were successfully surviving in fully forested interglacial environments, in western as well as more central parts of Europe (Ashton 2002; Gaudzinski 2004; Roebroeks et al. 1992; Tuffreau & Roebroeks 2002). The character of such interglacial adaptations has hardly been studied though, as the record from the short interglacial periods is very

poor compared to our information from colder types of environments. The German site of Neumark-Nord in the Geisel valley in the county of Sachsen-Anhalt in Germany is among the rare sites where interglacial adaptations can be studied. The now abandoned lignite mine at Neumark-Nord has been a focus of research since the 1980s (Mania et al. 1990). Three Pleistocene lake basins have been discovered so far. The current excavation focuses on the lake basin Neumark-Nord 2. Since 2003 large-scale excavations of Middle and Late Pleistocene Middle Paleolithic findscatters have been taking place (initiated by Thomas Laurat and Enrico Brühl). The Pleistocene overlying the lignite here has proven to be very rich in stone artifacts and associated faunal (and sometimes floral) remains. Their spatial concentration in the littoral zone bears witness to extensive hominin interglacial occupation. An overview of the current research will be given.

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Cosmogenic Burial Dating of the Acheulian Tool-Bearing Rietputs Formation, Northern Cape Province, South Africa

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A new absolute dating technique provides crucial evidence regarding early Acheulian hominid distribution. Cosmogenic burial dating of an ancient alluvial deposit of the Vaal River (Rietputs Formation) in the western interior of South Africa shows that coarse gravel and sand aggradation there occurred ca 1.60±0.36Ma, with individual ages ranging from 1.89±0.19 to 1.34±0.22Ma. This was followed by aggradation of laminated and cross-bedded fine alluvium at ca 1.26±0.20Ma. The Rietputs Formation provides an ideal situation for the use of the cosmogenic nuclide burial dating method, which is based on the build-up and decay of ^{26}Al and ^{10}Be in the mineral quartz, as samples could be obtained from deep mining pits at depths ranging from 7 to 16 meters. This allows for adequate shielding from continued cosmic radiation. Accumulation ceases with burial, and the inherited ^{26}Al and ^{10}Be concentrations decay at different rates, allowing for the determination of a burial age according to the known half-lives of the two nuclides. A total of five individual mining pits within an area of roughly 5 km^2, at the Rietputs Formation type-site near the town of Windsorton, were sampled. Two of these pits were sampled stratigraphically and results indicate that coarse gravel and sand deposition can range from ca 100 to 400ka. The dates provide only a minimum age for the stone tool technology preserved within the deposits, and each assemblage represents a time averaged collection. Bifacial tools distributed throughout the coarse gravel and sand unit can be assigned to an early phase of the Acheulian. This is the first evidence for early Acheulian artifacts in South Africa that have been found outside of the early hominid sites of the Gauteng Province. These absolute dates also indicate that handaxe-using hominids inhabited southern Africa as early as their counterparts in East Africa.

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Digital Elevation Models as Heuristic Tools

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Digital elevation models use modern relief data collected by satellites, and manipulation of these satellite images provides a novel tool to visualize and ask questions about hominin paleolandscapes. A sequence of well calibrated diatomites in the Chemeron Formation near Lake Baringo, Kenya, indicates precessional (23kyr) cycling of extensive and relatively deep lakes in the Rift Valley around 2.5Ma ago. But how deep and how extensive? The nature of the exposed diatomites suggests they formed at least 5km from the shore of the lake, which was up to 150m deep. GIS methods facilitate the "filling" of a digital elevation of the modern Baringo Basin to 150 meters above the current altitude of major diatomite outcrops. The "lake" produced by this means extends the entire width of the Rift, from east to west, and gives a plausible estimate of the lateral extent of these features. However, a significant emergent land mass—the Tugen Hills—remains nearer to the diatomites than the postulated 5km. Other geological evidence suggests that the Saimo fault, which has controlled uplift of the Hills, was mostly active after the end of Chemeron deposition, currently recorded at 1.6Ma. It is quite possible that the Tugen Hills did not exist, at least not in their present major form, at the time of these Pliocene lakes. Although modern topographic controls on lake formation may not necessarily reflect those that existed in the Pliocene, these simple approaches provide useful ways of visualizing plausible hydrologic patterns in the Rift Valley's past. The models produced offer insights into the past geological structure of the area, the nature of rifting, and provide a new means of thinking about how early hominid landscapes have changed since the fossils were buried.

Radiometric Dating at Zhoukoudian (Locality 1) Based on Cosmogenic Nuclide Dating of Stone Tools

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The cave fill at Zhoukoudian is one of the most famous *Homo erectus* sites in China, with remains from at least 40 individuals and tens of thousands of stone tools. The site is divided into 16 stratigraphic levels. A majority of the hominid fossils were recovered from Layers 7–11, and much of the remainder were found in Layers 3–4. Previous dating at Locality 1 has been controversial. Early estimates dated Layers 1–3 to ca. 200ky and Layer 10 to ca. 500ky. More recently Shen et al. (2001) used U-series dating of flowstone to show that Layers 1–2 are ca. 400ky old, while Layer 5 is at least 600ky old. To refine the chronology of Locality 1, we used cosmogenic nuclide burial dating of quartz tools with $^{26}Al/^{10}Be$. The burial dating method is based on the buildup of ^{26}Al and ^{10}Be in quartz exposed to cosmic rays near the surface, and their subsequent radioactive decay after deposition in the cave. The method dates the time that quartz enters the cave, and accurate dating requires that material has not been reworked within the cave environment. The stone tools at Locality 1 are ideal, because they must have been brought to the cave by hominids. We analyzed four tools from the 1937 collection. Three of the samples gave ages that agree to within analytical error, with an average age of 730±130ky. For unknown reasons, the fourth tool did not agree, with an apparent age of 1660±220ky. It is possible that this tool was made of quartz derived from a previously buried deposit. Our radiometric ages confirm the antiquity of the lower hominid-bearing levels, and are consistent with ages inferred from U-series dating of flowstone. They suggest relatively rapid infilling of Layers 7–10.

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Estimating Hunter-Gatherer Group Size Via Spatio-Allometric Analysis

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It has long been recognised that the reconstruction of hominin population sizes is vital to the analysis of paleolithic society, yet there is no consistently applicable method with which to pursue such reconstruction. Existing methods have been applied piecemeal, and rarely have been related back to the archaeological record from which they derive. The replication of results has proved difficult, and the comparison of estimates produced via different techniques has been impossible. At the heart of the problem is the lack of an empirical basis relating the material residues of modern hunter-gatherer land use to those encountered in the archaeological record in a quantitative and explicitly spatial manner. Grove (2007a, 2007b) has recently proposed a method with which to estimate group size, range area, and land use patterns based on spatial distributions of material culture and allometric constants relating primate body mass to population density. The current research tests that method, designed for use with archaeological data, by employing as input a detailed dataset on Dobe !Kung site distribution (Yellen 1977) and demography (Howell 1979). This dataset, for which the variables to be estimated are known, allows for a comprehensive evaluation of the model. The known values of 690 individuals over a seven year period (Howell 1979:45) inhabiting an area of some 320km^2 (Yellen 1977: 54) fall well within the 95% confidence limits of the model predictions, at 738±102 individuals and 313.07±9.89km^2 respectively. The current research employs these predictions in the production of two land use maps via probability density functions based on (a) site distribution, and (b) site distribution weighted by data on duration of occupation and number of persons inhabiting specific sites. Again, results closely mirror those suggested by the data, while discrepancies between the two maps highlight areas of reconstruction for which archaeological data remain insufficient.

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Cranial Scaling Relationships in Early *Homo*

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The descriptions of fossils with relatively small endocranial capacities from Dmanisi (DM-2700) and Ileret (ER-42700) as *Homo erectus*

s.l. mark a paradigm shift in our understanding of variability in early *Homo*. Whereas low levels of sexual dimorphism used to be considered a hallmark of even our earliest ancestors, it now seems more likely that reduced size-dimorphism developed much later in the history of our species. In order to better interpret patterns of variability in extinct taxa, understanding the covariation of shape and size is essential. We investigate craniofacial scaling relationships of early *Homo* in the context of hominin allometries using 3D geometric morphometrics. We digitized 47 landmarks and 300 semilandmarks on curves and the neurocranial surface on crania of chimpanzees, orangutans, gorillas, and modern humans, as well as on virtual reconstructions of australopithecines (*A. africanus*, *A./P. robustus*, *A./P. boisei*) and early *Homo* (*Homo habilis* s.l. and *Homo erectus* s.l.). The coordinates were converted to shape variables using Procrustes superimposition and analyzed using principal component analysis; the allometric trajectory of each group was calculated by regressing shape on the logarithm of centroid-size. Even though there exists considerable variation in centroid size among early human crania, the overall scaling relationship is almost isometric -- in stark contrast to the patterns of allometric scaling found in *Gorilla* and *Pongo*. We detail these results for the face and the neurocranium separately and discuss the biological implications of this unusual scaling pattern.

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Paleoclimate: Neandertal and Early Modern Human Occupation at Amud and Qafzeh, Israel

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Early modern humans were present in Israel from c. 115kyr, while Neandertals were present between approximately 70 and 40 kyr. It has been proposed that early modern humans and Neandertals alternated as interglacial warm, dry climate was followed by cool, dry glacial-age climate, better suited to cold-adapted Neandertals. We tested this hypothesis through stable oxygen and carbon isotope analyses of goat and gazelle enamel carbonate from Qafzeh Cave (occupied by early modern humans approximately 92kyr) and Amud Cave (occupied by Neandertals between 70 and 53kyr). A baseline comparative sample was obtained from modern goats and gazelles in Israel. Through sequential analyses of second and third molar teeth, we obtained a seasonal pattern of variation in $\delta^{18}O$ of goat enamel by up to 6‰, indicating seasonal changes in $\delta^{18}O$ of precipitation at Amud. In contrast, $\delta^{18}O$ of goat enamel at Qafzeh shows less seasonal variation, while modern goats show much smaller variations, as would be expected in a winter-only precipitation region like present-day Israel. We infer that at Amud rain fell throughout the year during the time of occupation, whereas climate during the occupation of Qafzeh was closer to present-day conditions, with limited or no rain in summer. Data from the enamel samples indicate that these periods of summer rains also were associated with higher humidity and denser forest cover in the Galilee. It appears that between 70 and 55kyr the southern Levant experienced a climate characterized by year-round precipitation, such that Neandertals at Amud lived under colder and generally wetter conditions than those of today. On the other hand, the climate at 92kyr, when early modern humans were present, was hotter and drier, similar to the present-day.

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Plants in Neanderthal Diet: Plant Microfossil Evidence From the Dental Calculus of Shanidar III

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Relatively little is known about the diet of Neanderthals and contemporary modern humans, and what is known is drawn largely from indirect measures of diet such as faunal remains and isotope signatures. Despite these piecemeal data, many theories on the diets of Neanderthal and modern human groups have been formulated, including ideas that Neanderthals focused solely on meat from large game while modern humans had a more varied diet. Plant microfossil analysis, a technique relatively underused in paleoanthropology, has the potential to answer many questions about the plant portion of diets of these ancient populations. Plant microfossils such as starches and phytoliths can be recovered from from a variety of archaeological contexts, and are identifiable to plant family, genus and even species. A few previous studies of plant microfossils from Neanderthal sites in the Near East have suggested that they may have used plants extensively, and may have even consumed grains (Albert et al. 1999, 2000; Henry et al. 1996; Madella et al. 2002). However, these studies examined only microfossils trapped in soils, which may be subject to contamination, or may not represent dietary use of the plants. Using methods described at last year's Paleoanthropology Society Meetings (Henry, Piperno, and Brooks 2007), we have examined plant microfossils trapped in the dental calculus of Shanidar III, a Neanderthal fossil dating to around 35kya from Shanidar Cave, Iraq. Abundant plant material was found on these teeth, including both starches and phytoliths. Preliminary identification of the starches suggest this individual was consuming grass seeds. This is the first direct evidence of dietary use of plants by Neanderthals, and the discovery of starch grains from grasses indicates these staples of modern human diet were consumed well before the origins of agriculture.

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Evidence for Short MSA Occupation Events at PP9 (Mossel Bay, South Africa) at 133ka and 85ka: Evidence for Early Systematic Exploitation of Marine Resources During Single Occupation Events

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PP9, a large multi-chambered cave at Pinnacle Point, has a long geological history with punctuated MSA occupations. These are of short duration, and thus provide a different perspective than at other PP and southern Cape sites where occupations are dense and stratigraphically compressed. The oldest deposits are a series of raised beaches and sediments of MIS 11 age overlain by deposits of MIS 6 age. A dune fills the lower portion of the cave (9b) around 133±6ka and the first MSA occupation occurs. This thin MSA layer is covered by a dune that is partially eroded away by the MIS 5e high sea stand (~125ka). A second large dune in-fills the cave around 88±6ka and allows access to a series of higher chambers (9c) where a short MSA occupation occurs around 85±4ka. Both occupations are associated with combustion features, large quantities of brown mussel and opercula of *Turbo samarticus* and a range of fauna including Cape Fur seal. This points to a rocky seashore environment and occupation appears to have taken place on dunes during sea level advance at the beginning of MIS 5e and MIS 5a. A number of partially worked beach cobble cores and refits suggest primary production of lithics and cut marks occur on almost all taxa. The dune continues to grown and seals the cave soon after this occupation at which point speleothem begins to form in a cavity behind the dune. This sequence of events and occupations mirrors part of the sequence seen at PP13B (Marean et al. 2007) and shows extensive use of marine resources by 133±6kyr, even during short punctuated occupations. No ochre occurs at the site and illustrates the practical nature of potentially a single occupation event, contrasting with sites like PP13B and Blombos.

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Late Pleistocene Environments and Technological Change in a Northeast African Refugium: Current Research at Moche Borago Rockshelter, Southwestern Ethiopia

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Paleoenvironmental and genetic data indicate the cold, arid conditions of Late Pleistocene Africa's OIS 4 and OIS 2 may have resulted in severe environmental changes and significant hunter-gatherer population bottlenecks. Drawing upon modern rainfall and atmospheric

circulation patterns and limited paleoenvironmental data, we hypothesize that the tropical highlands of southwest Ethiopia were a major biogeographical refugium for human populations of northeast Africa and the Horn during these arid periods. To test this hypothesis, we have embarked upon a program of survey and test excavations in the southwest Ethiopian highlands. Test excavations and radiocarbon dates at Moche Borago, a large rockshelter on the flank of a dormant volcano on the eastern edge of the putative refugium, have revealed an archaeological and paleoenvironmental sequence spanning (at least) the last 50ka. Ground Penetrating Radar suggests at least two more meters of stratified deposits lie below our deepest sondage of ca. 2m, while dating samples collected on-site by OSL, ESR, and Ar/Ar specialists have the potential of extending the chronometric dating of the deposits beyond 50ka. Although the faunal remains and modified ochre pieces have yet to be analyzed, preliminary analyses of the largely obsidian assemblages encompassed within a complex Late Pleistocene sequence of aeolian, fluvial, and volcanic depositional environments, reveal surprising combinations of artifacts displaying Mode 3, 4, and 5 technology. These include large Levallois points, small non-Levallois foliate points, backed blades and crescents, and other shaped tools. These new data may clarify Late Pleistocene hunter-gatherer adaptations, the nature of technological change and innovation during bottleneck periods, and how refugium conditions shaped the social organization of founder groups and their descendents who moved out of the Horn and out of Africa.

Identifying Cut Marks Produced From Flakes Versus Bifaces: Further Evidence for Interpreting the Function of Early Stone Tools (Oldowan and Acheulian)

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The function of stone tools is a long-standing topic of interest in archaeology, a central issue being whether different tool types served different functions. The functional aspects of bifacial core tools, in particular, have been the subject of intense controversy, with some workers suggesting that they were simply cores used to make other tools and others arguing that these tools were used specifically for butchering and food processing. In light of this debate, it would be interesting to know if different tool types produce distinctive cut marks. If different tools do produce diagnostic cut marks, then cut mark analysis can provide direct evidence of the tool used to butcher material recovered at archaeological sites. In this study, we report the results of an experiment in which mule deer limbs were butchered by a professional butcher using a core tool (a bifacial handaxe), a flake, and a sidescraper. The cut marks produced by each of these tools were then analyzed and their distinctive features described. A blind test composed of twenty photographs of cut marks produced by each tool type was administered to 100 subjects in order to estimate the accuracy of identifying the tool type used to produce the cut marks. The results from this analysis suggest that there are clear differences between the cut marks produced by handaxes and those produced by flakes that can generally distinguish the two tool types. However, cut marks produced by sidescrapers exhibit an intermediate morphology that overlaps those of bifaces and flakes; thus, it may be difficult to determine the tool type used for butchery if sidescrapers are present in an archaeological assemblage.

Early Upper Paleolithic on the Central Plain of Eastern Europe: New Research at Kostenki-Borshchevo

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During 2007, the international project resumed field research at Kostenki and Borshchevo on the Don River (Russian Federation), where Upper Paleolithic open-air occupations are buried in a sequence of loess-like loam, colluvium, and spring deposits on the first and second terraces. The exceptional concentration of early Upper Paleolithic (EUP) occupations (i.e., antedating MIS 2) reflects a conjunction of factors that: (1) attracted people and animals to the area (e.g., active springs) during MIS 3; and (2) attracted archaeologists (i.e., large Gravettian occupations), who eventually probed below the younger levels and encountered EUP artifacts that otherwise would have remained undiscovered. EUP occupations are confined to the second terrace and are subdivided by a volcanic tephra that has been identified as the CI Y5 (dating to ca. 39cal ka). During 2007, field research was undertaken at Kostenki 1, 8, 9, 14, and Borshchevo 5 with a focus on layers above the tephra and below loess-like loams deposited at the beginning of MIS 2 (i.e., EUP dating to ca. 38–30cal ka). These occupations are buried in the Upper Humic Bed and its stratigraphic equivalent (an *in situ* soil at Kostenki 1) and contain modern human remains at Kostenki 1, 8, 12, 14, and 15. They yield evidence of a broad diet and economy based on small mammals, birds, and freshwater aquatic foods, in addition to large mammals. The artifact assemblages are highly variable and include those: (a) dominated by typical Upper Paleolithic artifact forms; (b) dominated by typical Mousterian artifacts and end-scrapers; and, (c) containing a mixture of (a) and (b). The variability has been interpreted in terms of several different cultural traditions (including EUP "transitional" industries), but alternatively may be explained in terms of functional differences and sampling; many of the "Mousterian" tools appear to be expedient forms used for butchering large-mammal carcasses.

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Land Use by Late Pliocene Hominins in the Makaamitalu Basin, Hadar, Ethiopia

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Some thirty years ago, Isaac and Harris introduced the concept of "scatters between the patches" into archaeological research of the early Pleistocene Oldowan sites in Koobi Fora, drawing attention to the variability of mobility and land use patterns of early stone tool-makers and laying the ground rules for "landscape archaeology." Here we report on the results of such an approach applied to the ~2.36Ma landscape of the Makaamitalu Basin in Hadar, Ethiopia, where two *in situ* localities, A.L. 666 and A.L. 894, were likely formed on the levee of the paleo-Awash river. Each locality contains clear spatial associations of lithics and fauna, ca. 30cm thick. Whereas A.L. 666 has eroded extensively, A.L. 894 is a "macro-site" (Isaac 1981) exhibiting high densities of artifacts. To clarify the landscape context of the two sites we excavated a series of outcrop-controlled trenches, placed at various distances and directions from the excavated localities. The almost complete lack of finds from the trenches confirms that the associations of stone and bone are not fortuitous. We used sedimentological and paleontological data to characterize the specific locations of the two occurrences against the surrounding low-density background (as defined by Isaac et al. 1981). In addition, evidence from refitting studies and lithic analysis suggests that lithic reduction sequences were segmented in various (unknown) locations on the landscape. We discuss the implications of these observations for understanding land use behaviors of late Pliocene hominins in this region. Finally, we place these results in the context of the early stone tool-bearing occurrences from Gona (~2.5Ma; Semaw 2000; Semaw et al. 2003) West Turkana (~2.34Ma)(Roche et al. 1999) and Olduvai(1.76-166Ma; Tactikos 2005) to discuss longer-term trends.

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Isotope Analysis of an Early Upper Paleolithic Human and Associated Fauna from Tianyuan Cave, Zhoukoudian, China

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We analyzed the carbon and nitrogen isotopes of collagen extracted from an early modern human and a number of associated fauna (unidentified herbivores as well as silka deer) from Tianyuan Cave, Zhoukoudian, China, dated to 42,000–39,000cal BP. Carbon isotope results from the fauna, with the exception of one deer, indicate that most of these herbivores had a C_3 diet (^{13}C = -19.4±0.8‰). A single deer had a carbon isotope value (-14.2‰) indicative of a largely C_4 diet. The nitrogen isotope values of the herbivores were in the expected range for herbivores, between approximately 4 to 7‰, with an average of 5.2±1.2‰ (4.7±1.0‰ for bone samples only). The human had a ^{13}C value of -17.6‰ and a ^{15}N value of 11.1‰. The carbon isotope value indicates a contribution of C_4 foods, either by direct consumption of C_4 plants or, more likely, the consumption of animals that consumed C_4 plants. The nitrogen isotope value is much higher than the average value of the herbivores (approximately 6‰), which is higher than the trophic level shift observed for mammals of 3 to 5‰. Therefore, the human must also have been consuming protein from species that we have not measured, such as omnivores or freshwater fish, both of which have higher ^{15}N values than herbivores. These other species have not been preserved at the site. Relatively high ^{15}N values have also been documented for more recent but earlier Upper Paleolithic humans in western Eurasia, suggesting that this pattern may generally characterizes higher latitude Eurasian people in this time period.

New Archival Evidence Confirming the Provenience of the 1931–1933 Ngandong *Homo erectus* Fossils, Java

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When the Geological Survey of the Netherlands Indies unearthed the 14 Ngandong *Homo erectus* fossils in 1931–1933, Survey geologists maintained that the remains occurred with artifacts and thousands of vertebrate bones in the ~0.5-m-thick basal bed of a river terrace deposit, and represented one living population. Unpublished Survey reports, photographs, and maps provide details on the bone-rich stratum, and testify to the systematic methodologies of the 828-day, ~4610 m^2 dig. A site map (1:250) shows the topography, terrace-outcrop limits, monthly excavation blocks, and discovery points of all but one hominin find. Beyond witnessing four hominin specimens *in situ*, the geologists evidently examined seven other discovery points, before continued digging destroyed critical stratigraphic relations, but after geological assistants (who supervised the excavation) removed the specimens. The geological circumstances were clear because the conglomeratic discovery bed unconformably overlay marl, and the terrace stood isolated ~20m above the Solo River. Ngandong VI calvaria (Ng 7 in recent terminology) is the best documented discovery. It was photographed in a 2-by-2-m exposure of volcaniclastic sand and fine gravel containing marl cobbles and 19 disarticulated non-hominin fossils. Ngandong V also was photographed in volcaniclastic gravel. Based on available records, at least five *Homo erectus* cranial fossils are securely attributable to the bone bed, and the other finds also could originate from this stratum. Several specimens, as described in the literature, have open neocranial sutures and plastic deformation indicative of burial soon after death. The non-hominin fossils, which represent ecologically diverse taxa, included partially articulated remains, but overwhelmingly were broken elements, often showing considerable surface damage. Although embedded in a fluvial deposit with detritus from a volcano ~40km away, the specimens vary widely in size and shape, giving little indication of hydrodynamic sorting. Large eruptions, lahar floods, and human action would account for the deposit.

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Humeral Torsion in Hominoids: What is it and Who has it?

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Humeral torsion, as measured by the orientation of the transverse plane of the humeral head relative to the bicondylar axis, exhibits considerable variation among fossil hominins and extant humans. The fossil humeri from Flores (LB1/50), Dmanisi (D2680, D2715, D4507), Nariokotome (KNM-WT15000), Ileret (KNM-ER739), and Hadar (AL288-1i, f) exhibit low degrees of torsion compared with those of modern humans. Among modern humans, torsion increases during development, and is typically most pronounced in adults. However, low degrees of torsion have been reported in athletes engaged in overhead throwing activities. The question as to which extent humeral torsion conveys a functional, developmental, and/or phyletic signal thus needs further examination. In this study, we use geometric morphometric methods to quantify three-dimensional humeral shape. We examine humeral shape variability in ontogenetic series of extant hominoids and use this body of evidence to assess the shape of fossil hominin humeri in a wider comparative context. While there is overlap between African great apes and humans with respect to the angle of torsion, 3D shape analysis shows a clear distinction between taxa. Comparisons between humeral ontogenetic trajectories of taxa representing different locomotor adaptations permit new insights into developmental, functional, and phyletic aspects of humeral shape variability in fossil hominins.

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The Chronostratigraphy of Middle Paleolithic Industries in France: New Data from the Southwest

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We will discuss the Middle Paleolithic chronostratigraphy of Southwestern France with respect to new data recently derived from salvage operations. These data differ from those that are associated with karstic contexts and have allowed us to better understand settlement of the region between Oxygen Isotope Stages 8 and 3, including the early Middle Paleolithic. For the latter part of this period, we focus on the Quina Mousterian because it is well documented, associated with cold climatic conditions, and is one of the richest types (facies) present in Southwestern France at the end of the Middle Paleolithic. This unique lithic industry was defined in the 1950s by François Bordes, and L. Bourguignon (1997) recently defined its operative schemes from a technological standpoint ('Quina debitage'). We integrate a number of Quina archaeological sequences into a chronostratigraphic framework and discuss its relationship to other industries, e.g., Mousterian of Acheulian Tradition, Denticulate Mousterian, etc. We contend that there is a correlation (climatic, chronological…) between the Quina Mousterian and Heinrich Event 5.

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Paleohabitat Spatial Models for Koobi Fora Plio-Pleistocene Environment, Northern Kenya

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The Plio-Pleistocene site of Koobi Fora, Northern Kenya, is a prolific source of fossil mammal remains that provide a great opportunity for scientists to understand the evolutionary processes and trends associated with hominin species. To date, six hominin species represented by over 200 specimens have been recovered at the Koobi Fora Formation (Harris et al. 2006). In an attempt to place these hominin fossils into their paleoenvironmental context, bovid fossils postcranial and dental ecomorphological data were modeled in Geographic Information Systems (GIS) technology. Spatial models and statistics helped to uncover paleohabitat patterns not easily identifiable using conventional techniques. Results from multivariate statistics show significant differences in bovid morphological data between species inhabiting open, intermediate, and closed habitats. Overall, open and closed habitat forms were consistently distinguished by Discriminant Functional Analyses (DFA) statistics for the majority of the identified elements. Equally, intermediate habitat forms also were distinguished, though to a lesser degree (<50%). Spatial paleohabitat models show that the Koobi Fora paleoenvironment from ca. 4.3–~0.7myr changed from closed (browsing) habitats to open country (grazing) conditions. During Interval-B (3.4–2.5myr) time period, bovids were predominantly browsers inhabiting a mosaic of closed to wooded habitats. During the time period for Interval-C (2.5–1.94myr), the environment was an admixture of open and closed habitats, while during Interval-D (1.56–1.38myr) time period, the open conditions further intensified. For Interval-F (1.6–~0.7myr) time period, the environment was mainly open with closed micro-habitats diminishing and subsequently replaced by intermediate conditions. These results corroborate previous studies which suggest that the East Africa Plio-Pleistocene environment changed from wet, warm, and closed habitat conditions during the early Pliocene to dry, cold, and open habitat later in Pleistocene. This study underscores the importance and dynamics of localized variability for Koobi Fora paleohabitats.

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A Behavioral and Anatomical Evaluation of the *Homo helmei* Hypothesis

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The origin of modern humans is both an anatomical and behavioral problem, but these kinds of evidence have rarely been considered together in a single analysis. Recently, a human phylogenetic hypothesis has been proposed on almost exclusively behavioral grounds, with a minimal anatomical basis. Here, we test this hypothesis that a new hominid, *Homo helmei*, arose during the Middle Pleistocene and gave rise to both Neandertal and modern human lineages. Foley and Lahr (1997, Lahr and Foley 1998, Lahr and Foley 2001a, Lahr and Foley 2001b) have argued for the existence of this species, based upon the appearance of Mode 3 tool types and typified by the Florisbad and Jebel Irhoud crania. In order to evaluate this claim, we examine two lines of evidence. First, we compare data from African and European fossils that date to both before and after the hypothesized emergence of *H. helmei*. Under the *H. helmei* hypothesis, we would expect there to be evidence of speciation and divergence as seen in a statistical increase in interregional diversity over time. Secondly, we examine whether the behavioral record (as seen through archaeology) is consistent with the hypothesis. The validity of *H. helmei* as a real species is based primarily on the emergence of Mode 3 technology and the claim that this has to be associated with a speciation event, a research paradigm based upon the assumption that these units of analysis are natural entities governed solely by stylistic and functional processes. Both examinations refute the hypothesis. By approaching the question from an anthropological perspective that incorporates both behavioral and anatomical evidence, we are able to better understand this critical time period and provide clarity to the question of modern human origins.

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3D Trabecular Microarchitecture in SKX 5020, A First Metacarpal Attributed to *Paranthropus robustus*, Compared with *Pan* and *Homo*

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Since Susman (1989) first described SKX 5020, a right first metacarpal, it has been subject to debate regarding its taxonomic affiliation and as a signal for Paranthropine tool use. While Susman notes that it "resembles most closely the first metacarpal of modern humans" (p. 459), he later suggests that SKX 5020 should be considered *Paranthropus* based on its large size (relative to SK 84, an additional MC 1 from Swartkrans that has been attributed to *Homo erectus*) and the fact that the craniodental remains from Member 1 were 95% *Paranthropus*. The overall similarity between SKX 5020 and SK 84 figured into Susman's argument that *Paranthropus* possessed a level of manual dexterity cf. *H. habilis*. Susman's taxonomic and behavioral claims have been disputed (Trinkaus and Long 1990). In this paper, we compare microCT 3D measures of trabecular bone mass and architecture from the head of SKX 5020 with samples of *Pan troglodytes* (n=12) and *Homo sapiens* (n=3). Images were captured using a Skyscan 1172 desktop scanner with a nominal voxel resolution of 13 microns, and ca 48mm^3 VOI were isolated and analysed using proprietary software, CTAn. Results indicate that SKX 5020 shares morphological similarities with both *Pan* (e.g., relatively high bone volume fraction, with thick, preferentially oriented trabeculae) and *H. sapiens* (e.g., architecture with poorer connectivity, rod-like and widely separated trabeculae). The pattern in SKX 5020 suggests a MC 1 which experienced lower functional loading compared to *Pan*, but also had reduced dexterity as suggested by a higher degree of anisotropy than that found in either of the comparative taxa.

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New Evidence Suggesting Organized Flaking in Early Acheulian Core Reduction Strategies, Rietputs 15 (Northern Cape), South Africa

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The site of Rietputs 15 which is part of the Rietputs Formation, Windsorton, South Africa, has yielded the first early Acheulian collection in southern Africa to have an absolute date. Cosmogenic burial dating has provided a collection from the site with a minimum age of 1.43±0.23Ma. This date indicates that Rietputs 15 artifacts are some of the oldest Acheulian artifacts in South Africa and places it firmly in the early Acheulian. In addition to the diagnostic bifaces, such as handaxes and cleavers, the collection contains a number of highly "organized" cores. Out of all the cores in the entire collection approximately 10% display a number of features which demonstrate hominids were controlling the core in order to exploit the largest surface, often for a preferential removal. The most common form of organization is asymmetrical control in which the underside is worked pyramidally so that the larger top surface may be exploited. However, should the largest face be a side of the core accessible with minimal effort, the hominids focused flaking there, producing a single platform core similar to a blade core. These cores tend to be worked much less on the striking surface and other sides suggesting that the blank was carefully selected for its shape. This early form of organization may stem from two factors. First, the hornfels that is being used is a fine-grained material which makes for high quality knapping results. Secondly, the hornfels is typically found in "blocky" forms. Such blanks have a number of faces and angles which may assist and even influence the core organization. Such evidence supports the claim that core organization in the early Acheulian needs to be re-evaluated.

Is the Victoria West a 'Proto-Levallois' Industry?

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The Victoria West Paleolithic industry from South Africa has widely been regarded as a 'proto-Levallois' technology, and thus as a transitional 'ancestral form' to the prepared core Levallois industries of the Middle Paleolithic and African MSA. Similarities in form between Victoria West cores in terms of surface morphology and the removal of large flakes from a prepared surface led to hypothesized schemes of technological evolution from Victoria West industries through to fully developed Levallois industries. However, the phylogenetic basis of this Victoria West 'proto-Levallois' hypothesis, and the assumptions of phylogenetic homology upon which it rests, have never been tested formally. In recent years, archaeologists have begun to use phylogenetic methods drawn from biology to test hypotheses of technological and cultural evolution. Here, the phylogenetic assumptions of the Victoria West 'proto-Levallois' hypothesis are tested directly using a cladistic (maximum parsimony) protocol. The cladistic analyses indicate that Victoria West cores are not the basal sister taxon of a Levallois clade, as predicted by the proto-Levallois hypothesis. Moreover, character analyses demonstrate that several characters relating to core surfaces and flake scar morphology are not phylogenetically homologous, but result from convergent technological evolution within the Acheulian techno-complex. Post-hoc analyses further determine that these results are not confounded by choice of outgroup or raw material factors. The results also were shown to be robust on the basis of the ensemble Retention Index statistic, bootstrap analyses, and permutation tests. Hence, it is concluded that Victoria West cores

do not represent a 'proto-Levallois' technology, and that the term 'para-Levallois' should more correctly be applied on phylogenetic grounds.

Human Use of Marine Resources, Pigments, and Bladelets at Pinnacle Point Site 13B (South Africa) During the Middle and Later Pleistocene

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Genetic and anatomical evidence suggests that *Homo sapiens* arose in Africa between 200 and 100 thousand years (ka) ago, and recent evidence suggests symbolic behavior may have appeared between ~135–75ka. This evidence directs our focus to Marine Isotope Stage 6 (MIS 6), when—from 195–130ka—the world was in a fluctuating but predominantly glacial stage, when much of Africa was cooler and drier, and when dated archaeological sites are rare. In a recent paper in *Nature* (Marean et al. 2007) documented that humans had expanded their diet to include marine resources by ~164ka (±12ka) at site PP13B on the south coast of South Africa, perhaps as a response to these harsh environmental conditions. The associated material culture documents an early use and modification of pigment, likely for symbolic behavior, as well the production of bladelet stone tool technology. Here we expand on those results with comparisons to MIS 5 occupations at PP13B, and enrich our previous presentations with newly collected data on the large mammal fauna and shellfish assemblages. The combined richness of the Fynbos Biome found on the south coast of Africa, with its high diversity and density of geophyte plants, and the rich coastal ecosystems of the associated Agulhus Current combined to provide a stable set of carbohydrate and protein resources for early modern humans along the Cape of South Africa during this crucial but environmentally harsh phase in the evolution of modern humans.

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A Reassessment of the La Quina 9 Mandible (Charente, France) Through Its Virtual Reconstruction

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The Neandertal mandible exhibits a combination of archaic and derived features and more specifically a derived character complex on its lateral corpus. However, some variations observed within the Neandertal group have led some authors to challenge the discrimination power of these features and to link this variation to spatial and temporal diversity. Within this framework, the La Quina 9 specimen is considered by some authors as an "unusual" classic Neandertal, lacking the derived complex of features of the lateral body and with a symphyseal morphology they called "intermediate" between Neandertals and early modern humans. Authors however disagree about the absence of a retromolar space, which is due to its state of preservation that in turn prevents a complete and accurate assessment of its dimensions and symphyseal angles. This piece retains the entire left half of the corpus and a large portion of the left ramus. The symphyseal region is well preserved and its lower part extends a few millimeters on the right side. Based on a synchrotron radiation microtomographic record, we present a 3D virtual reconstruction of this specimen using mirror-imaged of the right side (with Amira®4.1.2 software). The new reconstruction allow us to assess the overall dimensions of the mandible, symphyseal angles, and the presence or absence of a retromolar space. The dimensions and features of this specimen are compared to samples of Neandertals from OIS 7–3, early modern humans (found in Middle and Upper Paleolithic contexts), and recent humans. This reassessment of La

Quina 9 provides new insight on Neandertal mandibular variation during OIS 4–3 and the variations through time and space within the Neandertal group are then discussed. We also discuss the proposed association between the lateral corpus derived complex and mandibular size as well as between dental attrition levels and the retromolar space.

Artifact Trampling, Bipolar Fracturing, Edge Damage, and Polishing: Taphonomic Implications of a Namibian Early Stone Age Assemblage Recovered from an Elephant Wallow

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This paper presents an analysis of a surface-collected lithic assemblage located near a spring in the channel of the Nhomadom drainage, in the Khaudom National Park, Northeastern Namibia. The geological context of the site is that of an elephant wallow, where elephants dig during the dry season to maintain access to disappearing surface water. This paper focuses on the relationship between this seemingly unusual taphonomic context and the characteristics of the lithic assemblage. Specifically, the assemblage shows very high frequencies of bipolar fracturing, retouch-like edge damage, broken flakes, and polishing. The characteristics of the lithic assemblage are compared to (1) unmodified gravels from the same locality; and, (2) lithic assemblages from nearby localities in upland geological contexts. The polish is analyzed using scanning electron microscopy. In addition, a program of experiments is presented in which natural gravels are split using bipolar percussion, and the results are compared with the archaeological assemblage. Implications from this analysis are drawn for other important African Early Stone Age sites, especially the Omo localities. Recently, De la Torre (2004) has argued that several Omo localities, which have high frequencies of bipolar fracturing, were not the result of hominin knapping. This paper suggests that artifact trampling may be the source of high levels of bipolar percussion at some important African Early Stone Age sites, such as the Omo assemblages. The paper offers some analytical approaches for recognizing trampling as a taphonomic dynamic through the documentation of a relatively small set of archaeological signatures. It is argued that these analytical approaches may be useful in terms of the identification of early stone tool technology, given emerging problems of taphonomic ambiguity.

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Middle Paleolithic Blady Tools in Hayonim Cave (Israel): To What Purpose?

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The Near Eastern area is well-known for its high component of elongated blank production at the beginning of the Middle Paleolithic period. Our technological studies have shown that in all these assemblages, the blady component for a long time considered as exclusively Levallois, clearly results from diversified production methods. Besides the classical Levallois method for elongated blank production, our research demonstrates evidence from 220/230,000ya of other debitage systems that we have grouped under the name of the Laminar Method. In terms of geometric core construction («volumetric concept» Boëda 1988, 1994), they are close to those documented later in the Upper Paleolithic, even if the productivity and the end-product regularity are clearly not the same. Recent excavations in Hayonim Cave have exposed a thick Middle Paleolithic sequence in which assemblages from Layer lower E and F are characterized by increasing frequencies of blades and elongated points, often retouched (the so-called «Abou Sif points»). These blady assemblages are dated from 230,000 to 160,000ya, by TL and ESR methods (Mercier et al. 2007; Rink et al. 2004). In these assemblages, while recurrent Levallois core reduction strategy elaborated on relatively flat flaking surfaces results in wide, thin, elongated blanks, the Laminar Method, identified in the form of semi-pyramidal and semi-prismatic cores, results in narrow, thick blades, here frequently retouched into elongated points. Thus the two reduction strategies, both aimed at the production of elongated blanks, clearly resulted in different techno-morphological end-products. To what purpose? Why were two core reduction strategies used simultaneously for elongated production? Microwear analysis shows these products were used in two clearly different ways—not unexpectedly, lateral edges were used on retouched blades, however, the convergent retouched points have a use limited to the distal area, which is unlike their use in other Levantine Mousterian sites.

Starch on Lithics from the Mozambican Middle Stone Age

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The advance in microbotanical analysis that allows assessing the role of tubers, grains, piths, and legumes in the past is now manifest (Torrence and Barton 2006) and available to archaeologists working on the African Middle Stone Age. The quest for direct lines of

evidence for Paleolithic plant consumption during this crucial time period has taken several scientists to study residues and use-wear on flaked stone tools (Lombard 2005; Wadley and Lombard 2007; Williamson 2004). Past work has established lithic function through multiple lines of evidence and the spatial breakdown of use-wear and microscopic traces on tool surfaces (e.g., Lombard 2007). This paper focuses on the quantitative analysis of starch assemblages and the botanical identification of grains from flake and core tools to learn about human ecology of carbohydrate use around the woodlands of the Great African Rift. The processing of starchy plant parts is deduced from the occurrence of starch assemblages that presumably got attached to stone tool surfaces by actions associated with extractive or culinary activities. Specifically, we investigate starch grains from stone tools recently excavated in northern Mozambique at the site of Mikuyu, which presumably spans the middle to late Pleistocene and represents similar sites found along the Malawi/Niassa corridor that links East, Southern, and Central Africa (Betzler and Ring 1995; Clark and Haynes 1970; Kaufulu 1990; Ring and Betzler 1995). Starch was extracted and processed with a diverse tool kit consisting of scrapers, cores, points, flakes, and other kinds of tools. The microbotanical data suggests consumption of small scale resources, specifically the endosperm from nuts and grains, as well as underground organs, fruit pulp, and trunk starch. Our data suggest a great antiquity for starch use in Africa as well as an expanded diet and related intensification in the Niassa basin.

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Effects of Global Pleistocene Climate Change on Local Environments and Human Land-Use

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The Upper Pleistocene was marked by climate change across the world. However, humans rarely respond to global change; they adapt to their local environment and its changes in resources. In order to interpret the changes in human behavior, particularly those related to subsistence, mobility, and land-use, during the Upper Pleistocene, it is necessary to understand their immediate dynamic landscapes. Southwestern France and Mediterranean Spain will be examined in this research. These settings are unique for their long archaeological traditions and climatic positions. France likely experienced the full weight of glaciation and its corresponding effects, while southeastern Spain would have been less impacted. The degree to which these statements are true and verifiable impact archaeological arguments that Spain served as a refugia for people and animals during times of climate stress. Over the last decade, Reid Bryson and a team from the University of Wisconsin Center for Climatic Research have developed computerized models to predict past climatic conditions into the Upper Pleistocene. These Archaeoclimatology Macrophysical Climate Models can be used to retrodict past climatic conditions at an immediate local level and at a resolution of 100 years. Using modern weather stations as input for the models, this poster will present the results of climatic modeling for southwestern France and Mediterranean Spain as well as empirical testing through comparisons with existing pollen analyses. Results of intensive survey from the Valencia region of Spain and locations of archaeological sites in that region as well as the Dordogne region of France will be used to approximate occupation patterns. Overlaying these site locations and archaeological survey results on the reconstructed climatic landscape will provide insight into human decisions concerning land-use in the face of climate change.

Behavioral Implications of Early Acheulian Technology: An Indian Perspective

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The use of large flakes detached from "giant cores" for the manufacture of large cutting tools distinguishes the Early Acheulian of India and Africa from that of Europe and China. Because the giant cores are too large to carry around, the tools made from them must have been intended to be carried. Some technology to carry these objects seems to be implied by this. Manufacture, use, and discard of tools occur at different points in the landscape. The absence of debitage from some Acheulian assemblages therefore reflects the discard of finished tools away from the place they were made, rather than geological processes. Complete chaîne opératoires are rarely recovered from one spot. In most assemblages the giant cores are 'missing' with only the finished products from this chaîne opératoire present. Small cores to produce small flakes also are present in most Acheulian assemblages and form a second chaîne opératoire. Even though this chaîne opératoire is more complete, there is a mismatch between the cores and flakes showing that both cores and flakes were brought into and removed from the sites. This is shown at Bori, where these cores also were made on non-local rocks. Flakes from such cores also were imported as shown by the presence of 20 flakes made on siliceous rocks (each from a different core) with not a single core on any siliceous rock present. Even when stone is available locally, the finished tools are not made on the local rocks. Thus tools recovered from river gravels at Bori and Chirki were made on weathered nodules, which do not occur in the river but were brought from elsewhere. The routine transport of objects appears to be one of the major behaviorial innovations of the Indian Acheulian. This behavior is present in the earliest sites. Limitations on mobility due to raw material constraints therefore seem unlikely.

Marrow Bone Selection and Fatty Acid Composition: Implications for the Evolution of Human Subsistence Strategies

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Because it is a fat-rich resource, several authors consider the tool-assisted extraction of marrow from medium- and large-sized ungulates a key innovation that opened a new ecological niche to hominin foragers. However, we still know little about factors that guide the selection of marrow bones. Utility models are particularly helpful in that respect, as they provide insights into how this resource might have been maximized in the past. Recently, a new utility index, the Unsaturated Marrow Index (UMI), has been introduced (E. Morin, J*ournal of Archaeological Science* 2007). This new model examines decision-making among the Nunamiut with respect to marrow bone selection. Confirming Binford's intuition, results obtained with this model show that marrow chemical composition affects bone selection. It is argued that unsaturated fats increase marrow palatability, which explains the preferential selection of bones with highly unsaturated marrow by contemporary foragers. Other factors affecting marrow selection, particularly the age of the prey and season of procurement, also are examined. The UMI model is then applied to various hominin and carnivore sites in late Pleistocene Europe to assess its predictive value when confronted with archaeological data.

A Comparative Analysis of the Relationship Between Head Posture and Atlanto-Occipital Joint Morphology in Anthropoids

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It has long been suggested that posture influences aspects of primate basicranial morphology. Previous research has used the position and spatial orientation of the occipital condyles and foramen magnum to determine taxonomic affinity or to discuss locomotion and posture. These studies often revealed statistically significant relationships between these features of the primate basicranium and cranial base flexion, as well as relative brain size. This research, however, failed to elucidate the influence of posture upon basicranial morphology. Because they experience compressive forces that are transmitted from the head, the articular surfaces of the atlanto-occipital joint are expected to reflect head position during locomotion and resting behaviors. These aspects of basicranial anatomy, however, have not been systematically studied. The present study explores the role of posture in primate basicranial morphology by investigating landmarks that are less influenced by encephalization or other structural effects and are more reflective of positional behavior. Specifically, the shape of the opposing articular surfaces of the atlanto-occipital joint in 15 extant anthropoid species (n=108) are quantified using three-dimensional data to explore the relationship between atlanto-occipital joint morphology and neck posture. This research addresses whether anthropoids with pronograde postures possess articular surface morphologies distinct from those with orthograde postures. The results reveal a complex morphological pattern that limitedly supports the hypothesis and permits an evaluation of the morphology of fossil hominins within the comparative framework of the extant primate sample. Fossil hominin morphology does not differ from *Homo sapiens*, nor from the rest of Hominidae. This suggests an orthograde neck posture in the fossil sample that is found across extant hominoids, but within the context of a unique mechanical environment not necessarily exhibited in *H. sapiens* today. Application of this pattern to the fossil record is limited to broad categories of posture, and should not be utilized to argue differences in locomotor repertoires.

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Basicranial Angulation and Influence on Overall Cranial Shape in Humans

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The cranial base is positioned between and interacts with the face, neurocranium, and brain. Accordingly, it is a key area to understand the ontogeny and phylogeny of modern human skull form. A number of hypotheses address spatial packing of the brain related to midsagittal basicranial angulation and interpetrosal angulation. Numerous known cranial base angle measurements between pre- and postchordal planes correlate to various degree with one another and provide similar information about overall angulation. However, cranial base angulation is a result of growth, including flexion and extension, which can occur at three locations—the spheno-ethmoid synchondrosis, the mid-sphenoidal synchondrosis, and the spheno-occipital synchondrosis. Therefore it is impossible to detail the angulation and related morphology of the cranial base with a single angle measurement in the midsagittal plane. Here, 3D geometric morphometrics is used to investigate cranial base morphology and the different factors which lead to previously described overall angulation of the cranial base. We use 305 internal and 305 external anatomical landmarks and semilandmarks on the cranial base, the neurocranium, and the face. Our cross-sectional sample consists of 90 modern human skulls ranging in age from newborns to adults. We quantify and visualize shape changes and differences in the cranial base and related endocranial and facial morphology in an ontogenetic subsample of European humans and an adult subsample of diverse populations. Three-dimensional visualizations of ontogenetic and adult shape variation in humans reveal detailed information about the factors leading to flexion and extension, as well as shape differences in the rest of the cranium related to base angulation. Our results allow for a more complete interpretation of cranial base angulation in an ontogenetic and phylogenetic framework and help to clarify and enhance discussions of the morphology in fossil hominin specimens.

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Preliminary Shape Analysis of the LB1 *Homo floresiensis* Capitate-Metacarpal Facets

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Three carpals attributed to the LB1 *Homo floresiensis* remains are described as possessing symplesiomorphic morphological patterns comparable to those of extant African apes and fossil hominins that predate 1.7Ma (Tocheri et al. 2007). This analysis focuses on the morphology of the LB1 capitate-metacarpal (MC) facets. It uses a comparative sample of Late Pleistocene and Holocene human capitates divided into four sub-samples (Neandertals, N=6; early modern humans, Qafzeh 3 and 9; Upper Paleolithic humans, N=9; Holocene humans, N=33) and a cast of the LB1 capitate in order to assess the extent to which LB1's capitate-MC facets can be said to be within or outside the range of morphological variation of this comparative human sample. A 10 x 10 grid was projected onto the capitate's distal surface and the gridline intersections digitized to obtain landmarks (Niewoehner 2005, 2006). The three-dimensional coordinates were imported into the Morphologika2 PC program (O'Higgins and Jones 2006) for a geometric morphometric analysis. Principal component scores then were used in a discriminant function to determine LB1's morphological affinities. The LB1 capitate is distinct due to its unusual combination of reduction in the radioulnar breadth of the capitate-MC2 facet and extreme concavity, or cupping, of the palmar aspect of the capitate-MC3 facet. Capitate-MC2 breadth reduction is apparent in some Late Pleistocene human specimens, but distinct capitate-MC3 facet cupping is not. When forced into one of the sub-samples, the LB1 capitate is classified by the discriminant function as early modern human. This analysis confirms that LB1 has a combination of capitate-MC facet morphologies that are outside the range of variation of these human sub-samples. The classification result is clearly an artifact of the limited sample composition; therefore, a more credible assessment of LB1's morphological affinities must include capitates from apes and earlier hominins.

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New Research on the Early Upper Paleolithic in Central Europe: Excavations in Willendorf II, Austria (2006 and 2007)

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In 2006 we started new excavations at Willendorf II, a site originally excavated between 1908 and 1955. The site's deposits cover the time period of >55,000 to 23,000 years uncal BP and include nine archaeological layers separated by sterile loess. The early levels from Willendorf II play a key role in the discussion of the dispersal of modern humans into Europe and of the origin(s), dating, and dispersal of the Aurignacian. In recent years, however, the evidence has been debated both for the ^{14}C dates and for the cultural attribution of the Early Upper Palaeolithic (EUP) assemblages. Our new work at the site is aimed at clarifying these issues and at placing the EUP occupations in their climatic and environmental context. Our excavations are sampling the whole sequence along the site's existing main section. Special attention is being paid to better understanding the site formation processes, collecting dating samples (large dating program: ^{14}C-AMS on bone and charcoal, OSL, and TL), expanding the EUP lithics sample, and obtaining malacology samples for environment reconstruction. We further collected abundant samples for palaeomagnetic, tephrachronological, and pollen analyses. Here we present the results to date, reassess the known sequence and discuss our findings in the context of the Middle to Upper Paleolithic transition in Central Europe. We report on the discovery of both new Gravettian and Aurignacian horizons (8a and 3b) as well as new ^{14}C dates for the Aurignacian Layer 4 (GrA-35403: 31250+230/-210 BP and GrA-35406: 31170+230/-210), and preliminary dating results for the underlying Early Aurignacian Layer 3. Taken together these results support previous work done at the site and along with new lithic analysis suggest one of the earliest assemblages of the Aurignacian in Central Europe.

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The Role of Fire in Neandertal Adaptations: The Case Study of Pech de l'Azé IV, Layer 8

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Evidence for the use of fire has been documented at numerous Mousterian sites, though fire is certainly not ubiquitous and its role in Neandertal adaptations is not well understood. Pech de l'Azé IV (France) provides insight on this issue, yielding a 50cm thick horizon (Layer 8) of dark, primarily anthropogenic sediments that represents one of the clearest examples of the controlled use of fire in the European Middle Paleolithic. Spatial associations of these combustion components at the microscale clearly show that numerous burning events occurred. The burned zones are lenticular in profile and lack paving stones. Detailed microscopic and macroscopic geoarchaeological study reveals evidence of multiple burning, trampling, and hearth-cleaning events. The associated faunal spectrum indicates a temperate and wooded environment. Faunal remains provide extensive evidence of Neandertals' exploitation of large ungulates, and in a few cases, small mammals and birds. They also reflect the probable use of animal bone as a source of fuel for fire. The lithic assemblage shows an emphasis on both core reduction and tool production for items used on-site. Although an abundance of burnt flints is evident, there is no clearly discernable correlation between the use of fire and associated lithic assemblage. We also find no clear spatial relationship between combustion features and artifact assemblages. In other words, there is nothing in particular about the stone tool or faunal assemblages suggesting that the exploitation of ungulate prey or the lithic tool kit were adjusted to the use of fire in any way. Moreover, the horizons above Layer 8 show almost no evidence of fire. This emphasizes the importance of fire in Layer 8, but also raises questions regarding the conditions under which Neandertals used fire.

The Case Against Sexual Selection as an Explanation of Handaxe Morphology

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In two recent publications, Kohn and Mithen (1999; Mithen 2005) argued that the distinctive, symmetrical teardrop shape of Acheulean handaxes was the product of sexual selection. This work has been cited in conference presentations, academic publications, a recent anthropological textbook, and the popular press. It is not surprising that such an intriguing, and emotionally appealing, scenario of

mate choice among extinct humans should capture the imagination of the general public. However, the acceptance of this scenario in the archaeological literature, and lack of critical evaluation of its principal assumptions by paleoanthropologists, is less easy to understand. We outline the necessary assumptions and conditions underlying the argument for sexual selection as an explanation for handaxe morphology, critique this argument on the basis of the available evidence from comparative ethology, experimental psychology, and the archaeological record, and present several more parsimonious explanations that are directly based on hard data. Key conditions for Kohn's and Mithen's hypothesis cannot be tested, because to do so would require impossible observations of the biology and behavior of extinct organisms. The sexual selection hypothesis is also unsupported by archaeological evidence, ignoring the effects of technological limitations, typological practice, and factors that may be related to culture or style on handaxe morphology. The best available evidence strongly suggests that variation in handaxe morphology is governed by a number of complex factors that differ in influence over time and space, rather than a single overarching mechanism such as sexual selection. As with most questions of interest in Paleolithic archaeology, we are better served by context-specific, historically situated explanations than monocausal scenarios, particularly when our desire is to understand the form and function of an artifact such as the handaxe, which is found in the record, in one form or another, for more than 1.5 million years.

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New Investigations in the Kurnool District of India: Out of Africa Dispersals and the Evolution of Modern Human Behaviors in the Late Pleistocene

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The Indian subcontinent has an important role to play in assessing the geographic movement of human populations as they spread Out of Africa. Yet, the archaeological record of the subcontinent has not contributed substantial insights about human dispersals, which supposedly occurred at ca 70–50kyr based on genetic coalescence dates. Here we present new archaeological data and findings carried out in Late Pleistocene contexts of the Kurnool District, Andhra Pradesh, India. Surveys have established that the Kurnool District contains a wealth of archaeological sites spanning from the Acheulian to the late phases of the Paleolithic. Field investigations carried out in cave, rockshelter, and open-air contexts provide new insights about the sequence of Late Pleistocene occupations in the region. Investigations in the Jurreru River Valley provide unique insights about Middle Paleolithic occupations in association with tephra deposits related to the Toba Volcanic Super-eruption of 74,000 years ago (Petraglia et al. 2007). Rockshelter excavations supply new information about symbolic items associated with blade and bladelet assemblages. New research conducted in the famous Billasurgam cave complex provides fresh insights into Pleistocene faunas and environments. The Kurnool District investigations provide data that are of great use in evaluating modern human dispersals into the subcontinent and the evolution of modern human behavior.

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Culturally Mediated Migration Lowers Genetic Diversity: A Metapopulation Model with Implications for Humans, Neandertals, and Their Common Ancestor

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Modern humans display lower genetic diversity than great apes. A recent analysis of Neandertal nuclear DNA found their genetic diversity to be on par with that of humans. It also yielded an estimate for the effective population size of the human-Neandertal ancestor that is much closer to estimates for humans than for apes (Green et al. 2006). Why are Neandertals, modern humans, and their common ancestor characterized by levels of genetic diversity that are at least 2–4 times lower than those found in extant apes? In humans, but not great apes, cultural traits mediate migration between groups. If culturally mediated migration is more ancient than previously thought, could the fine-grained population structure it provides explain the relatively low genetic diversity of modern humans, Neandertals, and the human-Neandertal ancestor? To address this question we explore how culturally mediated migration affects neutral diversity in subdivided populations (i.e., metapopulations) with a spatially explicit agent-based model that includes dual-inheritance of genetic and cultural traits. We find that when migration is mediated by a high cultural similarity threshold, between-group selection can sustain significantly lower levels of genetic diversity in the metapopulation (H_T) over thousands of generations, even without severe bottlenecks in census population size. In addition, we find that increasing the rate of cultural innovation allows for lower cultural similarity thresholds to significantly affect genetic diversity. Our theoretical work has implications for reconstructions of Pleistocene hominin evolution that are based on ancient and contemporary DNA. We raise the possibility that humans, Neandertals, and their common ancestor exhibit relatively low genetic diversity as a result of a deep, shared history in which culturally mediated migration maintained a low effective population size.

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Environmental Contexts of Early *Homo*: Pedogenic Carbonate Isotopic Evidence From the Nachukui Formation, West Turkana

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The Turkana Basin of northern Kenya preserves evidence for Plio-Pleistocene ecosystems during key adaptive transitions in the early hominin lineage. Potential selective factors of hominin morphological and behavioral evolution are inferred from these reconstructed environments. The origin and dispersal of *Homo* from Africa are often placed within the context of savanna grassland ecosystems, which has been primarily investigated by isotopic analyses of pedogenic carbonates. The Turkana Basin has been extensively sampled for pedogenic carbonates, and as a result, floral compositions on a basin-wide scale have been reconstructed. However, the Nachukui Formation, containing KNM-WT 15000, Oldowan and Acheulian lithic technologies, and earliest dental remains for *Homo* in the basin, is only now being sampled, and to date, results have not been reported. Here we present isotopic values ($\delta^{13}C$, $\delta^{18}O$) of pedogenic carbonates collected July 2007 from the Nachukui Formation in collaboration with the West Turkana Archaeological Project. We compared two members that mark major evolutionary landmarks and contrasting landscapes in the region and sampled in proximity to archaeological sites. The Kalochoro Member, bound by the Kalochoro and KBS Tuffs (2.34–1.87Ma), contains the Lokalalei site complex, which has provided fossil and lithic evidence for earliest *Homo* and Oldowan technologies in the Turkana Basin. The Kaitio Member, defined by the KBS and Lower Koobi Fora Tuffs (1.87–1.48Ma), witnessed technological advancements and includes the Kokiselei site complex, which has yielded one of the earliest Acheulian assemblages. Our results corroborate previous sedimentological and faunal studies of these site complexes, interpreted to represent diverse habitats along floodplains showing a mosaic pattern of vegetation cover. Kalochoro floodplains occur adjacent to large river systems and show evidence of gallery forests, which contrast to Kaitio habitats along smaller rivers with reduced portions of woody vegetation.

Anatomical Correlates for Increased Gape in the Neandertal Face

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Several aspects of the Neandertal facial and mandibular anatomy suggest that Neandertals were able to produce an unusually large gape. One is the low height of the condyle relative to the occlusal plane, manifested in the discrepancy in height between the tips of the coronoid and condylar processes (Rak and Hylander 2003). Another is the relatively short distance between the mandibular condyle and the mandibular foramen. Moreover, unlike other hominins, the anterior margin of the medial pterygoid muscle is positioned only slightly caudal to the anterior margin of the superficial masseter. Arguably, Neandertals appear to have a more retracted superficial masseter. This is in contrast to those hominins that provide a longer power arm for the masticatory muscles and have no need for a large gape (of which the robust australopiths are the most extreme example). In addition, it is our contention that in Neandertals the posterior end of the dental arcade has migrated anteriorly, i.e., there is a forward shift of their molars, which in turn likely contributes to the formation of the retromolar space. Thus, in Neandertals the vertical distance between the upper and lower molars are greater than in a mandible with the same gape size in which the molars have not shifted anteriorly. The proximate functional benefit of a large molar gape in Neandertals is likely linked to (food?) object size whereas the ultimate benefits are still an enigma.

Preliminary Taxonomic and Zooarchaeological Analyses of the Faunal Assemblage from Grotte des Contrebandiers, Morocco

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The site of Grotte des Contrebandiers, Témara, Morocco, has long been known for its rare association of hominid remains and Aterian stone tool industry. Though the Aterian was widespread in northern Africa, and Aterian hominids have recently been suggested as the first modern human population to spread throughout the world (Hublin et al. 2007), little is understood about the environmental context within which this technology was used. Paleoenvironmental hypotheses for the industry have run the gamut from dry deserts

to humid grasslands and woodlands, while the coastal position of Contrebandiers may have supported fluctuating Mediterranean scrub and forests dependant on glacial cycling. Further, taphonomic studies of fauna found with Aterian technology have been neglected, leaving the nature of hominid subsistence patterns and use of the environment largely unknown. Preliminary analyses of the Contrebandiers large mammal fauna collected during initial excavations in the 1950s and recently renewed excavation reveals that the paleoenvironment at the time of deposition was likely a rich woodland-grassland based on the presence of grassland taxa such as *Alcelaphus*, *Ceratotherium*, and *Phacochoerus*. However, the presence of *Sus*, *Papio*, and *Hippopotamus* likely indicate more wooded and wet habitats. Further, the hominids utilized a wide array of food sources including mammals, reptiles, and eggs, as well as marine resources. Taphonomic studies included analyses of bone fracture patterns and surface modification using a 45x microscope. Preliminary results indicate that the bones in the assemblage were not heavily processed for marrow extraction, indicating further that the paleohabitat during deposition of the Contrebandiers assemblage was productive. Additionally, carnivore damage in the collection is rare. This first glimpse into the ecology of Aterian hominids provides a baseline for future work comparing the paleoecology and subsistence strategies of contemporaneous populations across Europe and Africa, and an understanding of their potential differential success.

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Paleoenvironmental Implications of New Micromammal Fossils from the Hadar and Busidima Formations, Ethiopia

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This paper reviews the systematics, biogeography, and paleoenvironmental implications of new micromammal discoveries from Hadar localities AL894, AL666 and Dikika localities DIK-1 and DIK-2. Since the efforts of Sabatier (1979, 1982) no work has been done on micromammals from the Hadar Formation. The earlier studies focused on micromammal assemblages from the older (ca 3.2Ma) Sidi Hakoma Member. The new micromammal fossils from four localities in the Basal (DIK-2), Sidi Hakoma (DIK-1), and "Upper Kada Hadar" Members (AL 894/666) of the Hadar and Busidima formations, respectively, range from ca 3.4 to 2.3Ma. They expand the known biodiversity and associated habitat diversity of these hominin bearing deposits. Multivariate ordination techniques are used to explore the community composition and similarity to modern and fossil rodent communities. The older faunas from DIK-2 and DIK-1 share much in common with micromammals from Members B and C of the Omo Shungura Formation while the younger localities at AL894/666 are similar to Bed I Olduvai Gorge. Both older and younger assemblages have bush and woodland adapted species, suggesting a relatively mesic and closed environmental preference for *Australopithecus afarensis* and the tool making hominins of the "Upper Kada Hadar" Member.

Right Time, Right Place? An Empirical Evaluation of the Case for Acculturation Over the Transition Interval in Italy

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This paper reviews the concept of 'acculturation' as traditionally used in studies of the Middle-Upper Paleolithic transition to operationalize manners of detecting that phenomenon in the archaeological record of OIS 3. Introducing the conceptual heuristic of 'middle ground' into this debate permits the definition of fundamental notions linked to the issue of acculturation, each of which has empirically testable implications. Focusing principally on three of these concepts—proximity, contemporaneity, and behavioral transfer—I evaluate whether the Uluzzian 'transitional' industry of Italy can rightly be considered the result of the acculturation of hominins using Mousterian technology (i.e., Neanderthals) by hominins using proto-Aurignacian technology. On the basis of technology, chronology, and geography, the Uluzzian clearly fails to meet the criteria for acculturation. This indicates that traditional acculturation scenario might not adequately account for an important fraction of the archaeological record of the transition interval. Further, this conclusion also forces a rethinking of the origins (as well as of the eventual disappearance) of the Uluzzian in the southernmost third of the Italian peninsula. In this case, a consideration of the distinctive ecology and geography of meridional Italy strongly suggests that Uluzzian technology and behavioral strategies constitute a coherent, flexible, and multimillennial adaptation to the more open environments of southern Italy during this climatically turbulent segment of OIS 3. The paper closes with a consideration of the implications of this scenario for the behavioral capacities of the hominins responsible for developing and using Uluzzian technology.

Early Hominin Subsistence Activities: The First Archaeological Evidence (With Cutmarks and Usewear Traces) From the Plio-Pleistocene Localities of Ain Hanech and El-Kherba, Eastern Algeria

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The current archaeological data on early hominin subsistence activities in Africa is derived chiefly from Sub-Saharan Plio-Pleistocene sites, such as Bouri, Gona (Ethiopia); FLK Zinj, BK site (Tanzania); FxJj50 (Kenya); and Sterkfontein Member 5, Swartkrans Member 3 (South Africa). The recent studies at Ain Hanech and El-Kherba in northeastern Algeria have broadened the range of Plio-Pleistocene hominin subsistence activities to North Africa. Dated to 1.78 million years ago, Ain Hanech and El-Kherba yielded an Oldowan industry associated with a savanna-like fauna contained in floodplain deposits, including elephants, hippo, rhino, equids, bovids, girafid, suids, and carnivores. The faunal assemblages are dominated by large and medium-sized adult animals, especially equids with at least 10 individuals. The mammalian archaeofauna preserves numerous cutmarked and hammerstone-percussed bones. Made of limestone and flint, the stone assemblages consisted of core forms, debitage, and retouched pieces, and represent a North African variant of the Oldowan Industrial Complex. Evidence of microwear is found on several flint artifacts, indicating their use by early hominins in meat processing. Overall, our subsistence analysis indicates that early hominins were largely responsible for the site accumulation, which also is corroborated by other relevant taphonomic evidence. Moreover, this finding documents for the first time evidence of early hominin large animal foraging capabilities in northern Africa during the Early Pleistocene.

Digital Mapping of Early Versus Middle Stone Age Surface Sites in the Seacow River Valley South Africa

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Locations of some one thousand Acheulian and Middle Stone Age (MSA) surface sites within a 5,000 sq km area of the Seacow valley, South Africa, have been transferred to digital maps. All localities are now air-photo rectified on a background showing full drainage details and 20m contour intervals. Reasonably accurate measurements between sites and quarries or waterpoints are now possible, a vast improvement over published maps. Analysis of these distances shows that MSA site location choices have a great deal more in common with those of the Acheulian than they do with the Holocene settlement pattern, which focuses sharply on hills and ridges overlooking waterholes. By contrast Acheulian and MSA sites tend to be out in the open flats with limited viewscapes and less concern for distances to waterpoints. The two settlement patterns are not identical, however, the MSA pattern showing a marked preference for riverine settings, with sites less firmly tethered to hornfels quarries than the Acheulian. Although MSA spatial organization on this semi-arid treeless landscape shows few hints of Early Modern Behavior, there are rare cases of MSA lookout stations, where a few lithics have been dropped at ridge crests, hilltops, and other highpoints regularly visited by Holocene hunters. One unique exception is a steep-sided 300m high conical hill with spectacular views in all directions. Its flat top is approached with great effort only via two narrow slits in its near-vertical rim, used today by local livestock in search of fresh pasture. The top, however, supports a substantial MSA site set well back from the rim. There are no Holocene traces whatsoever. The only possible interpretation is that this configuration was used as a natural game trap and kill site, which in turn displays a level of forward planning, which might reasonably be argued as Modern in character.

Quina Occupations at Roc de Marsal, Dordogne, France

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Roc de Marsal is a cave in the Vézère River Valley in the Dordogne region of SW France that contained Middle Paleolithic, Upper Paleolithic, and Medieval period components. It has been the focus of ongoing excavations by the present team since 2004, but is best known for the recovery of an almost complete skeleton of a Neandertal infant during excavations carried out there in the 1950s and 1960s. The Middle Paleolithic deposits of Roc de Marsal include a particularly deep and rich Quina Mousterian component. ESR dates for the base of these levels suggest an age associated with terminal OIS 5/beginning of OIS 4—notably older than has typically been recognized for this particular industrial facies. Faunal preservation is very good and this assemblage represents a substantial database for addressing aspects of Quina Mousterian large game exploitation and, potentially, patterns of site use. The lithic assemblage is dominated by large, heavily cortical, transverse scrapers with a high tool to debitage ratio; classic Quina both technologically and typologically. Although analysis is ongoing, this assemblage will provide an optimal database for comparison with components from other sites in the regions (e.g., Combe Capelle Bas and Pech de l'Azé IV).

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The Oldowan-Acheulian Transition: New Insights from Gona, Ethiopia

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The timing and context of the Oldowan-Acheulian transition is unclear, and the emergence of the Acheulian Industry in Africa has yet to be documented within reliably-dated primary context sites. Two archaeological sites—Konso (Ethiopia) and Kokiselei (West Turkana)—preserve Early Acheulian artifacts dated to ~1.7–1.6 million years ago (Ma), but details on the artifacts and their contexts have yet to be fully available. Two Early Pleistocene sites at Gona, named OGS12 and BSN17, have potential for resolving the timing and context of the emergence of the Acheulian. Systematic excavation at OGS12 has yielded crudely made handaxes, large flakes, and debitage *in situ*. A tuff located ~90cm below the OGS12 excavation was dated to ~1.64Ma by $^{40}Ar/^{39}Ar$, and the handaxes appear to be 1.6Ma. BSN17 has yielded >25 freshly eroded handaxes from the surface, an *in situ* horizon has been identified, and excavations opened in 2006 and 2007 have yielded more than 50 artifacts, but diagnostic handaxes have yet to be recovered *in situ*. The artifact horizon at BSN17 appears to be just below the Boolihinan tuff (BHT, estimated ~1.6Ma). Further, BSN17 is located a few hundred meters east of BSN12, where a contemporary partial cranium of early *Homo erectus* (~1.6Ma) has been discovered. The site is located close to a major river which was the source of stone tool raw materials. OGS12 is located in a different depositional context than BSN17, a long distance from the closest raw material sources. Geological studies including paleomagnetism, $^{40}Ar/^{39}Ar$ dating and tuff chemistry are underway. Our investigations may help clarify the reasons for the major behavioral changes seen during the Oldowan-Acheulian transition and the behavioral adaptations of early *H. erectus*.

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Agent Based Modeling (ABM) Experiments Help Evaluate Hypotheses About Niche Separation in Early Pleistocene Hominid Species in East Africa

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Agent Based Models (ABM) provide computational tools with which to simulate parameters of multi-variate behavioral systems and analyze with GIS the emergent patterns of agent behavior generated by different sets of experimental conditions. We have created an agent based model HOMINIDS (Hungry Omnivores Moving, Interacting, and Nesting in Independent Decision-making Simulations), in which we define simple behavioral rules for agents who forage in simulated landscapes. The experimental landscapes are spatially explicit, dynamic, and derived from field vegetation survey data on seasonal abundance and distribution of different plant foods collected in modern analogs of Plio-Pleistocene habitats from two different semi-arid riparian settings. Using the original plant food field data as a baseline, we experimentally manipulate the edible productivity and abundance of different types of key plant foods, such as different species with edible roots, to evaluate the impact of plant food availability in space and time on the foraging patterns of two different hominid agents. In addition to plant foods, we can run the model with a variety of stochastically generated carcass-feeding opportunities. Here we report statistical and graphic GIS results of repeated, single-year experiments. The hominid agents, *Australopithecus boisei* and *Homo ergaster*, are modeled with simple attributes that influence their foraging and nesting behavior. These include energetic requirements, gut capacity, nesting rules, travel and search rules, and different cost/benefit rankings for foods based on chewing/technological abilities, and simple cooperative opportunities. By keeping the parameters of agent behavior relatively simple (e.g., no demographic or cognitive realism), we are able to evaluate the sensitivity of resulting subsistence patterns to the different behavioral settings used in the simulations. Our results show both similarities and significant differences in land-use behavior between the two types of hominid agents which have implications for the selective advantages and archaeological visibility of hominid subsistence behaviors.

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Further Explorations Into the Chronology of the Obi-Rakhmat Site, Uzbekistan

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In the Tien Shan Mountains, northeastern Uzbekistan, the Obi-Rakhmat rockshelter has yielded a newly discovered hominid associated with an abundant, Paleolithic industry and rich faunal assemblage in typical cave fill sediment. Results from dating eight bovid teeth by electron spin resonance (ESR) have previously been presented (Skinner et al. 2007). One tooth from Layer 12.3 averaged 57±2ka assuming linear U uptake, while those from Layer 13 averaged 66±2ka, that from Layer 14.3, 73±4ka, and those from Layer 21.2 averaged 87± 4ka. The current project involved dating three more teeth from Layer 14.2 of the Obi-Rakhmat site to confirm the correlation between depth and age. Dating multiple samples from the same layer checks the possibility of reworking and improves age estimates. The average LU age of teeth FT49, FT50, and PT14 is 66.7±6.0ka. Combined with the age of FT26, the average LU age of layer 14.2 is 67.8±5.2ka. The agreement of the samples' ages is within the margin of error, meaning there is no significant reworking in the layer. The age of layer 14.2 is slightly younger than initially predicted, but fits the chronology of layers around it. The date of the hominid remains was based on sedimentation rates, so this is now also slightly younger than the initially predicted 74ka. These dates indicate that the site was inhabited during Oxygen Isotope Stages (OIS) 5a–4, as climates were generally cooling, but beginning to fluctuate more wildly.

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Topographic Interpolation as a Tool for Excavation: Examples from the Abri Castanet, Dordogne (France)

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Topographic interpolation has long been used for recreating landscapes from discrete topographic points. Here we report on a methodology for using interpolation to record the surface morphology of strata within an archaeological excavation. This methodology is of particular utility for the complex stratigraphy of cave and rockshelter sites, as it allows for true three-dimensional correlations between stratigraphic units and greatly facilitates correlations over multiple years. Additionally, this system allows for the display of artifact proveniences and photographs of features within the strata. Topographic points are recorded using a Topcon total station, in conjunction with WinEDM. With some training, data collection is quick, efficient, and can be done concurrently with excavation. For example, at Abri Castanet, only the most topographically varied of strata required more than 50 points (less than 20 minutes) per square meter. Topographic points are then analyzed and projected using the ESRI ArcGIS software package. After experimentation, an Ordinary Krige interpolation with a spherical semivariogram model was found to be the most accurate interpolation algorithm. These interpolated surfaces are then be projected into three-dimensions. While the surfaces typically are shown either as grids or graded rasters, we have experimented with "draping" photographs of the stratigraphic layers over each surface by carefully marking known three-dimensional points in each of the photographs. This allows us to increase the stratigraphic detail recovered as we excavate. Examples of these methods will come from the Abri Castanet, an Aurignacian site from the Dordogne region of Southwestern France. Particularly, we will focus on the reduction of a 1 by 2 meter witness section, but will also include work on more extensive stratigraphic layers, and the correlation of two disparate (~15m) areas of the site.

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Enamel-Dentine Junction (EDJ) Morphology Distinguishes the Lower Molars of *Australopithecus africanus* and *Paranthropus robustus*

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Tooth crown morphology plays a central role in hominin systematics, but the removal of the occlusal aspect of the outer enamel surface by attrition removes evidence of the type of detailed crown morphology that has been shown to discriminate among extant hominoid and fossil hominin taxa. This results in either small sample sizes and/or comparisons that are limited to only gross aspects of tooth morphology (e.g., overall size and shape of the crown). The enamel-dentine junction (EDJ) is the developmental precursor of the outer enamel surface and must undergo considerable attrition, especially in thick-enameled hominins, before the morphological

evidence it preserves is compromised. In this paper we explore whether the shape of the EDJ can be used to distinguish between the mandibular molars of two southern African archaic fossil hominins: *Paranthropus* (or *Australopithecus*) *robustus* and *Australopithecus africanus*. We extracted the EDJ surface from microCT images through segmentation and then used geometric morphometrics to compare molar shape (1) between *P. robustus* and *A. africanus*, as well as (2) along the molar row within each species. We analyze 3D landmark and semilandmark coordinates collected along the marginal ridge which runs between adjacent dentine horns, and around the circumference of the cervix. In a discriminant analysis of Procrustes shape variables we can readily distinguish lower molars of the two archaic southern African hominins, and furthermore, discriminate first, second, and third molars within each taxon with reasonable reliability. These results confirm that the EDJ preserves taxonomically pertinent shape information in teeth in which occlusal wear has removed the morphological details of the outer enamel surface.

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Synchrotron Investigations of Fossil Hominin Dental Structure and Development

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Recent non-destructive X-ray synchrotron microtomographic studies have revealed internal tooth structure, including dental microstructure, with high fidelity (Tafforeau et al. 2006; Tafforeau and Smith in press). Anthropological applications include investigations of enamel thickness and root morphology in a number of human and primate fossils, as well as developmental features in fossil hominin enamel and dentine (Smith et al. 2007; Tafforeau and Smith in press). These studies have provided the earliest evidence of a modern human life history in a 160,000 year old early *Homo sapiens* from Morocco (Smith et al. 2007). Here we review recent anthropological applications of synchrotron microtomography, including on-going experiments on additional early *Homo sapiens* and Neanderthal juveniles. One of the most powerful uses of this technique is the non-destructive detection of the neonatal (birth) line, in addition to the incremental long-period line periodicity. The lack of these parameters in previous studies has led to broad estimations of developmental timing and age at death in other fossil hominins. Given the recent finding of a rapid developmental profile in a juvenile Belgian Neanderthal (Smith et al. in press), synchrotron imaging allows accurate non-destructive assessment of multiple Neanderthals, leading to clearer resolution of the origins of modern human life history and resolution of the long-standing debate over developmental differences between Neanderthals and our own species.

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New Hominin Specimens From Cooper's Cave, South Africa

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The Plio-Pleistocene locality of Coopers D has produced a large faunal assemblage, including several hominin specimens. To date four isolated teeth and a single edentulous mandible have been referred to *Paranthropus robustus*, representing at least three juvenile individuals. This material is most similar to specimens from Drimolen, while comparison with other South African *P. robustus* material confirms the taxonomic assignment of these fossils. All dental specimens exhibit considerable hypoplastic pitting, indicating some form of metabolic disturbance during dental development. One hominin vertebral fragment with fully fused epiphyses demonstrates the presence of at least one adult individual, though taxonomic attribution of this post-cranial specimen is uncertain. Recent excavations have revealed additional hominin materials, including a mandible fragment with a short corpus and wide alveoli that are most consistent with OH 13 (*Homo habilis*). If confirmed, this affinity would mark Coopers D as only the third locality in South Africa with contemporaneous *Homo* and *P. robustus* in a single deposit, after Swartkrans and Drimolen. Efforts to date South African cave sites suffer from geological complexity and a scarcity of material suitable for direct dating. The deposits exposed in locality D at Coopers are of particular interest in that they preserve a relatively simple stratigraphy consisting of two fills separated by a discrete flowstone

layer. Preliminary uranium-lead dating of this flowstone layer, as well as other speleothem material intercalated with the fossil bearing sediments (breccias) has been successful and correlates with our previously published biochronology dates of between 1.9 and 1.6Ma. As a result, Cooper's Cave represents the most precisely dated *Paranthropus robustus* site in South Africa.

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Hunters of the Acheulo-Yabrudian through Middle Paleolithic in the Eastern Mediterranean Basin

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Recent zooarchaeological findings on hominid predatory niche, prey capture techniques, and carcass processing at cave sites in the eastern Mediterranean Basin indicate that large game hunting and delayed consumption of transported meat were in regular practice by the late Lower Paleolithic (Acheulo-Yabrudian) period, if not earlier. The 200–400,000 year old assemblages from Qesem Cave in Israel provide early examples of prime-age-focused ungulate hunting, a predator-prey relationship that became typical by the Middle Paleolithic, and continued among foraging peoples though recent times. Almost nothing is known about plant consumption during the late LP, but the meat diets of these early hominids were exceptionally narrow, centering on large game animals and supplemented by small quantities of slow-moving small animals. Some aspects of the late Lower Paleolithic faunas are broadly similar to those of the later periods, but other aspects imply distinct patterns of communal feeding: (1) the types of tool marks and their anatomical placements on bones from Qesem cave indicate redundant, very simple flesh cutting and removal activities only; (2) the cut marks are more abundant, larger and more 'randomly oriented' than is typical of Middle and Upper Paleolithic faunas studied by the author in the same region; and, (3) numerous heavy-handed motions are apparent, and there is a comparatively high incidence of "criss-crossing" and mixed angles when many cut marks occur on the same specimen. These preliminary observations suggest greater posture variation between strokes during butchering operations during the late Lower Paleolithic in comparison to Middle and Upper Paleolithic faunal assemblages in the study area. These contrasts between the late LP and early MP may indicate subtle but important differences in the mechanics of meat sharing.

Technological Variation in the Earliest Oldowan (2.6Ma) from Gona, Afar, Ethiopia

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Technological variation provides key evidence for reconstructing the behavior and evolution of Plio-Pleistocene hominins. However, the nature and meaning of Oldowan variability remains highly controversial. Two competing paradigms dominate research—a quantitative behavioral ecological approach and a more descriptive/interpretive chaîne opératoire technological approach. The former emphasizes the uniformity of simple flake production as a stable adaptive strategy throughout the Oldowan, whereas the latter identifies more specific inter-site variations in technique as evidence of significant cultural, phylogenetic, and/or cognitive differences. In particular, it has been proposed that: 1) earlier (Pliocene) sites are distinguished by simpler (unifacial) reduction strategies limited to the exploitation of naturally occurring platforms; and, 2) Oldowan inter-site variation is too great to be accommodated within a single archaeological entity. The first is an empirical question and the second a matter of interpretation, though both may benefit from a more deliberate integration of the prevailing paradigms. Here we apply such an integrated approach to three Pliocene assemblages (EG10, EG12, and OGS7) at Gona, all dated to 2.6 million years (Ma). Results indicate a full range of "classic" Oldowan technological variation in these earliest known occurrences, including systematic and intensive bifacial reduction. This is consistent with the idea of "technological stasis" throughout the Oldowan time period. Nevertheless, significant differences are evident between sites. While knapping was uniformly skilled, differences in core morphology, technological flake types, platform dimensions, and the occurrence of split flakes attest to differences in predominant reduction strategy. Raw materials and paleo-landscape contexts also vary between these sites, and we propose that ecological context and the social transmission of techniques should be considered as complementary elements of explanation. Based on these results, the naming of additional stone tool industries (such as the "Pre-Oldowan") does not seem warranted at this time.

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A Shelter in the Storm: The Solutrean Adaptations in SW Europe During the Last Glacial Maximum

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The story of human cultural evolution in the Upper Pleistocene of Europe did not end with the Middle to Upper Paleolithic transition. This process had taken place against the backdrop of fluctuating environmental conditions in late Oxygen Isotope Stage 3 that were far from pleniglacial in severity. Indeed, humans had inhabited high latitudes during this period, albeit at low population densities. The descent toward the maximum conditions of cold and aridity of OIS 2 would see major changes in technology, subsistence, "artistic" expression, and social organization in the so-called Gravettian, followed by a gradual,but major contraction of the human range in Western Europe during what is known as the Solutrean of southern France and Iberia. This paper summarizes the current state of our knowledge of the human refugium in SW Europe during the LGM and its implications for the re-population of NW Europe and highland areas during the subsequent (Tardiglacial) Magdalenian. The Solutrean is characterized by major developments in weapon technology (foliate & tanged points, the atl-atl, antler points combined with backed bladelets), eyed needles, portable and rock art, and intensified subsistence (both through situational specialization and overall diversification). There are strong indications of the elaboration of BOTH regional economic + social territories AND of inter-regional social networks. There was both overall cultural unity and considerable regional diversity in specific adaptations, as well as in point styles. The paper reviews the results of recent excavations (including El Miron Cave, Cantabria), site distribution studies (notably in Andalucia and on the southern edge of the Paris Basin) and rock art discoveries (such as Coa in Portugal) to illustrate how some humans survived the serious LGM crisis. The archeological record would seem to be supported by recent genetic studies that show SW Europe as a major source area for modern populations in NW Europe.

Correlating Climate Change and Culture Change in the Levantine Epipaleolithic: A Matrix Correlation Approach

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Recent developments in paleoclimatology provide high resolution regional and global chronologies for the Late Glacial period (ca. 23.0–11.7kya). This is of great interest for paleoanthropological research on the Epipaleolithic Levant, where terminal Pleistocene climate change likely had a key influence on biocultural dynamics involved in pre-agricultural sedentism and incipient horticulture. Yet, the nature and extent of that influence remains debated. Among the main questions are whether post-Last Glacial Maximum climatic amelioration (ca. 19.0–13.0kya) provided a critical push toward Early Natufian sedentary foraging. A related question focuses on whether the Younger Dryas cool and dry episode (12.9–11.7kya) catalyzed a return to residential mobility, combined with early horticultural experiments that mark the Late Natufian archaeological culture. It remains methodologically challenging to test hypotheses about temporal correlations between trends in the Levantine Epipaleolithic record and Late Glacial paleoclimate datasets. More specifically, the available Epipaleolithic ^{14}C database is too small and patchy to apply Bayesian statistical methods, which work best with more detailed stratigraphic or intersite seriation data to inform prior models. This presentation introduces a non-parametric matrix correlation approach to testing hypotheses about the fit of available radiocarbon dates—and their associated calibration distributions—to regional Levantine Epipaleolithic chronological models. Using the most recently posted CalPal calibration curve (CalPal2007_HULU; <http://www.calpal.de>), I offer a statistical evaluation of the following questions: 1) Did the Kebaran archaeological culture emerge during or after the Last Glacial Maximum?; 2) Can the Geometric Kebaran archaeological culture be tied to the relatively cool and dry Older Dryas, likely caused by the Heinrich I North Atlantic ice discharge events?; 3) Can Early Natufian sedentism be linked to rapid climatic amelioration after 16 kya?; and, 4) Can the Late Natufian archaeological culture be linked to the onset of the Younger Dryas?

New Interpretations of the Pleistocene Fossil- and Artifact-Bearing Deposits at Swartkrans Cave, South Africa

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Research at Swartkrans between 1948 and 1986 revealed important paleoanthropological findings, including the sympatry of *Australopithecus robustus* and early *Homo*; realization that hominids were common prey of carnivores; identification of a hominid bone tool technology; and, identification of perhaps the earliest evidence of hominid control of fire. Building on this work, we initiated the Swartkrans Paleoanthropology Research Project in 2005. Our fieldwork has included the removal of a large dolomite block and adhering fossil-bearing breccias that were attached to the cave's north wall, a portion of the Hanging Remnant (HR, c. 1.7 million

years [Myr] old) of Member 1. This removal exposed several distinct breccias that formed as part of an extensive sedimentary sorting process during deposition of the infill. This new exposure may provide clues to a separate cave opening for the HR infill. Adjacent to Member 1 is Member 4. A test excavation by Brain in the 1980s into the surface of this deposit yielded ~2,000 Middle Stone Age (MSA) lithic artifacts. Our new excavations have added another 1,500 artifacts to this total, making it the largest and most complete MSA assemblage in the Sterkfontein Valley. In addition, we have identified two stratified layers underlying the MSA level: (1) a large volume of brecciated talus infill that contains an abundance of early Pleistocene fossils (including *A. robustus*); and, (2) a lower deposit that appears to be a previously unknown extension of the 1.8–1.7 Myr. old fossil- and archaeology-rich Lower Bank infill of Member 1. We report here on our current research at the site, particularly on new stratigraphic interpretations and paleoathropological findings.

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Differences Between Human-Accumulated Faunal Assemblages at Two Contemporaneous Middle Stone Age Sites in the Western Cape, South Africa

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Research on the African Middle Stone Age (MSA) has entered a phase where finer resolution in chronologies and a larger sample of sites allows for a more detailed examination of human behavior during this important period in prehistory. New data from Blombos Cave and Pinnacle Point Cave 13B (PP13B) illustrate a case in which differences in faunal exploitation are clear even between sites in close geographic and temporal proximity. These two coastal MSA sites are less than 200km from one another and contain deposits that overlap by ca. 50,000 years during the last interglacial, yet the human-accumulated assemblages show distinct differences in body size abundance, taxonomic abundance, and other subtle indications of human faunal exploitation behavior. This study is the first to enable taphonomically-informed comparisons between MSA faunal assemblages in the Western Cape, and the results indicate that a larger sample of sites is likely to uncover a much wider range of variability in human subsistence behavior than has previously been described.

Building a Tephrochronological Framework for the Central Anatolian Paleolithic

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The prehistory of Anatolia has the potential to address a number of key issues in Pleistocene cultural geography, including hominin population dispersals and contractions, as well as the degree and extent of regional traditions of artifact production. However, as a result of a short history of Paleolithic research, basic data on the nature and timing of archaeological variation in the area remain incomplete. The recently discovered and excavated site of Kaletepe Deresi 3 (KD3) provides an important datum, as it is the only stratified Lower and Middle Paleolithic site in central Anatolia and the only excavated Acheulian assemblage currently known from Turkey (Slimak et al. in press). The site occurs within the Central Anatolian Volcanic Province, where lavas and tephra from Pleistocene volcanism allow the possibility for estimating the age of archaeological sites, which for KD3 is presently constrained to ~0.16–1.0Ma on the basis of dated bedrock and correlated airfall tephra. Mouralis (2003) conducted extensive field- and laboratory-based investigations of the physical and chemical evolution of Hasan Dağ, Ericyes Dağ, Göllü Dağ, and Acigöl, the potential source volcanos for the predominantly rhyolitic tephra in the vicinity of KD3. These data form our present reference set for constructing a multivariate classification model using discriminant function analysis. On the basis of tephra geochemical composition determined by >400 electron microprobe analyses, the model is used to determine the probable volcanic source of airfall and reworked tephra from KD3 and the nearby site of Körkuyu. Discriminant function analysis provides a quantitative and probabilistic method to assess tephra classification that complements and strengthens prior correlative efforts. Our results help to guide ongoing efforts to expand the presently modest sample of radiometrically dated volcanic rocks in the Central Anatolian Volcanic Province relevant to hominin occupation of the area at KD3 and elsewhere.

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New Aurignacian Human Remains from Chez les Rois (Charente, France)

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Over the last decade, several human skeletal remains previously assigned to the Aurignacian have been attributed to more recent periods. The scarcity and poor state of preservation of human remains from secure Aurignacian context has led some authors to question the taxonomic affiliation of the makers of this technocomplex. Excavations conducted between 1948 and 1952 at the site of Chez les Rois (Charente, France) yielded one of the largest collections of human remains assigned to the Aurignacian. The taxonomic attribution of these remains has recently been challenged, and their chronological and archaeological context has been reevaluated. The new excavation of this site, conducted since 2005, has confirmed the presence of three main stratigraphic units, all attributed to the Aurignacian. The lithics from the lowermost layer are technologically and typologically close to the Early Aurignacian, the upper layers to more recent stages of this technocomplex. Only losangic antler points, however, are found in the three units. Three human teeth were found *in situ*—a deciduous upper molar, a lower permanent molar, and a lower permanent incisor. The upper molar comes from the uppermost unit, the two permanent teeth from the lowermost unit. We provide the first description of these new Aurignacian human remains. Their morphological features, crown and root dimensions are compared to those of Neandertals, early and recent modern human samples, and, in particular, to other known Aurignacian specimens from Europe. No definitive taxonomic conclusion can be drawn for the deciduous upper molar and the lower incisor. The characters of the permanent lower molar make more likely an atttribution to modern humans rather than to Neandertals. Our results then support that modern humans produced the Aurignacian technocomplex at les Rois. Our comparative analysis provides new insight into the European early modern human variability.

The Still Bay Points of Blombos Cave (South Africa)

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We present the results of a technological and morphometric analysis of all the Still Bay points from the 1993–2004 excavations in layers of the M1 and M2 phases of Blombos Cave. This sample includes about 370 points and point fragments and a few other unifacial points and bifacial pieces of non-Still Bay morphology. We have been able to reconstruct the manufacturing sequence of the bifacial points from initial shaping (by direct internal percussion) to finished morphology (by direct marginal percussion). Modifications following the final phase of shaping suggest intensive curation and a relatively long use-life of some pieces. There is evidence of axial hafting and resharpening of the point within the haft. Identifications of impact fractures and manufacturing breaks are based on comparisons with experimental and archaeological bifacial points of verified function (Paleoindian points from bison kill sites, replicates of Solutrean shouldered points mounted as spear-heads or arrow-heads and shot into adult cattle with a cross-bow and a straight bow by a group of French technologists, and experimental replication by V.M. on local raw materials). The relatively high coefficient of variation of some morphometric attributes and the evidence of modifications changing the shape and nature of the active edge of some pieces suggests that the Still Bay points, like the backed pieces of the Howiesons Poort and the unifacial points of post-Howiesons Poort times, are not a monofunctional class and are less standardized and less functionally specialized than Upper Paleolithic and Paleoindian points. However, based on recent advances in OSL and TL chronologies, it seems possible to suggest that trends to specialized hunting weaponry emerge in the late MSA to become more evident in the LSA and Upper Paleolithic and that the period between 80 and 35 ka in South Africa witnessed relatively rapid rates of changes in weapons and technology characteristic of more recent periods of human evolution.

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Morphology of the Easternmost Neanderthals

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Neanderthals once were thought to have ranged from Western Europe through the Near East to Central Asia. According to recently published genetic data on the fragmentary remains from Okladnikov Cave, their geographic range must be extended to include southern Siberia (Krause et al. 2007). Until now, only limited information on the morphology of these easternmost Neanderthals was published, concentrating on the dental remains (Shpakova and Derevianko 2000; Turner 1990). Okladnikov cave, in the northern

foothills of the Altai mountain range, yielded a rich lithic industry most similar to the Western European Mousterian, as well as teeth attributable to at least three individuals and postcranial fragments to at least two individuals. The teeth show archaic traits like a very complex occlusal pattern and a large anterior fovea, but no derived Neanderthal traits like an uninterrupted mid-trigonid crest, or strong taurodontism. All teeth are rather small, and fall in the lower half of the Neanderthal range of variation. The postcranial remains are all small fragments, but allow some morphological conclusions. A manual phalanx is strongly flattened and has a very broad distal end, similar to Neanderthals and Middle Pleistocene *Homo*. An adult humerus is very small, with a relatively small olecranon fossa. The child humerus has very thick cortical bone throughout the distal half of the shaft, and increased antero-posterior bending strength compared to a sample of 23 modern children. The distal part of the shaft is flattened medio-laterally, similar to non-modern *Homo*. In general, the remains are characterized by a diverse, non-modern morphological pattern, but no Neanderthal autapomorphies can be perceived. We discuss the implications of the presence of these "non-Neanderthal-like" Neanderthals at the periphery of their distribution.

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Refining Data Collection and Documentation of Pliocene Animal Trackways at Laetoli and Their Potential Use in Paleoecological Interpretations

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Animal trackways provide a time-averaged snapshot of paleoecological information that is otherwise difficult to extrapolate from the geological record. Ichnological studies of animal trackways, particularly at paleoanthropological sites are very few. The Laetoli paleoanthropological site in northern Tanzania provides an opportunity to refine methods used in collection of trace fossil data, documentation, and interpretation in a paleoecological context. We present preliminary results from a revised ichnological study of select Laetoli animal trackway sites D (Locality 11) and J (Locality 10). A combination of systematic mapping and high resolution overlapping digitization was used to collect data for stereoscopic and photogrammetry analysis at the Bureau of Land Management's National Operations Center Division of Resource Services (NOC-DRS) Photogrammetry Lab. Whereas dik-diks are highly represented at both Sites D and J (43.18% and 50.7%, respectively), lagomorphs are abundant at Site D (43.10%) yet absent at Site J. Elephants, buffaloes, hyenas, and guinea fowls are also present at Site J, thus implying some localized and differentiated fauna composition between the two Localities (10 and 11). Comparable ecological data on fauna composition from modern wildlife census of the western zone in the Ngorongoro Conservation Area indicate that at present the Laetoli area lacks large buffalo communities; however, hyenas and elephants frequent this area especially during the rainy season. Based on this preliminary comparative study, we conclude that the present landscape at Laetoli differs significantly from Pliocene ecological settings.

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Upper Limb Motion During Stone Tool Production

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The ability to produce and use tools is recognized as a key adaptation in hominin evolution, and is considered by some to be a driver of the elaborate cognitive capabilities of modern humans. Past studies have linked aspects of upper limb morphology with the ability to produce stone tools. However, we currently lack the quantitative data on upper limb motions needed to evaluate the mechanical context of tool production. This study evaluates the kinematics of hand, wrist, and elbow joints during two types of knapping based on 113 swing cycles (47 flake production, 66 retouch). Data were captured from three amateur knappers using a VICON motion analysis system (50 Hz). Knapping conditions were kept constant—separate hammerstones were used for flaking (0.928kg) and retouch (0.389kg), and the type, mass, and dimensions of the nodules were initially similar (cortex-free raw Texas flint, n=8, mean weight=5.85kg; s=1.22; mean length=40.5cm, s=2.76; mean circumference x=34.1cm, s=6.65). Results demonstrate that both flake production and retouch swing-cycles are divisible into two phases—an up-swing phase marked by upward limb motion and increasing wrist extension, and a down-

swing phase marked by downward limb motion and increasing wrist flexion. Interestingly, inter-swing motion consistency appears to be inversely related to flake production efficiency, an observation that deserves further study. In virtually all cases (99%), maximum wrist extension occurs within 0.02 seconds after the initiation of the down-swing phase, setting up the wrist posture in preparation for hammer striking. Flexion past the neutral plane differs significantly between knapping activities, occurring in only 1.3% of flake production swing-cycles compared with >50% of retouch swing-cycles. These results suggest that wrist movements are critical to accurate flake production and especially retouch.

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Environmental Change and Neanderthal Settlement Patterns in the Altai Mountains, Siberia

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Neanderthals penetrated deep into northern Asia, as recently demonstrated by ancient DNA results on hominin remains from Okladnikov Cave in the Altai Mountains (Krause et al. 2007), and as suggested by the wide distribution of Middle Paleolithic artifact assemblages in southern Siberia and Mongolia. However, little is known about the behavioral adaptations and settlement patterns of Neanderthals in this vast, remote region. A useful starting point of inquiry is the northwestern Altai, where a group of cave and open-air sites with stratified Upper Pleistocene archaeological horizons has been excavated using modern methods over the past two decades. Paleoenvironmental data indicate that the narrow Altai foothills zone (~500–1,200masl) was a refugium for many species during cold, dry episodes, while higher elevations were repeatedly affected by mountain glacial advances. Although it has been proposed that the Altai foothills were continuously occupied during the Upper Pleistocene, artifact assemblages are of low density and consistent with brief visits and high residential mobility, perhaps representing occupations largely restricted to climatic optima (i.e., ca. 125kyr and 50–30kyr). Recently completed taphonomic analyses of associated archaeofaunal assemblages support these interpretations. At the Denisova and Strashnaya cave sites, bones have been extensively modified by carnivores and there is little direct evidence for processing by Neanderthals. At the open-air sites of Kara-Bom and Ust'-Karakol 1, and at the protected Ust'-Kanskaya cave site, hominin butchery of a small number of fairly complete bovid and equid carcasses is documented. The implications of these results for hypotheses concerning Neanderthal settlement and the Middle-Upper Paleolithic transition in Siberia as a whole are briefly discussed.

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