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New Data on the Transition from the Gravettian to the Solutrean in Portuguese Estremadura

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From an anthropological perspective, the passage from the Gravettian to the Solutrean is one of the most interesting transition periods in Old World Prehistory. Between 22 kyr BP and 21 kyr BP, during the beginning stages of the Last Glacial Maximum, Iberia and Southwest France witness a process of substitution of a Pan-European Technocomplex—the Gravettian—to one of the first examples of regionalism by Anatomically Modern Humans in the European continent—the Solutrean. While the question of the origins of the Solutrean is almost as old as its first definition, the process under which it substituted the Gravettian started to be readdressed, both in Portugal and in France, after the mid 1990's. Two chronological models for the transition have been advanced, but until very recently the lack of new archaeological contexts of the period, and the fact that the many of the sequences have been drastically affected by post depositional disturbances during the Lascaux event, prevented their systematic evaluation. Between 2007 and 2009, and in the scope of mitigation projects, archaeological fieldwork has been carried in three open air sites—Terra do Manuel (Rio Maior), Portela 2 (Leiria), and Calvaria 2 (Porto de Mós) whose stratigraphic sequences date precisely to the beginning stages of the LGM. Together with the multidisciplinary data from the Lapedo Valley rock shelter sites—Abrigo do Lagar Velho and Abrigo do Alecrim, under excavation since 1998—they allow us not only to re-evaluate the existing models for the transition, but also to enlarge the criteria of comparison between Gravettian and Solutrean in Portuguese Estremadura to subsistence strategies, mobility patterns, and inter-site functional variability.

Technological Diversity and Geochronology of Middle Stone Age Industries in the Central Rift Valley, Kenya: Implications for the Evolution of Modern Human Behavior

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New dated Middle Stone Age industries in the central Rift Valley of Kenya document diachronic changes in technology, technological diversity and new innovations. The ages reported below are preliminary single-crystal laser-fusion $^{40}\text{Ar}/^{39}\text{Ar}$ dating results. Marmonet Drift (GtJi15), in the Naivasha basin, contains a 20-meter sequence with four archaeological horizons. The earliest horizon lies ~1m above a pumice tuff dated ~230 ka, and 6m below a pumice tuff dated ~200 ka. Scrapers, denticulates, unifacial points, flakes with thick faceted platforms, and radial/Levallois cores predominate. The second industry resembles the first, and lies 11m above the basal tuff. The overlying undated basaltic tuff has a deeply eroded upper surface, marking a significant unconformity. The sparse industry 1m above this tuff marks the first appearance of thin, invasively flaked artifacts. A pumice bed dated to ~100-110 ka lies 15–16m above the basal tuff. The fourth industry, from 16 to 18.5m above the basal tuff, also contains thin invasively flaked points and knives. Flake platforms are thinned intensively and resemble punch blade platforms. Deighton's Cliff (GrJi7), in the Nakuru basin, is L.S.B. Leakey's type-site for the Kenya Magosian. A tuff overlying this occurrence is dated to ~130–120 ka. Shaped tools comprise microlith fragments, points, burins, outils écaillées, scrapers, and notches. Very small artifact sizes and artifacts with double patina suggest that the LSA-like features of this industry partly reflect conservation of scarce lithic raw materials. Invasively flaked points and intensive platform

reduction at Marmonet Drift, and a suite of LSA-like features at Deighton's Cliff, suggest a substantial increase in diversity, flexibility and innovation of lithic technology in the East African MSA between 230 and 100 ka. These features may have appeared earlier here than in southern Africa, which suggests an eastern African origin for these aspects of modern human technology and behavior.

Further Exploration of the First Use of Fire

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Fire represents one of the first technologies available to early hominids. Natural events such as lightning strikes or volcanic eruptions would have allowed them to harvest fire for purposes of warmth and protection from predators. Definitive evidence for the use of fire can be deduced from hearths (Karkanas et al. 2007), the earliest of which appear to date to about 0.5 Ma, but other, earlier, charred materials are suggestive of earlier, albeit sporadic, utilization of fire. Previously a study of the burnt bones from Swartkrans by electron spin resonance (ESR) suggested strongly that they had been heated to campfire temperatures, rather than grassfire (Skinner et al. 2004). In that case these samples indicated that over 1 Ma years ago hominids were aware of the value of fire and able to control it to some extent. However the spectra did not precisely match previous studies of burnt bones by ESR (Michel et al. 1998) and a number of inferences were drawn from results on other materials, primarily flint. Further experimentation, using fossil bones from a younger site, has reproduced the paleothermometry and explained the variations in spectra. Thus the initial conclusion about the age of the earliest use of fire is confirmed.

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The Acheulian Origins of Levallois Technology: A View from Revadim, Israel

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The multi-layered Late Acheulian site of Revadim provides a rare opportunity to study patterns of continuity and change within the lithic assemblages of the Late Lower Paleolithic period in the Levant. This open-air site was excavated to a large extent (ca. 250 sq.m.) and yielded a wealth of lithic and faunal remains following meticulous field recovery procedures. The rich lithic assemblages (over 500,000 items in total) are typical of the Late Acheulian in the Levant, including the unavoidable hand-axes but mostly dominated by flake-production and flake-tools. In the Levant common knowledge indicates that hand-axe production stops completely and abruptly before the beginning of the Middle Paleolithic Mousterian following the emergence of the Levallois technology. While Mousterian sites in the Levant are indeed completely devoid of hand-axes, the emergence and origins of the Levallois technology remains an open question. Some have claimed this is a new innovation of the Middle Paleolithic while other argued it has its roots in the Lower Paleolithic Acheulian. The study of the lithic assemblages from Late Acheulian Revadim might shed new light on the Lower Paleolithic origins of Levallois technology and promote our understanding regarding the technological shifts that took place during the transition to Middle Paleolithic life-ways in the Levant. Our study is supportive of the claims that prepared core technologies and the production of predetermined flakes were practiced already at the end of the Lower Paleolithic period. However, we were surprised to notice the fact that at Revadim

predetermined flakes were removed both from well-prepared flake cores as well as from reused hand-axes, indicating the complexity and flexibility of Late Acheulian lithic production and the possible multiple origin of Levallois technology.

Micromammal Microwear Texture Analysis—Preliminary Results and Applications for Paleoecological Study

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Proxies for diets of fossil taxa (e.g., stable isotope, mesowear, and microwear) have been used as proxies for paleoecological reconstructions. Due to methodological considerations related to size, the majority of these studies have used medium and large mammals only. Rodents, which are numerous in archaeological sites, have not been readily tapped as a resource for these types of analyses. Here we present preliminary results testing the use of microwear texture analysis in small rodents by comparing data obtained from two groups of North American rodents that differ in diet as well as in their preferred habitat. This method offers high resolution, repeatable, 3D measures of surface textures and has been proved useful for distinguishing diets in larger taxa. We sampled four species of North American rodents grouped into two diet categories: the folivores *Oryzomys palustris* (n=2) and *Sigmodon hispidus* (n=6); and the omnivores/granivores *Peromyscus maniculatus* (n=4) and *Perognathus longimembris* (n=1). A Sensofar white light confocal microscope was used to gather elevation data on the labial surface of lower incisor teeth at 0.18 μ m lateral spacing for an area of 102 X 139 μ m and which were analyzed using scale sensitive fractal analysis software. Results indicate that folivore and granivore species differ significantly in microwear texture attributes. The folivores have lower values for heterogeneity but higher values of anisotropy and texture fill volume than granivores. The groups did not differ in complexity. These results mirror results published to date for primates and ungulates. This study suggests that microwear texture analysis can be used to distinguish between rodents on the basis of diet. Microwear texture analysis of rodents therefore has the potential to serve as a paleoecological indicator; an important finding given the ubiquity of micromammals in many archeological faunal assemblages.

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Two New Hominin Partial Skeletons From the Malapa Site, South Africa

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Work in Plio-Pleistocene deposits of the newly discovered site of Malapa, South Africa, has resulted in the recovery of two partial skeletons of early a new species of early hominin. The fossiliferous deposits can be dated to just under two million years in age. These skeletons represent two of the most complete early hominin skeletons yet discovered, and represent a rare case of two Plio-Pleistocene hominin individuals found in direct association with one another and in secure geological and chronological context. The preservation of the material is excellent. The first individual described is a juvenile male represented by a relatively intact cranium, partial mandible, and partial postcranial skeleton. The second is an adult female represented by isolated maxillary teeth, a partial mandible, and partial postcranial skeleton. These skeletons add substantially to the sample of early hominin fossils in Africa, providing complete specimens of a number of skeletal elements previously unknown or known only from fragmentary and/or incomplete remains. Among other areas of interest, they present an opportunity to assess sexual dimorphism in cranial and postcranial morphology within a single fossil species. These skeletons will aid substantially in clarifying a number of issues revolving around the taxonomy and functional morphology of early hominins in Africa and shed

light on the origins of the genus *Homo*.

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Ex Africa semper aliquid novi: Implications of the Early Emergence of Levallois Technology in Africa

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Recent studies by Stout and others have suggested that, in early human evolution, increasing technological complexity likely was associated with more complex patterns of brain activation. The mid-Pleistocene innovation of the Levallois technique may represent a similar cognitive shift in lithic tool production, as it involves the prior conceptualization of both flake size and shape on a core which is being reduced through an asymmetrical volumetric strategy. In Eurasia, this technological shift from *façonnage* to *débitage* appears to take place during the late Acheulean, ca. 350–300 kya. In Africa, however, new dating of Middle Pleistocene archaeological sites with late Acheulean/Levallois technology is yielding older dates for the emergence of Levallois technology, ~700–500 kya, marking the initiation of the Early Stone Age (ESA) to Middle Stone Age (MSA) transition. This date range also coincides with the disappearance in Africa of *H. erectus/ergaster* and the emergence of *H. heidelbergensis*. Thus the emergence of Levallois technology suggests a possible opportunity for research into the functional aspects of larger brain sizes during human evolution. We reviewed images and descriptions of Levallois technology in early Middle Pleistocene African archaeological sites in the Smithsonian's Human Origins database and other published and online sources, especially from East Africa. We suggest that despite variation in definitions of Levallois in Africa, this re-evaluation of the chronology of Levallois emergence, along with fossil discoveries attributed to *H. heidelbergensis* at early mid-Pleistocene sites, suggests a correlation between technological complexity and morphological evolution.

On the Edge: The Upper Paleolithic from Vale Boi, Algarve, Portugal, and the Arrival of the First Modern Humans to Southwestern Iberia

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Rock shelters have been most important in the study of prehistoric archaeology, particularly in what concerns Paleolithic times. In Portugal, however, very few rock shelters have been found, tested, and excavated that shed light on the Paleolithic occupation of the Western edge of Europe. This poster will focus on the rock shelter of Vale Boi (Algarve, Southern Portugal), a site with a long stratigraphic record starting with early Gravettian and including Solutrean, Proto-Solutrean, and Magdalenian. The Gravettian, present in various areas of the site and in different levels, is dated to c. 26,000 RYBP corresponding to the earliest modern humans in the region. The humans most likely came from the Spanish Mediterranean coast as bone technology and body ornaments seem to confirm. Starting with the early Gravettian occupations, subsistence was mixed with both terrestrial and marine elements, indicating an intensification and diversification of dietary resources from very early on that included grease-rendering. Interpretation of the site and of the diversity of human occupations will be discussed, focusing on differences across time, and interpreted based on various aspects, such as site formation processes on slope deposits, intra-site spatial organization, subsistence, technology, and social and symbolic behavior.

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Morphological Variability of the Deciduous Dentition in Living and Early Fossil Hominins: The First Molar

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Morphological variability of the deciduous dentition in living and early fossil hominins is still poorly known, and, moreover, there are very few comparisons among species. In the present paper we present the initial results of the morphometrical analysis of a large sample of first deciduous molars (maxillary and mandibular) in living great apes, humans and fossil hominins. Using 2D digital images of the occlusal surface, we measured different metrical traits as cusp areas and diameters following Wood and Abbott (1983) and Wood and Engleman (1988). Furthermore a series of non-metrical traits were scored, based on Hanihara (1961) and Grine (1986). We examined 214 Ldm1 and 253 Udm1 of great apes (*Pongo pygmaeus*, *Pongo abelii*, *Gorilla gorilla*, *Pan troglodytes*, and *Pan paniscus*), 23 Ldm1 and 33 Udm1 of humans (Europeans and South Americans) and 12 Ldm1 and 7 Udm1 of South African fossil hominins (*A. africanus*, *P. robustus*, and early *Homo*). Dimensionally all the species are well distinguishable. Moreover, some of metrical and discrete variables allow differentiation between apes, human populations and fossil hominins. Morphology of the first lower deciduous molar is very variable among species and it is characterized by the presence of four or five cusps in humans and fossils, whereas in apes more than three cusps are never present. Morphology of first upper deciduous molar crown also is very variable in the species considered. While in humans and apes the crown is divided in two main cusps that are variably developed, in fossil hominins, more often, four cusps with a morphology more similar to the second deciduous molar are present.

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Middle and Later Stone Age Occupations Dating to Marine Isotope Stage 3 and 4 at Erfkroon, South Africa

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In 2009 excavations at Erfkroon, located 65km northwest of Bloemfontein, produced *in situ* archaeological and faunal remains dating to Marine Isotope Stages (MIS) 3 and 4. Erfkroon is a large (~2.2 × 0.5km) complex of gullies that expose Middle and Late Pleistocene Modder River terrace deposits. In 2006 and 2008 we discovered and sampled Middle Stone Age (MSA) and Later Stone Age (LSA) occupations and spectacular faunal remains in nine stratigraphic units spanning the last ~165 ky. Preliminary age control was established with infrared and optically stimulated

luminescence (OSL), and electron spin resonance techniques. In 2009 we focused on MSA and Early LSA occupations. One excavated MSA occupation dates to the MIS 3–4 boundary and contains stone tools with alternatively beveled retouch and possible fresh water mussel shell exploitation. An Early LSA occupation was excavated and produced a viable sample of stone artifacts that include abundant grinding stones and scaled pieces (*pièces esquillées*). Interestingly, abundant warthog remains are found in late MIS 3 deposits, but not in older sediments, possibly suggesting fluctuations in population density and/or increased exploitation of these species. Additional pedestrian survey located abundant faunal remains, including two partially articulated bovid skeletons, numerous Late MSA and Early LSA occupations, and a historic occupation that may be Griqua. Three newly discovered Early LSA occupations are actively eroding out of the terrace deposits and a number of other Early LSA occupations were already eroded with artifacts in lag on the surface. These results suggest that there was a dense occupation of Early LSA groups in the western Free State during MIS 3 times. In the summer of 2010, OSL, radiocarbon, ESR, sediment, and paleoenvironmental samples will be collected from excavation profiles. This will provide more precise chronological control and more robust paleoenvironmental interpretations for the occupations at Erfkroon.

Continuity or Discontinuity? Patterns of Land Use and Climatic Changes in the Late Pleistocene of the Iberian Peninsula

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The Western Mediterranean is a key area for the understanding of population history of Neanderthals and modern humans and for testing different scenarios of their interaction (Weniger 2006; Bradtmöller et al. in press). As part of the long-term research project CRC 806—Our way to Europe, which is funded for 12 years by the DFG—our sub-project tests cultural patterning of late Neanderthals and modern humans in their environmental setting based on new stratigraphic data. The present state of research argues for the earliest immigration to Iberia by modern humans not from Africa via the strait of Gibraltar, but via Central Europe. Thus, Iberia appears as a late refugium of Neanderthals. The background for our study is the outstanding archaeological record of this period in the Iberian Peninsula. Based on a multi-proxy approach we analyze a cluster of major archaeological sites (e.g., a new excavation at Cueva Morin, Cantabria in 2008) from the Pyrenees to Gibraltar. The project focuses on the transition between Mousterian and Aurignacian as well as Aurignacian and Gravettian. For that we assume that the process from the Middle to Upper Paleolithic was finished at the latest with the onset of the Gravettian. We compare similarities and differences of both cultural changes to understand the underlying processes and their possible relationship to environmental changes. Analysis of lithic inventories, new radiometric dating, and reanalysis of selected profiles from key archaeological sites providing new sedimentological information build the backbone of the project. Laboratory analysis focuses on the detection of possible climatic changes in the profiles. First results of this work will be presented in our poster.

Archaeological and Paleoenvironmental Implications of >40 ka Charcoal Radiocarbon Dates from Moche Borago, Ethiopia

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Current genetic data suggest that modern human populations expanded out of Africa into Eurasia and Greater Australia ~40–60 ka. However, chronometric dating of archaeological and fossil sites to this critical time period has been limited and problematic, due in part to: 1) complications in radiocarbon calibration beyond 40 ka; 2) the (mis)conception that early MIS 3 sites are too old to be radiocarbon dated; and, 3) lingering mistrust of ages from U-series, OSL, and other alternative chronometric dating methods. Recent excavations of Late Pleistocene deposits at Moche Borago Rockshelter, southwestern Ethiopia, have produced thirty conventional and AMS radiocarbon ages on charcoal ranging from ~53,000 to ~41,000 cal. BP, each within an accuracy of two standard deviations, making Moche

Borago one of the most accurately dated early OIS 3 sites in all of Africa. Here we draw upon these dates to discuss how recent methodological improvements in site sampling, pretreatment, and analysis of radiocarbon samples, as well as significant advances in the understanding of past fluctuations in the global carbon reservoir, now make it possible to obtain relatively inexpensive calibrated, accurate AMS ^{14}C age calculations to ~60 ka, without the use of A-Box or other non-conventional methods. We conclude by considering how other Late Pleistocene sites with the potential of providing continuous radiocarbon ages to 60 ka, can and should be re-dated to help resolve the cultural and paleoenvironmental ambiguities that currently plague our understanding of the archaeology of MIS 3 Africa.

Insights into Social Learning from Variation in Oldowan Tool Production

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Current debates in the study of Oldowan technology center on the rate and degree of temporal variation in artifact form. The Oldowan archaeological record possibly documents variance in types of artifact production that may be associated with skill or social learning processes. Yet much of the variety in attributes of artifacts that is often associated with levels of cognition is difficult to separate from ecological or biological differences in the makers of these tools (e.g., raw material availability and quality, functional differences in tool forms). However, recent reviews of tool use among humans and non-human primates indicates that the production of sharp edged stone tools (like those found in the Oldowan archaeological record) requires a heightened level of accuracy in powerful bimanual movement. Thus investigation of the variation of this accuracy in Oldowan tool forms may reflect aspects of skill and learning in hominin groups. Here we investigate measures of this accuracy reflected in degrees of variation in platform attributes of Oldowan flakes in a large dataset from the Lake Turkana basin where raw material can be held constant. This dataset spans the crucial time period from 1.95–1.65 Ma when changes in hominin body form and diet may be associated with selection pressures acting on the co-evolutionary nature of culture. We use a 4000 yr. old collection of artifacts, which also incorporates simple core and flake technology, as a model of modern human levels of variance in a similar technology to evaluate the levels of variation in Oldowan tool production. Aspects of time averaging and archaeological palimpsests are investigated using refit sets that are presumed to be the result of individual variation. Results suggest Oldowan tool use incorporated selection of particular platform sizes and external platform angles to enhance the efficiency of tool use through time.

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Wood Fuel Availability for Heat Treatment Drives the Rise and Fall of Silcrete as a Raw Material in the Middle Stone Age of South Africa

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Quartzite is the dominant lithic raw material for the majority of the Middle Stone Age on the coast of South Africa. Then after 75 ka there is a well-known broadening of raw material selection to include silcrete. Silcrete becomes a common, and sometimes dominant, raw material in both the Howieson's Poort and the Still Bay. After 60 ka it drops in abundance and becomes less common. This puzzling appearance and disappearance of this red to grey lustrous raw material has been explained as reflecting changing functional needs, shifts in mobility, the appearance of trading networks, and evidence for the use of raw materials for symbolic behavior. We have shown that the majority of silcrete at Pinnacle Point is heat treated, and heat treatment is an obligate technology for committed use of silcrete (Brown et al. 2009). The flora in coastal South Africa is fynbos and renosterfeld (both typified by C_3 grasses and significant winter rain). Both are evergreen, fine-leaved vegetation types virtually devoid of trees and lacking the woody fuel needed for regular heat treatment. A high resolution speleothem curve of changing vegetation for Pinnacle Point shows that the shift to silcrete-heat treatment occurs synchronously with a shift to more summer rain and a vegetation type including

C₄ grasses. Climates and vegetation with these characteristics have substantial woody growth ideal for burning and heat treatment. We argue that silcrete's appearance and disappearance is constrained by the abundance of wood fuels, and between 75–60 ka an increase in summer rains and woody vegetation made committed heat treatment a viable technology.

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Lower Paleolithic Adaptations in Eurasia: Handaxe and Microlithic Zones

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Southern Eurasia and Africa offered for early hominins in Early and Middle Pleistocene favorable environmental conditions and these regions were inhabited by groups using handaxes. The northern border of handaxe dispersal is limited by the Movius line (Lycett and von Cramon-Taubadel 2008; Petraglia and Shipton 2008). Lower Paleolithic sites lying northward from the Movius line are characterized by the presence of small size core-flake assemblages which are still not numerous but they are known from Central and Northern Europe, and Central and North-Eastern Asia. In contrast to the handaxe zone in Southern Eurasia and Africa, the main feature of these lithic assemblages is domination of microlithic technology (Burdukiewicz 2009). A spatial, chronological, and ecological variability of microlithic assemblages suggests that they correspond to adaptation to the forest zone of Northern Eurasia. The, most possibly local, microlithic assemblages could have developed in relative isolation from each other as well as from other technocomplexes like Pebble Tools (Mode 1) or Acheulean (Mode 2). For example, in Europe microlithic assemblages occur in an environment with a climate ranging from the Mediterranean to the boreal, but always in an association with woodland or woodland-steppe vegetation. No assemblages of similar type are recorded for colder periods. Another interesting group of issues relates to the beginnings of a cultural organization of the micro-environment, domestication of fire, and the emergence of hunting. A rich lithic and organic material in Lower Paleolithic sites preserved in travertine (Vértesszöllos, Isernia, and Bilzingsleben) or the site with the wooden spears in pit bog sediments (Schöningen), due to their properties favoring preservation of organic materials, have conserved exceptional traces of these early settlers of Northern Eurasia (Burdukiewicz and Ronen 2003). In contrast to early assemblages from Africa and Southern Eurasia in northern latitudes, the usage of microliths as inserts in composite tools seems to be the most important feature.

Mixed Signals in the Dentition: Assessing the Contribution of Phylogeny, Taxonomy and Allometry in Determining Molar Shape

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In the examination of fossil data, teeth are used extensively as both taxonomic discriminators and also as the source of characters for phylogenetic analysis. Few studies, however, have assessed the degree to which dental data reflect taxonomic or phylogenetic signals. Here we test hypotheses about the signal content of upper and lower M2 molars by assessing the degree of congruence between their shape variation and genetic distance. We extracted coordinates and areas from 2-D occlusal photographs of unworn upper and lower adult M2 molars (n=20) of ten extant primates and five euarchontoglires. Landmarks were placed on cusp apices to generate shape variables for geometric morphometric analysis. To assess the level of phylogenetic signal in M2 shape variables, we correlated a matrix of genetic distances among taxa with the covariance matrix of M2 shape. We also tested taxonomic discrimination in M2 shape by assessing the degree of overlap between 95% confidence intervals of group centroids in Canonical Variates

Analysis. In addition, we quantified allometric trends in the data by regressing the relative sizes of each M2 cusp on a geometric mean of cranial size. When compared against a known molecular topology, lower molars have higher phylogenetic signal, whereas upper molars show higher taxonomic discrimination. We hypothesize that this result is caused by the relative stability of the mesial cusps of the lower molar compared with the relative instability of all upper molar cusps. However, taxonomic discrimination was higher overall in large-bodied taxa and phylogenetic signal stronger in small-bodied taxa. A subsequent allometric analysis suggested that there is less stability in both shape variables and relative cusp areas in large-bodied taxa. Stability always decreased mediolaterally regardless of cranial size. Tooth type and absolute cranial size are strong confounding variables that must be accounted for before conducting phylogenetic analysis using dental data.

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From Gravettian to Solutrean in Southwestern Iberia: A Technological Perspective

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Despite the embryonic state of research, the Upper Paleolithic occupation of Southwestern Iberia is currently attested to by a reasonable number of sites. The last decade of archaeological work has brought to light a wide range of data that has allowed a better understanding of the archaeological patterns in the region between the well-known sites of the Spanish Levant and of the Portuguese Estremadura. Though many sites have been identified in southern Portugal, only Vale Boi (Algarve) presents a fairly complete diachronic record, confirming the presence of all techno-complexes characteristics of this phase. The identification of extensive occupations belonging to the Gravettian and Solutrean made Vale Boi a crucial element in understanding the shifts and continuities that occur in the economic, social, and technological systems of the communities that inhabited the extreme of southwestern Iberia from ca 25,000 to 10,000 BP. This paper focuses on the technological and typological variability of lithic and bone tools assemblages of the Gravettian, Proto-Solutrean, and Solutrean occupations. The results from the techno-typological analysis suggest, beyond the traditional dichotomy between the predominance of backed pieces vs. the presence of bifacial retouch, differences that seem to be related either to patterns of adaptation to environmental settings, or, more important, with different technological traditions present in southern Spain and central Portugal. These links confirm the role of Algarve as an important region of connection between the Atlantic and Mediterranean worlds.

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The Use of Dwellings During the Middle Paleolithic in Northern Europe

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Neandertals have long been seen as cognitively incapable of constructing open-air shelters. Recent years have shown a resurgent interest in Neandertal spatial organization and provided clues that perhaps Neandertal shelters did exist yet remain taphonomically invisible. At the same time, Neandertals have traditionally been depicted as a “cold adapted” Pleistocene species though advancements in hominin bioenergetics and paleoclimate reconstructions that suggest that morphology was an insufficient buffer. To maintain homeostasis, hominins must have supplemented endothermy with various extrasomatic behavioral solutions (White 2006; Aiello 2003). It is suggested through archaeological, ethnographic, and primatological data that one effective solution might have been the use of dwellings though, to date, no studies have assessed their thermoregulatory benefits. In this poster, I intend to outline computer simulations and laboratory experiments of dwelling structures to evaluate their performance (Chu 2009). I integrated these data into models of Neandertal cold tolerance and climatic reconstructions of known occupation sites during the Last

Glacial Maximum in Northern Europe (The Stage 3 Project), in order to assess their usefulness to Pleistocene hominins. It was clear that within the constraints of their toolkits, early hominins most likely constructed simple dwellings above other technologies in order to help them survive.

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Music and Figurative Art in the Swabian Aurignacian

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Figurative art and music are often considered indicators of advanced cultural development. The timing of the appearance of figurative art and music in the archaeological record has been of considerable debate. With its long history of research and excellent conditions of preservation, the caves of the Swabian Jura in southwestern Germany provide some of the best evidence for early artistic traditions. Recent discoveries of flutes made from bird bones and mammoth ivory and figurines carved from mammoth ivory from the basal Aurignacian at Hohle Fels indicate that music and figurative art were established in the behavioral repertoire of modern humans at the time of their spread across Europe. In the European context, these classes of artifacts appear suddenly in remarkably varied and sophisticated forms roughly 40,000 years ago.

From Rhomboid to Rectangle: Virtual Wear of Early *Homo* Molars

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A key trait used to distinguish *Homo habilis* molars from those of *Homo erectus* is the shape of the tooth outline. *Homo habilis* molars are considered to be rectangular while *H. erectus* ones are characterized as asymmetrical and rhomboidal, which is the derived condition. We tested the hypothesis that the outlines of early *Homo* molars change with wear so that they become more rectangular. Our sample consisted of three *H. habilis* individuals (OH 13 [M1 and M2], OH 24 [M1], and KNM-ER 1813 [M1 and M2]) and one *H. erectus* (KNM-ER 15000 [M1 and M2]). High quality casts of the maxillary molars were scanned with medical CT (pixel size - 0.293mm; slice thickness - 0.5mm). Molar outline was analyzed from the scans using the freeware ImageJ. Each slice, beginning at the occlusal surface and going down the tooth crown, represented a stage of virtual wear. To quantify the shape change in the molar outline, a quadrilateral was drawn for each tooth, with sides aligned with the buccal, lingual, medial, and distal edges of the teeth. Then the angles at each corner of the quadrilateral were measured through the slices of virtual wear. With few exceptions, each angle on each tooth became closer to 90 degrees with virtual wear. Moreover, both obtuse and acute angles approached 90 degrees with virtual wear. Thus, each of these teeth of early *Homo* became less rhomboidal and more rectangular. These results support the hypothesis that rhomboidal molars become rectangular when worn in life. Results of this study have implications for using molar outline shape to diagnose worn molars of early *Homo*, since worn *H. habilis* molars may actually belong to *H. erectus*.

A New Lithic Collection From FLK North Bed I (Olduvai Gorge, Tanzania): Reconstructing Operational Sequences and Hominin Activities

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Recent work at FLK North Bed I (Olduvai Gorge, Tanzania) has unearthed a new archaeological assemblage recovered with precise control of its stratigraphic position. Vertical reconstruction of the sequence suggests that the site constitutes a refuse continuum, probably tinged by some sort of vertical migration of materials within the clay deposit, deposited over a long period of time. In the present work, the technological study of the new lithic sample retrieved in the course of our fieldwork is described. The results of our analysis show the co-occurrence in the same site of different technological behaviors. At FLK North, hominins were involved in both percussion/battering activities and, through freehand and bipolar knapping, in core reduction (Diez-Martín et al. 2009). However, the reconstruction of the operational sequences in the various levels or depositional units recognized shows that core reduction was probably a marginal and very fragmented behavior, while percussion/battering activities occurred more regularly throughout the sequence and show a more diversified set of behaviors. Fragmentation of the knapping operational sequence might indicate fragmented tasks (with a high rate of functional transfer) and interests or aims of hominins at this precise spot, that is to say, a low, non-organized hominin impact on the site and its resources. If hominin presence at the spot was related to percussion behaviors and if they were not involved in regular cutting-edges production and carcass processing, as recent taphonomic studies suggest (Domínguez-Rodrigo et al. 2007), then hominins' sporadic and low-impact visits to the site over a long period of time must have been driven by other activities probably linked to the exploitation of alternative resources, not related to animal manipulation.

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New Data on the Paleolithic Settlement of the Lori Depression, Northern Armenia

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This paper presents the initial survey results of a new international paleoanthropological project, the Lori Depression Paleoanthropological Project (LDPP). A major goal of this project is to document the Paleolithic settlement of northern Armenia and place it within a broader regional context. Prior to survey, GIS-based predictive modeling was undertaken to identify areas suitable for preserving Paleolithic sites. Based on this predictive modeling, the Debed River Valley in the northeast of the country was chosen for focused reconnaissance survey during the summer of 2009. Ultimately, a total of 25 open-air sites were identified spanning the Lower Paleolithic through Upper Paleolithic.

Although previous research has documented a rich record of Paleolithic occupation in Armenia, the prehistory of the Debed River Valley has, until now, been virtually unknown. Although all documented sites are currently known mainly from lithic surface scatters, three sites are particularly promising for future work. Bagratashen 1 preserves both Late Acheulean and early Middle Paleolithic material, and limited test excavation indicates that the transition between these two industries may be preserved *in situ* at this site. Oldowan-type chopper forms were identified on the surface of Haghtanak 3 and Ayrum 2, which may signify hominid presence in the area during the Early Pleistocene. The site of Dmanisi, which lies about 40km from the study area, clearly indicates that region could accommodate hominid habitats during the Plio-Pleistocene. These results support the contention that the Lesser Caucasus was an important corridor for the movement of hominid populations throughout the Pleistocene.

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Châtelperronian at the Grotte du Bison, Arcy-sur-Cure: Stratigraphic Correlations and Spatial Organization.

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Arcy-sur-Cure is a key site for documenting the transition from the Middle to Upper Paleolithic. An important stratigraphic sequence covers the transition in the Grotte du Renne, including important fossil, industrial, and spatial structure information. The neighboring Grotte du Bison was excavated by Leroi-Gourhan until 1963. Investigations were taken up in 1995 to complete an exhaustive study of occupation of this cave. These recent excavations focused on correlating the stratigraphy with that of the adjacent Renne (David et al. 2006). Preliminary results at the Bison demonstrate essentially continuity in industrial succession from the late Mousterian into the Châtelperronian. These excavations have yielded new hominin fossils from three individuals in Level I, an Early Typical Mousterian occupation (David et al. 2009). These are important for comparative studies of populations preceding the transition, addressing the question concerning the relationship between changes in Neandertal technology and ecology—not how did Neandertals differ from anatomically modern humans, but rather, how did Mousterian Neandertals differ from Châtelperronian Neandertals? The latest part of the occupation of the Grotte du Bison was explored in the 2009 excavation season of a remnant of the Châtelperronian Level D in a 4m² witness block against the west wall of the cave mouth. A previous sample of this level yielded dates of 33,670±450 BP and 34,050±750 BP and a coherent pollen spectrum which correspond to the Châtelperronian Level VIII of the Grotte du Renne. The discovery of a hearth at the base of Level D indicates a focal point for the distribution of faunal and lithic artifacts mapped on that surface and renders spatial distribution of artifacts from previous excavation of Level D more coherent and should provide more information about the nature of the occupation and its significance for evaluating behavioral modernity among Châtelperronian Neanderthals.

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Buccal Dental Microwear Signals in the Gracile Australopithecines *A. anamensis*, *A. afarensis*, and *A. africanus*: Adaptations to Open Environments with Climatic Shift

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Buccal dental microwear analyses of *Australopithecus afarensis* fossil specimens have shown a time-related stability in dietary habits through at least one million years of hominin evolution. The present analyses show that this dietary stasis does not hold for all the gracile australopithecines. A clear correlation between climatic conditions and microwear patterns are observed when *A. anamensis* and *A. africanus* are compared to *A. afarensis*. Their buccal microwear patterns clearly signal the ecological shifts that took place in Africa between 4.5 and 2.5 ma. The results obtained point out the uniqueness of *Paranthropus*' dietary specializations.

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Middle and Late Pleistocene Paleoscape Modeling along the Southern Coast of South Africa

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Changing climates, environment, and sea level during the Middle and Late Pleistocene must have had significant impacts on early modern humans and their behavior. Many important archaeological sites occur along the current coastline of South Africa where the gradual slope of the offshore Agulhas bank meant that small changes to sea level height potentially caused significant shifts in coastline position. The geographic context of these currently coastal sites would have been transformed by sea level shifts from coastal to near-coastal to fully terrestrial. To understand human adaptations as reflected in the archaeological deposits of these now-coastal sites we need to accurately model coastline position through time. Prior research has relied on pre-existing, static bathymetric contour data that best fit existing chronologies of sea level and coastline changes. While informative, the applications of these data are limited. A more effective methodology derives original contour data representing coastline position from a chronology of sea level height. This provides a dynamic and organic user experience for more detailed studies of coastline fluctuations through time. Here, we introduce our Paleoscape model—a conceptual tool to ground the records for human behavioral evolution within a dynamic model of paleoenvironmental changes. Using integrated bathymetric datasets, GIS, and a relative sea level curve we are able to estimate the position of the coastline at 1.5 ka increments over the last ~420,000 years astride the Agulhas Bank of South Africa. We compare these model predictions to strontium isotope ratios from speleothems from several sites at Pinnacle Point, near Mossel Bay, South Africa, as an independent test. We then compare the coastline predictions to evidence for shellfish exploitation through time, also from PP13B. Both tests suggest our model is relatively robust and that the methodology may be applied towards other areas along the South African coast.

Ecomorphological Analysis of the Bovid Distal Humerus and Mandible, with Application to Pliocene Hominin Paleoecology at Laetoli, Tanzania

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Ecomorphology explores the links between an organism's morphology and ecological variables such as diet, habitat vegetation cover, substrate use, and predator avoidance strategies. Bovids inhabit a wide range of habitats and are often well-represented at hominin localities, so are particularly well-suited for ecomorphic analysis. Previous ecomorphological studies have focused on a diverse range of post-cranial skeletal elements, including the femur, metapodials, phalanges and astragalus. Here we present discriminant function models of the distal humerus, using linear measurements, dimensionless shape indices, and articular facet areas and perimeters. These models characterize antelopes to one of four habitat types—open, light cover, heavy cover, and forest—with an accuracy of at least 80 percent. We also expand ecomorphological methods beyond two-dimensional morphometrics of the postcranial skeleton by presenting a three-dimensional geometric morphometric (GM) analysis of the bovid mandible. GM maintains relative geometric information of 3D data, treating objects as whole units and thus providing a more accurate quantification of shape. The GM analyses clearly distinguish mandibles of bovids with dietary preferences ranging from obligate browsers to obligate grazers. These methods are applied to fossil humeri and mandibles from the Upper Laetoli Beds (3.85–3.63 Ma) and Upper Ndolanya Beds (~2.66 Ma) of Laetoli, Tanzania, with our results considered in light of previous paleoenvironmental analyses.

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Archaeological Evidence for an Order-of-Magnitude Increase in Population Numbers Across the Neanderthal-to-Anatomically Modern Human Transition in Western Europe.

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The extinction of the Neanderthals and the associated colonization of Europe by Anatomically Modern Human (*Homo sapiens*) populations (ca 40–30 000 BP) represents one of the most important demographic transitions documented in the archaeological and anatomical records. Nonetheless, attempts to investigate archaeologically the demographic processes surrounding this transition are rare and frequently restricted in scope to abstract mathematical models (e.g., Zubrow 1989) or large-scale site distribution maps (e.g., van Andel et al. 2003). Here we report the results of an in-depth paleodemographic study of the Middle-Upper Paleolithic transition in the 'classic' region of south-western France, focusing on the three successive chrono-typological periods of the Mousterian of Acheulean Tradition (MTA), the Châtelperronian, and the Aurignacian. Three main aspects of the archaeological evidence were identified as appropriate 'proxies' for changes in past population numbers and densities: 1) data on total numbers of occupied sites in the study region across the three periods; 2) data on the overall spatial extent of archaeological occupation levels, as a potential reflection of the sizes of the human groups who occupied the sites; and, 3) the overall intensity and duration of human occupation at each site as reflected by the overall accumulation rates of two different forms of occupation residues (stone tools and faunal remains). These archaeological proxies of population all suggest—separately, independently, and convergently—that overall population numbers and densities increased

substantially over the Neanderthal to *Homo sapiens* transition within the south-western France region, and by reasonable inference, probably other regions of Western Europe; a conclusion further supported by both osteological and genetic evidence (e.g., Briggs et al. 2009; Trinkaus 1995).

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Does Size Matter? Paleoecological Reconstruction of Sites in the Chemeron Formation, Tugen Hills, Kenya

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The Baringo Paleontological Research Project (BPRP) has collected fauna from a number of sites between 2.7–2.9 Ma from the Ndau Tributary in the Chemeron Formation, Tugen Hills, Kenya. Some of these are site complexes where individual collection areas are given the same site number because they are believed to be from the same horizon; but they are kept distinct by supplementary letters in case they are not. For example, BPRP Site #100 has subsidiary sites #100a, #100b and #100c. In a project on the paleoecology of the southern Chemeron Formation, sites are analyzed at a number of levels. One is a conventional analysis of individual faunal assemblages from each site. What are the differences in paleoecological reconstruction from treating subsidiary localities in site complexes as separate entities, rather than clustering them as a single site? The main sites typically have a greater density and diversity of fossils and longer faunal lists. Clustering collection areas has the most impact on community composition and simple presence/absence lists for the smaller collection areas—subsidiary or otherwise. Paleoecological reconstruction will be most affected by whether or not subsidiary sites are clustered. BPRP collection methods offer an opportunity to explore the meaning of the term “site” and implications of that definition on analysis.

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A Quantitative Analysis of Beads in Gravettian Burials

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This paper presents a quantitative analysis of the numbers of beads that compose personal ornaments found in Gravettian burials as a way to evaluate the complexity of that form of material culture, as well as social and ritual conventions, during that period. Multiple statistical tests reveal higher intra- than inter-site variability in the number of beads and ornaments per individual. While differences in adornment do not appear to have been correlated with the sex or age of the deceased individuals with which they were found, several explanations are provided for the overall trends in ornamentation across Eurasia. A global trend, however, is for the higher parts of the body (head, torso, arms) to have been preferentially ornamented and to be adorned with the greatest number of beads. The

differential ornamental trends for the lower body regions also are discussed. We conclude by discussing the most salient implications of these observations for conceptualizing the use of personal ornaments in the Late Pleistocene as a whole.

Environmental Context of the Acheulean to Middle Stone Age Transition: A Regional Comparison Between East and Southern Africa

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Three important events occurred in the human clade during the latter half of the middle Pleistocene (780–130 ka): the abandonment of the widespread and highly persistent Acheulean industry; the origin of behavioral innovations characteristic of the Middle Stone Age (MSA) industrial complex; and, the evolution of *Homo sapiens* by ~195 ka in East Africa. Although the archaeological transition is reflected in both East and southern Africa, previous studies suggest that the two regions may have experienced different climatic conditions during the middle Pleistocene. This research tests the hypothesis that environmental change was associated with and may be implicated in the Acheulean to MSA transition. Paleohabitats were reconstructed for Acheulean and MSA horizons at two sites, Cave of Hearths, South Africa (Beds 1–3 and Beds 4–9), and Olorgesailie, Kenya (Member 10 and several post-Olorgesailie Formation localities), using ecological structure analysis based on trophic (feeding) adaptations of fauna. In order to identify environmental stability or variability, which requires a longer temporal component, additional faunal assemblages from Olorgesailie and the central interior of southern Africa are examined. Results indicate different regional patterns surrounding the archaeological transition, with stable open grassland conditions in the central interior of southern Africa and arid-moist variable conditions in East Africa. Comparisons of multiple East and southern African sites conform to this regional perspective. Current evidence suggests that the archaeological transition occurred earlier in East Africa, which was characterized by environmental instability through changes in vegetation cover and moisture. Patchier and/or less stable environments have significant consequences with respect to managing risk, and it is likely that hominins responded to habitat changes through innovative behavioral adaptations.

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Nasura 1, a New 2.3 Ma Site in the Nachukui Formation, West Turkana, Kenya

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The Nachukui Formation, located on the western part of the Lake Turkana Basin (Northern Kenya), is known to yield a large number of archaeological sites, grouped into eight major complexes and ranging from 2.4 to 0.7 Ma. Among them are the Lokalalei sites, the oldest ones found and excavated so far in Kenya. In this presentation, we report a new early Pleistocene (formerly late Pliocene) site, recently discovered and still under investigation. Nasura 1 is located within a sequence of sandy and silty fluvial sediments interpreted as belonging to a branch of the large axial Paleo-Omo river. Several tuffs are included in the sequence; 25m above the lower one, interpreted as the Kokiselei Tuff (= Tuff E of the Shungura Formation, 2.4 Ma), is the securely identified Kalocho Tuff (= Tuff F of the Shungura Formation, 2.34 Ma). The archaeological horizon lies at the top of a silty sand only 60 to 80cm above the Kalocho tuff, which makes this new site securely dated at 2.34 Ma. Limited in two directions by natural erosion, Nasura 1 has been excavated over 98m² so far. It is a low density site which has produced 603 remains, with 96% lithics. The lithic assemblage is mainly composed of whole and broken flakes (94%), less than 20 cores (3%), a few cobbles bearing percussion marks (likely hammerstones), and very few unmodified cobbles. We will describe this assemblage, and show its main technological and petro-archaeological characteristics. In the end, we will see how it compares with the

similarly dated assemblages of Lokalalei sites.

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Variation in the Production and Use of Scrapers During the Middle Stone Age: Evidence from Olorgesailie, Kenya, and Aduma, Ethiopia

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Scrapers dominate the formal tool categories of Middle Paleolithic Eurasian assemblages, with multiple explanations for their patterns of variability. However, scrapers have been less well-defined or studied in the African Middle Stone Age (MSA). To what extent do formal scraper categories exist in the African MSA and what factors, such as raw material economy, curation, or technology, underlie their variability? Within- and between-site variations are studied in lithic assemblages from two MSA site complexes, Olorgesailie, Kenya, and Aduma, Ethiopia. Site-specific analyses explore tool production and raw material economy in MSA scrapers. The Aduma lithic sample dates to approximately 80 ka to 100 ka and includes 127 scrapers. The Olorgesailie sample comes from several sites in post-Olorgesailie Formation sediments both older and younger than 220 ka. This sample includes 86 scrapers whose dimensions and features were compared to those of unretouched flakes from the same localities. The Olorgesailie sample showed a preference for thicker flakes for scraper production. Comparisons between the older complex at Olorgesailie and the younger complex at Aduma revealed differences in tool production and raw material economy. The Olorgesailie scrapers as a group are significantly thicker than those from Aduma, likely showing variation between sites in the preference for blank size upon which stone tools were produced. While workable obsidian sources do not occur within 25–30 km of either locality, 65% of the Aduma scrapers were produced on obsidian. However, at Olorgesailie, only 6% of scrapers were made from obsidian while 84% were made from volcanic materials. Additionally, obsidian scrapers at Aduma were not reduced to the same degree as obsidian scrapers at Olorgesailie. This implies that obsidian was a particularly scarce and valuable resource at Olorgesailie, resulting in the continual curation of obsidian tools. These results provide valuable insight to both regional and temporal variations in African MSA scraper production.

Late Quaternary landscapes and seascapes of Portuguese Estremadura: Middle and Upper Paleolithic settlement

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Since 2005, we have conducted a multidisciplinary archaeological survey to study flexibility in human adaptation to changing coastal landscapes in the Late Pleistocene of Portuguese Estremadura. Variations in coastal productivity affected resource availability through space and time and survival of Paleolithic populations would have necessitated flexible adaptations. We use a multiscale landscape perspective for integrating regional and site data to interpret Paleolithic settlement patterns because geological and archaeological processes operate at many different temporal and spatial scales. Artifact concentrations dated to MIS 3 and 2 are associated with raised beaches, overwash mud deposits, tidal mud flats preserved in the coastal cliffs, eolian sand deposits in the diapiric valley, and Cretaceous flint deposits in the uplands. Climatic instability, sea level fluctuations and tectonic uplift characterize MIS 3. The survey

has identified several localities along the coastal cliffs and diapiric valley between São Pedro de Muel to Peniche. Neanderthals occupied these landscapes at places like Mira Nascente and Vale Pardo. Most of the MIS 3 landscape is not preserved immediately inland from the shore. There are vestiges of Pleistocene sand deposits within the diapiric valley between Caldas da Rainha and Pataias. These landforms have very sparsely distributed Middle Paleolithic artifacts. Middle Paleolithic sites occur in uplands near Cretaceous flint raw material sources. The coastal dunes were active from early MIS 2 through the Early Holocene. Upper Paleolithic artifacts occur at Fanhais, likely dated to the Gravettian. There are Gravettian occupations and workshops near the upland Cretaceous chert sources. During MIS2 sea level decreases and rivers begin downcutting and washing sediment out the Alcoa and Tornada. After H1 people continue to occupy the sands along tributary streams at sites like Valado, Quebrada dos Cravos, Sombra City dated to the Magdalenian and Epipaleolithic. Also, the terraces above Cós, have evidence for Early Magdalenian occupation.

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An Oldowan-Acheulian Interface? A View from the Burahin Dora Area, Hadar, Ethiopia

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The headwaters of the Burahin Dora drainage, Hadar, Ethiopia, yielded surface and *in situ* archaeological occurrences. Restricted excavations in A.L. 1101 revealed a thin, well-defined horizon bearing a core-and-flake industry. Technological characteristics of this assemblage differ from those seen in the >2.35 Ma sites (A.L. 894 and A.L. 666) located ~3km to the northeast, in the Makaamitalu Basin. Such characteristics include, among others, the exclusive presence of exhausted bifacial cores and a relatively large number of flakes with bipolar dorsal face scar patterns. *In situ* and surface isolated finds, located in close proximity to A.L. 1101, are characterized by the presence of roughly-shaped “proto-bifaces.” The archaeological occurrences in the Burahin Dora overlie a thick tephra that has recently been identified as the Burahin Dora Tuff (BDT; Campisano 2007) and placed stratigraphically above the 1.5–1.3 Ma-old AST-3 that is found in the Gona research area (Campisano and Feibel 2008). The combination of chronology and typo-technological characteristics suggests that our work in the Burahin potentially sampled a late Oldowan/early Acheulian landscape. The discovery of young archaeological occurrences in this area of the Hadar project enables a diachronic comparison of the technological make-up of lithic assemblages of the early and late Hadar sites, viewed against the background of differences in local raw material affordances and site formation processes. In combination with evidence from other similar-age archaeological occurrences (e.g., Konso, Kokiselei 5; Olduvai, Upper Bed II), insights from Hadar archaeology pertain to the understanding of variation and evolution throughout the Oldowan time span.

Mass Death and Lahars in the Taphonomy of the Ngandong *Homo erectus* Bonebed, and Volcanism in the Hominin Record of Eastern Java

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Lahar-flood transport and deposition, following mass death in a large-mammal aggregation, best explain the accumulation of 14 *Homo erectus* specimens excavated in 1931–1934 with ~25,000 other vertebrate fossils from a high terrace of the Solo River at Ngandong. Sand-gravel in the bonebed came from an andesitic stratovolcano ~50km away,

more than from local bedrock. The human paleodeme attributable to the bone bed was probably ≥ 5 (Huffman et al. 2009). Calvarial fossils vary from small vault fragments to a near-complete calvaria retaining delicate ethmoid- and sphenoid-structures. Disarticulation with dispersal largely accounts for the less-complete of these specimens. According to discoverers' reports, Bibos comprised $>50\%$ of a non-hominin assemblage containing ≥ 10 terrestrial mammals, together with turtle and crocodile. Broken disarticulated elements greatly outnumbered well-preserved specimens and partially articulated skeletons. The bioclasts, numbering $\sim 5/m^2$, varied widely in shape and size (0.01–2.50m long). With no tooth marks and few verifiable artifacts reported, direct biogenic or anthropogenic accumulation is unlikely. More plausibly, drought or volcanic eruption concentrated buffalo, cattle, deer, hippopotamus, *Homo*, leopard, muntjak, pig, rhinoceros, Stegodon, and tiger upstream of the site; starvation and volcanism decimated the aggregation, leaving dense scatters of weathering remains along the Solo; lahar flooding then entrained the material in a hyperconcentrated flow, transporting the bioclasts—little sorted hydrodynamically—downstream to Ngandong, where valley narrowing triggered deposition. The Trinil *Pithecanthropus* bonebed also evidently originated from population concentration, mass death, and lahar flooding, as possibly did the Mojokerto child-skull deposit. Volcanism deeply affected life, death, and fossilization of *Homo erectus* in eastern Java, where the volcanic province has produced ~ 100 hominin fossils. *Homo erectus* ostensibly lived for ≥ 1.5 my among bovid-cervid herds supported by rich volcanic soils. Ash falls, pyroclastic flows/surges, and lahar flows/floods periodically killed the humans and herbivores, leading numerous remains to be preserved in volcanoclastic strata.

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The Age of the 20 Meter Solo River Terrace, Ngandong (Java, Indonesia), Reconsidered

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Homo erectus dispersed widely throughout the Old World and was likely ancestral to *H. sapiens*. The demise of this successful taxon remains obscure, however, in part because of uncertainties regarding the geological age of its populations. In 1996, we published 'open'-system (ESR/U-series) ages that suggested that the *H. erectus* sites of Ngandong and Sambungmacan and the faunal site Jigar were, surprisingly, as young as 35 to 50 ka. While initially encountering strong debate, this young age has become increasingly accepted. Here we report results of the Solo River Terrace (SoRT) project which began fieldwork in 2004. Stratigraphic and sedimentological evidence show a series of related depositional facies apparently accumulated over a short duration. SoRT recovered large pumices suitable for $^{40}\text{Ar}/^{39}\text{Ar}$ dating within the fossiliferous deposits of both Ngandong and Jigar. Although previous attempts to date small pumices yielded insufficient gas, incremental heating analyses of hornblende from the new pumices give a significantly older age than our ESR/U-series ages on teeth from the same deposits. Either the ESR/U-series ages are anomalously young or the pumices are reworked. For taphonomic reasons, we favor the former. Interestingly, the difference between the ages is similar to differences between "open" and "closed" system dating at other sites such as Zhoukoudian. We raise the possibility that our 'open'-system dates reflect postdepositional events. If verified, this would have important consequences for dating hominin evolution generally and would profoundly influence

interpretations of the biogeographic and phylogenetic relationships of Pleistocene *Homo*.

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Defining Spatial and Temporal Resolution at the Middle Paleolithic Site of Neumark-Nord 2 (Saxony-Anhalt, Germany): Preliminary Results and Perspectives for Future Research

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Temporal and spatial resolution at archaeological sites strongly affects our perception of the archaeological record as a mirror of past hominin behavior. Defining temporal and spatial resolution are ultimate challenges in the analyses of Early and Middle Paleolithic sites. Analyses of site formation processes and/or taphonomical histories aim to implement a chronological and biostratigraphic frame for analyses here. However, in this context, frames of reference often suffer from methodological uncertainties. In-depth investigations of "high resolution archives" bear the potential to resolve these methodological limits in order to reveal defined aspects of past hominin behavior. Middle and Late Pleistocene biotopes uncovered in the coal mining district of Sachsen-Anhalt (Germany) have the potential for high resolution analysis. In this paper we concentrate on the geoarchaeological context of the faunal assemblage from the recently excavated site of Neumark-Nord 2. Continuous sedimentation within the 1.8ha large pond allows accurate estimates of sedimentation rates and the analysis of the relative depositional chronology of the faunal accumulation and lithic assemblage during the Eemian Interglacial. More than 120,000 faunal remains along with over 20,000 lithic artifacts located in an area of 500m² were buried in different sedimentary milieus which enable the analysis of the biostratigraphic sequences within defined spatial boundaries to disentangle hominin activities within the Eemian biotope of Neumark-Nord 2.

A Stratigraphic and Chronological Revision of Neanderthal Burials in Western Europe: Chronicle of a Long-Awaited Aging

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One important issue that could be addressed in the past several years is that of the chronology of the first European burials and the reevaluation of their cultural context. European Neanderthal burials are thought to belong to the recent Mousterian phase (60–40 ky). New radiometric ages and the reexamination of environmental frameworks, along with updated industries, allow us to make more precise determinations for several burials that appeared to be already firmly chronologically established. In fact, certain burials could be attributed to OIS 5 (130–75 ky):

- Le Régourdou, with a temperate faunal assemblage that corresponds to either the Last Interglacial (5e) or a following temperate phase (5c, 5a);
- At Roc de Marsal with a faunal assemblage and a suite of ages that correspond to ca. 70 ka (end of OIS 5), the child 'burial' precedes the Quina Mousterian sequence (OIS 4);
- The same is true at La Quina where the skeleton recovered out of cultural context precedes the thick Quina deposits;
- At La Chapelle-aux-Saints, the burial precedes the Quina level. A reexamination of the series shows an association

between Levallois and Quina reduction sequences, which indicates a likely mixing of the two occupations;

- Finally, the impressive, but un-dated, burial assemblage from La Ferrassie is associated with a Levallois Mousterian industry, which commonly characterizes the more ancient Mousterian phases (OIS 5).

By combining new ages, archaeostratigraphies, and environmental associations, we can make serious arguments that several burials from southwestern France precede the lower Pleniglacial (OIS 4) and the Quina Mousterian. For the latter, the treatment of the bodies appears to follow other models: butchery, consumption (Marillac, Combe-Grenal). Other Neanderthal burials (Le Moustier, Saint-Césaire, Spy, Mezmaiskaya) are certainly more recent (OIS 3), which is not contradictory. We will present a new diachronic model of body treatment in its chronological, climatic, and cultural contexts, which brings the European Neanderthal closer to the record of the Near East.

Predation on *Proconsul* at the Kaswanga Primate Site on Rusinga Island, Kenya

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In 1984 and 1985, the Miocene Kaswanga Primate Site (KPS) on Rusinga Island yielded 10 individuals of *Proconsul heseloni*, represented mainly by limbs, hand and foot bones. Preliminary work by Alan Walker (2007) suggested that the KPS assemblage represents hunted prey of a medium-sized creodont based on the presence of tooth pits, intrasite spatial patterning, and skeletal part frequencies. However, other hypotheses explaining bone accumulation, surface modification, and post-depositional processes should be further tested. Alternate explanations for the skeletal parts represented include preferential bone destruction by trampling and weathering or predation from another kind of predator. Alternative hypotheses for the surface modification are predation by other predators, such as raptor and reptilian species. Here we present the first taphonomic data on the location, frequency, and size of tooth pits and scores, as well as weathering stages and, where possible, breakage patterns of the KPS *Proconsul* specimens. Skeletal part frequencies were also formally compared to published feeding experiments, a mortality profile for the site was generated, and possible predatory creodont taxa were considered. Results of this study support Walker's hypothesis and weaken alternative taphonomic explanations. The KPS assemblage mortality profile most closely resembles a "Living Structure" profile, suggesting that *Proconsul* likely faced its strongest selection pressure from predation before reaching adulthood.

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Spatial Behavior in the Aurignacian: New Excavations at Breitenbach, Germany

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Understanding the spatial behavior of past hominins is of key relevance for our perception of the evolution of modern human behavior. While the first evidence for a complex internal organization of sites is documented in the European Mid-Upper Paleolithic Gravettian, the preceding Aurignacian is predominantly known from cave sites, where the finds are deposited within the given space of the natural rock formation. In this respect, the site of Breitenbach

(Saxony-Anhalt, Germany) gives a unique chance to study an Aurignacian open-air site in great detail and to provide new insights into the complexity of Early Upper Paleolithic site use. Early excavations at the site run in the late 1920s have already indicated the great potential of this site by revealing spatial patterns that resemble those of the large and complex structured Gravettian open-air sites of Eastern Central Europe. In summer 2009 new excavations run at Breitenbach by the Römisch-Germanisches Zentralmuseum Mainz (RGZM), the Faculty of Archaeology of Leiden University, and the Cultural Heritage Department of Saxony-Anhalt (LDA) explored the site over its entire extent and spotted areas with best preservation conditions on which to focus in the following years. First results confirm the exceptional character of the site, already noticed in the reports of the old excavations, to understand whether or not complex patterns of spatial organization arose as early as the EUP Aurignacian. The present contribution finally addresses the question of the chronological position of Breitenbach in the context of the Early and Mid-Upper Paleolithic Record of Central Europe.

Late Pleistocene Neanderthal Land Use, Territoriality and Interspecific Competition in Central Europe: A View into the Balve Cave (North Rhine-Westphalia, Germany)

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Late Pleistocene Neanderthals were efficient and specialized hunters on the peak of the trophic pyramid. Neanderthal hunting behaviors and strategies require high degrees of mobility in Pleistocene landscapes and implicate territorial and nutritional competition with sympatric carnivores. However settlement systems, and their variations and limitations, are not well understood, since it is impossible to connect archaeological sites of different function in a broader context. Thus patterns of subsistence strategies seen in archaeofaunas scattered across Europe only reflect the niche geography of Neanderthals and not behavior related to past landscapes. The faunal material from the Balve Cave highlights special aspects of Neanderthal land use, territoriality and competition during the early Weichselian. The fauna is dominated by cave bears, indicating an intensive use as a hibernation den. Active exclusion of this food competitor in particular for access to the cave demonstrates Neanderthals' exclusive claims upon the Balve Cave and occupations in frequent intervals. In the diverse species composition of the herbivore assemblage we witness opportunistic hunting in the vicinity of the cave and the value of bones as raw material. For a long time interval the Balve Cave was an important and exclusive locality to exploit the landscapes in the vicinity of the cave, which Neanderthals aggressively defended against competitors. This behavior can be interpreted as territoriality and suggests seasonal variations in land use.

Comparative Labyrinthine Morphology of Eocene Omomyid Primates

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Morphological variation of the bony labyrinth across taxa not only reflects differences in locomotor behavior and hearing performance, but also conveys significant phylogenetic information. For example, geometric-morphometric analysis of the bony labyrinth of extant strepsirrhines shows that phenetic variation is well-correlated with neutral genetic variation, and that the labyrinthine morphology of the fossil adapiforms is close to the inferred state of the ancestral strepsirrhines (Lebrun et al. in press). Here we use a similar morphometric approach to elucidate the labyrinthine morphology of the Eocene genera *Necrolemur* and *Microchoerus* (Microchoerinae, Omomyidae) and its affinities with that of their closest living relatives, the tarsiers, and their contemporaries, the adapines. Some labyrinthine features characteristic of *Necrolemur* and *Microchoerus* are also found in *Tarsius*, but the overall inner ear morphology of these fossils is closer to that of the adapines. Furthermore, the labyrinths of Omomyidae and extant Anthropoids differ widely in morphology. Our data further indicate that the labyrinthine morphology of Omomyidae—like that of Adapiformes—is close to the ancestral state of primates.

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New Data on Palaeoenvironments and Plant Gathering of Neanderthals from Barakayevskaya and Monasheskaya Cave Sites, Northern Caucasus (Results of SEM Pollen and Palaeobotanical Study of Layers with Anthropological Remains)

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The detailed reconstructions of paleoenvironments for layers with Neanderthals' anthropological remains for Barakayevskaya and Monasheskaya cave sites (Northern Caucasus) are given. The first paleobotanical and palynological evidence of plant gathering are obtained. The traditional pollen and new SEM paleobotany-palynological data are interpreted in the context of A.A.Grossgaim's monograph "Plant resources of Caucasus" (Grossgaim 1952). Remains of water plants found inside dry caves that are located 80m above the river are interpreted as indicators of plant gathering or anthropochors. The wood remains are found in Monasheskaya cave site where the 60% of the artifacts have traces of wood-working. The geobotanical stress for the plants is reconstructed for the layer of Barakayevskaya cave site with the Neanderthal child's anthropological remains. The article shows the importance of SEM-study for obtaining information on plant gathering of Neanderthals.

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Neanderthal Reproduction, Fertility, and Life History

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It has been conjectured that Neanderthals lived lives that were, in the oft-cited words of John Hobbes, "nasty, brutish, and short." The combination of a short lifespan, long, drawn-out life history, and high mortality rates provides one explanation for Neanderthal population decline and eventual extinction. Recent research supports the hypothesis that Neanderthal lifespans were short and that their lives were dangerous. Does this necessarily mean that they were capable of producing fewer offspring? To address this question, we predicted the average number of offspring that a Neanderthal female could produce during a reproductive lifetime (total fertility rate, or TFR) by subtracting estimates for age at first reproduction (AFR) and interbirth interval (IBI) from an estimate of average lifespan. We used phylogenetically independent contrasts regression analyses to predict AFR and IBI in Neanderthals from estimates of adult female body mass. We generated two sets of estimates. First, we predicted values for AFR and IBI using the non-human primate regression line. Second, we added or subtracted the residual value for modern humans to or from this estimate, respectively, to reflect the possibility that, like modern humans, Neanderthals deviate significantly from

other primates for the timing of these two events. Estimates for Neanderthal TFR vary between 3.6 and 8.8 offspring, encompassing the range of variation in modern human hunter-gatherer groups. However, other research indicates that Neanderthals exhibited high levels of juvenile and adult mortality, thereby reducing actual fertility rates. Combined with other factors, a slow but short life history and low fertility may explain why, during the late Pleistocene, Neanderthal populations waned while those of *Homo sapiens* waxed.

Shedding Light on the Movius Line Controversy: Metric Comparisons of Handaxes From the East and West

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Patterns of Paleolithic variability in eastern and western portions of the Old World continue to engender controversial debate. Most famously, debate has focused on variability in the absence/presence and form of "handaxes" east and west of the so-called "Movius Line." Recent discoveries of handaxes in East Asia have produced two viewpoints. Some workers suggest such artifacts fall outside the typical range of artifact forms seen in western examples and emphasize processes of technological convergence. Others, however, suggest that such artifacts overlap in form with western examples, and may thus represent instances of dispersal by western populations into East Asia during the Middle Pleistocene. Here, we use statistical comparisons of metric datasets to shed further light on these issues. The results of these analyses demonstrate several points. Firstly, width is consistently the least variable of biface attributes regardless of region, suggestive of a possible widespread functional constraint on handaxe width. Secondly, on the basis of t-tests, mean thickness in a large western Acheulean sample (n=2,925 handaxes) is statistically different from mean thickness in Korean handaxes (n=58) and handaxes from the Luonan Basin, China (n=236). Moreover, comparison of Thickness/Length ratios with both Width/Thickness ratios and Thickness/Width ratios demonstrate that East Asian handaxes are consistently thicker for any given length, while other ratios remain comparatively constant. In combination, these analyses thus suggest that East Asian handaxes are, on average, a different shape from western examples and that this shape difference manifests itself in a statistically thicker profile. Since greater thickness in Acheulean bifaces is a plesiomorphic feature, we suggest that the most probable explanation for East Asian handaxe forms is that they represent instances of technological convergence, and should not be used to support suggestions that western hominin populations dispersed into East Asia during the Middle Pleistocene.

Dentognathic Variation in the Dmanisi Hominins: Effects of Pathology and Age-Related Compensatory Mechanisms

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The Plio-Pleistocene hominin sample from Dmanisi (Georgia) is unique in offering detailed insights into patterns of morphological variation within a paleopopulation of early *Homo*. A particularly high degree of diversity is found in craniofacial morphologies, but the factors causing variation are still relatively unexplored. Here we analyze the dentognathic morphology of the Dmanisi specimens with a focus on potential in-vivo factors bringing about variation, such as growth, aging, trauma, and pathology. Applying clinical standard protocols of dentognathic diagnostics revealed that the Dmanisi sample exhibits a vast variety of pathologies, which are similar to those found in modern humans, and which are also present in the great apes. We identify severe tooth wear caused by heavy masticatory loading, and aging as principal causes of dentognathic variation in Dmanisi. Inferred patterns of wear/age-related dentognathic alteration in Dmanisi were similar to those found in modern humans and great apes, indicating common basic mechanisms of in-vivo compensation of the effects of tooth wear. Our findings show that evaluation of in-vivo processes of dentognathic remodeling in fossil hominins is of critical importance for the taxonomic and phyletic interpretation of dentognathic features.

Buccal Dental Microwear Signals in the Robust Australopithecines, *P. aethiopicus*, *P. robustus*, and *P. boisei*: The Low Microwear Density Paradox Revealed

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Low microwear feature densities have been observed in *Paranthropus boisei* fossil specimens. This unexpected result seems to be inconsistent with the hard, tough dietary habits associated with this Hominin clade. The present poster presents relevant information on buccal dental microwear showing a great consistency in the microwear data in all the robust australopithecine species, including *P. aethiopicus*, *P. robustus*, and *P. boisei*. The heavy loading hypothesis for these robust species is not supported by the buccal microwear analyses made.

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Erb Tanks: A Middle Stone Age Rockshelter in the Central Namib Desert, Western Namibia

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This paper reports on the 2009 excavations at the Erb Tanks site on the east-central Namib gravel plains of western Namibia. Erb Tanks is one of only a handful of known stratified Middle Stone Age (MSA) sites in Namibia, with a stratigraphic sequence stretching from the historic period through the MSA; it is also one of the few southern African sites with MSA ostrich egg shell (OES) beads. The excavations focused on a shallow rockshelter located adjacent to a perennial gravity well, which continues to act as an important source of water for local fauna and Damara livestock. In addition to Later Stone Age (LSA) forager and pastoralist remains, our excavations recovered substantial quantities of stratified MSA stone tools, animal bones, OES fragments, and OES beads. This paper presents: (1) A preliminary chronology for the site based on three independent dating techniques (AMS radiocarbon, amino acid racemization, and optically stimulated luminescence [OSL]), which combined suggest dates associated with the MSA materials of at least 55 ka and possibly substantially older; (2) an analysis of the MSA lithics, which are characterized by low frequencies of retouch, few formal tools, core reduction strategies dominated by centripetal and occasionally Levallois techniques, and the exploitation of predominantly local raw material resources; and, (3) a discussion of the OES beads associated with MSA levels in terms of their stratigraphic position and their potential significance. These findings are made all the more interesting by the location of the site in one of Africa's most extreme arid environments. While our research is preliminary, it is clear that Erb Tanks has the potential to contribute substantially to our understanding of MSA early modern human ecology in southern Africa.

New Archaeological Occurrences from Upper Burgi Member Exposures at Koobi Fora, Kenya: Implications for Evolving Hominin Diet and Foraging Behavior

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The appearance of the genus *Homo* is a landmark event in human evolution. While extensive research has been conducted regarding the physical evolution of this genus, there has been little research into evolving behaviors that may have differentiated the genus *Homo* from the earlier hominins. The introduction of significant amounts of meat or marrow into the diet utilizing stone tools near the end of the Pliocene may represent early behaviors that defined the

origin of our lineage. There is presently no published evidence of this tool use prior to 2.5 million years ago (Semaw et al. 1997). However, fossil bones of animals exploited for food preserve unequivocal evidence of hominin modification during butchery (Capaldo and Blumenschine 1994; Shipman and Rose 1983) and, in the absence of stone tools, these modified bones are archaeological traces that can be utilized to identify hominin presence and foraging behavior on the landscape. Koobi Fora has yielded a continuous paleontological record of hominin evolution that extends back over 4 million years (Feibel and Brown 1989), but there has been no systematic archaeological research conducted in the time interval prior to 1.9 million years ago when Upper Burgi Member (2.2–1.89 Ma.) sediments were deposited. Therefore exposed sediments of the Upper Burgi Member at Koobi Fora provided a unique opportunity to test this research approach. Here I report on the results of survey and excavation at Koobi Fora conducted between 2004 and 2006 that provide evidence of evolving behavior defined by these new archaeological traces (modified bone) and allow for meaningful inferences to be made about changing diet and foraging strategies at geographically widespread locations on the ancient landscape. The evidence appears consistent with published data from older Plio-Pleistocene sites in Kenya (Kibunjia 1994) and Ethiopia (Dominguez-Rodrigo et al. 2005; de Heinzelin et al. 1999). A model of bi-modal foraging behavior that may have persisted from 2.5 Ma until the appearance of *Homo erectus* (Bunn 1994) in this specific region of East Africa is hypothesized.

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Developing a Tephrostratigraphic Framework for the Oldowan-Acheulean Transition in Bed II, Olduvai Gorge, Tanzania

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Bed II is a critical part of the early Pleistocene record of Olduvai Gorge, Tanzania. Its deposits laterally include lacustrine, lake margin, fluvial, wetland, and volcanoclastic fan environments with a variety of hominin traces, and vertically include transitions from humid to more arid conditions (with associated faunal changes), from *Homo habilis* to *Homo erectus*, and from Oldowan to Acheulean technology. Bed II is stratigraphically and environmentally complex, with facies changes, faulting, and unconformities, making site-to-site correlation over the ~20km of exposure difficult. Bed II tuffs are thinner, less evenly preserved, and more reworked than those of older and better studied Bed I. Six marker tuffs (Tuffs IIA–IID, Bird Print Tuff (BPT), and Brown Tuffaceous Siltstone (BTS), after Hay [1976]), plus additional local tuffs, were collected from sites throughout the gorge between 1999 and 2009 and analyzed by electron microprobe for phenocryst (feldspar, hornblende, augite, titanomagnetite) and glass (where available) composition. Using central "Junction" Locality 44 as a type section, compositional comparisons between sites are now possible. Tuff IIA is compositionally indistinguishable from the rest of the Lemuta Member of which it is a part, Tuffs IIB and IIC are highly contaminated and reworked at most sites (making correlation difficult), and the BTS is identifiable using hornblende but only locally preserved. The BPT and Tuff IID, however, are widespread and identifiable using phenocryst compositions (high-Ca plagioclase and high-Ti hornblende, respectively). So far, Tuff IID is confirmed at Locality 80 to the west and at some sites to the east (as mapped by Hay [1976]), but was originally misidentified at Locality 91 (SHK Annexe). These correlations are an important first step for establishing a basin-wide, high-resolution

tephrostratigraphic framework for Bed II, and a regional framework for potentially Bed II equivalent sites nearby (Peninj, Manyara, Laetoli).

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The Modern Human Colonization of India: An Evaluation of Two Alternative Models

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There are currently two alternative and contrasting models for the modern human colonization of India and southern Asia: one which posits a dispersal by populations of the L3 (and derived M and N) mitochondrial DNA lineages from Africa at around 55,000–60,000 BP, associated with typically African 'Howiesons Poort-like' technology (Mellars 2006a, 2006b); and, the other which posits a much earlier dispersal of modern human populations to India before the time of the Mt. Toba volcanic super-eruption ca. 74,000 BP, followed by a much later, rapid and *in situ* evolution from typically Middle Paleolithic/Levallois technology into the classic sequence of Indian microblade and microlithic technologies, at around 35,000 BP (Clarkson et al. 2009; Petraglia et al. 2007, 2009). This paper will compare and contrast these two models, and assess the implications of the two models for the current patterns of DNA, archaeological, and demographic evidence in Africa and India. It will be argued that an Out-of-Africa dispersal at 55,000–60,000 BP, associated with microblade and backed-segment technology derived from north-eastern Africa, best fits the current patterns of all these aspects of the available evidence. The further implications of this evidence for the ensuing modern human colonization of southeastern Asia and Australasia will also be briefly assessed, in the light of these two opposing evolutionary and demographic models.

A Micromorphological Perspective on the Anthropogenic Deposits of the Howiesons Poort Occupation of Diepkloof Rock Shelter, Western Cape, South Africa

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The 3.6-meter sequence of MSA deposits at Diepkloof Rock Shelter, dated from 40 ky BP to >130 ky BP, contains evidence of Ante-Stillbay, Stillbay, Howiesons Poort and Post-Howiesons Poort occupations, making it one of the most complete archaeological sequences in southern Africa for the MSA. As such, it is a key site for understanding the cultural evolution of modern humans in Africa during this important time period. The deposits themselves were strongly influenced by anthropogenic processes, particularly the Howiesons Poort and Post-Howiesons Poort layers, which consist largely of localized hearths, ash dumps and burnt bedding. Here we present the results of a micromorphological study of the Howiesons Poort sequence at Diepkloof, focusing on the layers where numerous engraved ostrich eggshell fragments were found. The role that humans played as depositional agents in forming the site as well as the role that post-depositional diagenetic processes played on the preservation of the archaeological record will be addressed.

Lithic Residue Analysis: A Comparison of Imaging Techniques

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Visual analysis of organic residues on stone tools is used as a means of interpreting prehistoric stone tool functions. The most commonly used method, light microscopy, can produce excellent images, but sometimes lacks the resolution necessary for accurate residue identification. Another imaging technique, scanning electron microscopy (SEM), has great potential for residue analysis but is rarely used. This study is the first to apply the two techniques to the same samples in order to improve the reliability of visual characterization of residues. First, experimental flint tools were used for a variety of tasks involving processing of plant and animal tissues. Residues on these tools were then located and imaged using a stereomicroscope. The same residues were then examined using Variable Pressure (Environmental) SEM as well as conventional SEM. Our results lead us to conclude that the two imaging techniques, light microscopy and SEM, are complementary. Light microscopy is useful for quickly locating residues, and provides useful optical information such as color and transparency. However, certain residues from widely disparate sources (plant vs. animal) sometimes appear remarkably similar under light microscopy. SEM, on the other hand, provides topographic information and can yield excellent resolutions under much higher magnifications. In addition, energy-dispersive spectroscopy (EDS), available with most SEMs, can help characterize the elements present in a residue. The main shortcoming of SEM is the need to coat samples with an electrically conductive substance such as carbon or gold. However, good images can be obtained on uncoated samples in a Variable Pressure SEM by manipulating image modes (backscattered versus secondary electron), accelerating voltage, and other factors. We advocate that neither technique should be used exclusively; rather, they should be used together in order to yield the most accurate residue identifications.

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Newly Discovered Hominin Remains from Upper Laetolil Beds in Northern Tanzania

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The Laetoli paleoanthropological site in northern Tanzania continues to produce fossil mammalian remains that help us understand hominin origins and their associated depositional environs. The continued joint field school in paleoanthropology at Laetoli, which is coordinated by the University of Colorado-Denver, Weill-Bugando University College of Health Sciences, and the University of Calgary, has recently recovered some australopithecine cranial and postcranial remains from Localities 7 and 10 within the Upper Laetolil Beds. In this paper we provide preliminary description of the geological and taphonomic context associated with the recently recovered hominin remains from Laetoli.

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Mosaic Morphology in a Mandible and Maxilla from Loiyangalani, Southeastern Shore of Lake Turkana, Northern Kenya

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In 1976 an associated human mandible and partial maxilla were found on the surface near Loiyangalani, on the southeastern shore of Lake Turkana, northern Kenya. It is undated, but its fossilization and overall morphology make it likely that it is Middle or Late Pleistocene in age. Briefly described by Twiesselmann (1991), it is now possible to reassess this specimen in light of current knowledge of Middle-Late Pleistocene human facial variation. The largely complete Loiyangalani mandible is exceptionally long: among the larger Middle Pleistocene ones, matching the longest of the Late Pleistocene ones, and outside of recent human ranges of variation. The corpus is robust, similar to the most robust Pleistocene *Homo* mandibles. The ramus is wide and has a low coronoid process with a shallow asymmetrical mandibular notch. It also lacks a retromolar space, despite the mandibular length and modest dental dimensions. Combined with these non-Neandertal archaic *Homo* characteristics is a distinctly derived modern human-like anterior mandibular symphysis, displaying a prominent tuber symphyseos, distinct incisurae lateral of the tuber, but lacking prominent lateral tubercles. This is the pattern among all Middle Paleolithic/MSA and Early Upper Paleolithic modern humans and most Mid Upper Paleolithic ones, and it is absent from all archaic *Homo*. In addition, the maxilla has a narrow nasal aperture breadth close to Upper Paleolithic and recent human means, and distinct from those of archaic *Homo* and Middle Paleolithic/MSA modern humans. The mandibular corpus also reduces in height distally from the canine to the third molar. Although currently undated, the Loiyangalani mandible and maxillae present a mosaic of distinctly archaic *Homo* and derived modern human features. As such, it raises questions regarding the morphological constellations of later archaic and/or early modern human facial skeletons.

One Size Doesn't Fit All? Modeling Technological Change in the Middle Stone Age of Southern Africa

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The Howieson's Poort (HP) is a sub-stage of the Middle Stone Age (MSA) that has received attention for the appearance and proliferation of innovative technologies such as backed tools (some microlithic), and yet, these technologies disappear at the end of the phase. Some have invoked social processes (e.g., the development of gift-giving and/or regional social networks) to explain the florescence of microlithic technology during the HP (e.g., Ambrose 2002); these models posit that such networks would have helped mitigate stress resulting from a decline in environmental productivity. The disappearance of backed tools after the HP thus has often been linked to climatic amelioration at the end of OIS 4; however, because recent data suggest that the end of the HP predates the transition to OIS 3, Cochrane (2008) proposed that its disappearance marks the systemic collapse of a regional social network due to localized population extinctions. We believe that the principles of behavioral ecology may provide a parsimonious alternative to the current models (e.g., Elston and Kuhn 2002; McCall 2007) and focus our model-building efforts on the costs/benefits relating to the changes in environment, subsistence, and technology evidenced during and after the HP. One of the primary advantages of this framework is that it can be more directly tested against the archaeological record; Sibudu (South Africa) offers an ideal location for just such a test. We find that while an ecological model may explain the proliferation of the backed tools; it does not seem to adequately account for their disappearance. The data suggest that a "one size fits all" model may be insufficient, as the processes that ushered in the innovative technologies of the HP need not be the same processes that explain their disappearance. The implications of this for our understanding of behavioral change during the MSA are discussed.

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The Early Upper Paleolithic of the Middle Danube Region: Modern Human Dispersal or Local Evolution?

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The Early Upper Paleolithic (EUP) record throughout Europe is characterized by various changes in human behavior. Different models explaining these changes and the emergence of the EUP have been proposed over the past decades. The research presented here focuses on answering the question of whether the EUP changes in human behavior are due to local evolution or diffusion processes. The applied approach is based on the methodology developed by Tostevin (2000) including an attribute analysis and the use of the individual steps in the knapping process as units of analysis. Building on Tostevin's work, knapping behaviors are compared between assemblages, but in an attempt to further develop Tostevin's approach the analysis is structured along the reduction sequence. Using such a methodology, the models of local evolution, diffusion, and stimulus diffusion are tested against the archaeological record of the Middle Danube region. The Middle Danube region was selected as a test case as it is located along one of the proposed dispersal routes of modern humans into Europe, shows variability of EUP technocomplexes (Bohunician, Szeletian, Aurignacian), and provides a secure chronostratigraphic framework for the time period in question (appr. 45 to 30 ka BP). Here the assemblages of the Willendorf II sequence can now be added to this study. Among these is the recently expanded Layer 3 assemblage representing an Early Aurignacian and now securely dated to around 38 ka BP (Haesaerts et al. 1996; Nigst et al. 2008). The results suggest the rejection of the local evolution model for the development of the Szeletian and the support of the model of early modern human dispersal into Europe as manifested by the Bohunician.

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Hominin Predation Hazards from Carnivores on the FLK Zinjanthropus and FLKNN OH7/OH8 Landscapes, Olduvai Gorge

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The hominin remains from FLK 22 and FLK NN 3, Bed I, Olduvai Gorge, occur on biologically productive lake margin landscapes. These landscapes have been shown to afford hominins not only carcasses, rootstock and potable water, but also predation risk from large mammalian carnivores and crocodylians. Here we report taphonomic evidence of predation of these hominins. Our results show that hominin bones of mainly subadults were fed on by carnivores, suggesting youngsters were more vulnerable to predation than adults. Most hominins are also *Homo habilis*, the

presumed stone tool user. Their apparently greater vulnerability to predation than *Paranthropus* may be due to more frequent interactions with large predators also exploiting larger mammal carcasses at and near FLK 22 and FLK NN 3. Predation on Oldowan hominins may have selected for individuals capable of monitoring and mapping predator land use, and deploying effective defensive weaponry and cooperative defensive actions.

How and Why Was Sahul Colonized So Rapidly? Why Did the Material Record Change So Slowly Over Such a Long Period Thereafter? Explanatory Hypotheses From Foraging Theory and Preliminary Tests

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African-derived, anatomically modern humans first colonized Sahul (Pleistocene Australia-New Guinea) about 45–46 kya BP. Founding populations probably numbered in the hundreds, arrived via paddle-or sail-powered watercraft, and practiced economies based in part on pelagic fishing. Models of 'prey choice' and 'ideal free distribution' help frame several general 'predictions' about post-arrival colonization processes: 1) Movement was determined by rapid depletion of high ranked prey near initial landing points, followed by immediate relocation to still-unoccupied habitats further afield; 2) Depletion of high-ranked intertidal shellfish was a primary catalyst for relocation in coastal settings. 'Natural' and anthropogenic fires had a similar effect in terrestrial situations, mainly through creation of highly attractive but easily depleted resource patches; and, 3) High amplitude, short-term climate change complicated assessments of foraging opportunities, sometimes effectively eliminating them over very large areas on intra-annual time scales; frequent, long-distance relocation and occasional extinction of local human populations throughout MIS 2 and 3 were among the results. Archaeological data are largely consistent with these predictions. Pre-Holocene populations continent-wide were very low, highly mobile, made frequent use of high-ranked resource 'flushes,' and invested little in high-cost processing gear. Ethnographically reported demographic, economic, and technological patterns did not emerge until after the onset of relatively stable climatic conditions post-10 kya BP. This scenario challenges phylogenetic and cultural transmission-based explanations for the persistent simplicity of Sahul lithic technology. It also raises important, previously under-appreciated questions about the role of humans in Late Pleistocene megafaunal extinctions.

Integrating Quantitative and Qualitative Data in Multivariate Analyses

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Quantitative information is commonly recorded to discern patterns of processes such as lithic taxonomy, morphology, and paleoecological community organization. These data are usually analyzed within an appropriate data-space to test hypotheses, and generate inferences related to our understanding of said processes. Qualitative, or nominal variables, also are usually recorded, and provide valuable information regarding the process of interest. However, in general, integrating quantitative and qualitative variables into a single analysis has proved challenging for researchers attempting to describe and analyze observed patterning. Here we present an approach to integrate quantitative and qualitative characters within a single quantitative framework. We use a common ordination technique, Principal Coordinates Analysis (PCoA), to project qualitative presence/absence information, as well as count data into normally distributed Euclidean space. We provide examples of this approach using stone tool taxonomy/typology data, as well as paleo- and modern ecological community analyses. Results demonstrate that housing quantitative and qualitative variables under a single analytical "roof" renders a more informed patterning of paleoanthropological data.

Hominin Transition From Closed Forest to Open Environment: The Evidence From Buccal Dental Microwear Analyses

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Buccal dental microwear has shown to be a reliable indicator of dietary habits and ecological conditions of Plio-Pleistocene hominin species. Buccal dental microwear results on *Australopithecus afarensis* (Estebanaranz et al. 2009) have provided consistent results comparable to those obtained with occlusal microwear research (Grine et al. 2006). We now present a complete comparative analysis of the buccal dental microwear variability of fossil hominin specimens, including *A. anamensis*, *A. africanus*, *P. aethiopicus*, *P. robustus*, *P. boisei*, *H. habilis*, and *H. ergaster*. Results show a clear correlation between buccal microwear patterns and habitat reconstruction, with high densities of scratches in both closed environments for the australopithecines, similar to the non-hominin Hominidae, and in open savannas for the *Homo* specimens. However, the robust australopithecines and the Early *Homo* specimens show intermediate, somewhat low, striation patterns. The results obtained do not support a highly carnivorous, with nil consumption of plant foods, diet for the Early *Homo* clade as might be derived from the "Expensive Tissue Hypothesis."

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The Adriatic Plain as a Last Glacial Maximum Refugium: The View From Grotta Paglicci (Italy)

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The harsh climatic conditions during the Last Glacial Maximum (LGM; 25,000–14,700 years ago) witnessed the contraction of human populations, who subsequently expanded with the Late Glacial (14,700–11,500 years ago) warming into newly occupied regions across Europe. The ways people responded to their changing environment and exploited the new food resources available and the ways their mobility patterns and social networks were affected are some of the questions raised about past human responses and solutions to the climate change. Grotta Paglicci can provide us with unique insights into the LGM occupation of Southern Europe. At the spur of Italy (Gargano, Puglia), it is uniquely located in what would have been the hinterland of the now submerged Adriatic plain. With sea levels lower by 125m, the plain was the largest land surface exposed in the Mediterranean during the LGM. Human occupation in central Southern Europe is presumed to have centred on the plain. Excavated in the 1960–90's, the site has a complete and long sequence spanning the whole of the Upper Paleolithic, being especially rich in the period of the LGM. This paper presents the first results of a new project we have initiated at Grotta Paglicci. It builds upon on-going work on material from the site, with a particular emphasis on the Epigravettian sequence. The study of the faunal remains is our springboard for an exploration of past human mobility and settlement patterns during the transition to the Late Glacial, with the aim of placing the site, and the concomitant past human activities, in their landscape.

New Actualistic Data on the Ecology and Energetics of Scavenging Opportunities

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Arguably sprouting from the seed planted by Raymond Dart's research on the Taung and Makapansgat fauna in the 1920s and 50–60s, respectively; growing into part of the 1960s model of “Man the Hunter” with an archaeological focus on home bases and food sharing developed by Glynn Isaac; and, fluorescing in the 1980s with Lewis Binford and Rob Blumenschine's models and data—both archaeological and actualistic—on scavenging opportunities, the so-called “hunting-scavenging debate” has blossomed into an important research focus in Plio-Pleistocene hominin behavioral ecology. Here I present new data on potential scavenging opportunities from fresh carnivore kills documented with an actualistic study on a game conservancy in Laikipia, Kenya. I argue, as others have before me, that scavenging opportunities in a particular ecosystem will vary due to carnivore density and guild composition, prey biomass and community structure, and habitat (e.g., vegetation, physiography). In this study, I found that while scavenging opportunities—edible meat, marrow, and brain—vary among carcasses, most carcasses retained some scavengeable resources. Excluding within-bone resources, even the scavengeable meat on “defleshed” size 3 prey carcasses are usually substantial enough to meet the total daily caloric requirements of at least one adult male *Homo erectus* individual. Variables affecting scavenging opportunities from carnivore kills include carnivore taxon, prey size, number of feeding carnivores and/or season of kill, and possibly habitat. We should expect, rather than be surprised by, variability in scavenging opportunities in different locales. Therefore, we should focus our research efforts on identifying which variables condition these differences, in order to render our findings applicable to the variety of ecological settings characterizing the past. Finally, I clarify some oft-used and misused terminology in this debate, and attempt to steer the early hominin carnivory research paradigm away from the current “either-or” approach.

Reconstructing the Evolution of Birth Mechanisms in *Homo* From Combined Maternal-Neonatal Fossil Evidence

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Modern human childbirth differs from birth in nonhuman primates in that the fetus typically rotates as it passes through the maternal birth canal. The birth canal in humans is a tunnel of changing cross-sectional shape and the fetus rotates first to align the longest axis of the relatively large and long fetal head along the longest axis of the birth canal and secondly to align the relatively broad shoulders along those same dimensions. This complex birth mechanism means that modern women benefit from the presence of birth attendants and has important implications for the social context within which birth takes place. The consistently broad shape of the australopithecine birth canal suggests that they had a mechanism of birth that was unlike that seen in any living hominoid species. In this paper, we use recent fossil discoveries and new analyses of old discoveries to help determine the antiquity of the modern human birth mechanism. We consider birth in Mid-Pleistocene *Homo* using new computerized reconstructions of the Tabun and Kebara Neanderthal pelvises, the Jinniushan pelvis from northeastern China, as well as the Mezmaiskaya Neanderthal neonate. Our analyses show that female pelvic morphology alone is only partially informative about the birth mechanism of fossil hominids, and that obstetric inferences critically depend on our knowledge about neonatal cranial morphology. Combined fossil cephalopelvic data indicate that archaic humans from across the full geographic spread of the Old World shared the modern human rotational birth mechanism. Furthermore, we infer *Homo erectus* neonatal cranial dimensions to perform an obstetric analysis of the recently described female *H. erectus* pelvis from Gona, Ethiopia. The results of these analyses provide additional support for the hypothesis that a rotational birth mechanism preceded the evolution of anatomically modern humans.

Late Pliocene Avifauna from the *Zinjanthropus* Land Surface, Olduvai Gorge, Tanzania

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Taxonomic and taphonomic data on fossil birds collected by the Olduvai Landscape Paleoanthropology Project (OLAPP) are applied to the paleolandscape reconstruction developed by OLAPP for the *Zinjanthropus* land surface in the FLK area at Olduvai Gorge, Tanzania. The occurrence and densities of different avian ecotypes vary across the land surface in ways that corroborate and further refine OLAPP's landscape reconstructions of wetland, peninsular, and riverine facets in this part of the paleo-Lake Olduvai Basin lake margin. Avian taphonomic profiles further support OLAPP's reconstructions by varying across the paleolandscape in ways observed in similar, modern environments of northern Tanzania. Results support the use of fossil bird assemblages, even small accumulations, in reconstructing aspects of paleoenvironments not reflected in mammal faunas.

Carnivores and Modern Humans as Accumulators: Interpreting Prey Selection and Changing Subsistence Strategies Through Time in the Western Cape, South Africa

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The archaeological record of the Western Cape (WC), South Africa, includes early examples of possible advanced human behaviors and also spans glacial cycles associated with dramatic climatic fluctuations. Paleoenvironmental contexts for WC modern human occupation are often reconstructed using mammals from archaeological assemblages, but are plagued by bias of subsistence strategies of humans who accumulated them. Therefore, this study seeks to create an unbiased reconstruction of environmental change over the last ~160,000 years to better understand the evolutionary context of WC modern humans. To avoid comparisons between unbiased modern communities and biased archaeological assemblages, this analysis uses the structures of archaeological large mammal communities to reconstruct WC paleoenvironments from Marine Isotope Stage (MIS) 6 through the Holocene through the lens of human "prey species." To do so, mammalian community structures including only families regularly found preyed upon in the WC archaeological record were constructed for 52 modern African sites in defined habitats. This variation was used to compare the assemblages of 100 levels from 15 WC sites spanning MIS 5 to MIS 1 to reconstruct changing paleoenvironments and human subsistence strategies. WC carnivore accumulations were included in the analysis to compare and contrast their changing subsistence strategies with those of modern humans, as well as the resulting paleoenvironmental reconstructions. Results indicate that while a general paleoecological trend can be identified for each MIS, paleohabitats are not consistently reconstructed according to the commonly cited dichotomy that glacial periods were characterized by grasslands while interglacials were not. Additionally, carnivore accumulations are found to routinely result in environmental reconstructions comparable to those of human accumulations. Therefore, changing the strategy for reconstructing WC paleoenvironments results in novel paleoecological interpretations that have consequences for how we interpret the evolutionary contexts of some complex human behaviors.

Shifts in Neanderthal Mobility: Mousterian Technological and Subsistence Strategies in Western France

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We propose a reassessment of Neanderthals' subsistence and technological behaviors applied to the rich Mousterian record from western France and based on a set of in-depth technological and zooarchaeological analyses ranging from the early stages of the Middle Paleolithic circa 300,000 years BP up to the final stages circa 35,000 years BP. A far-reaching comparative approach of the technological systems and related subsistence strategies shows that the final purpose of lithic production, determined by site function and related mobility patterns, has a direct impact on the

lithic "chaînes opératoires," which may be structured according to a single purpose or to multiple purposes. Such alternative options and the related flaking or shaping technical principles result in the distinction of four technological systems: single purpose flaking systems, single purpose (MTA) shaping systems, Quina multipurpose flaking systems, and discoidal-denticulate multipurpose flaking systems. These systems reflect innovative and distinct responses to the dietary needs and correspond to time-limited occurrences. The single purpose flaking systems relate to a collector subsistence-settlement system and are widely predominant during the early stages of the Middle Paleolithic, prior to OIS4. The Quina and discoidal-denticulate multipurpose systems are both adapted to a high seasonal mobility based on the planned and selective acquisition of migrating large ungulates, in particular reindeer and bison, during the final stages of the Middle Paleolithic (OIS 4–3). While the single purpose MTA shaping systems respond to non-selective foraging activities embedded in a logistic organization of the subsistence activities and occur chronologically between the Quina and the discoidal-denticulate multipurpose systems. Beyond their diversity, the strategies developed during the recent stages of the Middle Paleolithic reveal a determining role of the hunting activities in the organization of late Neandertal societies that echoes a phenomenon well documented for the Upper Paleolithic societies.

New Chronometric Data for Pech de l'Azé IV and its Place in the Middle Paleolithic of South-Western France

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The relative and absolute chronological position of the technological and typological variants of the Mousterian in Southwest France have been the subject of debate for over forty years. Since the advent of both ESR and TL dating methods in the 1980s, a database of chronometric dates for a growing number of Middle Paleolithic sites has been steadily accumulating. Recent summaries by Guibert et al. (2008) and Jaubert (2008), appear to show a complex pattern of broadly overlapping Mousterian variants in the late Middle Paleolithic and has led some to conclusions very similar to Bordes' initial culture group models for Mousterian variability (e.g., Delagnes and Meignen 2006). Here we report new thermoluminescence (TL) dates from the Mousterian cave site of Pech de l'Azé IV. This site contains a deep sequence of Middle Paleolithic industries with considerable technological and typological variability associated with a well preserved fauna. Originally excavated by F. Bordes in the 1970s, the site was recently re-excavated in part to gain a better understanding of the geological context of the assemblages and to obtain chronometric data. Dates are now available for the two Levels, 8 and 6, from the base of the sequence. The results for Level 8 date this deposit of Typical Mousterian associated with a temperate fauna and extensive evidence for the use of fire into OIS 5c. The 'Asinipodian' industry from Level 6 is placed at the end of OIS 5 to early OIS 4. At a very local scale, these new dates allow us now to begin the integration of the Pech IV sequence with previously dated ones from Pech de l'Azé I and II. At a more regional scale these dates provide additional new data points from the more poorly dated late interglacial and early OIS 4 period.

A Revised Chrono-Stratigraphy for the Paleolithic Sequence of Caverna delle Arene Candide (Liguria, Italy)

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Since June July 2008, a multidisciplinary research team has been excavating the Late Pleistocene deposits of the

Caverna delle Arene Candide, near Finale Ligure, Liguria, Italy. One of the stated goals of the project is to refine our understanding of the cultural and depositional history of this site, which comprises a nearly continuous sequence stretching from at least the Gravettian to the Byzantine period. This paper presents the first results of the field seasons conducted in 2008 and 2009. A combination of new fieldwork and archival research has led to the development of a revised chrono-stratigraphic scheme for the exposed deposits at the Arene Candide. This updated framework incorporates new stratigraphic observations, the recently obtained direct date for the so-called 'Young Prince' burial, and notes by the site's original excavators, and it proposes an updated view of the radiocarbon dates available for the site's Paleolithic sequence. This coherent framework accounts for all of the available chronometric data without having to resort to the selective discard of given age determinations, and concludes that the deposits in which the Young Prince was buried date to ca. 25,000 BP. In the broader context of the Early Upper Paleolithic of Liguria, new radiocarbon dates of ca. 27,000 BP from deposits just below that layer strongly suggest the presence of Aurignacian-age deposits at the site. The paper also presents new chronometric, archaeological and human paleontological data on the site's Epigravettian deposits, some of which likely correspond to the levels in which the 'Epigravettian necropolis' was found by L. Bernabò Brea and L. Cardini in the 1940's.

The Biogeography of *Giraffa* sp. in the Southern Levant and the Implications for 'Out of Africa'

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Hypotheses pertaining to 'out of Africa' have focused on the large mammals that dispersed from Africa into Eurasia during the Plio-Pleistocene. The dispersal of giraffids as browsers has drawn much attention as outliers to the general pattern of primarily grazing taxa leaving Africa. This study analyzes the evidence for the presence of the genus *Giraffa* in the Levant and tests the hypotheses that: 1) the presence of *Giraffa* in the Levant indicates an African dispersal starting in the late Pliocene; and, 2) its presence in Eurasian Plio-Pleistocene sites represents one or more dispersal events correlating with hominin dispersals. Results indicate that *Giraffa* specimens are present in three Levantine sites; Bethlehem (ca. 2.5 Ma), 'Ubeidiya (ca. 1.6–1.2 Ma) and Latamne (ca. 1.0 Ma). Taxonomic analyses of *Giraffa* material indicate that 'Ubeidiya specimens can be assigned to *G. juma*e while Latamne can be identified as *G. camelopardalis*. The remains found in Bethlehem are too fragmentary to be assigned to species but are most probably *G. juma*e based on biochronological considerations. Results show that contrary to previous suggestions, only three sites in the Levant provide evidence for the presence of two *Giraffa* species. This confirms an African dispersal beginning at the Late Pliocene and at least two dispersal events. A previously unnoted dispersal event dated to the Epivillafranchian is observed by the *Giraffa* present at Latamne, which differs from the species in earlier sites. The timing of the appearance of both *Giraffa* taxa in the Levant does not appear to correlate with the dispersal of hominins. The taxa dispersing with hominins are typically grazing ungulates and are associated with open and dryer habitats. The appearance of a browser taxon such as *Giraffa* in the Levant, during more humid periods, further supports the association of early hominin migrations with expansion of savanna-like habitats.

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A New Species of Early Hominin from South Africa

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Two new hominin skeletons recently recovered from the Plio-Pleistocene site of Malapa in South Africa cannot be

accommodated within any existing fossil taxon. As a result, we establish a new species on the basis of a unique combination of primitive and derived characters of the cranium and postcranium. This new species is descended from *Australopithecus africanus*, though it can be clearly differentiated from it on the basis of a series of cranial and postcranial characters. The cranium is small, though the vault is relatively transversely expanded with widely spaced temporal lines. The arrangement of the supraorbital torus, nasoalveolar region, infraorbital region, and zygomatics results in a derived facial mask. The mandibular symphysis is vertically oriented with a slight bony chin and a weak post-incisive planum. The teeth are proportioned similar to *Homo*, but with a cuspal arrangement of the post-canine dentition more akin to *Australopithecus*. The skeletons denote small-bodied hominins that retain an australopithecine pattern of locomotion, suggesting habitual bipedalism together with a significant arboreal component. However, several derived features in the pelvis and proximal femur link the Malapa specimens with later *Homo*. Combined craniodental and postcranial evidence suggests that the transition from a small-brained, small-bodied, more arboreal-adapted hominin to a larger-brained, larger-bodied, full-striding terrestrial biped occurred in an unanticipated mosaic fashion. As a result of the discovery of this new species of early hominin, it may be necessary to revisit current hypotheses surrounding the early evolution of the genus *Homo*. In addition, the craniodental morphology of these new hominins allows us to re-examine the taxonomic status of more fragmentary crania from southern and eastern Africa.

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Strontium Isotope Evidence of the Mobility Patterns of Eastern Iberian Neanderthals

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Zooarchaeological and spatial analyses studies from Middle Paleolithic Eastern Iberia sites show a high level of mobility in Neanderthal populations. Additional evidence for this mobility pattern (which is also observed in other Iberian Neanderthal populations) is provided by short and spontaneous occupation periods of caves and rockshelters as well as by studies of alternating carnivore-human occupations in the sequences of the sites for this period. To provide additional evidence to evaluate the territorial range for Neanderthal mobility patterns in this area we undertook laser-ablation strontium isotope analyses of enamel and dentine from eight teeth from eight different individuals from three Valencian Middle Paleolithic sites in the Valencia Region. These data were compared with baseline local strontium isotope values determined through the measurement of solution strontium isotope values of modern plants and shells from the region. The value of the $[^{87}\text{Sr}/^{86}\text{Sr}]$ was measured using a ThermoFinnigan Neptune multi-collector inductively coupled plasma spectrometer (MC-ICP-MS) coupled with the NewWave UP213 laser-ablation system.

Modeling Middle Stone Age Lithic Discard Due to Impact Fractures Using Experimental Data From a Calibrated Crossbow, Pinnacle Point, South Africa

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Convergent points from Middle Stone Age assemblages frequently show tip and edge damage related to high-impact collisions. The relative frequency of points showing impact damage compared to unbroken points often varies

between sites and stratigraphic layers within an assemblage. Variation in impact fracture frequency has been argued to reflect changes in the relative importance of hunting. From this model, assemblages with higher frequencies of impact fractures suggest increases in hunting behaviors and low frequencies indicate less hunting. Here we test this hypothesis with the alternatives that variation in impact fracture frequencies reflect: 1) differences in landscape use strategies of MSA hunters; or, 2) a combination of hunting and landscape use variability. Convergent points were experimentally replicated on raw materials local to the South African coast near Pinnacle Point and hafted into a calibrated crossbow. Each point was thrust into a carcass until it was broken beyond use. A survivorship analysis of these catastrophic failures indicates that successful hunting attempts would rapidly degenerate spear tips. A stochastic model was created using this known rate of point breakage, ethnographic faunal transport patterns, knapping breakage rates, and landscape variables to create hypothetical assemblages of damaged points. The results of the model suggest that although hunting intensity may contribute to variation in the frequency of impact fractures, differences in site use history and landscape utilization strategies may be the dominant determinate of where damaged points are discarded.

New Organic Artifacts From the 2008–2009 Excavations in Schöningen (Lower Saxony, Germany)

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The Lower Paleolithic site of Schöningen is known for its well-preserved wooden artifacts, including eight wooden spears. During the 2008–2009 campaign the excavation team recovered some organic artifacts. The archaeological remains are in an interglacial succession (OIS 9 or 11) above the Elsterian till and below the Drenthe till of the Saalian glaciation. Organic artifacts from sites of such antiquity are rare, and include processed wood, burnt wood, worked bones, and bones with cut marks and percussion marks. Furthermore, several stone artifacts were discovered, which help to better understand the site. The scientific analysis have been continued and intensified in the last campaign and includes research in geology, palynology, macro and micro fauna, stable isotopes, OSL, and iron oxides. These multidisciplinary studies aim to assess the age of the geological strata within the context of global climatic trends. The results of such studies will place the 30-meter Middle Pleistocene profile of Schöningen among the most important reference sections in northern Central Europe.

Stone tool Use-Wear Evidence and the Implications of Cognitive Development of Peking Man *Homo erectus* at the Zhoukoudian Locality 1

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About 20,000 stone tools were recovered at the Zhoukoudian Locality 1 cave Peking Man *Homo erectus* site during excavations in the 1930s and the 1960s. The study of the Zhoukoudian lithic technology and tool-use patterns has not been given much attention in the recent studies of Peking Man cultural materials; in particular, the current hypothesis of *Homo erectus* being carnivores' prey at Zhoukoudian has not been tested against lithic evidence. This research applies a use-wear analysis of lithic artifacts to the study of Peking Man stone tools recovered from the Late Phases of occupations (Layers 1–5) at the Zhoukoudian Locality 1 cave, dated ca. 400–200 years ago (kyr). The use-wear technique examines microscopically the microfractures, rounding, and polish that are retained on the working edges of stone tools to determine the use function of tools. The results indicate that the Peking Man intentionally produced morphological-typed tools (e.g., pointed tools vs. scrapers) for multiple activities within the cave. In particular, most pointed tools had a hafted device for hand-gripping functions, suggesting a complex production process and a wide

range of stone tool uses at the Zhoukoudian cave. This study provides new evidence of Peking Man behaviors; they were hunters who knew how to make and how to use specific stone tools *in situ*. This line of evidence refutes the current hypothesis that the carnivores were actually the owner of the cave who brought the carcasses of Peking Man into the cave. The *Homo erectus* living at Zhoukoudian must have been much smarter in term of tool uses than previously believed.

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Hominin See, Hominin Do: An Experimental Reconstruction of Acheulean Imitation

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The site of Isampur Quarry in India is one of the oldest Acheulean quarries in the world and is unique in having the entire reduction sequence from raw material procurement to discard preserved at a single locality. Our experimental reconstruction of biface manufacture at Isampur showed that there were two distinct trajectories which resulted in two distinct tool types: handaxes and cleavers. These canalized reduction strategies in which both the means and the goal were reproduced indicate that true imitation was part of the behavioral repertoire of the Isampur hominins. A propensity for imitation among Acheulean hominins explains the unparalleled longevity and homogeneity of the industry. We hypothesize that early stone tool use would have created a selective pressure for increased fidelity in social transmission, so that each hominin in a group would not have to invent their own idiosyncratic knapping techniques. This culminated in the evolution of true imitation, which neurobiological evidence suggests first appeared c. 1.9 million years ago, immediately prior to the appearance of the Acheulean.

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The OIS 5e Middle Paleolithic Site of Le Grand Abri aux Puces (Vaucluse, France): Paleogeography, Paleoenvironment, and Initial Results of New Excavations

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Le Grand Abri aux Puces (GAP), located on the right bank of the Ouvèze River (Vaucluse, Provence, southern France) was discovered in the late 1870's by Hector Nicolas, a road and bridge engineer from Avignon. This site, due to a century of amateur spelunking, has been known to contain well-preserved stone tools and faunal remains, but our excavations in 2008 and 2009 were the first professional, controlled excavations at the site and have revealed the presence of a very rich and diverse faunal assemblage and stone tools with immaculate surface preservation. Before excavation could begin, however, we had to remove several tons of stone blocks from the surface of the sediment by hand (these blocks have probably protected the site from further pirating by curious visitors whose presence is evidenced by modern AA batteries and work gloves, etc.). Our excavations have exposed at least four archaeological

layers and produced 25 macrofaunal species, as many for the microfauna, 27 malacological species, and abundant charcoal. The charcoal fragments are large and preserve small twigs with their pith and bark still intact. A large part of the stone tools retain their original freshness and preserve microscopic use wear. The information issuing from paleontology, micropaleontology, malacology, and anthracology all place the principle GAP human occupation (Layer 2/3E) unambiguously in a temperate climatic phase. Different biometric and biochronological characters of the fauna converge to place the layers found thus far from before the last glacial, and most likely in OIS 5e (127 ~ 117 kya). The lithic elements, mainly composed of tools of superior quality, demonstrating particular technical investment, and made from widely distributed raw material sources, lead us to hypothesize brief passages of hunting groups in the cave focused around a programmed, anticipated activity. This hypothesis will be refined and tested during further excavations.

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NESPOS. Pleistocene People and Places

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The increasing amount of data and the growing importance of digital techniques in archaeology and paleoanthropology require a new form of data organization. The wiki-like data base NESPOS combines all these requirements of archaeology and palaeoanthropology. It is the result of the 24-months-research project which started in 2004 and was funded by the European Union. The project was initiated by the Neanderthal Museum and accomplished in close cooperation with European partners (Gröning et al. 2005; Semal et al. 2004; Weniger et al. 2007). Since 2006 the data base has been run by the international NESPOS Society. NESPOS was the working platform of EVAN (European Virtual Anthropology Network) a project funded by the EU and successfully finished in 2009. At the same time NESPOS started as a working platform of the CRC-806 "Our way to Europe." Today NESPOS offers a broad range of possibilities for researchers and a broad range of cooperation, e.g., including the Natural History Museum London and Delphi ct-scanning facility or Breuckmann surface scanning facility. NESPOS provides an integrated two application 3D visual simulation and collaborative rendering engine, the VisiCore Suite. NESPOS has an open space that offers meta data on sites to the great public. Data security is guaranteed by security spaces that can optionally be accessed by all registered members, just several individually selected members or only by the providing institution or researcher. Currently NESPOS provides more than 1500 data sets including fossil humans and modern reference data of *Homo sapiens* and primates and information on more than 120 Pleistocene sites. A minor part is still scans from archaeological key objects (e.g., bone tools, mobile art) (Breuckmann et al. in press) which will be constantly increased.

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The Ancient Human Occupation of Britain (AHOB) projects: A Progress Report

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The Ancient Human Occupation of Britain (AHOB) projects began in 2001, and are collaborations involving archaeologists, paleontologists, and earth scientists from many institutes (Stringer 2006). AHOB1 investigated major questions about the human colonizations of Britain including the earliest evidence for human arrival, and the overall pattern of occupation during the Paleolithic, and what was controlling it. Incontrovertible archaeological evidence was recovered from a pre-Anglian context at Pakefield, dating from ~700 ka, suggesting humans first arrived under a Mediterranean-type climate. Repeated episodic colonization and abandonment suggests that occupation was controlled by two main factors: geography (was there a sustained connection to the continent?) and climate (was Britain a viable place for early humans?). In particular, no good evidence of a human presence could be identified for most of Marine Isotope Stages 5–6, suggesting a human absence for more than 100,000 years. AHOB2 (2006–2009) extended collaborations into continental Europe. Further research at pre-Anglian sites has shown that the earliest occupations covered a wider range of environments than that of Pakefield, and it is possible that even earlier sites than Pakefield will be discovered. At the other end of the Paleolithic record, new radiocarbon dating using ultrafiltration has revolutionized our knowledge of the recolonization of Britain after the last glacial maximum, with human arrival virtually coincident with warming at ~14.7 ka. The third phase of AHOB will run until 2012 and will continue to address key questions about the timing and nature of the earliest human occupations of Britain, but will also collaborate to examine records from under the North Sea, and evidence from across Europe. It will include the publication of a major volume on AHOB research and of studies of human fossils from Boxgrove, Pontnewydd, and Kent's Cavern.

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Ontogenetic Age and Taxonomic Status of the OH 8 Foot from Olduvai Gorge

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Forty-eight years after its discovery, the taxonomic status and developmental age of the holotype of *Homo habilis* is still being debated. Leakey (1961a, b) initially thought that the hominin fossils from FLK-NN Level 3 represented a youthful representative of a new hominin species. Soon after Leakey was challenged by investigators who questioned the establishment of a new taxon and by others questioned the subadult status of the OH 8 foot. Following Day and Napier (1964), Leakey retreated from the position that OH 8 belonged to the type of *H. habilis*. In the diagnosis of *Homo habilis* by Leakey, Tobias, and Napier (1964), Leakey placed OH 8 in the paratype. In the 1970's, some suggested that OH 8 represented *Paranthropus boisei*. The consensus was that the OH 8 foot was that of an adult or perhaps even an aged individual. Our evaluation of the Olduvai holotype together with comparative studies of skeletal materials and x-rays of modern humans and apes confirms the initial observations of Leakey that: a) OH 7 and OH 8 are from one individual; b) the individual was a subadult; and, c) the fossils represent *H. habilis* not *P. boisei*. The significance of the above lies in the fact that while the OH 7 hand displays a combination of primitive and derived features, the OH 8 foot is characterized by a more derived, human-like total biomechanical pattern. This morphological pattern is not observed in earlier hominins, including *A. afarensis*, for which we have comparable anatomy.

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Direct Radiocarbon (AMS) Dating of Split-Base Points From the Protoaurignacian of Trou de la Mère Clochette, Northeastern France: Implications for the Timing of Technical Innovations in Europe and the Characterization of Early Upper Paleolithic Technocomplexes

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Dating split-base points has very rarely been undertaken. This is unfortunate given that these artifacts are critical to our definition and characterization of Early Upper Paleolithic technocomplexes, as they are considered to be the type fossil of the Early Aurignacian/Aurignacian I. In this paper we present accelerator mass spectrometry (AMS) radiocarbon dates on two split-base points and a hominin molar from the site of Trou de la Mère Clochette, Jura, France. Although the molar proved to be Neolithic in age, the split-base points date to the Aurignacian and are, in fact, the oldest dates so far (Bolus and Conard 2006; Flas 2008; Hofreiter and Pacher 2004; Jacobi and Pettitt 2000; Jacobi et al. 2006; Otte et al. 1998) on directly dated shaped Aurignacian organic points from Europe. Furthermore, what is particularly interesting about this site is that its lithic industry has strong affinities with the Protoaurignacian (Brou 1997; Brou et al. 2009), rather than with the Early Aurignacian (*sensu* Bon 2002, 2006), the latter being the industry with which split-base points have usually been associated. In being located in Northeastern France, at the intersection of the Danube and Rhone corridors and very close to the Swabian Jura, this site, its Protoaurignacian lithic industry, and these new dates are particularly relevant to our characterization of Early Upper Paleolithic industries, to discussions about the evolution of the Aurignacian and to wider debates regarding the timing of key technical innovations (see, among others, Bar-Yosef and Zilhão 2006; Camps and Szmids 2009; Le Brun-Ricalens et al. 2005; Mellars et al. 2007; Szmids et al. in press; Zilhão and d'Errico 2003). Our paper will present these new results and discuss their implications in this wider context.

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Engraving Patterns of Ostrich Eggshell Containers in the Howiesons Poort from Diepkloof Rock Shelter (South Africa): A 60-ky-old Graphic Tradition

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Diepkloof is a large quartzitic rock shelter overhanging the Verlorenvlei River, about 15km from the current shorelines, approximately 200km north of Cape Town (Western Cape, South Africa). Ongoing excavation since 1999 progressively exposed one of the most complete archaeosequences for the southern African MSA. The 4-meter-deep section documents continuity in evidence of Pre-Stillbay, Stillbay, Howiesons Poort, and post-Howiesons Poort occupations. One of the main changes occurred at the time of the Howiesons Poort with the appearance of intentionally marked ostrich eggshells. To date, more than 200 engraved fragments have been recorded, mostly from two layers within a sub-sequence of ten HP layers. These standardized engravings attest to a limited range of motifs that were executed in accordance to geometric rules. A few fragments with characteristic punched holes demonstrate that ostrich eggshells were used as containers, as documented among historic !Kung groups. The unique collection of engraved ostrich eggshell fragments from Diepkloof Rock Shelter, dated by TL and OSL to approximately 60 ky, documents the earliest graphic tradition currently known. This collection calls for a new interpretation regarding the question of symbolic practices and clarifies the cultural identity of the Anatomically Modern Humans of the time.

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The Malawi Earlier-Middle Stone Age Project: Preliminary Results from 2009 Fieldwork

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The Malawi Earlier-Middle Stone Age Project (MEMSAP) has been developed to investigate the relationships between Middle Stone Age behavior, demography, paleoclimate, landscape change, and resource availability in the Malawi Rift. The project will involve: 1) excavating important sites in the Middle to Late Pleistocene Chitimwe Beds of northern Malawi; 2) analysing the recovered lithic, pigment, and possibly fossil materials; 3) contextualizing them within their depositional environments; 4) constructing a regional chronology; and, 5) linking these data to an existing high resolution paleoclimatic dataset. The inaugural field season was held in 2009. We mapped and sampled two sites—Mwanganda's Village and the Airport Site. We also surveyed the deposits southwest of the Chaminade Secondary School, where Clark et al. (1970) investigated stratified *in situ* Middle Stone Age deposits containing abundant unweathered lithic artifacts and pigments. We present here a summary of this work along with an outline

for future MEMSAP research.

Paleoenvironmental Context for Middle Stone Age Hominins in Equatorial Africa: The Pleistocene Wasiriya Beds of Rusinga Island (Kenya)

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Western Kenya is well known for abundant early Miocene hominoid fossils. However, we have identified a Pleistocene sedimentary archive that contains stone tools and abundant, well-preserved fossil fauna in the Wasiriya Beds, Rusinga Island, Kenya. Co-occurrence of Middle Stone Age artifacts and associated fossils is rare in eastern Africa, particularly in the region bounding Lake Victoria. Surface and *in situ* Middle Stone Age artifacts (Levallois flakes, bifacial points) from the Wasiriya Beds co-occur with a diverse fossil fauna that includes numerous ungulate taxa, micromammals, and gastropods with radiocarbon age estimates of >33–45 ka. Sediment lithology and the fossil ungulates suggest a local fluvial system and associated riparian wooded habitat within a predominantly arid grassland setting that differs substantially from the modern environment, where local climate is strongly affected by moisture availability from Lake Victoria. In particular, the presence of oryx (*Oryx gazella*) and Grevy's zebra (*Equus grevyi*) suggests a pre-Last Glacial Maximum expansion of arid grasslands. The environmental reconstruction also is supported by: (1) the presence of several extinct specialized grazers (*Pelorovis antiquus*, *Megalotragus* sp., and a small alcelaphine) that are unknown from Holocene deposits in eastern Africa; and, (2) isotopic analyses of pedogenic carbonates, sedimentary organic matter, and herbivore teeth. Artifacts and fossils occur in a complex that includes intercalated trachyphonolitic fallout and reworked distal tephra deposits. In addition to their potential for radiometric dating, electron microprobe geochemical analyses demonstrate that these tephra deposits can be used for local stratigraphic correlations among sites on Rusinga Island and suggest that these likely derive from Quaternary volcanoes in the Central Kenyan Rift Valley. The combination of artifacts, a rich fossil fauna, diverse substrates for isotopic analyses, and volcanoclastic sediments makes the Wasiriya Beds a key site for understanding the paleoenvironmental context for modern human origins in Equatorial Africa.

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The Definition, Variability, and Limits of the Mousterian of Acheulean Tradition in the Aquitaine Basin (France)

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The Mousterian of Acheulean Tradition, or MTA (Bordes 1953, 1954), which is observed primarily in open-air contexts in Western Europe (Turq 2000), has recently been investigated in the context of cave or shelter sites (Soressi 2002; Soressi et al. 2008). At this point, then, it is possible to reexamine a number of MTA assemblages from the larger geographic area of the Aquitaine Basin and to take into account a number of major environmental differences. This work allows us to have a more complete view of the intra-facies variability of this industrial group, and to propose new responses to a number of principal questions concerning it. First, apart from the presence of bifaces, are there other technological and/or typological characteristics of this techno-complex? What is the nature of both synchronic

and diachronic variability within it? And finally, what is the relationship between it and other Mousterian facies?

Tracing Neandertal Movement and Mobility Using Strontium Isotope Analysis: Case Studies from Belgium

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Strontium isotope ratios ($^{87}\text{Sr}/^{86}\text{Sr}$) in tooth enamel can be used to track past human and animal migration and movement patterns. Until recently there have been very few applications of this technique involving Neandertal remains, mostly due to the large sample sizes required for traditional, solution based, analytical methods. We apply a relatively non-destructive sampling method, using a laser ablation microprobe coupled to a multicollector inductively coupled plasma mass spectrometer (LAM-MC-ICP-MS) on dental enamel from Neandertals to produce strontium isotope values. With this method we are able to identify whether the Neandertals lived in the area where they were found during the period of tooth formation or spent this period of time elsewhere. Here we present the results of new analyses of 16 teeth belonging to 3 Neandertals found at the Belgian sites of Engis, Scladina, and Walou. The $^{87}\text{Sr}/^{86}\text{Sr}$ ratio obtained on these Neandertal teeth is compared to the bio-available strontium isotope values in the limestone area surrounding the caves (Meuse river), as well as in different geological areas located further north and south to the Meuse river. For these bio-available Sr isotope data, we collected and analysed 90 plant and snail specimens from 20 locations across different geological bedrocks using solution MC-ICP-MS. Using both solution and LAM-MC-ICP-MS we also analysed rodent and small carnivore teeth found at the site of Scladina and Walou in the layers which yielded the Neandertal remains. The $^{87}\text{Sr}/^{86}\text{Sr}$ values from the Engis and Scladina deciduous molars are consistent with the bio-available Sr isotope values from the area around the cave, suggesting very little movement from this region during their early childhood. The permanent premolar from Walou, as well as eight permanent teeth belonging to a single individual from Scladina representing different periods of life, allow us to discuss possible changes in lifetime mobility.

The Relative Efficacy of Developmental and Functional Cranial Modules for Reconstructing Global Human Population History

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This study assessed the relative efficacy of cranial modules defined on the basis of developmental and functional integration (Olson and Miller 1958) for reconstructing neutral genetic population history. Specifically, two hypotheses were tested: (1) The "basicranial hypothesis" predicts that the endochondrally ossifying basicranium will be more reliable for reconstructing population history than intramembranously ossifying regions of the human cranium. This is based on the assumption that early ossification of the basicranium and its distinct functional constraints produce a cranial structure that is relatively immune to nonneutral evolutionary pressures (Lieberman et al. 1996); and, (2) The "single function hypothesis" predicts that cranial regions associated with a single (sensory) function are less reliable indicators of neutral genetic history. Here the prediction is based on the reverse logic of that applied by Lockwood et al. (2004) who suggested that multi-functional complex integrated cranial regions are less likely to exhibit homoplasy and, therefore, provide a more accurate morphological proxy for genetic relationships. Craniometric population affinity matrices were generated from 3D geometric morphometric data representing different developmental and functional cranial modules for 12 globally distributed human populations. The congruence between the craniometric matrices and a neutral genetic population matrix based on autosomal microsatellite markers was assessed using a series of Mantel matrix tests. The results did not support the predictions of the "basicranial hypothesis," as the intramembranously ossifying vault was more strongly correlated with the genetic data than the endochondrally ossifying basicranium. However, the results did support the predictions of the "single function hypothesis" as all three

sensory modules were less strongly correlated with the genetic data than complex, multi-functional modules. These results have important implications for understanding which aspects of cranial anatomy provide the most accurate inference model for assessing fossil hominin relationships.

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A Fresh Perspective on Neanderthal Clothing: Inferring Pleistocene Attire Using Modern Analogues

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Despite a general lack of archaeological evidence for Paleolithic clothing, archaeologists have long debated how Neanderthals clothed their bodies. There are many complex, unresolved issues, such as Neanderthal thermal adaptations and technological capabilities. Regardless, few researchers have investigated clothing variability in historic foraging populations. Such data would allow archaeologists to better understand how much clothing needs to be worn under different environmental conditions. In this research project, clothing data were collected for 245 unique hunter-gatherer groups. Clothing data were tested against a wide variety of environmental factors, following the analytical strategies of Binford's (2001) *Constructing Frames of Reference*. It was determined that the amount of body covered is correlated with a number of environmental conditions, including the mean temperature of the coldest month and average annual wind velocity. A mathematical model was developed to predict the amount of body covered by clothing for any set of environmental conditions. This model was then used to predict Neanderthal clothing patterns during Oxygen Isotope Stage 3, using the paleoenvironmental reconstructions published by the Stage Three Project (van Andel and Davies 2003). It is now possible to estimate how much clothing a Neanderthal likely wore in various parts of Europe from 60,000 years ago until extinction. This research demonstrates that archaeologists cannot have a single image of Neanderthal attire. The species would have needed varying degrees of clothing over its vast geographic and temporal range. Furthermore, one may use this data to infer why Neanderthals were unable to colonize various parts of Eurasia.

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The Early Middle Paleolithic of Misliya Cave, Mount Carmel, Israel

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Misliya Cave, Mount Carmel, Israel, contains Lower Paleolithic (Acheulo-Yabrudian) and Middle Paleolithic (Early Mousterian) layers (Weinstein-Evron et al. 2003). The latter, widely exposed on the upper terrace of this long-collapsed cave, were excavated over an area of ca 20m². The 4m thick Mousterian layers contain a series of well-defined hearths, extremely rich lithic assemblages, and abundant animal remains. Preliminary TL dates suggest human occupation around 250,000 years ago. No significant changes in material culture were observed throughout the sequence. Geological observations indicate that the cave's ceiling last collapsed during the Mousterian habitation. Repeated construction of hearths and high density of finds suggest intensive occupation. The layers of the largest hearth, about 1m in diameter and 20cm thick, are alternately hard, calcified, and friable. Burnt flints, bones and botanical material attest to the habitual use of fire. Some 50,000 flint artifacts were retrieved. The technologically diverse lithic industry highlights laminar production alongside the use of Levallois methods. Laminar techniques included preparation of crested blades, as well as use of tabular flint. Levallois reduction involved mostly the unidirectional convergent method for preparing points and triangular flakes. The tool-kit is dominated by various types of points and retouched blades. The closest analogies for this "Tabun D-type" industry are Hayonim Cave Layer E and Hummal. The faunal assemblage is dominated by ungulates, with fallow deer (*Dama mesopotamica*) and mountain gazelle (*Gazella gazella*) being the most common. Body-part analysis, age profiles, and bone-surface modifications observed at this almost exclusively anthropogenic assemblage attest to systematic ungulate hunting and 'modern' carcass transport and butchery patterns (Yeshurun et al. 2007). The human remains include several non-diagnostic infant's skull fragments, two isolated teeth, and a phalange. Morphometrical analysis of the teeth and phalange will help their placement within either the Skhul/Qafzeh early *H. sapiens* or Kebara/Amud Neanderthal Levantine populations.

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The Repeated Replacement Model—Rapid Climate Change and Population Dynamics in Upper Pleistocene Europe

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Considerable parts of Europe regularly turned in the Upper Pleistocene into a high risk environment for humans. The CalPal GISP2 Hulu age model displays 12 Greenland Stadials (GS) between 50 calBP and 20 calBP. These cold events had an important impact on the line of the human frontier and displayed a pronounced yo-yo effect. Southwest France, the Northern Mediterranean, and the Black Sea were possible refuge areas. Hunter gather populations outside

of the refuge areas had two possibilities to react: Bear up or take flight. The human reaction pattern under increased climate forcing is summed up in a four step cascade model: resistance - retreat - micro extinction - macro extinction (Bradtmöller et al. in press). At different stages of the model a re-expansion of the population is expected. Changes in social structure, settlement pattern, or technology are highly probable as reaction to the 12 GS. But only four major cultural changes are recorded. Obviously cultural change in the Upper Pleistocene needs a very robust signal to be visible in the archaeological record. We expect macro extinctions of populations as driving forces. The Iberian situation provides a good example. Here cultural changes are located during GS3, GS5, and GS9, which coincide with HE2, HE3, and HE4. Archaeologically visible cultural change seems to be linked to Heinrich Events (HE). The reason for this patterning is probably desertification. Several marine cores from the Iberian margin show strong aridity linked to Heinrich Events which is also true for the Eastern Mediterranean. The repeated replacement model argues that during Heinrich Events refuge zones turned for short time into semiarid risk environments and led at least four times to macro extinction of human populations including late Neanderthal populations.

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Hand Pressure Distribution During Stone Tool Production

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The robust thumb of later *Homo* is widely thought to be an essential anatomical component of stone tool production. Researchers have hypothesized that this derived anatomy was selected in part to generate high forces and withstand high forces acting on the thumb during hard hammer percussion and may have facilitated precision handling and knapping. Functional and EMG studies indirectly support these hypotheses; however, data are lacking on loads experienced during stone tool production and their distribution across the hand. Using a dynamic pressure sensor system (200 Hz), pressures acting across the hand were collected from eight experienced knappers replicating Oldowan chopping tools. Knappers used hammerstones requiring five-digit power and three-jaw chuck grips. Using a five-digit power grip, peak pressures occurring at strike were significantly higher on digits I-III compared to pressures measured for digits IV-V. Pressure acting on digit I was not consistently higher compared with pressure on digits II-III. Using a three-jaw chuck, pressure at strike was consistently and significantly higher on digit II and/or digit III compared the other digits across all knappers. The thumb experienced low to moderate loads. Pressure was frequently highest at the distal phalanx when using either the five-digit power grip or the three-jaw chuck grip. These results support qualitative descriptions of manual pressure concentration on digits II and III, as reported by Marzke and Shackley (1986). However, they do not support the hypothesis that loads experienced during stone tool production are significantly higher on the thumb compared to the other digits. This calls into question hypotheses linking the derived, robust thumb anatomy in *Homo* specifically to stone tool production.

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Scapular Axillary Border Sulcus Variation in Recent Modern Humans and Neandertals: A Cross-Sectional Metric Approach

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Recent studies suggest that variation in scapular axillary border sulcus morphology has an epigenetic baseline as indicated by the early expression of sulcus type during growth and the differential expression of the sulcus types between populations of recent modern humans, Upper Paleolithic humans, and Neandertals (Churchill 1996; Franciscus and Schoenebaum 2000; Moran and Chamberlain 1997; Trinkaus 2006, 2008); while a functional relationship between the bisulcate pattern and axillary border thickness has also been suggested (Busby 2006; Franciscus and Schoenebaum 2000; Odwak 2006). We examined recent modern human sulcus morphology (n=120 Indian Knoll Late Archaic hunter-gatherers and n=120 European-American specimens) with cross-sectional contour molds of the axillary border to calculate an index of continuous variation in ventral to dorsal border width (IDX), total axillary border width (W), and total cross-sectional area (TA). Least squares regression (LSR) of IDX, W, and TA versus 14 humeral, clavicular, and scapular osteometric variables in the pooled modern human sample shows highly significant ($p < 0.0001$) correlations for W and TA with all variables and no significant correlations between IDX and any other variable. Principle components analysis of all upper limb variables showed that overall shoulder size (PC1) accounts for 83.3% of the total variance and humeral robusticity (PC2) accounts for 8.4% of total variance. LSR of IDX versus PC1 and PC2 scores showed no significant correlations, whereas TA and W were significantly correlated with overall shoulder size and humeral robusticity. We also scaled TA and W to body size in Neandertal scapulae (n=10) with glenoid fossa length and regressed it against IDX, and no significant results were found. We conclude that sulcus type (IDX) is most likely an epigenetic trait providing possible phylogenetic information, while TA and W reflect biomechanically relevant measures of axillary border robusticity providing functional (behavioral) information.

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Endo- and Ectocranial Covariation in *Pongo*: Implications for Fossil Hominoid Cranial Integration

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The extent of morphological integration among different cranial regions can be estimated by assessing the degree of correlation between shape descriptors of each region. Previous studies have assessed cranial integration in hominoids (e.g., Mitteröcker and Bookstein 2008), though most have focused exclusively on ectocranial regions. Here I test the interplay between endo- and ectocranial morphology. I digitized 32 endo- and 32 ectocranial 3-D landmarks on Sumatran (n=12) and Bornean (n=14) adult, wild shot, orangutan crania. All crania had their vaults sectioned, rendering the endocranium accessible. Shape variables were generated by generalized Procrustes analysis (Rohlf and Slice 1990). I then quantified the degree of covariation between different sets (blocks) of shape variables using the multivariate Escoufier RV coefficient (Klingenberg 2009). Significance was determined by comparing *a priori* modularity hypotheses with a null distribution of the RV coefficient. Firstly, I tested the hypothesis that endo- and ectocranial morphology are tightly integrated. To test hypotheses of modularity, I subdivided the cranium into regions based on developmental criteria. Preliminary results indicate that endo- and ectocranial shape variables are

highly correlated ($RV .95, P < .001$), suggesting tight integration between these two regions. Endocranial regions tend to exhibit slightly lower RV values with increasing subdivision (multi-RV: 2 blocks .98; 4 blocks .89; 8 blocks .77) than ectocranial regions (multi-RV: 2 blocks .99; 4 blocks .99; 8 blocks .98). *A priori* hypotheses of endocranial modularity, however, had much lower statistical significance ($P = .63$), than those of the ectocranium ($P = .04$). Ectocranial regions therefore appear to be slightly more integrated than endocranial regions. The implications of these findings are discussed with respect to fossil hominoid cranial morphology.

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Refining the Chronology of the Middle-to-Upper Paleolithic Transition in the Iberian Peninsula

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It has been proposed that, south of the Ebro drainage system, Neandertal populations persisted for several millennia after their disappearance everywhere else in Europe. The duration of that persistence is a point of contention: until 32–30 (if the earliest Upper Paleolithic of Portugal and western Andalucía is a Late Aurignacian) or until 24–28 ka ¹⁴C BP (if it is a Middle Gravettian). But it has also been suggested that the Iberian pattern is a byproduct of erroneous dating and insufficient data, creating the illusion of punctuation in a process that would have been characterized by a straightforward East-West gradient. In order to address these issues, we dated, using radiocarbon on bone and charcoal with advanced pretreatment techniques (ABOx and ultrafiltration), radiocarbon on shell, U-series (D/A) on bone, and U-Th on speleothems, the following sites of relevance: Pego do Diabo, Oliveira, and Figueira Brava (Portugal), Humo (Malaga), and Cueva Antón, Sima de las Palomas, Cueva de los Aviones, and Cueva Pernerias (Murcia). For Portugal, our results place the later Aurignacian (III–IV) ca 29–30 ka ¹⁴C BP, and the latest Mousterian ca 32 ka ¹⁴C BP. For southern and eastern Spain, our results place the latest Mousterian no earlier than ca 31 ka ¹⁴C BP. For Iberia south of the Ebro drainage, these results: (1) confirm that a Neandertal-associated Middle Paleolithic persisted for some five millennia after modern humans, as represented by the Oase fossils, first appeared in Europe; (2) constrain the Transition to an interval of at most two millennia around ca 31 ka ¹⁴C BP; (3) suggest that the well-defined but imprecisely dated Aurignacian II of these regions should be assigned to that interval; and, (4) shed light on the systematic exploitation of marine resources by late Middle Paleolithic Iberian Neandertals.

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Digging Stick Use and Hand Biomechanics

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Researchers hypothesize that the evolution of the human hand was shaped by the demands of manual manipulation, notably making and using tools. As part of a broader study examining the biomechanical context of tool use, this

study examines hand biomechanics involved in foraging for Underground Storage Organs (USOs), as multiple lines of evidence suggest that they were important food resources in human evolution. Among extant tropical and sub-tropical hunter-gatherers USO exploitation is nearly ubiquitous. Many hunter-gatherer groups acquire USOs through excavation using an unweighted digging stick made from a sharpened piece of wood. Tens of kilograms per day can be gathered by an individual in this manner. Recently, savanna dwelling chimpanzees at Ugalla, Tanzania have also been reported using sticks, bark, and pieces of logs to excavate USOs growing beneath a hard layer of earth which they were unable or unwilling to penetrate by hand. We report here the results of an experimental investigation to determine which parts of the human hand are most affected by the forces involved in digging stick use. We specifically examine the role of the thumb, which is gracile in *Australopithecus* and evolved greater robusticity in *Homo*. In this study volunteers used a digging stick outfitted with dynamic pressure sensors (200 Hz) to excavate earth in a manner consistent with documented digging techniques used by hunter-gatherers. Preliminary results show that while individual variation in digging technique influences pressure distribution, the phalanges of rays 2–5 regularly exerted pressures of over 250kPa during excavation. In contrast, the thumb exerted relatively low forces. This suggests that digging stick use did not play an important role in the evolution of the thumb in early *Homo*, and also suggests that the gracile thumb of *Australopithecus* would not have limited their ability to use digging sticks.

The First Europeans Outside Africa: Paleoindividuals, Paleopopulations, and Paleospecies

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The Out-of-Africa (OoA) scenario of human evolution posits that genetic and phenetic distances of dispersing populations increase with increasing geographic distance from Africa, while genetic and phenetic variation within populations decrease. While the genetic and phenetic signature of modern human populations is largely congruent with an OoA-II scenario, evidence for OoA-I, i.e., dispersal of early *Homo* into the Eurasian continent, is scarcer, and thus more difficult to interpret in terms of current models of dispersal. The Plio-/Pleistocene sample of early *Homo* from Dmanisi plays a key role in addressing OoA-I questions, as this unique sample provides insights into patterns and ranges of morphological variation within an early hominin paleopopulation outside Africa. In this talk, we present an overview of the comparative skeletal morphology of the Dmanisi fossils from a biological and from a biogeographic perspective. The evidence from Dmanisi suggests that biological variation within paleopopulations of early *Homo* was substantial, but well within the range of variation found in modern human populations. These findings have important implications for the assessment of patterns of variation in early African *Homo*, especially in *H. erectus* sensu lato: underestimation of variation within paleopopulations tends to result in overestimation of local evolutionary trends and/or speciation events. Overall, the current empirical evidence from Plio-/Pleistocene *Homo* thus is compatible with the following most-parsimonious scenario: a single species of early *Homo* in Africa, and OoA-I as the prime source of early human intraspecific diversity.