Abstracts for the Paleoanthropology Society Meetings

The Hyatt Regency Hotel, Columbus, Ohio, U.S.A. 27–28 April 1999

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0047–2484/99/0400A1+26$30.00/0

The ''trunk torsion hypothesis'' and Neandertal superior pubic ramal morphology

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Researchers have long recognized a unique morphological pattern among the Neandertal superior pubic rami. The Neandertal rami are both absolutely and relatively longer than those of modern humans, they evidence a ''reversed'' pattern of sexual dimorphism, and the rami are also relatively thinner than those of modern humans.

Several hypotheses, including obstetrical and biomechanical, have been put forward to account for the differences between the superior pubic rami of Neandertals and modern humans, but none has gained much acceptance, and none accounts for all of the observed divergences from modern human morphology.

The ''trunk torsion hypothesis'' accounts for all of the observed morphological differences in the superior pubic ramal morphology of Neandertals, and links the unique morphology to adaptations for close-range predation in Neandertals.

If Neandertals were making use of bimanual, unilateral thrusting in their hunting of large prey, large torsional forces would have been generated along the body axis. In order to maximize the force delivered to the prey, these torsional forces would have to have been counteracted at the substrate. The adductor muscles of the thigh would have played an important role in producing such counter-torsional forces.

The pubis is at a particularly important intersection for transmission of torsional forces. The torsional forces generated in the upper body are transmitted by the abdominal wall muscles to the pubis, and the torsional forces generated in the lower body are transmitted by the adductor muscles (among others) to the pubis as well.

The hominid pubis is shown to be comprised of two interdependent biomechanical elements. In Neandertals, the distance between these two elements is increased in order to allow for the expansion of the adductor muscle group, resulting in their unique ramal morphology.

Preliminary tests of paleoanthropological predictions for hominid land use in the east-central portion of the lowermost Bed II Olduvai Basin, Tanzania

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We present preliminary tests of predictions on the density and composition of Oldowan stone artefact and larger mammal bone assemblages made earlier by Blumenschine and Peters (1998; *Journal of Human Evolution* **34**, 565–607) for the paleo-Olduvai lake basin during lowermost Bed II times. The tests draw upon only a portion of our excavated sample from Olduvai Gorge (34 trenches, 1512 stone artefacts, 1874 larger mammal bone specimens) that is derived from three paleolandscape units (Lower Lacustrine Plane, core of

the Groundwater Wetland, Pyroclastic Debris Apron) in the east-central portion of the basin. The test results presented here are intended to demonstrate that synchronic traces of hominid activities in their paleolandscape context can be used to test models of hominid land use based fundamentally on landscape ecostructure.

The Lower Lacustrine Plain preserves relatively low artefact and bone densities, very low abundances of long bone ends, and high proportions of detached pieces made exclusively on quartzite. These observations match predictions for this treeless landscape facet in which hominid activities would be limited to brief scavenging forays with minimal in-facet butchery and tool discard. The Groundwater Wetland preserves assemblages with the highest artefact and bone densities, lower relative abundances of detached pieces, and proportionately fewer artefacts made on quartzite, as predicted. The heavy predominance of tooth-marked bone over butchery-marked bone suggests that the exposed portion of the Groundwater Wetland did not support dense groves of trees at which hominids could thoroughly process carcasses in relative safety. Artefacts and bones occur at extremely low densities in the Pyroclastic Debris Plain, as is consistent with the absence perennial stream facets to the southeast of the paleo-lake.

The utility of these tests for evaluating the paleolandscape ecology and hominid land use components of our previous models are discussed.

Environmental changes in early hominid evolution derived from analysis of fossil mammals from the lower Omo Valley, Ethiopia

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The lower Omo valley of southern Ethiopia has an unparalleled record of fossil mammals associated with Plio-Pleistocene Hominidae. In this study, we use the Omo database to elucidate the nature and timing of changes in Plio-Pleistocene hominid environments. The use of the Omo mammals in paleoenvironmental reconstruction begins with analysis of taphonomic conditions and potential biases in the preservation and representation of taxa. Taphonomic conditions, as measured by the abundance of different bovid body parts (e.g., horn cores, isolated teeth, and postcranial elements) changed gradually between Shungura Member B and lower Member G, followed by an abrupt shift in upper Member G. This taphonomic shift was independent of changes in taxonomic abundances; thus, we regard the taphonomic effects on patterns described below as minimal. An analysis focusing on the early part of the Omo sequence shows that important changes in the relative abundance of bovids occurred between Shungura Members B and C, but a broader analysis incorporating the entire sequence indicates that further changes in bovid relative abundance occurred above Shungura Member G. Member G itself represents a transition between environments dominated by Aepycerotini, Tragelaphini, and Bovini, and environments dominated by Alcelaphini, Antilopini, and Reducini. To the extent that bovids serve as indicators of past environments, these changes imply that the Omo sequence was deposited under wet and wooded conditions from 3·4 to 2·8 Ma and under drier but still wooded conditions between 2·8 and 1·9 Ma. The fauna in the upper part of the Omo sequence, after 1·9 Ma, reflects drier and more open conditions. The early changes, dating to about 2·8 Ma, may coincide with the origins of the robust australopithecine clade. The later changes, dating to about 1·9 Ma, correspond with the origins of early *Homo erectus*, or *H. ergaster* in East Africa.

The Middle Stone Age of the Ethiopian rift: new data from the Middle Awash

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We report on four seasons of fieldwork on the Middle Stone Age occurrences along the West bank of the Awash River in the northern Ethiopian Rift, as part of the Middle Awash Project, under the overall direction of B. Asfaw, Y. Beyene, J. D. Clark, T. D. White and G. Wolde Gabriel. In the area known as ''Aduma'', Acheulean occurrences were noted in patinated lag gravels along the modern valley margin. These are succeeded, in much younger sediments, by three separate MSA levels. The earliest MSA with large blades and bifacial, pick-like implements with square bases, occurs in association with a body of lag gravels. The medial MSA characterized by small points, reduced numbers of blades and both discoidal and Levallois cores, as well as other types, occurs in a valley fill of finely stratified crossbedded silts and fine sands. The artefacts in these sediments are associated with mammal remains, particularly still semi-articulated hippos and horizons of at least partially allochthonous, occluded clams as well as gastropods. These sediments and fossils suggest settlement along a short-lived but highly energetic floodway, with the artefacts dropped along minor channel margins or shores of small floodplain lakes. A final MSA horizon of diminutive points, Levallois cores, bladelets and perforators is associated with settlement along a tributary valleyway on the flood plain after a period of soil formation. Three partial hominid crania were recovered from the middle MSA horizon at Aduma and one has been described by Y. Haile-Selassie. Dating and environmental contexts of these materials will be discussed in terms of what is known about the MSA of the Horn of Africa as well as of their intermediate position between southwest Asia and sub-Saharan Africa.

Cut mark evidence for meat-eating and tool use by Pleistocene early hominids in Java

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Cut mark investigations of Pleistocene fossil faunal bones recovered from Java demonstrate butchery and related tool use by Pleistocene early hominids. Studies conducted at institutions in Indonesia, Germany and the Netherlands during 1997–98 examined over 30,000 fossil specimens, and recovered a total of 55 cut mark grooves in 17 clusters.

Cut marks consisting of 46 grooves in 11 clusters from the excavated bones range in age from the Lower, Middle, and probable Upper Pleistocene. Cut marks have been observed on a specimen of *Bos* sp. (Indonesian-Japanese Collection) originating from the Lower Pleistocene Pucangan black clay bed (1.15 Ma by fluorine dating) at the Bukuran locality

in Sangiran. Bones of *Bos* sp. from the excavated geologic pits at the Bukuran locality revealed cut marks dating to the Middle Pleistocene. A skull of *Cervus* sp. (original Oppenoorth Collection excavated from the Layer III of Ngandong collected with hominid fossils) showed cut marks dating probably to the Upper Pleistocene. In addition, nine cut marks in six clusters from surface collections bearing rough geologic correlations, from the Middle Pleistocene Kabuh Formation of Sangiran, are also documented.

Extremely low counts of archaeological cut marks are partly due to the rigorous definition of cut marks applied in this investigation, but are also due to poor fossil surface condition. All of the localities revealing archaeological cut marks match with the places where hominid fossils have been discovered. In particular, the Bukuran locality in Sangiran should receive special attention for future survey and excavation.

This new cut mark evidence establishes butchery and meat-eating subsistence by Javanese Pleistocene early hominids. Therefore, the earlier vegetarian view of Pleistocene Javanese early hominids requires a revision. This evidence further implies meat-eating was a common mode of subsistence by the Pleistocene early hominids in the entire Old World.

Airflow dynamics in the Neandertal nose

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Neandertal nasofacial anatomy reflects large, projecting noses with wide piriform apertures, bi-level nasal floors with deep sills, and large, paracoronally-oriented inferior conchae. This morphology has been argued to enhance airflow turbulence, and thus facilitate heat and moisture exchange in the respiratory tract, as an adaptation to high respiratory demands in a cold, dry climate.

To test these arguments we studied airflow (using water and dye, with adjustment of flow rates to maintain dynamic similarity) in anatomically-accurate acrylic models of human nasal passageways, derived from direct casting of ten caucasian cadavers. Measures of the projection of the external vestibule, naris angle, relative sill height, and conchal projection were taken directly on the casts. By examining the flow regimes (laminar versus turbulent) at varying flow rates, we tested the proposed relationships between aspects of nasal morphology and turbulent air flow. Specifically, we tested the claims that the size of the external nose, the relative depth of the nasal floor, and the size of the turbinates are inversely related to the flow rate at which flow shifts from a laminar to a turbulent regime.

Results show nasal projection and nasal sill morphology to have no appreciable effect on airflow dynamics. Turbulence was positively related to the angle of the nares relative to the floor of the nasal chamber, with more inferiorly directed nares being associated with more turbulent regimes. Conchal projection was inversely related to turbulence, with larger conchae serving to induce streamlines within an otherwise turbulent flow. Results suggest that certain aspects of the Neandertal nose (large, projecting conchae and probably also wide mediolateral breadth) served as mechanisms to *reduce* turbulence and decrease the energetic cost of air transport in highly active hominids who, because of cold and/or dry air conditions, were constrained to nasal ventilation.

Levantine Mousterian mobility patterns: the view from Mt Carmel, Israel

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The Levantine Mousterian represents an ideal setting for understanding lithic technological strategies employed in an area of abundant (though not ubiquitous) stone tool raw materials. Depending on the type of mobility strategies employed by the stone tool-using hominids, groups would have been required to carry either mobile toolkits or stockpile residential localities with future supplies of raw materials. Understanding the signatures of mobile (curated) toolkits versus locally produced assemblages can allow for a better understanding of the different landscape activities Middle Palaeolithic hominids employed.

This paper presents the results of a techno-typological analysis of material from two sites in the Wadi el-Mughara, Israel—Tabūn and Skhul. Quantitative analysis of unifacially retouched scrapers supports the reuse and recycling of stone tools in Tabūn B, while Tabūn C and D and Skhul B1 and B2 lack evidence for similar raw material economies. By integrating an economically oriented analysis of unretouched débitage with the scraper analysis, it is possible to view the reuse of stone tools in these sites as organized by the tool-using hominids' differing mobility strategies. Since these two sites contain residues associated with both Neandertals and early modern *Homo sapiens*, such conclusions can provide insights on Upper Pleistocene human evolutionary scenarios.

Middle Paleolithic zooarchaeology: hyenas and hunters at Prolom II

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Prolom II, a stratified archaeological cave deposit located in the eastern Crimean Peninsula, Ukraine, dates to the early Würm. Stone tool industries from four human occupation levels are characteristic of the Middle Paleolithic. Abundant faunal material is dominated by saïga antelope, horse, bison, hyena and fox. This zooarchaeological investigation, discerning between natural and cultural modifications of the animal bones, examined approximately 4000 faunal specimens. The primary goal was elucidation of the human patterns of exploitation of faunal resources in prehistoric subsistence.

The high proportion of carnivores suggests that some of the faunal material is present as a result of non-human agents. Morphological characteristics, such as gnawing marks and punctures, were abundant on most skeletal elements of the herbivorous species. Bone destruction patterns were consistent with carnivore and scavenger behaviour as documented in modern comparative studies. Stone tool cut marks were present and identifiable under microscopic examination on six specimens of saïga antelope.

Our preliminary conclusion is that the site was occupied alternately by a variety of carnivores, primarily hyenas and occasionally humans. These occupations were probably short-term stays, and the deep stratigraphic deposits represent accumulations over very long periods of time. We cannot assign more than a few of the faunal specimens to human

hunting or modification, despite the large number of stone tools present at the site. In fact, the densest and highest frequencies of stone tools occurred in the same levels as the greatest frequencies of hyena bones, which are very unlikely to represent human prey. The human contribution to the faunal assemblage appears to be minimal, and the entire collection of bones cannot be used to characterize human subsistence patterns. This is consistent with a growing literature that reassesses the role of humans in the accumulation of animal bones in a variety of kinds of archaeological sites.

Unique *vs*. non-unique aspects of Neandertal upper respiratory anatomy

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The last three decades have seen considerable discussion of Neandertal upper respiratory tract specialization principally focusing on scenarios for climatic adaptation and speech capacity. From this, a number of traits in the internal nasal fossa and ectobasicranial region have been pointed to as possible Neandertal autapomorphies absent in all other hominids. These purported Neandertal specializations and their behavioural and taxonomic implications have remained speculative and controversial. This paper presents the results of a comprehensive morphometric analysis of the internal nasal fossa and ectobasicranial region in Neandertals compared to a large range of fossil and recent human samples from Europe, the Near East and Africa.

Various linear measures of internal breadths, depths and heights throughout the nasal fossa, and discrete measures of internal nasal floor configuration (i.e., ranging from smooth to strongly bilevel) fail to differentiate Neandertals from other hominids. Neandertals either align with non-Neandertal archaic humans along a shared size vector, and/or with early modern humans in aspects of shape that are theoretically predicted from airflow mechanics in varying ambient conditions. Only one linear measure places every sufficiently preserved Neandertal specimen in a unique position relative to virtually all other hominids: extremely low values for the subtense from the basion-staphylion chord to hormion (BSHS). This approximates a measure of ectobasicranial flexion previously noted by Laitman and colleagues. In non-Neandertal hominids BSHS is positively correlated with internal and external nasal heights and nasal bridge projection, however, Neandertals depart markedly from this pattern in a negative direction.

Thus, while Neandertal internal nasal fossa anatomy provides no evidence for specialization, the ectobasicranial region does. The latter result seems to lend additional support to scenarios involving speech limitations among the Neandertals. However, alternative explanations involving differential development in neurocranial and facial growth fields is equally or even more likely.

Qafzeh-Skhul, West Asian ''Neandertals'' and modern human origins

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Previous work has suggested that the earliest modern humans in Europe (the so-called ''Cro-Magnons'') were characterized by tropically adapted, or ''African-like'' body

proportions, which supports the ''Replacement'' model of modern human origins. If, however, population replacement of archaic *Homo sapiens* by African modern humans occurred throughout the Late Pleistocene Old World, then we should expect to find African-like body proportions in the earliest modern humans in Western Asia, as well. This study uses West Asian Late Pleistocene body shape data to test two hypotheses. The first is whether the earliest (presumed) modern humans in the Levant (the Qafzeh-Skhul hominids) were characterized by tropically adapted, or African-like, body proportions. The second is to test whether the Qafzeh-Skhul hominids represent a biologically taxonomically distinct population from the ''Neandertals'' found at sites such as Amud, Kebara, Tabūn, and Shanidar, versus the ''Multiregional Evolution'' interpretation that all West Asian Late Pleistocene hominids are members of a single, highly variable population.

Multivariate analyses (PCA of log-shape transformed data and linear discriminant functions) indicate that the Qafzeh-Skhul hominids have African-like, or tropically adapted proportions, while those from Amud, Kebara, Tabūn, and Shanidar have more European-like, or cold-temperature adapted proportions. This finding is corroborated by the work of other paleontologists (Brace, Churchill, Ruff, and Trinkaus), and, importantly, by zooarchaeological analyses which indicate a strong Afro-Arabian component in the Qafzeh faunal collection (Tchernov, 1988, 1992; Rabinovich and Tchernov, 1995). This suggests that there are in fact two distinct populations in Late Pleistocene Western Asia, and that the early modern humans from Qafzeh and Skhul were likely African in origin—a result more consistent with the ''Replacement'' model than its rival ''Multiregional Evolution'' counterpart.

Variety in the paleoenvironment of early *Homo erectus* of Java, Indonesia

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The Plio-Pleistocene geology of eastern Java provides insight into the paleoecology of early *Homo erectus*. The connection between geology and paleoecology is found in the lithofacies and biofacies of the hominid-bearing formations and correlative geologic units. The facies indicate that the 125 by 250 km area of known hominid fossil occurrence contained volcanic mountains, calcareous uplands, broad river valleys, sandy river courses, a large lake/lagoon, a coarse-clastic marine delta, and the muddy/calcareous shorelines of a marine embayment during the Plio-Pleistocene. *H. erectus* presumably frequented these paleogeographic districts, as well as a volcanic coast and the Indian Ocean shore that were located nearby. This complex of physical conditions undoubtedly supported a diverse set of ecosystems—it does so in modern Indonesia—and the homeland of early *H. erectus* evidently offered many potential hominid habitats. Diverse habitats are suggested by the contexts of hominid discoveries. For example, the Perning Mojokerto fossil, the easternmost *H. erectus* known and possibly the oldest hominid remains outside Africa (1.81 ± 0.04 Ma), is in a marine deltaic setting. By contrast, at Sangiran Dome 180 km west of Perning, *H. erectus* remains have been found in lacustrine and fluvial deposits. Although often linked to a few ecosystems, early *Homo* may have had more flexible ecological behavior than is normally supposed. In any event, the geology of eastern Java prompts a reexamination of our

assumptions about the range of environments that hominids occupied in the Plio-Pleistocene and adaptations that they possessed.

By a preponderance of the evidence, the Neanderthal upper respiratory tract differed from that of living humans

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The nature of the Neanderthal upper respiratory, or ''aerodigestive'', tract has played an important role in reconstructing their behaviors and evolution. Whether or not aspects of the region (e.g., hyoid morphology, hypoglossal canal size) fall within ranges for modern human populations has generated considerable discussion with differing views expressed. There are, however, current lines of research which indicate that key elements of the Neanderthal upper respiratory region would have differed from those of extant populations. Our ongoing developmental, comparative and experimental research in cranio-facial biology, for example, has shown that the external contour of the basicranium is closely linked to the morphology of the upper respiratory tract and can thus be a valuable guide in its reconstruction in fossil hominids such as Neanderthals. In this vein, studies have demonstrated Neanderthal basicranial differences from both living humans and some other later Pleistocene hominids, suggesting corresponding differences in overall configuration and placement of structures such as the larynx, pharyngeal constrictors, eustachian tube or tongue. Moreover, our new comparative and CT-imaging analyses of the piriform aperture, internal nasal cavity, and paranasal sinuses are increasing understanding of these crucial, yet poorly investigated respiratory components. Our assessments of potentially apomorphic features in Neanderthals, such as a uniquely derived internal nasal margin, may well reflect specialized respiratory functions/physiologic activity. Similarly, studies of the comparative anatomy of external and middle ear components such as the ossicles (Masali *et al.*, 1991), have suggested differences in the physics of sound reception and what this implies about the speech producing mechanism. Research on semicircular canal orientation (e.g., Spoor & Hublin, 1997), a critical determinant of head position which is intimately tied to aeration and respiratory tract fluid drainage, provides strong evidence to support apomorphies in this region as well. When data from these varying approaches are considered together, the picture that emerges is of a suite of head and neck features which appear different in Neanderthals. The collected weight of the evidence thus supports the interpretation that upper respiratory related functions in Neanderthals (be it for respiration, aeration, deglutition, pressure control, sound reception or vocalization) would have differed from such activities in living humans. To borrow from legal dictum, while we can not establish ''beyond a reasonable doubt'' that Neanderthal upper respiratory tracts differed from ours, it does seem that their distinctiveness is supported by a ''preponderance of the evidence''.

Identifying ecological niche from $^{13}C/^{12}C$ and $^{18}O/^{16}O$ ratios in enamel carbonate: results of a modern pilot study and application to extinct fauna

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Stable carbon isotope analysis of fossil tooth enamel carbonate is an established tool for paleodietary reconstruction, while phosphate-based $^{18}O/^{16}O$ studies have been mainly directed at establishment of paleotemperature climate proxies. Recent studies of fossil enamel suggested firstly, that variation in $^{18}O/^{16}O$ ratios amongst different species of fauna is patterned in predictable ways, and secondly, that biogenic $^{18}O/^{16}O$ ratios are retained in fossil enamel carbonate. However, little is known about the complex pathways of oxygen isotopes in modern African foodwebs. Here we report the results of a modern study of oxygen isotope pathways in faunal assemblages from two locations in southern Africa, one in Botswana, and the other in the Northern Province of South Africa, which differ in key environmental variables. We find that $^{18}O/^{16}O$ pathways are clearly complex, but in general patterned according to drinking behaviour, diet, and physiology. As a rule, herbivores that drink little (e.g., impala) are more enriched than those that drink frequently (e.g., alcelaphines); animals which tend to eat underground storage organs (e.g., warthogs) are somewhat depleted, while most primates and carnivores are clearly depleted. Isotope ratios in fossil fauna from the Swartkrans assemblages reveal similar patterns. The combined data separate the behaviour of somewhat similar co-existing species. For instance *Papio robinsoni* and *P. (D) ingens* in Swartkrans Member 1 have identical $^{13}C/^{12}C$ ratios but the latter are enriched in ^{18}O, leading us to suggest that their major dietary focus was folivory. We believe that combined carbon and oxygen isotope analysis of faunal assemblages with high numbers of extinct species will help to clarify the ecological niche of many enigmatic species, and at the same time provide greater information about environmental conditions.

Implications of mosaic evolution in non-primate taxa for understanding changes in hominid behavioral ecology

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Ecological relationships between hominids and other species played an important role in hominid evolution. Hominid behavioral models for specific sites or regions must include the behavior of species found there. Most models account for differences in behavior between extinct and extant species, but few take into account that substantial behavioral differences may occur between congeners and that the behavior of modern species may differ from the past behavior of that species/genus.

Our research on the ecomorphology of the spotted hyena genus *Crocuta* indicates that *Crocuta* has changed radically in behavior since appearing $\sim 3{\cdot}7$ Ma. The earliest species

was similar in behavioral ecology to extant brown hyenas. Bone-cracking capabilities improved by 1·9 Ma, but without the enhanced flesh-slicing features indicative of predatory behavior seen in *Crocuta* today. Morphology of the limbs and axial skeleton suggests that this intermediate species did not possess the unique transport capabilities of modern *Crocuta*. The modern species appears after 0·9 Ma. Thus, the spotted hyena behavioral complex did not evolve until long after many of the key changes in hominid dietary behavior. The implications of this for modeling hominid behavior will be discussed.

Due to mosaic evolution, behavioral changes through time cannot be understood unless all skeletal elements are studied. Therefore, the identification of both craniodental and postcranial material of non-primate taxa to the most restrictive taxon possible is crucial for paleoecological research. Understanding the total morphological pattern of species from a given site and time provides a means for testing hypotheses of hominid behavioral opportunities based on actualistic and other studies.

Shape measurements of the early hominid cranial base

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The taxonomic status of Sts 19 has been a subject of considerable debate for years. Studies using metric and non-metric features of the posterior cranial base have suggested affinity with either early *Homo* or *Australopithecus africanus*. We use ''Mossiman'' shape variables to compare the posterior cranial base of Sts 19 to that of fossil hominid crania from East and South Africa and to comparative samples of *Pan*, *Gorilla* and modern humans. These variables have been found to be quite useful for analysis of allometric and non-allometric shape variation.

Two measurements of cranial base width (bi-foramen ovale and bi-stylomastoid) and a length measurement (stylomastoid foramen–foramen ovale, average of right and left sides) were transformed into shape variables. For each cranium, individual measurements were logged (to base 10) and divided by the log–geometric mean of all three measurements. This procedure yields shape variables that can be used separately or in combination.

Two of the shape variables effectively discriminate among extant and fossil crania. Relative bi-stylomastoid width is greater in humans than in African apes. In terms of this dimension, Sts 19 and two East African crania (KNM-ER 3883, KNM-WT 15000) are above the 95% range for African apes and within the modern human range. The other two South African crania (Sts 5, MLD 37/38) and KNM-WT 17000 are below the 5% range for modern humans and within the African ape range.

In terms of relative length (stylomastoid foramen–foramen ovale), two crania (Sts 19, KNM-ER 3883) are close to the mean for modern humans and below the 5% range for *Pan* and *Gorilla*. Species differences in shape variables defined by neural foramina may reflect differences in brain size and shape.

Supported by NSF Dissertation Improvement Grant SBR-9634155.

Anatomy, context, age and affinities of hominids from the Kapthurin Formation, Baringo, Kenya

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The Kapthurin Formation is a fossiliferous sequence of fluvial, lacustrine, and volcanic rocks, spanning the period from ca. 600 Ka to ca. 200 Ka, exposed in the Rift Valley west of Lake Baringo, Kenya. Two hominid mandibles (KNM-BK 67, KNM-BK 8518) and associated postcrania (an ulna, KNM-BK 66; two phalanges KNM-BK 64, 65; and a right first metatarsal KNM-BK 63) have been recovered by previous workers from sites in fluvial sediments in the middle part of the formation. Our program of $^{40}Ar/^{39}Ar$ dating now provides bracketing dates for the hominid fossils: ca. 500 Ka for a grey tuff unit (GT) that overlies them, and ca. 600 Ka for an underlying pumice tuff unit (K2). The Kapthurin hominids have been attributed to *Homo erectus* or to ''archaic *H. sapiens*'' by earlier workers. Reexamination of the previously described Kapthurin ulna and mandibles, as well as study of the undescribed phalanges and metatarsal, confirms an impression of archaic morphology comparable to that of the Mauer mandible (*H. heidelbergensis*), but also reveals some similarities with the earlier Pleistocene specimens of *H. ergaster*, such as KNM-ER 992 and KNM-WT 15000. Over thirty archaeological and paleontological sites are now known from the Kapthurin Formation as a whole. Our faunal collections in the part of the section containing the hominids has produced specimens representing open, perhaps arid conditions (e.g., *Oryx*), as well as others indicating more closed habitats (e.g., *Kobus*, *Cricetomys*). The fossils in these sites are associated with small channel features, a series of paleosols, and rare artefacts. About 1 km to the east, penecontemporaneous sites are associated with the shore of an ancient alkaline lake. These sites contain aquatic fauna including *Clarias* and *Hippopotamus*, as well as stone artefacts of a small flake-based industry that lacks handaxes.

Faunal dating of southern African fossil assemblages: a reflexive test

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In order to postulate and test dates for southern African faunal assemblages, all shared species of large mammals from the Plio-Pleistocene of East Africa were used to delineate time ranges for the southern fauna. Initial age approximations were determined as the midpoint of the time range encompassing the maximum number of contemporaneous shared species. Dates were then calculated with a weighted factoring of species falling outside that time range. Three sets of dates were created: (1) direct dates from analysis of shared East African fauna; (2) dates adjusted for southern African faunal seriations and site stratigraphy; (3) maximum dates for the southern African assemblages.

In order to test these dates, a reflexive approach was used in which the southern African fauna were used to calculate dates for East African assemblages; these estimates were then compared to known radiometric dates. Only assemblages with more than five shared species were tested.

The reflexive ages from the direct approach had an error range of 0–700 Ka with a mean error of 200 Ka. The adjusted dates yielded an error range of 0–600 Ka with a 195 Ka mean error. In most cases the ages of the East African assemblages were underestimated; to test if this was an artefact of the analysis, maximum dates for southern African fauna were used. This yielded a small improvement in accuracy in reflexive dating, but still most East African assemblage ages were underestimated.

It is concluded that most proposed faunal dates of southern African assemblages probably fall within 200 Ka of the actual ages. The underestimates from the reflexive dating of East African assemblages are likely attributable to biogeographic differences, due to later appearances of most species, including the hominids, in southern Africa.

''Acculturation'', ''co-existence'' and the end of the Neanderthals

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Most recent models of the process of replacement of Neanderthals by anatomically modern populations in Europe have posited a prolonged period of coexistence, potential interaction, and various forms of ''acculturation'' between the two populations—with the French Châtelperronian generally being cited as a classic illustration of this. Recently this model has been vigorously challenged [d'Errico *et al.*, 1998 *Current Anthropology*, **39**, (Suppl.) 1–44 June 1998] with a range of arguments that the supposedly ''acculturated'' industries are in fact entirely earlier than the first appearance of anatomically and behaviourally modern populations in western Europe. This in turn has fundamental implications for our understanding of the whole processes of the emergence of characteristically ''modern'' behaviour—and its cognitive implications—and the demographic and other processes by which the European Neanderthals eventually became extinct.

The aim of the present paper is to re-examine these issues in the light of new dating evidence for the chronology of the final Neanderthal and earliest modern populations in Western Europe. It will be shown that a chronological overlap of at least 3000–5000 years can be firmly documented, allowing ample time for various forms of contact and interaction between the two populations. This in turn implies that most if not all of the ''new'' elements in the behavioural repertoire of the final Neanderthals emerged only *after* the appearance of behaviourally modern populations in northern Spain and the adjacent Mediterranean coast. Models will be presented as to how this coexistence of the two populations was related to the occupation of largely discrete territories, with contrasting ecological conditions and associated economic patterns. The relevance of these patterns to the eventual demise of the Neanderthals will also be discussed.

Quantifying bone modification by African wild dogs and spotted hyenas: implications of models estimating the timing of hominid and carnivore access to animal carcasses

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The paper is an experimental treatment of carnivore bone modification with two inter-related objectives that have implications for the archaeology of human origins. First, tooth marks produced by captive African wild dogs (*Lycaon pictus*) and by captive spotted hyenas (*Crocuta crocuta*) are compared to quantify the range of variation and dimensional overlap between the marks. A prediction is that the smallest marks produced by *C. crocuta* will be indistinguishable from those produced by *L. pictus*, and that other carnivores (e.g., jackals, felids) should be studied under controlled conditions. As Bunn has observed, if paleoanthropologists wish to entertain species-specific scenarios on the ecology of hominid–carnivore interactions, we must be able to identify at least the body size of the responsible carnivore. Second, captive *L. pictus* will be provisioned with long bones that have been defleshed and broken for marrow, simulating secondary access to hominid-processed bones. The purpose is to test Blumenschine's ''spotted hyena'' model using a differenct carnivore species. The model, independently confirmed by Marean, shows that the frequency of tooth-marking on mid-shaft fragments is low ($\sim$10–15%) when hyena access is secondary and high ($\sim$70%) when access is primary. But how will other, especially smaller, carnivores treat processed bones? What if hungry canids consider mid-shaft specimens from defleshed and broken long bones worth chewing or, at least, mouthing? Coupled with the expectation of dimensional overlap between tooth marks created by carnivores of different body sizes, analysts may no longer be justified in plugging all carnivore tooth marks (especially the most inconspicuous) into Blumenschine's model without qualification. On the other hand, it should be possible to establish statistical relationships between tooth mark size and anatomical attributes of skulls and teeth for extant carnivore Families, and, possibly, to directly infer carnivore body size and/or taxa from tooth-marked fossil faunas.

Evaluating the archaeological evidence for a Lower/Middle Paleolithic division in Western Europe

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While the Middle/Upper Paleolithic transition of Western Europe has been the focus of much research and debate, little attention has been paid to the nature of the Lower/Middle Paleolithic transition. However, as the number of radiometrically-dated assemblages grows, the traditional, typologically-defined basis for a division between the Lower and Middle Paleolithic is weakening. This issue is examined here in light of three separate lines of evidence. First of all, a critical synthesis of published archaeological data is used to analyze the patterns of archaeological change throughout the Middle and early Upper Pleistocene in Western Europe. Specifically, the chronological dimensions of lithic industrial variability during this time are examined. Second, the notion that retouched flake tools become more

standardized through time is tested. This test is applied to Middle and Upper Pleistocene assemblages from the French sites Orgnac III, La Chaise, and Combe-Grenal. Finally, the creation and reification of the Lower/Middle Paleolithic division is discussed in historical perspective, which shows that the definition of these two periods, far from being well-established, has been plagued by inconsistencies from the very beginning.

These three lines of research indicate that the differences between so-called Lower and Middle Paleolithic stone tool assemblages in Western Europe are far less significant than has traditionally been assumed. The notion that there is a clear diachronic pattern to lithic industrial variability is challenged, and it is instead suggested that culture change during this time is mostly synchronic and mosaic in nature. These results bear important implications for our understanding of the nature and tempo of human biological and behavioral evolution.

Hofmeyr and the origin of anatomically modern South Africans

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The nearly complete human cranium from Hofmeyr, in the Eastern Cape Province of South Africa, was discovered over 40 years ago but has not been fully prepared or published. The preservation of the specimen and the archaeological context of the site indicates a late Pleistocene age, but this date still requires confirmation.

The morphology of the Hofmeyr skull presents a mixture of both archaic and modern morphology. The conformation of the zygomatic, the steeply rising frontal and the general form of the cranial vault are anatomically modern and have similarities to modern Khoisan populations. Despite this, the supra-oribital and mid-facial regions are distinctly archaic. In many ways the Hofmeyr frontals are more archaic than the specimens from Klasies River Mouth or Border Cave.

The importance of Hofmeyr is that this specimen may very well be the key to understanding the transition from archaic to modern forms in southern Africa. Most Late Pleistocene African specimens are fragmentary and arguments about their archaic or modern nature are equivocal. The relatively good preservation of the Hofmeyr skull has the potential to identify both the nature of the anatomical transition to modernity and the antiquity of the aboriginal Khoisan of southern Africa.

Shlyakh—a new Middle Paleolithic site in the South Russian Plain

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The excavations of the Middle Paleolithic workshop of Shlyakh, situated 112 km northwest of Volgograd in the Middle Don region of Russia, were started by P. Nehoroshev in 1990–91, and, following a break, resumed by the authors in 1998. Shlyakh is an open-air site located on a source of flint nodules and slabs of which have been found eroding out of Carboniferous limestone outcrops. The site is delimited to the north, west and south by a

deep bend in the dry Panica ravine, the bottom of which lies 8–10 m below the surface of the site. The thickness of the Quaternary deposits reaches 6 m. The stratigraphy consists of eight principal layers, each of which can be further subdivided into smaller units (from two to four). The overwhelming majority of archaeological objects were found in layers six (buried soil) and seven (sandy loam) at a depth of 4–5 m below the present surface. The main assemblage includes about 2500 lithic artefacts, represented primarily by cores, flakes, and blade fragments. The analysis of blanks suggests that the assemblage contains elements of both Middle and Upper Paleolithic technology. The retouched tools (about 50) consist of side-scrapers, backed knives, ''Proto-Kostenki'' knives, unifacial points, atypical burins and end-scapers, and truncated–faceted pieces. The absence of bifacial tools distinguishes the industry of Shlyakh from most Middle Paleolithic sites of the Russian Plain. The low percentage of tools (2·6%) confirms the supposition that the site served primarily as a workshop. Faunal remains are not numerous. The analysis carried out by A. K. Kasparov has revealed that the fauna is dominated by steppe bison. Palynological data may prove to be more helpful in reconstructing the paleoenvironmental conditions on the site. Pollen samples taken in 1998 are now under study. The geological and absolute age of the site is still unclear, but it is hoped that several TL and C-14 analyses which are now in progress in different labs will answer this question.

Can grandmothering explain the evolution of *Homo erectus*?

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Despite recent, compelling challenge, the evolution of *Homo erectus* is still commonly attributed to big game hunting and/or scavenging and family provisioning by men. Here we use a version of the ''grandmother'' hypothesis to develop an alternative scenario; that climate-driven adjustments in *female* foraging and food sharing practices, possibly involving tubers, favored significant changes in ancestral life history, morphology, and ecology leading to the appearance, spread, and persistence of *H. erectus*. Available paleoclimatic, environmental, fossil, and archaeological data are consistent with this proposition; avenues for further critical research are readily identified. This argument has important implications for widely-held ideas about the recent evolution of long human lifespans, the prevalence of male philopatry among ancestral hominids, and the catalytic role of big game hunting and scavenging in early human evolution.

Postcranial differences between the earliest modern humans and recent people

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Multivariate analyses of postcranial remains show that the Early Modern humans from the Israeli sites of Qafzeh and Skhul differ substantially from recent (Holocene) populations. This report examines the features responsible for the differences and their implications for modern human origins.

A data set was gathered of 122 dimensions of the postcrania of the Skhul-Qafzeh hominids and nine recent human groups which differ in geographical origin, subsistence practices, and climatic adaptations: Canonical variates analyses (CVAs) assessed the distinctiveness of the Early Modern human skeletons. Except for Qafzeh 9, all of the well-preserved Early Moderns differ significantly from the recent groups. To explore this contrast between Early Modern and recent humans, the measurements of each partial skeleton were compared to the nearest recent groups from CVAs or groups that closely match the fossils in probable climatic adaptations or lifestyle.

Most of the recent populations have considerably shorter average stature than the Early Moderns. However, differences in long bone shaft shape and robusticity also contribute to these instances. Variations in long bone midshaft shapes almost certainly derive from differences in habitual activity and are not phylogenetically informative.

Other features that distinguish Skhul-Qafzeh hominids from recent humans may be useful phylogenetic characters if they do not develop in response to habitual activities during life. These features include a remarkably straight radius (except in Skhul VII), a low ulnar coronoid process, a dorso–palmarly flat proximal articular surface of metacarpal I, a long biomechanical neck of the femur, and a short talar neck. Only the first metacarpal articular morphology and short talar neck could indicate Neandertal ancestry (or more ancient common ancestry); the other traits are plesiomorphies or Skhul-Qafzeh apomorphies.

Supported by the Wenner-Gren Foundatoin, the Boise Fund, and NSF IBN-9603833 (to Daniel Lieberman).

Stone tool cut marks on Stw 53, an early hominid from Sterkfontien, South Africa

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Stone tool cut marks on Stw 53, a Plio-Pleistocene hominid partial cranium from Sterkfontein Member 5 (Gauteng, South Africa), constitute the earliest unambiguous evidence that hominids disarticulated the remains of one another. The cut marks occur on the inferolateral aspect of the zygomatic process of the right maxilla. The position of the cut marks—a pattern that has been observed on a wide range of butchered mammalian species—is consistent with incision of the masseter muscle, presumably to remove the mandible from the cranium. It is not possible to infer the reason(s) for the intentional removal of the mandible of Stw 53. This evidence extends deeper into prehistory a pattern of tool assisted, hominid-on-hominid carcass reduction that is also evident in more recent stages of human evolution.

Supported by the NSF SBR-9614930 (to T.R.P.), the Wenner-Gren Foundation, No. 6109 (to T.R.P.), the University of Wisconsin Natural History Museums Council (T.R.P.), and the Harry Frank Guggenheim Foundation (T.D.W. and N.T.).

Reconstructing Oldowan hominid paleoecology

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The late Pliocene of Africa is notable for the appearance of two new hominid genera (*Homo* and *Paranthropus*) as well as the earliest archeological traces. These appearances may reflect novel hominid adaptive responses to both a changing resource base over geologic time as well as an increasingly seasonal distribution of food over the annual cycle. While regional environmental change has been documented during the Plio-Pleistocene of East Africa, it is difficult to resolve what the relative proportions of specific habitats were at a given place and time, and how these proportions may have changed over time. Detailed reconstructions of paleohabitats based on paleontological and geological evidence are necessary in order to better understand the interplay between environmental change and hominid biological and behavioral evolution.

Here we use antelope and swine postcranial ecomorphology as well as stable isotopic analyses of tooth enamel and paleosol carbonates to evaluate Oldowan hominid paleoecology, with a focus on hominid activities at Bed I Olduvai Gorge, Tanzania and Kanjera South, Kenya. This use of complementary methodologies at multiple localities provides a more accurate assessment of the range of variation in Oldowan hominid habitat usage. Information about habitat structure and hominid foraging ecology is drawn from ecomorphic analysis of archeological fauna. Stable isotopic analysis of pedogenic carbonates provides an indication of vegetation structure at points on the landscape where archeological accumulations formed. Ungulate dietary preferences are reconstructed through stable isotopic analysis of enamel. Taxon-based paleoenvironmental reconstructions are carried out following the characterization of the habitat and dietary preferences of extinct taxa. Results provide a refined understanding of the paleoenvironmental settings of these localities and assist in the interpretation of Oldowan hominid paleoecology and behavior.

Hominid responses to Pleistocene paleolandscapes, Olorgesailie Formation, Kenya

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Excavation and stratigraphic observation of five broadly exposed stratigraphic layers, dated 990 to 650 ka, have been conducted in the Olorgesailie Formation, southern

Kenya rift valley. Generally rich in fossils and stone artefacts, these strata represent paleolandscapes, or narrowly defined intervals (single paleosols or sandy units) that can be traced laterally over extensive areas (typically 0·1–10 km^2). The paleolandscape approach was developed to systematically evaluate spatial co-variations between ecological parameters and evidence of hominid activity. Each target interval integrates a variable amount of time over which climate, vegetation, and sedimentary processes altered a landscape inhabited by hominid toolmakers and other animals. Based on radiometric dating and sedimentary characteristics, each paleolandscape represents a period between 10 and 1000 years, and exhibits a unique set of topographic gradients and environmental features (channels, mudflats, soil development). Stone artefacts and fossil animal bones were non-randomly distributed across the paleolandscape in each interval. Artefact–bone clusters were up to 293 times more densely concentrated than the laterally equivalent background scatter. A clumped but continuous distribution of artefacts and fossils in upper Member 1 (990 Ka) contrasts with highly patchy distributions in lower Member 7 (700 Ka). Comparisons between Members 1, 7 and 11 (650 Ka) demonstrate that the degree and patterns of artefact–bone concentration are independent of estimated degrees of time-averaging. The contrast between Member 1 and later periods of Olorgesailie also appears to be unrelated to other taphonomic factors and likely reflects a real change in hominid behavior. The change involved more strongly focused placement of specific artefact forms, especially bifaces, in particular areas of the landscape. The behavioral shift, in some instances, may be related to specific environmental features, including channels and sandy lobes on lake margin mudflats.

Middle Paleolithic human remains from Valdegoba Cave (Huermeces, Burgos, Spain)

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In 1987 systematic excavations were undertaken at the cave site of Valdegoba in northern Spain, near the city of Burgos. These excavations yielded several human remains of Pleistocene age as well as abundant Middle Paleolithic stone tools and faunal remains. The most complete and diagnostic of the human remains is represented by an adolescent mandibular fragment preserving the symphysis and numerous teeth. Additional remains include: a set of ten deciduous teeth corresponding to a single individual, an immature right fourth metatarsal, an adult left fifth metatarsal and the distal half of a left proximal manual phalanx. A date of 70 Ka was obtained at the top of the stratigraphy, representing a minimum age for all the human remains.

The adolescent mandible shows a mixture of mainly plesiomorphic as well as a few Neandertal characteristics. These include: the lack of a true chin, a mental foramen located under the P4, presence of a pronounced planum alveolare, presence of both superior and

inferior transverse tori, flattening of the curvature of the anterior dentition and a non-taurodont postcanine dentition. Based on the dental formation stages of the preserved teeth, the mandible belongs to an individual who was about 14 years old at the time of death.

The deciduous dentition preserves ten teeth, and based on dental formation stages, as well as comparison with the Shanidar 7 Neandertal infant, an age at death of 6–9 months seems most appropriate. Among the postcranial elements, the hand phalanx shows a relatively broad head and the metatarsals show relatively high robusticity indices.

In sum, the human remains from Valdegoba cave are not inconsistent with a Neandertal classification.

Reconstructing locomotor behavior in early hominids: evidence from primate development

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Reconstructing locomotor behavior in early hominids has become complicated by a philosophical difference in how to interpret primitively retained morphology such as curved phalanges. One view argues that, as a feature inherited from an ancestor, phalangeal curvature does not necessarily reflect arboreal hand or foot use in the clearly derived, bipedal early hominids. The other view maintains that morphology, whether primitively inherited or newly derived, reflects the mechanical activities of daily life. This issue is examined here by documenting whether growth-related changes in phalangeal curvature are associated with changes in locomotor behavior during growth.

Gorillas and macaques (*Macaca mulatta* from Cayo Santiago) are fairly arboreal early in life, but become increasingly terrestrial as they reach adulthood. Gibbons and most orang-utans, on the other hand, are essentially arboreal throughout life. Humans offer an interesting contrast in that they do not habitually use their hands in arboreal settings. Included angle was calculated for the third ray in ontogenetic samples of *Gorilla gorilla* ($n=80$), *M. mulatta* ($n=169$), *Hylobates lar* ($n=81$), and *Homo sapiens* ($n=123$).

Fetal macaque phalanges are slightly curved, followed by a rapid increase in curvature in infants, then a significant decrease over the same years in which terrestriality is increasingly favored over arboreality. A similar significant decrease in curvature with age is observed in gorillas. In gibbons, moderate curvature is evident prior to birth, followed by the rapid acquisition of greater curvature with the onset of locomotion that does not change significantly throughout growth. Interestingly, phalangeal curvature in a Coalescent Native American human sample shows little change early in life, but increases during childhood and early adolescence, perhaps associated with increasing use of the hands in mechanically demanding activities involving grasping. The sensitivity of phalangeal curvature to functional use in extant primates suggests that it faithfully reflects arboreal use in early hominids.

New discoveries of hominid-modified bones from the Koobi Fora Formation, Kenya

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Recent surveys and excavations in Okote Member (1·64–1·39 Ma) deposits in the Koobi Fora Formation (East Turkana, Kenya) have focused on new archaeological localities yielding relatively dense accumulations of bones with breakage patterns and surface modifications diagnostic of stone tool-using hominids. These new finds effectively double the current sample of well-preserved stone tool-modified bones from the Koobi Fora Formation. We interpret these new archaeological occurrences as a result of *H. ergaster* behavior.

In this paper, we first describe the general character of these new occurrences, placing them in spatial and temporal context. We then present analytical data and observations on collected samples of modified bones from two different localities in Area 1A and Area 103 respectively. Preliminary results suggest that modified bones from several different taxonomic groups are represented, and there is a wide range of skeletal parts and anatomical locations with cut marks represented. We also report unique varieties of both stone tool cut marks and hammerstone-on-anvil percussion marks that expand our understanding of the morphological range of these marks. Finally, we consider these preliminary results in the context of specific hypotheses of *H. ergaster* foraging behavior and ecology. For example, it has been suggested that the nature of stone tool cut marks, the incidence of long bone fracturing for marrow, and the taxonomic profiles of modified bones all vary among the subregions of East Turkana as a result of differences in hominid lithic curation and resource transport. Our data are directly relevant to these observations, and we will suggest ways in which further research will most profitably proceed. In the future, we will be able to test behavioral explanations for these observed patterns with additional fieldwork and lab analysis.

Paleoenvironment of Allia Bay, East Turkana, Kenya 3·9 Ma: the stable isotope data

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Ecological information on the Pliocene Turkana basin is critical for evaluating hypotheses relating bipedal locomotion in *Australopithecus anamensis* (Leakey *et al.*, 1995 *Nature*, 376: 565–571) with subsistence strategies, as the latter would have been constrained by regional ecology. Although the site, situated near the perennial, ancestral Omo river, was moister than today (Feibel *et al.*, 1991 in: Harris, pp. 321–370; Coffing *et al.*, 1994, *AJPA* 93: 55–65), the ecological conditions away from the river are less clear.

We analysed fossil teeth (courtesy of Dr Meave Leakey of the National Museums of Kenya) and modern representatives of three faunal groups (giraffe, hippo, and suid) from the basin. The teeth were screened for diagenetic alteration prior to analysis of carbon and oxygen stable isotope composition of tooth enamel carbonate. Cathodoluminescence microscopy with ion probe analysis showed normal concentrations of P and Ca in all samples but marked variations in Mn, Fe, F, rare earth elements and crystallinity within and between teeth (Reeser *et al.*, 1999, AAPA poster session). Several of the fossil teeth were eliminated from isotope analysis based on these results.

Fossil teeth with minimal alteration had $\delta^{13}C$ and $\delta^{18}O$ values suggestive of conditions moister than today throughout the Pliocene Turkana basin. After correction for anthropogenic carbon input, modern tooth values are approximately 2–3‰ less negative in $\delta^{13}C$ and 6–9‰ more positive in $\delta^{18}O$ than the fossil teeth. These data are congruent with interpretations that the region supported a moist savanna woodland rather than the dry savanna woodland of today. Extant savanna chimpanzees in such regions (Schoeninger *et al.*, n.d.) feed on hard seeds in the dry season and we propose the same for *A. anamensis*.

Supported by Wisconsin Alumni Research Foundation and NSF SBR-9601532 (MJS).

Of isotopes and ecomorphology

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Bovids are among the most frequently utilized paleoenvironmental indicators, but little is known about the habitat preferences of extinct taxa. It is generally assumed that fossil bovids occupied the same habitats as their closest extant relatives. We test this assumption by reconstructing the diets of seven bovids from Makapansgat Limeworks, South Africa, since diet and habitat preference are linked. Ecomorphological and stable carbon isotope analyses are employed, allowing us to take advantage of the strengths, and overcome the weaknesses, of both. In most cases, fossil bovids had the same diets as their extant relatives, and probably occupied similar habitats. Some antelopines, however, seem to have been almost exclusive browsers, and not mixed feeders like their living counterparts. Therefore, the preferred habitats of these fossil species must remain in doubt. This is particularly significant because antelopines are commonly used as indicators of aridity.

Le Moustier 1, limb proportions and the ontogeny of the Neandertal form

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The Le Moustier 1 specimen, as the only adolescent Neandertal to preserve associated dental and postcranial features, is important because he allows an assessment of the relative development of Neandertal proportions and diagnostic features, giving us a much needed

window into the ontogeny of the adult Neandertal form. In this paper, we will assess the relative development of the postcranial skeleton of the Le Moustier 1 adolescent. The Le Moustier 1 postcrania possess a number of typical adult Neandertal features. For example, the radial tuberosity is placed medially, the radius is strongly curved, there is a prominent M. pronator quadratus crest on the ulna, and an anterior orientation of the trochlear notch of the ulna. Like adult Neandertals, the diaphysis of the Le Moustier 1 femur is robust, cylindrical, lacks a pilaster, has thick cortical bone and a relatively narrow marrow cavity. In addition, he has a distinctively large femoral head, a trait characteristic of male European Neandertals. Brachial, crural and robusticity indices yield conflicting results with regard to whether this adolescent had attained the distinctive adult Neandertal limb proportions. However, regression analyses demonstrate that by the dental age of 15.5 Le Moustier 1 already possessed the distal limb shortening which characterizes adult European Neandertals. Thus, for this trait Le Moustier is a scaled version of an adult male European Neandertal. It is clear therefore, that the analysis of the ontogeny of Neandertal skeletal proportions is complex, as limb lengths do not scale isometrically to each other in Neandertals and modern humans. This highlights the fact that the use of simple indices often masks underlying proportional relationships. A more detailed analysis of these and other limb proportions in comparison to several environmentally diverse modern human populations will be presented as part of this paper.

The Middle to Upper Paleolithic transition from the Levant to Central Europe: diffusion or *in situ* development?

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Across western Eurasia, newly published radiometric dates have given more support to the interpretation that the Middle to Upper Paleolithic transition had an east to west geographic progression. This paper investigates the significance of this trend by comparing the technological behaviors exhibited in 18 lithic assemblages from Central Europe, Eastern Europe, and the Levant dating between 60 and 30 Ka. The diachronic patterns of intra-regional and inter-regional change revealed in this analysis are tested against the hypotheses of *in situ* behavioral change versus behavioral diffusion/population movement as the dominant process by which the MP–UP transition appeared in each region.

The approach employed here is innovative because it samples assemblages within a specific time frame and applies a standardized analytical structure to all cases, thus avoiding the assumption that assemblages must fall within *a priori* categories such as ''MP'', ''Transitional'', or ''UP''. Further, this research contributes a unique theory-based treatment of the MP–UP transition by deriving model expectations for the two competing hypotheses from a combination of archaeological, history of science, and social anthropological theory regarding the problem of distinguishing diffusion from independent innovation. By testing the similarity between the regional patterns of diachronic change in lithic behavior between 60 and 30 Ka and the model expectations, the two hypotheses for the spread of the MP–UP transition are evaluated in each region. Thus, this research approaches processual explanation through historical reconstruction, a method which has

long been neglected in the field, and offers a new perspective on the origins of modern humans.

Pathology and persistence in the Pavlovian: paleopathology and mobility of Dolní Věstonice 15

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Since the 1986 discovery of a triple human burial at Dolní Věstonice II, there has been interest in the etiology of the abnormalities of the young adult Dolní Věstonice (DV) 15. DV 15 exhibits a perforated frontal sinus, orthodontic difficulties, pronounced M1 hypoplasia, moderate canine hypoplasias, sacrococcygeal fusion, large left conoid tubercle, medial curvature of the right humeral distal shaft, dorsal curvature and torsion of the left proximal radial shaft, irregular interosseus crest on the left distal ulna, low femoral neck angles, pronounced left femoral diaphyseal anterior curvature, and abnormal anterior curvature with medial tilting and retroversion of the proximal right femur. These are combined with osteoarthritis on the right glenohumeral joint (indicating excessive loading with the humerus in a parasagittal plane) and on the proximal interphalangeal joints of the right second and fifth manual phalanges. Whatever the ultimate etiologies of the abnormalities, the M1 hypoplasias and absence of radiographic evidence from fracture callus formation suggests that most of these changes were from infantile stress(es) with subsequent healing.

Despite these multiple (mostly developmental) changes, there is no evidence of debilitation. The upper limbs exhibit normal patterns of diaphyseal and articular asymmetry and shaft hypertrophy. The lower limbs, once distal of the proximal femoral abnormalities, are symmetrical in proportions and morphological details. Moreover, the femoral and tibial shafts and knee moment arms exhibit the locomotor hypertrophy of early modern humans. These data and the normal manual and pedal anatomy indicate an individual who participated actively in the economic activities and high mobility of the social group, once social care ensured survival. This is supported by the right upper limb osteoarthritis, which is best explained by loading from manual carrying and correlates with archeological indicators of mobility and material transport.

Supported by the Academy of Sciences (ČR) and the Wenner-Gren Foundation.

Stable isotope ratios of fauna and the environment of palaeolake Olduvai

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We have measured stable carbon and oxygen istope ratios in tooth enamel and ostrich eggshell from modern Tanzania and from palaeolake Olduvai to reconstruct the environment on the shores of the latter. The collection zones included the southwest Serengeti (Maswa) of 1998; Olduvai East, lowermost bed II (after 1·78 Ma); and Olduvai West, upper Bed I (after 1·83 Ma). Isotopic analyses were done in the Archaeometry Research Unit of

the University of Cape Town, using a Kiel II autocarbonate device and Finnegan MAT252 mass spectrometer.

After correction for industrial fossil fuel burning (which depleted biosphere $\delta^{13}C$ values by 1·5‰), the $\delta^{13}C$ values for similar species from the three collecting areas form a trajectory in which Olduvai West<Olduvai East<modern Tanzania. For alcelaphines, for example, the respective $\delta^{13}C$ values are 0·2, 2·2, and 3·2 per mil (1·5 has been added to the last, modern value of 1·7). These numbers indicate that the environment became progressively hotter and drier, leading to increased dominance of the grasslands by the NADP subtype of C_4 grasses. Ostrich eggshells show a trajectory of $-7{\cdot}0<-5{\cdot}6<-4{\cdot}3$ per mil, indicating a decrease in palatable browse over time. Ostriches prefer browsing, but have soft mouths that preclude thorny or scratchy bushes: a diet of pure browse would have yielded eggshell with $\delta^{13}C$ of about -10‰. The fauna of Olduvai East, which has been reconstructed as a wetland on sedimentary evidence, lived in a world dominated by C_4 plants: hippos ($\delta^{13}C=0{\cdot}7$‰), equids (0·1‰), and suids ($-1{\cdot}7$‰) were completely or largely dependent on C_4 plants, while crocodiles ($-2{\cdot}4$‰) and mid-size carnivores ($-2{\cdot}0$‰) were preying mostly on C_4 plant consumers. Tragelaphines like kudu are normally pure browsers and should have had $\delta^{13}C$ values of ca. -12‰; those of Olduvai East had values of $-5{\cdot}0$‰, indicating about 50% grass in their diets, much like kudu of the Kalahari Thornveld today.

Bone and ivory points in the Lower and Middle Paleolithic: A review of the evidence from Western Europe

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The existence of shaped bone and ivory points, to be used as awls or with wooden hafts, has been suggested for the Lower Paleolithic sites of Torralba and Ambrona and for several Middle Paleolithic sites, such as Vaufrey, Combe Grenal and Camiac. The use of hafted bone and ivory points would imply a spear armature technology similar to the well documented in the Upper Paleolithic, often considered an innovation introduced in Europe by anatomically modern humans.

The controversial ivory points from the two Spanish sites, whose fracture morphology is considered natural by G. Haynes, have been reanalyzed checking for putative traces of human manufacture as described by Howell and Freeman, that is, polish, flaking of stem, ground edges, striations from manufacture and contact with a haft or binding. We have been able to study 14 new tusk tips from the ongoing Ambrona excavations by a Spanish team. For these and the Middle Paleolithic points we use optical and SEM microscope analysis, comparative observations of Upper Paleolithic bone points, experimental observations of manufacturing traces, modern tusk samples, and data on pseudo-points from carnivore accumulations.

We show that none of the objects we have studied can be interpreted as an intentionally shaped point. We conclude that there is as yet no evidence in Western Europe of bone and ivory spear armatures befor the Uluzzian and Châtelperronian industries, at the very end of the Neanderthal period.

Our research shows that in the study of early bone tools we need to go beyond a simple morphological description. Human modifications should be documented by detailed microscopic analyses combining a variety of experimental, actualistic and taphonomic data, including knowledge of natural processes mimicking human artefacts.

Pre-Aurignacian reconsidered

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The analysis of so-called Pre-Aurignacian assemblages from Yabrud 1 (levels 15 and 13) leads to the conclusion that this industry is both typologically and technologically rather distant from Upper Paleolithic standards. At the same time, though not as advanced as it is sometimes thought to be, the Pre-Aurignacian provides a picture of what one might expect to observe in an ideal ''transitory'' Middle/Upper Paleolithic industry. The Pre-Aurignacian of Yabrud 1 is characterized by a nearly total disappearance of Lower–Middle Paleolithic tool types, while burins and end-scrapers (even if often atypical) become predominant. As to technology, in layers 15 and 13 of Yabrud blades represent almost the only type of blanks, while the overwhelming majority of flakes are by-products. Though the technology of blade production is not yet fully Upper Paleolithic in character, in most respects the blades themselves are closer to Upper Paleolithic than to Mousterian blanks. A comparison with several other Near Eastern assemblages (Tabun, Kzar Akil, Boker-Tachtit, Boker A, etc.) reveals that in all metrical characteristics, Pre-Aurignacian blades are closer to the ''transitional'' and/or Upper Paleolithic samples than to the Middle Paleolithic ones. Pre-Aurignacian together with the Amudian provide evidence of changes going towards blade-oriented non-Levallois (probably volumetric) blank production, light-weight tool-kits, more economic use of raw material, i.e., from Middle Paleolithic to Upper Paleolithic technology, and tool composition. However, neither the stratigraphic positions of the Amudian and Pre-Aurignacian nor their supposedly very old age favor the hypothesis that these industries might be the roots from which the later and true Upper Paleolithic cultures may have arisen. Both direct and indirect data support the idea of local, Yabrudian roots for the Amudian and Pre-Aurignacian. Taking into account both the stratigraphic position of these industries and their basic similarity in terms of direction of cultural transformation, it is reasonable to consider them contemporaneous and representative of a specific episode of a rather substantial (but reversible) change within the Yabrudian. The notion of an ''Intra-Yabrudian Episode'' and the designation of the Pre-Aurignacian and Amudian as the industries of this episode would seem appropriate on the basis of current evidence.