

Abstracts for the Paleoanthropology Society Meeting

**Westin Crown Center Hotel, Kansas City, Missouri, U.S.A.
27-28 March 2001**

Reconstructing Neandertal postcanine trait polarity: the cheek teeth speak

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This paper presents the results of a phylogenetic analysis of postcanine dental traits in Pleistocene and Recent human samples. The results challenge the view that the differences between Neandertal and modern human dental morphology lie primarily in their incisor variation. Moreover, they suggest that the Neandertal pattern is not the exclusive result of a combination of primitive retentions. This study builds on earlier studies and moves beyond standard scoring methods, which are based on modern humans. In so doing, it includes several discrete traits that have not been considered previously. It also goes one step further by exploring the polarity of the traits involved in the Neandertal dental pattern. Few have systematically explored the polarity of dental traits, which is essential to understanding the phylogenetic implications of Neandertal dental morphology. In addition to confirming an overall unique dental pattern, the findings of this study suggest the presence of Neandertal dental autapomorphies. These include a high frequency of the mid-trigonid crest in lower molars and unique morphology of the lower premolars. These data add to our growing knowledge of Pleistocene hominid dental variation and may ultimately be a useful guide for assessing the affinities of specimens of uncertain taxonomic affiliation.

Functional pattern of the *Australopithecus afarensis* hallux: architectural perspectives

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The degree of hallux abduction and opposability as well as the presence or the absence of a plantar arch have always been considered of major interest for the understanding of living primates locomotion. When Mary Leakey and collaborators discovered the Laetoli footprints (Tanzania) in 1978-1979, they exhumed the proof that a species of primate was able to walk bipedally 3.75 Ma. An early form of bipedalism has also been documented by contemporary fossil remains which are attributed to the species *Australopithecus afarensis*. In the debate concerning the way these early hominids walked on the ground, the organization of their hallux has been discussed and keeps being discussed. Our purpose is to add new architectural data to that debate focusing on the hallucal tarsometatarsal complex. The architecture of the *Australopithecus afarensis* hallucal tarsometatarsal complex is estimated by angular data, using the Hadar (Ethiopia) specimens. It is compared to those of a sample of 140 *Homo* (both actual and fossil), *Pan* and *Gorilla*. In *Australopithecus afarensis*, the architectural pattern is original in associating a flat medial foot and a slightly abducted hallux of which the cuneometatarsal joint is maintained in a frontal plane. It differs from the *Homo* one by a higher degree of abduction and to those of African apes by an abduction which is due to the obliquity of the metatarsal proximal joint area. This new architectural analysis strongly corroborates the originality of the *A. afarensis* foot. Using these architectural data and previous morpho-functional observations of the hallucal skeleton and the Laetoli footprints, an original functional pattern of the *Australopithecus afarensis* hallux is proposed, and locomotor implications are discussed. This work was supported by the CNRS, France.

ESR dating of an Acheulean quarry site at Isampur, India

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In the Hunsgi Valley, the Acheulean quarry site at Isampur records an early appearance of hominids in India. Siliceous limestone bedrock underlies the Isampur quarry. Three metres of stratified sediment capped by Late Pleistocene and Holocene deposits overlies the quarried bedrock at Isampur, where weathered limestone slabs were procured for stone tool manufacture. Springs supplied water to the site. Artefacts recovered from excavations include handaxes, bifaces, cleavers, as well as cores and hammerstones. Excavations indicate that the Isampur quarry represents a significant, intact Acheulean quarry site, providing detailed information about stone tool manufacturing sequences, space use, and hominid cognition. Faunal remains associated with the quarry debris include several mammalian teeth and bones. Since U series ages indicated that the site might exceed the $^{230}\text{Th}/^{234}\text{U}$ dating limit, several teeth were selected for ESR analyses. An herbivore tooth associated with the tool manufacturing waste was dated by electron spin resonance (ESR) dating. Dentine from the tooth averaged 15.73 ± 3.09 ppm, suggesting that this tooth has experienced diffusional uptake. Sediment associated with the site shows low concentrations of radioactive isotopes, and consequently low external dose rates. The thin sedimentary cover shielding the site requires assuming a cosmic dose rate averaging 0.102 ± 0.040 mGray/y in addition to the dose generated by the sediment. Preliminary ages for the tooth averaged more than 1 Ma. More teeth are being analyzed to confirm these results, and the appropriate uptake model must still be determined. Nonetheless, these preliminary ages hint that this site is the oldest archaeological site currently known in India, and that it may be among the oldest Acheulean sites.

ESR dating the hominid-bearing breccias at the Makapansgat Limeworks Cave, South Africa

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In the Makapansgat Valley near Potgietersrus, South Africa, the Proterozoic Malmani Dolomites host several caves which have produced early hominids, including the Limeworks cave. The Limeworks cave occupies some 1.5 ha with more than 10 m of deposits, some of which yielded *Australopithecus africanus* remains, as well as numerous other species and even a felid trackway. At least five stratigraphic members have been defined. Members 3 and 4 yielded the hominids, along with many other fauna. Faunal associations and paleomagnetic analyses have suggested ages near 3 Ma. Although most of the hominid finds originally came from the waste dumps, some can be related to the remaining stratigraphy in the site by petrographic and trace element analysis. Three alcelaphine teeth correlated with Member 3 have been dated using electron spin resonance (ESR), both standard and isochron analyses. Analyses of the breccias indicated external dose rates averaging between 0.190 ± 0.066 and 0.280 ± 0.050 mGray/y. Standard ESR ages for the enamel averaged 1.24 ± 0.23 Ma assuming early U uptake, 2.00 ± 0.36 Ma assuming linear U uptake (LU), and 4.14 ± 0.66 Ma assuming recent U uptake (RU). Isochron analyses yielded a LU age of 2.04 Ma with an external dose rate of 0.209 ± 0.139 mGray/y and no hint of secondary U mobilization. The good agreement between the isochron and the standard ages, and between the external dose rate determinations suggest that the external dose rate has not changed dramatically over time. At sites of similar age, the best uptake model has proven to lie between LU and RU, but the correct uptake model

must be assessed independently. Assuming LU for the teeth, Member 3 dates to 2.00 ± 0.36 Ma in age, but could be older.

Oldowan technology: new insights from digital image analysis of Koobi Fora lithic assemblages

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Oldowan technology has not enjoyed the in depth technological analyses frequently employed for investigations of later industries. Many studies of Oldowan technology have focused more on the date and context of the site rather than the morpho-technical aspects of the assemblage. Certainly the superficially simplistic nature of Oldowan technologies prevents the sophisticated studies often applied to other industries. However, we believe that the simple "core and flake" technologies actually represent a more sophisticated technological system that can only be viewed using higher accuracy techniques that are able to detect the more subtle differences between assemblages. For the last three years we have conducted a digital image analysis of seven flake assemblages from sites in the Koobi Fora Formation in northern Kenya. This analysis has focused on the quantification of morpho-technical change through time in the Oldowan and Karari Industries at Koobi Fora. Our analyses suggest that hominids in the Turkana Basin, during Okote Member times, consistently employed a core reduction strategy that was specifically adapted to the needs of a large bodied hominid on the open African savanna. We contrast these later assemblages with earlier ones in the KBS Member which did not utilize these methods. We emphasize the need to quantify the analyses of morpho-technical attributes rather than applying new "technologically influenced" names to previously derived typological classification schemes. Finally, we correlate changes in morphology of artifacts with changes in the lifeways of early hominids reflected in archaeofaunal assemblages and site distribution patterns in the Lake Turkana basin.

Intrinsic qualities of primate bones as predictors of survivorship in carnivore feeding assemblages

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Plio-Pleistocene faunal assemblages from Swartkrans Cave (South Africa) display unexpectedly high proportions of primate individuals when compared to their proportions within extant mammalian communities. C.K. Brain (e.g., 1981) has suggested that this departure from the expected may have resulted from a carnivore focus on primate predation and bone accumulation at Swartkrans. Brain's hypothesis prompted us to investigate this taphonomic issue as it relates to intrinsic qualities of baboon bones. Using three modern adult baboon skeletons, we identified several intrinsic bone qualities for this study: bone mineral density (BMD), bone size (i.e., volume) and bone shape (i.e., a ratio of volume to maximum bone length regardless of bone orientation). We collected data on these intrinsic qualities for approximately 81 bones per baboon skeleton. BMD was acquired using dual energy x-ray absorptiometry (DEXA). Bone volume was calculated using water displacement and maximum length measured with a standard osteometric board. We then investigated the relationship between these intrinsic bone qualities and the number of identified specimens (NISP) as well as the minimum number of elements (MNE) for baboon bones observed in carnivore refuse and scat assemblages. The refuse assemblage consists of baboon bones not ingested during ten separate experimental feeding episodes in which individual baboon carcasses were fed to individual, captive leopards and a spotted hyena. The scat assemblage is composed of those baboon bones recovered in the carnivore regurgitations and feces resulting from the feeding episodes. We address the degree to which each intrinsic factor predicts the presence of a bone in the refuse assemblage versus the scat assemblage, and the implications these findings have for primate fossil assemblages.

Migration of early hominids during the Pleistocene

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It is well known that *Homo erectus* possessed stone tools and left Africa migrating north into Eurasia and further. We have evidence of some of their migration paths from the discovered hominid fossils such as those in Asia, but we do not know the exact routes of their migrations. My research about *Homo erectus* yielded tools for deducing their migration paths. It is clear that *Homo erectus* depended upon hunting and gathering for food, and it is reasonable to assume that they followed along the paths taken by animals. Since both humans and animals needed water, the migration paths would follow along some water ways such as streams, creeks and rivers. Such has been the case from the maps of archeological sites in many parts of Asia, with these sites clustered along major rivers. It is also interesting to note that some of the sites are near ancient lakes. The most intriguing one of these is the Nihewan Basin in China. Using this knowledge, it is possible to hypothesize *Homo erectus*'s migration paths along existing or ancient waterways. One proposition is a northern entrance into East Asia by *Homo erectus* through the Tarim Basin or Dzungarian Basin. Presently, there are several rivers crossing between Kazakhstan and China in these regions. The potential routes of migration used by *Homo erectus* would be such water ways through the notch in the highland between Mongolia and Tibet. The human pump, as proposed by this writer previously, provides a further mechanism to propel the hominids through the highlands of Tibet and Mongolia by the northern entrance into East Asia .

Climbers and tool users: hand function and metacarpal strength of hominids at Sterkfontein and Swartkrans, and of nut-cracking chimps from the Tai Forest, Ivory Coast.

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Previous analysis by one of us (KC) showed that the cross-sectional geometry of metacarpals correlates with locomotor and manipulative function in humans, apes, monkeys, and *A. afarensis*. This study uses metacarpals to test arboreality in *A. africanus* from Sterkfontein, as well as the strength and function of hands from Swartkrans and those of tool-using chimpanzees from the Tai Forest, Ivory Coast. Tai chimpanzees use a hammer-and-anvil technique to crack hard-shelled nuts with stones or wooden clubs, a technique which can require significant force, and which may have been used by early hominids. Biplanar radiographs and shaft molds were taken of 11 metacarpals from Sterkfontein and 6 metacarpals from Swartkrans, as well as metacarpals I-V of 8 Tai chimpanzees. Bone strengths (based on engineering beam theory) were calculated from radiograph cortical thickness and periosteal shape data from the molds and compared with metacarpal length, head breadth, and body mass estimates.

The Tai chimpanzees are somewhat stronger on average than chimpanzees from other populations, but not markedly so. Also, their strength pattern across the metacarpus is nearly identical to that of non-nut-cracking chimpanzees, rather than human (specialized) tool-users. Their locomotion affects strength patterns far more than tool use. Thus significant hand strength in early hominids not known to have had a true toolkit likely results from locomotor function, e.g. climbing. The metacarpals of *A. africanus* are very strong, and are similar in many ways to the pattern found in *A. afarensis*. Like *A. afarensis*, *A. africanus* therefore fits a partially arboreal model. Conclusions about Swartkrans are complicated by the possibility of two species there and the presence of stone tools, but most of the Swartkrans metacarpals are as strong or stronger than those of *A. africanus* and *A. afarensis*. This research was supported by a University of California President's Postdoctoral Fellowship.

Hominid activities in an early secondary grassland at Kanjera South, Kenya

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The late Pliocene is notable for the extinction of *Australopithecus* and the appearance of *Homo*, *Paranthropus* and the earliest archeological traces. 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 geological and paleontological evidence are necessary in order to better understand the interplay between environmental change and hominid biological and behavioral evolution. Since 1996, carefully controlled excavations in ca. 2.2 Ma sediments at Kanjera South have recovered in situ Oldowan artifacts and archeological fauna in fluvial deposits in the margin of a small lake or playa. Archeological occurrences at several sites are stratigraphically superimposed, indicating that hominids were active in the area over tens to hundreds of years. Stable carbon isotopic values of paleosol carbonates from the archeological layers are more strongly positive than any Miocene or Pliocene East African samples to date, suggesting that hominid activities at Kanjera South were being carried out in an open (>75% C₄ grass) setting. An open setting is also suggested by high proportions of equids and alcelaphine antelopes in the archeological fauna. In contrast, gracile australopithecine sites and slightly younger Oldowan occurrences from Bed I Olduvai Gorge, Tanzania were formed in moister, more wooded settings. The Kanjera research is therefore notable in documenting hominid activities in what may be the earliest secondary grassland known from East Africa.

Seasonality, strategy and site function: reindeer hunting at Verberie

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Specialized hunting of a single species, often noted as a hallmark of the Upper Paleolithic, may not correctly characterize hunting strategies of that entire period. Early Upper Paleolithic sites dominated by a single faunal taxon may reflect more a general availability or abundance of that species. Encounter hunting, with no particular long-term strategic goal, characterized a generalized subsistence pattern. A strategic choice of a target species among others available was probably actually restricted to the end of the Upper Paleolithic, primarily the Magdalenian. During that period, the critical variable was probably seasonality. The ethology of certain species, particularly reindeer migration, may have provided a window of opportunity for acquisition of a temporarily abundant resource to be stored for subsequent consumption during the winter. The late Magdalenian site of Verberie (France) has been characterized as a fall reindeer migration interception kill site, based on analyses of site structure and of reindeer dental remains from several occupation surfaces. Continued excavation has yielded increasing numbers of occupation surfaces. These additional occupations appear to be characterized by differences in site structure and content, raising questions about potential differences in site role in annual economic rounds, most particularly for its role as a fall migration interception hunting camp. Reassessment of dental indicators for reindeer age profiles and seasonality will compare these newly discovered occupation surfaces with previously described ones. Re-evaluation of interpretations of site roles will be presented.

Evidence for summer rains during Neandertal occupation at Amud, Israel: the stable isotope data

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Most recent models of the occupation of Neandertals and early modern humans in Israel have posited that Neandertals entered the region approximately 70-40 ka as a result of European climate degeneration at the onset of the Wurm glaciation (Oxygen Isotope Stage 4). European Neandertals possess several morphological features which have been interpreted as adaptations (or exaptations) to cold temperatures and low moisture in contrast with early modern humans who display more tropical or subtropical adapted features. Bar-Yosef proposes that early modern human and Neandertal occupations alternated as climatic conditions in Israel fluctuated from warm and dry to cool and dry. We tested Bar-Yosef's hypothesis through stable oxygen and carbon isotope analyses of fossil herbivore enamel carbonate from the Neandertal site, Amud (~55 Ky.), located in the Upper Galilee to reconstruct paleoclimatic conditions during the late Pleistocene. A baseline comparative sample was established from the teeth of modern analogues across Israel representing present climatic conditions. Today, Israel is characterized by a long, dry summer and a rainy winter. Through zoning profiles and information on eruption and mineralization patterns for modern analogues, seasonal patterns in the d18O of rainfall was determined. Our data indicate systematic intra- and inter-tooth changes in oxygen composition (as much as 5 permil) consistent with seasonal changes in body water composition. These compositional differences reflect a bimodal pattern in rainfall and correspond to pollen data derived from the Hula Basin for this time period (Gat, 1981; Horowitz and Gat, 1984). It appears that 55 Kya. Israel enjoyed some amounts of summer rains and the Neandertals inhabiting Amud lived under wetter conditions than populations in Europe. Supported by Sigma Xi and the Wenner-Gren Foundation (to K.A.H.).

Microscopic investigation of stone tool function from Okote Member sites, Koobi Fora, Kenya

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One of the most obstinate and beguiling problems of the Paleolithic is artifact function. This is particularly frustrating at Early Stone Age archaeological sites where raw materials are not conducive to use wear polishes and plant remains are not preserved. Here we present the results of a pilot project applying a new approach to this old problem. During the summer of 2000, we excavated a series of sites from the Okote Member (ca. 1.5-1.6 Ma) of the Koobi Fora Formation with the goal of obtaining a minimally-handled, unwashed sample of artifacts for microscopic use-wear and residue analysis. The sites included four known sites (FxJj 18IHS, FxJj 18GU, FxJj 50, FwJj 1), one previously unexcavated site (FxJj73), and two previously excavated sites with unwashed artifacts (FxJj 17A, FxJj 17B). Excavated artifacts were placed immediately in self-sealing plastic bags and transported to the National Museum of Kenya for microscopic analysis. Non-artifactual samples (unmodified stones), sediment samples, and wind-borne particles were collected at each site to test for modern contaminants. All samples were examined using reflected light microscopy (100-500x magnification) for the presence of wear patterns and residues. Out of a sample of 175 artifacts, forty-seven (27%) exhibit possible use-related residues, including woody and non-woody plant tissue, starch grains, and hair fragments. Many of the artifacts display residues isolated along one edge or wrapped around an edge suggesting that they are use-related. The most likely explanation for the preservation of residues from this time period is that they are at least partially mineralized. These results represent some of the earliest direct evidence of stone tool function suggesting these artifacts were used to process a range of plant and animal materials. These techniques appear particularly promising for the investigation of plant use which is otherwise under-represented in the archaeological record.

Models of shape variation within and among species and the Neanderthal taxonomic position: a 3-D geometric morphometric approach on temporal bone morphology

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The taxonomic position of Neanderthals as a separate species or a temporal subspecies of *H. sapiens* is a matter of wide disagreement and has implications for modern human origins. Species recognition in paleontology must be based on analogy with living species, in which both intra- and inter-specific morphological variation is assessed. As several traits said to characterize Neanderthals are located on the temporal bone, two models of temporal variation were developed, based on modern humans and chimpanzees and using 3D geometric morphometrics. Within-species variation was assessed among modern human populations and between common chimpanzee subspecies, while between-species variation was evaluated in the two chimpanzee species. Fifteen temporal bone landmarks were recorded on 12 Neanderthals, 2 early anatomically modern humans, 4 Upper Paleolithic Europeans and 270 living humans. The latter represent nine populations of 30 spanning the extremes of the modern human geographical range and a time depth back to the Epipaleolithic. The chimpanzee sample included 35 *Pan paniscus*, 29 *Pan t. troglodytes* and 30 *P. t. schweinfurthii*. The analysis was conducted in complementary steps so as to include as many landmarks and as many fossil specimens as possible.

The specimens were superimposed in GRF-ND using Generalized Procrustes Analysis, which translates, rotates and scales the specimens for size, so that shape alone can be studied. The fitted coordinates were then analyzed statistically using Principal Components and Discriminant Function analyses. Neanderthals differ more in their temporal bone morphology from any modern human population than the two chimpanzee species differ from each other. They do not show affinities to modern Europeans. Although the modern groups overlap extensively, they do show geographic clustering. These results support the separate species hypothesis for Neanderthals.

Supported in part by NSF grants for: dissertation improvement (SBE 98-16223), NYCEP (BIR 91-13609) and AMNH 3D Visualization (ACI 99-82351)

The accretion model of Neandertal evolution

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The accretion model of Neandertal evolution specifies that this group of Late Pleistocene hominids evolved through the gradual accumulation of distinctive morphological traits in European populations. As they became more common, these traits also became less variable, according to those workers who developed the model. This evolution has been proposed to occur by a process of genetic drift, resulting from a small European population size and the isolation of this deme from contemporary human populations elsewhere either because of isolation-by-distance or because the Europeans were a distinct lineage. Here, we test an evolutionary model of gene flow between regions against fossil data from the European population of the Middle and Late Pleistocene. The results of the analysis clearly show that these Europeans were not significantly divergent from their contemporaries, even in a subset of traits chosen to make Europeans maximally different from other populations. The pattern of changes of these characters over time within Europe does not support the accretion model, either because the characters did not change in the manner specified by the model or because the characters did not change at all. From these data, we can conclude that special phenomena such as near-complete isolation of the European population during the Pleistocene are not required to explain the pattern of evolution in this region. Instead, the available data are consistent with the hypothesis that European Neandertals and their contemporaries had a similar level of interpopulation difference, though not necessarily the same differences in individual features, as populations in the same regions today.

High-resolution middle Pliocene landscape reconstructions at Laetoli, Tanzania

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Major morphological and behavioral innovations in the course of early human evolution have traditionally been evaluated in the context of semi-arid, open woodland habitats. In part, this paradigm has leaned on limited empirical paleoecological data collected from early hominid localities in East Africa. Interpretations of paleoenvironments in the Laetoli region of northern Tanzania have figured prominently in these discussions, primarily because fossil hominid material recovered from the upper Laetolil beds (3.8-3.5 Ma) are generally inferred to be associated with arid to semi-arid grassland and open wooded paleohabitats analogous to modern Serengeti ecosystems. However, recent interpretations of the paleoecology of Laetoli indicate that it may have been more heavily wooded, and therefore comparable to earlier hominid sites, such as Aramis (Ethiopia) and Tabarin (Kenya). A component of ongoing paleontological and geological research in the Laetoli area is to build on previous paleoenvironmental frameworks for the region by delineating small scale variation both vertically and laterally in the succession so that local vegetational heterogeneity can be assessed through time. Stable carbon and oxygen isotopic analyses of fossil enamel and paleosol components collected from a number of localities at different stratigraphic levels are being utilized to develop this high resolution spatio-temporal ecological reconstruction of the Laetoli region between ca. 4 -2.5 Ma. Preliminary isotopic analyses of fossil herbivore enamel, egg shell fragments, and paleosols from the lower Laetolil Beds (>4.3-3.8 Ma), the upper Laetolil Beds, and the upper Ndolanya Beds (~2.5-2.6 Ma) provide a basis for determining relative proportions of plants using the C₃ and C₄ photosynthetic pathways. These data allow us to constrain vegetational physiognomy and to an extent climate conditions prevailing during this interval.

A new Plio-Pleistocene fossiliferous locality, Gatarakwa, in Central Kenya.

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This presentation reports on a new paleontological locality discovered in Gatarakwa, the first Plio-Pleistocene fossiliferous deposits outside of the Rift Valley in Kenya. Gatarakwa covers an area ~16 km² and is bounded by latitudes 0° 14'S to 0° 12'S and longitudes 36° 43'E to 36° 45'E. Preliminary fieldwork was carried out in April 1999 and two sites were identified.

The Nguruwe site is an exposed road cut with a one meter thick fossil bed stretching 12 m in length. Specimens from this site were recovered in situ. This site has yielded a P4 identified as *Nyanzachoerus* cf. *kanamensis*. Other elements recovered include a partial pelvis, with its acetabulum intact, of a large mammal, and miscellaneous weathered bovid enamel fragments. The *N. cf. kanamensis* specimen suggests an age of 5-3 Ma, contemporaneous with Lothagam, Kanapoi, Chemeron, Kanam East, Omo Mursi Formation, lower Kaiso Formation and the Sangatole Formation of the Middle Awash.

The Ndovu site is located on a former quarry 6 km from Nguruwe. This site has produced more fossils, but these have been recovered in secondary context along erosion channels. Much of the survey and surface collection was done on a 50m by 40m exposure of the entire slope of the quarry. Over half of the fossils were recovered by crawl excavation. Identifiable elements of Bovidae, Rhinocerotidae (*Diceros* sp.), Gomphotheriidae (*Anancus* cf. *kenyensis*), Deinotheriidae and Rodentia have been recovered. These fauna suggest a closed habitat, but not necessarily dense forest.

Further habitat correlation and comparisons with other contemporaneous sites will follow the recovery and analysis of more complete fossils. Because this is the first locality of its kind outside of the Rift Valley in Kenya, further research at Gatarakwa will undoubtedly yield new insights into the evolution of early hominids beyond the Rift.

This project was funded by British Institute in East Africa, British American Tobacco and Kenya Museum Society.

Axial dysplasia in *Homo erectus*

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The remarkably complete 1.53 Ma juvenile skeleton of *Homo erectus* (KNM-WT 15000) from West Turkana, Kenya, presents a rare glimpse into the biology of this early human ancestor. Species wide inferences may be compromised, however, because of the presence of significant abnormalities in this individual's axial skeleton. These include diminutive and platyspondylic vertebrae, condylus tertius, kyphoscoliosis, pelvic and vertebral asymmetries, rib distortions, clavicular asymmetries, and spina bifida. Together these suggest a differential diagnosis of some form of dysplasia in KNM-WT 15000. Given the extent of these axial abnormalities it is not surprising that this specimen also suffered from the associated condition of abnormal neural canal stenosis. Some of these abnormalities are acquired (e.g., kyphoscoliosis and its associated rib distortions and clavicular asymmetries), but others are more likely congenital in origin. Thus, while an unequivocal diagnosis is not possible, these pathological changes are consistent with an axial dysplasia making this the earliest such condition presently known. In view of these observations, suggestions regarding the biology and behavior of *H. erectus* that are founded upon the morphology of the axial skeleton must be carefully reexamined in light of the described pathology.

Patterns of skeletal sexual dimorphism in human, chimpanzee, and gorilla

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Sexual dimorphism is often considered a major component of intraspecific variation, and tends to be correlated with the socioecology of the species. As such, it is one of the primary areas to be examined in studies of fossil samples. Because the degree of sexual dimorphism in living species is often expressed as the ratio of male versus female body size, studies of extinct species have also focused on estimated body size ratios, which are then compared with that in living species. Although estimating body size from fragmentary specimens can be quite accurate when applied to living populations, it is not always the case for fossil samples because the criteria developed from living populations may not be comparably reliable. An alternative to extrapolating the relationship between measurements of skeletal fragments and body size of living populations into extinct species to estimate body size would be to compare fragments directly. For a more informative comparison, the pattern of sexual dimorphism in different skeletal elements needs to be examined. Research on sexual dimorphism so far has dealt with individual or a limited number of skeletal elements with a focus on the cranium, mandible, and limb bones: few studies have examined the skeletal elements together. This study examines the patterns of sexual dimorphism in different skeletal elements in 94 humans, 48 chimpanzees, and 58 gorillas from the Hamann-Todd Osteological Collection at the Cleveland Museum of Natural History. The data set consists of thirty-nine metric variables in cranium, mandible, dentition, humerus, radius, femur, and tibia. As expected, the results show that gorillas are the most dimorphic overall. Humans are more dimorphic than chimpanzees in most of the variables. Chimpanzees are more dimorphic than humans in some variables including measurements on canines. These results have interesting implications for further studies in the evolution of sexual dimorphism in higher primates.

Home bases, raw material, and sedimentology from the Okote Member, Koobi Fora Formation, northern Kenya: a geoarchaeological study

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A long-standing paradigm used to interpret Early Pleistocene archaeology is the Home Base Hypothesis. Intrinsic to this hypothesis is the successive re-occupation of particular localities in a given environment because of their immediate association with resources that are vital to hominid ecology (i.e. raw material, water, and vegetation). These localities are epicenters of hominid behavior and are preserved as archaeological sites. Much of the data used to support this paradigm was collected from Okote Member archaeological sites found in the Koobi Fora Region of northern Kenya. The geoarchaeological study presented here indicates that a majority of the stone that was manufactured into Okote Member artifacts from seven sites was not obtained from local raw material sources. This suggests a larger extent to the hominid range of raw material procurement than previous studies have estimated. This new interpretation is inconsistent with the Home Base Hypothesis' "predicted" occurrence of raw material resources on the paleolandscape and consequently questions the validity of this paradigm. Hypothesized raw material sources were described and sampled for petrology, size, morphology, and sorting. These sediments are dominated by well-sorted basalt pebbles, and occur as scour and fill structures that are indicative of turbulent channelised- deposition. Artifact metrics were obtained from published data on archaeological sites FxJj 11, FxJj 16, FxJj 17, FxJj 18 complex, and FxJj 50. Sediments were compared to artifacts by expressing the variability of sediment size (longest axis) in a given sample as a percentage of the variability of artifact size (length) displayed by an assemblage. On average, hypothesized raw material sources can only account for less than 25% of the variability observed in the distribution of artifact sizes from a given assemblage.

Chronology of Middle Pleistocene events in the Kapthurin Formation, Baringo, Kenya

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Recent exploration and excavation clarify the nature of archeological events in the Kapthurin Formation, and ⁴⁰Ar/³⁹Ar dating and geochemical analyses of volcanic units establish the ages of these events. Both single-crystal total-fusion and laser incremental heating ⁴⁰Ar/³⁹Ar geochronological techniques were used. In the middle part of the section, Kapthurin hominids KNM-BK 63-67 and KNNM-BK 8518 are shown to be between 543 ± 4 ka and 509 ± 9 ka, the near contemporaries of Bodo, Ndotu, and OH 11 and 23. In the lower part of the formation, sites formed in an alkaline lakeshore setting (e.g. GnJh-31, GnJh-32, GnJh-57) are shown to be between 543 ± 4 ka and 552 ± 15 ka. They are notable for the rarity or absence of handaxes during this timespan, when the Acheulian industry occurs elsewhere in East Africa. In the upper part of the section, quantitative geochemical analyses of volcanic tephra with electron microprobe establish the precise stratigraphic relationships among sites and units dated by ⁴⁰Ar/³⁹Ar. Sites GnJh-03 and GnJh-15, containing traces of apparent behavioral modernity, including well executed blades and quantities of red ochre, as well handaxes made on Levallois flakes, are shown to lie in the interval between 509 ± 9 ka and 284 ± 12 ka. Points, the *fossiles directeurs* of the Middle Stone Age (MSA), are found at sites GnJh-17, GnJh-63, and GnJi-28, underlying a pumiceous unit dated to 284 ± 12 ka. The Kapthurin Formation thus demonstrates that the Acheulian to MSA transition was underway in this part of East Africa before 285 ka, and interstratification of sites classified as Acheulian, Sangoan, and MSA demonstrates that the Acheulian-MSA transition was not a simple, unidirectional process.

The Middle to Upper Paleolithic interface in the Russian Plain, with particular reference to Shlyakh, the Middle Don, Russia

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The materials which could shed light on the cultural processes occurring in the Russian Plain in the time period from about 60 to 30 ka are still rather poor, particularly as regards the first half of this chronological interval. While there are a number of relatively well studied early Upper Paleolithic sites predating 30 ka (Kostenki 12, 14 and 17), the information about the late Middle Paleolithic is practically lacking due to the paucity of relevant assemblages and absence of reliable dates. We report on the results of a three-year (1998-2000) project devoted to one of very few currently known sites that could partly fill this gap in our knowledge. Shlyakh is an open-air multilevel Middle/Upper Paleolithic site in the eastern part of the Russian Plain (112 km NW of Volgograd). The deposits revealed by 3 excavation pits and 22 test pits consist of 9 loam, sand, and gravel Holocene and Pleistocene layers, resting directly on motley clays of the Upper Carboniferous. Cultural remains were collected from layers 4c (Upper Paleolithic), 7, 8, and 9 (all Middle Paleolithic). Layer 8, occurring at a depth of 4-5 m directly below a buried soil, was found to be the richest archeological level. A series of AMS and conventional radiocarbon dates obtained for this level points to an age of ca. 40-45 ka. Such a chronology is corroborated by the results of palynological and paleomagnetic studies, the latter of which suggest that the main cultural level directly postdates the Kargopolovo paleomagnetic excursion (ca. 43 ka). Retouched tools from layer 8 include numerous sidescrapers, backed knives and proto-Kostenki knives, while the bifaces typical of the majority of East European Middle Paleolithic assemblages are absent. The industry is characterized by a protoprismatic laminar technology. The age of the assemblage and its peculiar lithic inventory enable us to consider the question of its relevance to the problem of the Middle to Upper Paleolithic transition in Eastern Europe.

A three-dimensional Geographic Information System for Swartkrans

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Fossil remains and tools found at the site of Swartkrans have been attributed to hominid activity, carnivore activity, and other phenomena such as alluvial deposition and gravitation. In fact, accumulations at this and other Plio-Pleistocene cave sites in South Africa have probably resulted from a combination of these factors. This presentation describes a method to allow researchers to archive and visualize fossil, artifact, and geological data in their spatial contexts, and to begin to tease apart taphonomic factors responsible for such accumulations. A 3D Geographic Information System (GIS) was built with data from a variety of sources: 1) a 1999 survey using a laser theodolite to record spatial coordinates for remaining geological features; 2) the digitization of C.K. Brain's field diagrams from the final seven years of excavation to reconstruct the original geology of the site; and 3) a relational database including information on more than 20,000 vertebrate fossils (macrofauna) and artifacts from Members 1, 2, and 3. Mapping and 3D reconstruction of sites such as Swartkrans present challenges when using traditional GIS approaches because they cannot interpolate data from overhang features (there must be only one z-value for each x-y coordinate). This study uses a new 3D approach combining Intergraph's Voxel Analyst and ESRI's Arcview 3D Analyst to overcome this limitation. Results present an accurate three-dimensional model of the site and its contents for data storage and analysis. This presentation demonstrates the analytical capabilities of GIS for spatially referenced data, including the evaluation of fossil and artifact distributions within their geological contexts, and the refitting of bone and artifact fragments found at a site.

The Vindija hominids: a view of Neandertal genetic diversity

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In order to further study the Neandertal mtDNA gene pool, we analyzed the amino acid composition and extent of amino acid racemization in 15 bones found in the Vindija Cave (Croatia). Seven samples proved to have a high content of amino acids, an amino acid composition similar to that of contemporary bone, and a low level of racemization of aspartic acid, alanine and leucine. One of the samples was dated by AMS to over 42 ka and used for a total of five DNA extractions. Following the earlier described approach, a total of 356bp of HVR 1 and 272bp of the HVR 2 were reconstructed from the Vindija sample. The results do not exclude that interbreeding between Neandertals and modern humans may have taken place, but they show that even if it occurred, Neandertals did not end up contributing mtDNA to the contemporary human gene pool. Despite the fact that more extensive sampling of Neandertals is obviously desirable, the current sequences indicate that: a) the diversity of Neandertals is so restricted that it is highly unlikely that any one Neandertal mtDNA lineage was divergent enough to form an ancestral lineage to some modern Europeans, and b) Neandertals seem to have been similar to modern humans in having a low species-wide mtDNA diversity. In the case of modern humans, the low genetic diversity seen both in mtDNA and nuclear DNA sequences is likely to be the result of rapid expansion from a population of small size. Thus, if the Neandertals also had a low diversity, this may indicate that they too had expanded from a small population. Analyses of further Neandertal specimens will reveal if a population history similar to that seen in modern humans underlies the reduced diversity in Neandertals.

A quantitative assessment of occlusal relationships in primates

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It is well known that variation in the shape and size of primate teeth within individuals and between species reflects differences in diet, phylogenetic history, and body size. Most studies of these attributes have investigated the maxillary and mandibular dentition in isolation, with only indirect information on their relationship in occlusion. This approach does not consider variables like the tightness of fit between maxillary and mandibular teeth. Since this is important for how teeth process food, variation in occlusion with respect to diet, phylogeny and size needs to be investigated both within and between species.

This study uses the quantitative method of Euclidean Distance Matrix Analysis (EDMA) to assess the occlusal relationship between maxillary and mandibular tooth rows in several small mammals. Three-dimensional coordinate measurements of landmarks located on P3 to M3 were collected from associated maxillary and mandibular dentitions of several primates (*Galago*, *Perodicticus*, *Samiri*, *Tarsius*) and non-primates (*Tupaia*, *Monodelphus*). Preliminary results indicate that tightness of fit varies with respect to diet, with insectivores exhibiting a tighter degree of fit than more frugivorous or omnivorous species. Tightness of fit also appears to be negatively correlated with the size and shape of the tooth rows, but is likely strongly influenced by phylogeny, at least at higher taxonomic levels. There are also species-level differences in the pattern of tightness of fit along the toothrow that may lead to a more refined understanding of dental occlusion.

The methodology used in this study has important applications to the study of fossil dentitions. Variation in the occlusal relationships within and between species over time can be investigated. Also, assessment of the pattern of fit within fossil species may facilitate the determination of taxonomic affinity of unassociated maxillary and mandibular dentitions.

Taxonomic and cladistic analyses of the specimens of early *Homo*: another point of view.

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Since the discovery of the first specimens attributed to *Homo habilis* in Olduvai Gorge in 1959, no consensus has been achieved concerning the taxonomic allocation of the specimens of early *Homo*. Three hypotheses have been expressed: all the specimens belong to the same species, *Homo habilis* (e.g., Tobias, 1978, 1985, 1991 and Miller, 1991, 2000); two species can be observed in that group, *Homo habilis sensu stricto* and *Homo rudolfensis* (e.g., Chamberlain, 1987; Wood, 1991, 1992, 1996; Rightmire, 1993; Lieberman et al., 1996; and Prat, 1997); and the more recent point of view that these specimens don't belong to the genus *Homo*, but to the genus *Australopithecus* (Wood and Collard, 1999).

The goal of this study is to critically reevaluate the hypotheses concerning the phylogenetic relationships of the australopithecines and the genus *Homo*, and to test if *H. habilis* belongs to the genus *Homo*. The original specimens commonly attributed to early *Homo* from the Plio-Pleistocene were studied. A numerical cladistic analysis on 122 morphological characters was carried out. However, because consensus concerning the content of the hypodigm of the species *Homo habilis* was never achieved, the Operational Taxonomic Unit used in this analysis is not defined by the species (as often used) but by the specimen. The result of this analysis shows, on the one hand, a particular taxonomic position for the Kenyan specimen KNM-ER 1805, and on the other hand that the specimens KMN-ER 1470, KNM-ER 1813, OH 24, OH 62, and Stw 53 belong to the genus *Homo* and not to *Australopithecus*.

Dental development in *H. heidelbergensis* from Sima de los Huesos, Atapuerca, Spain

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Enamel microstructure analysis has suggested that tooth development patterns in *H. neandertalensis* were different from those in modern humans. Modern human tooth development patterns were probably common to previous *Homo* species, while those in Neandertals resulted from a particular adaptation of this species. The aim of this work is to present some aspects of dental development patterns in *H. heidelbergensis* from Sima de los Huesos, Spain. The time of crown formation is influenced by the extension rate of enamel, the number of ameloblasts becoming active each day. In modern humans, the extension rate becomes lower towards the cervix producing a longer crown formation time. Changes of the extension rate through crown formation are estimated from the interval between perikymata. Perikymata are spaced near the cusp tip becoming closer toward the cervix. The study of the perikymata packing pattern in *H. heidelbergensis* teeth can suggest if it was close to that in modern humans.

The perikymata packing pattern was studied in 48 incisors, 30 canines, and 48 premolars found in Sima de los Huesos and attributed to *H. heidelbergensis*. Irrespective of total tooth height, the number of perikymata in each 10th percentile of total crown height was recorded. The variation of perikymata number through the 10th percentiles of the crown height enables us to establish the perikymata packing pattern. In *H. heidelbergensis* teeth, perikymata become closer toward the cervix, and comparison with modern human teeth shows that they follow a similar packing pattern. This would suggest that the extension rate becomes lower toward the cervix and most probably crown formation time in *H. heidelbergensis* was similar to that in modern human. Therefore, tooth development patterns of modern human type would have been present in *Homo* from the middle Pleistocene, and the tooth development pattern in Neandertals should be considered as a particular adaptation.

Continuing investigations in the Early Pleistocene locality of Ain Hanech, northeastern Algeria

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The research efforts undertaken in 1992 and 1993 have shown the importance of the Ain Hanech locality and established the foundations for long-term paleoanthropological investigations. To explore its great potential for investigating North African early hominid behavioral patterns and adaptation, we carried out further research at Ain Hanech in 1998 and 1999, focusing on studying the stratigraphy and dating, delineating new archaeological deposits, and excavating two localities. To enhance the regional stratigraphy with a biostratigraphic framework, the paleontological stratum of Ain Boucherit was positioned relative to the Oldowan occurrences. This stratum yielded a Plio-Pleistocene fauna including mastodon, elephant, equids, giraffe, bovids, suids as well as gastropod and white ostracod shells. In the stratigraphic sequence, the Ain Boucherit stratum is located 12m below the Oldowan occurrences in Unit P/Q of the Ain Hanech Formation. Unit P/Q presents a reverse paleomagnetic polarity, which may be dated to earlier than the Olduvai subchron. *Equus* teeth were also sampled for ESR dating to firmly resolve the age of the Oldowan deposit.

Based on test trenches and stratigraphic analyses, additional Oldowan deposits (A, B, and C) are delineated at Ain Hanech. While deposits A and B are difficult to discern, given that they accumulated in a homogeneous sedimentary matrix, level C is clearly isolated by 1m of sterile sediments below level B. All three deposits contain Mode I artefacts associated with Early Pleistocene fauna. The excavations at Ain Hanech yielded a large sample of Mode I technologies (core-forms, retouched pieces, debitage) associated with a fauna incorporating *Equus*, bovids, suids, elephant, hippo and rhino. The dig at the newly discovered nearby locality of El-Kherba exposed the remains of a large-sized bovid associated with Oldowan artefacts, indicating butchery activity as evidenced by microwear polishes on several stone tools.

Hungry Hadza Grandmothers

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Two recent articles generated intense interest in the foraging behaviors of *Homo erectus* females by proposing that 'grandmothering', specifically the collection of extra calories for one's daughters' offspring (O'Connell et al., 1999, *J. Hum. Evol.* 36:461-485), or cooking (Wrangham et al., 1999, *Curr. Anthropol.* 40:567-594) accounts for the differences between *Homo erectus* and earlier hominid species. The hypotheses proposed in both articles are tested using the same data set which consists of basic components (lipid, protein, carbohydrate, ash, kcal) of tubers similar to those normally collected by Hadza women east of Lake Eyasi in Tanzania (Vincent, 1985, *World Arch.* 17:132-148). Calorie yields calculated from the component analyses and calorie yields of modern domestic tubers are used to argue for high calorie return by *Homo erectus* foragers. Because Vincent's analyses showed variable results and were based on whole tubers, we analyzed additional tubers collected by Hadza foragers but examined only the edible portions by removing from analysis the typically expectorated inedible component. Energy yield varied substantially within (n=5, 60-264 kcal/100g dry weight in //ekwa) and between (n=3, 146-298) tuber species. Field observations on quid size suggest that cooking does not account for variation reported here or previously. On average, a 1kg //ekwa tuber contains only 80g of edible dry fraction yielding about 100 kcal, whereas a 1kg indigenous cultivated tuber averages 270g and 1,037 kcal. Calculating daily calorie retrieval using our and previously published (Hawkes et al., 1989, In V. Standen and Foley [eds]) Hadza tuber recovery weights indicates that Hadza 'grandmothers' barely meet their own daily requirements. While our results do not, of themselves, disprove either the 'grandmother' or the 'cooking' hypothesis, Hadza-collected tuber data can not be used in support of these hypotheses either.

Further 2.5-2.6 million year old artifacts, new Plio-Pleistocene archaeological sites and hominid discoveries of 1999 from Gona, Ethiopia.

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The team of scientists organized under the Gona Palaeoanthropological Research Project (GPRP) continued field research in Ethiopia. Fieldwork was reinitiated in 1999 with the large multidisciplinary group organized from CRAFT, Indiana University. Our systematic survey resulted in the discovery of numerous 2.5-2.6 Ma artifact localities within the Kada Gona, Ounda Gona, Dana Aoule and Busidima drainages. Excavations carried out at some of these localities have led to the recovery of in situ artifacts and associated fauna. The oldest artifacts well-dated to 2.5-2.6 Ma were originally documented from East and West Gona. The discovery of equally old localities in areas like Dana Aoule and Busidima which are 10 km away from Kada Gona imply that the first tool makers ranged in a wider area over the ancient landscape. Preliminary observations of the raw materials available in the conglomerates associated with the new localities (eg. at Ounda Gona) indicate that the hominids preferentially selected large-size and finer-grained cobbles for making artifacts. A wider variety of finer raw materials was utilized for making the artifacts documented at the new localities compared to East Gona, where trachyte was the most preferred type. In addition, more bifacial and multifacial flaking was observed on the artifacts documented from the new 2.5-2.6 Ma localities. Abundant Oldowan and Early Acheulian artifact localities associated with well-preserved fossil fauna were also documented through much of the GPRP study area. Based on preliminary Ar/Ar dates and associated fauna, most of the new Oldowan and Early Acheulian localities are estimated to date between 2.0-1.0 Ma. A partial skull attributed to *Homo erectus* was discovered at Busidima (BSN12). The skull was found within and beneath a tuffaceous layer in association with Oldowan and Early Acheulian artifacts and well-preserved fossil fauna. Based on the associated artifacts and fossil suids (including *Metridiochoerus compactus*), the skull is estimated between 1.5-1.0 Ma.

The research at Gona was funded by NSF (9818353) to SS, NT & KS, The L.S.B. Leakey Foundation, the Wenner-Gren Foundation and the National Geographic Society.

Are the P₄s of *Paranthropus* uniquely molarized?

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An expanded talonid is a feature of the postcanine teeth of 'robust' hominins, and is especially evident on the P₄s. However, it is not clear whether this is the result of selective enlargement of the distal crown, or due to the combination of allometry and the large absolute size of *Paranthropus* teeth. Our study investigates this phenomenon by examining the comparative context of relative talonid size. Explicitly, we test the null hypothesis that P₄ talonid surface area in *P. boisei* and *P. robustus* is the result of a combination of positive allometry and the large absolute size of postcanine teeth of these taxa.

Occlusal photographs of extant hominoid and fossil hominin P₄s were digitized, and five linear and area measurements recorded, namely total occlusal, talonid and trigonid area, mesiodistal length and buccolingual width. The total sample consists of 111 specimens: *Gorilla gorilla* (N=13); *Hylobates agilis* (N=8); *H. klossii* (N=7); *H. lar* (N=6); *H. muelleri* (N=8); *H. pileatus* (N=4); *Pongo pygmaeus* (N=15); *Pan troglodytes* (N=4); *Australopithecus afarensis* (N=1); *A. africanus* (N=1); *Homo sapiens* (N=21); *H. erectus* (N=1); *H. habilis* (N=3); *Paranthropus boisei* (N=7); *P. robustus* (N=12). Where possible, equal numbers of males and females were included in the extant samples.

Results suggest that P₄ talonids of 'robust' hominins are not enlarged relative to their overall size; i.e., they lie on the regression line generated from the comparative sample relating talonid area to overall crown size (R²=0.95; P<0.001). These data contradict hypotheses suggesting that P₄ talonid expansion is a uniquely derived feature of the 'robust' lineage. The large talonids of *Paranthropus* P₄s apparently can be explained by the absolutely large overall size of the P₄ crown.

This research was supported by The Henry Luce Foundation and a Smithsonian Post-Doctoral Fellowship.

Early Pliocene hominid remains from Gona, Ethiopia

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Renewed survey in the Gona project area in the Afar region of Ethiopia during 1999 and 2000 identified numerous archaeological and paleontological sites spanning the early Pliocene to the early Pleistocene. Here we discuss the paleontology and geology of the early Pliocene deposits surveyed in 1999.

At the base of the western edge of the Ethiopian escarpment are a series of fossiliferous sediments and intercalated tuffs that sample a variety of fluvio-lacustrine depositional environments. One of these tuffs located near the base of the sequence yielded a SCLF ⁴⁰Ar/³⁹Ar date of 4.5 Ma. The numerous associated fauna, including *Nyanzachoerus jaegeri* and *Anancus kenyensis*, support this early Pliocene age. Across the 40+ early Pliocene fossil localities, faunal diversity is high indicating sampling of a variety of environmental zones.

In 1999, two hominid fossils, a mandible fragment and a manual proximal phalanx fragment, were found at site WM3. Both specimens were surface finds, and no additional fragments were recovered in excavation. Specimen WM3/P1 is a right mandibular corpus spanning the M₃ and canine alveolus retaining the complete M₂ and broken M₁ crowns. The P₃, P₄, & M₃ are represented by their roots only and the C was lost prior to fossilization. The absolute and relative size of the molar crowns, thin marginal and occlusal molar enamel, and premolar root morphology are consistent with assignment to *Ardipithecus ramidus*. The incomplete phalanx (WM3/P2) retains the proximal 40% of the shaft and articular surface. The specimen is large, and taxonomic assignment, at this time, remains uncertain.

Research funded by NSF 9818353 to SS, NT, & KS; Wenner-Gren Foundation; National Geographic Society; & LSB Leakey Foundation; & NSF 9727519 to SWS.

Calibrating ESR dating using 2 Myr-old teeth

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Electron spin resonance (ESR) dating measures the accumulated radiation damage in solid materials. It can determine ages over a wide time span in such varied materials as teeth, shells, and earthquake-shocked quartz. ESR is a vital technique for paleoanthropology, using mammalian teeth. In sites such as those in South Africa, it is the only archaeometric method routinely available. Theoretical studies on tooth enamel show that the signal should be stable for hundreds of millions of years. Analyses of teeth from European sites have in fact yielded ages greater than 3 Ma. A number of initial studies at australopithecine sites, however, yielded ages considerably younger than the >1 Ma paleontological estimates. Given the complexity of the sites, reworking and/or attribution errors might explain these results. There was a possibility, nonetheless, that some hitherto unrecognized factor might be limiting the methodological accuracy. The European ages, after all, had not been calibrated by other precise methods. A cross-calibration study was therefore designed, using teeth in the British Museum (Natural History) collection. The early deposits at Olduvai Gorge are well-dated by K/Ar (and ⁴⁰Ar/³⁹Ar). Two elephant teeth have now been analyzed. As samples selected for destructive analysis, they are not among the best provenienced. One (CT13) is believed to be from Upper Bed I or Lower Bed II, which should imply an age of ~1.8 Ma. Our date, using the

Rosey program and assuming recent uranium uptake, is 1.83 ± 0.10 Ma. The other (CT11) is almost certainly from Bed II, between Tuffs IIC and IID. The age for this level should be ~ 1.5 Ma; we find, using the same assumptions as for CT13, 1.61 ± 0.10 Ma. A recent uptake model is supported by isochron analysis and paleoenvironmental considerations

Sex dimorphism among the Early Upper Paleolithic hominids from central Europe: cranial and pelvic metric variation.

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The determination of sex and the pattern of sexual dimorphism are important factors for biological, demographic and socio-cultural studies of human evolution. Sex assessment of Pleistocene hominids is influenced both by methodological approaches and sample preservation. Unfortunately the pelvis is often either preserved as small uninformative fragments or absent in most Pleistocene hominid remains and therefore other skeletal regions, mostly the cranium, are frequently used. In addition, indicators of sexual dimorphism are correlated with specific sexual dimorphic patterns which are not known for all Pleistocene hominid populations. This paper briefly reviews recent investigations of sex determination of the Early Upper Paleolithic hominid sample from central Europe (EUP-CE), focusing on assessments of sex based both on the cranium and the pelvis, with an emphasis on differences in the patterns of sexual dimorphism of the cranium and pelvis.

Several questions about sex determination and sex structure of the EUP-CE sample recently appeared mainly from studying the Dolní Vestonice 15 individual. However only some of the EUP-CE remains have sex determined by pelvic morphology (Dolní Vestonice 3, 13, 14, 15 and 16). Sex for the other individuals is estimated by cranial morphology (Mladec 1, 2, 5, Dolní Vestonice 11, 12, Pavlov 1 and probably all of the Predmostí sample). As a first step we analyzed recent human cranial and pelvic samples of known sex. The differences in body size and robusticity between the recent and Pleistocene hominids can be an important source of bias, especially in a discriminant analysis of cranial variation. Therefore we also compared the EUP-CE hominids with a reference sample using those individuals from the Early and Late UP of Europe and the Near East which have preserved cranium and pelvic bones. The differences and discrepancies between the sex assessments based on either the pelvis or the cranium can be interpreted as a general difference of sex dimorphism between those two skeletal parts. As a last step of the study we described variation in sex dimorphism of pelvic and cranial morphology compared to the sexual dimorphism pattern of a recent human sample of known sex and age (Spitafields - 18th-19th century AD), where both skeletal parts are preserved for each individual. The analysis confirms that there are differences in the pattern of sexual dimorphism between the EUP-CE and recent hominids, mostly in cranial metric variation and less in pelvic dimorphism. The EUP-CE hominids are shifted to the male portion of the recent human variability. This shift mainly affected sex assessment of female hominids like DV 3, which have been previously determined as female according to pelvic morphology. It is therefore apparent that assessments of gender, and by extension sexual dimorphism, among EUP hominids must take into account significant contrasts between them and at least some recent human groups in cranial morphology.

Stone tools and cognition in social context: an ethnoarcheological study from New Guinea

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Questions regarding the origins of human intelligence are central to paleoanthropology and are often addressed through the interpretation of prehistoric stone tools. In order to facilitate such interpretation, an ethnoarchaeological study was conducted among modern stone-ax makers from the highland village of Langda in Indonesian Irian Jaya (West Papua). This research was designed to explore the psychological dimensions of

flintknapping in a traditional context, with special emphasis being placed on identifying any material correlates of tool-making skill that might aid in the interpretation of archaeological assemblages.

Several types of data were collected from a total of eleven ax-makers, including both novices and experts. Raw materials, finished products and stone waste flakes were analyzed in terms of weight, dimensions and morphology. Videotapes of tool manufacture were collected and analyzed in order to quantify any variation in production strategy between novices and experts. Qualitative observations regarding social interaction, learning and teaching were made and interviews were used to assess explicit technical knowledge, terminology and concepts of appropriateness.

This research revealed multiple levels of social, cognitive and motoric organization in the stone-ax technology of Langda. In this traditionally egalitarian society, ax-making ability brings both prestige and material gain. Access to training, technical knowledge and raw materials is controlled by established craftsmen, in part through a nepotistic system of apprenticeship. Apprenticeship typically lasts several years and involves instruction, demonstration and facilitation as well as individual learning. Comparison of novices with experts reveals that tool-making ability is based on cognitive components such as knowledge of raw materials and explicit reduction strategies in addition to implicit motor skill. Furthermore, variation in ability between novices and experts is reflected in statistically significant differences in the debitage and finished artifacts that they produce. These findings suggest new directions and methods for the cognitive interpretation of archaeological evidence.

The relationship of body proportions with femoral and pelvic shape in recent humans and Late Pleistocene to Holocene fossil hominids

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Previous studies have documented a suite of morphological features that differentiate the hips of Neandertals from the Qafzeh-Skhul individuals and other later hominids. These include: longer pubic bones, more posteriorly rotated iliac blades, a more anteriorly located pelvic inlet, more circular femoral shafts, larger relative joint sizes, and lower neck-shaft angles. Recently, colleagues and I (1998) proposed that most unique aspects of Neandertal pelvic morphology are secondary spatial consequences of accommodating wide trunks while still maintaining locomotor efficiency. Biomechanical considerations along with the work of other researchers (Pearson, 2000; Ruff, 1995; Trinkaus et al., 1998) further suggest that wide pelvic breadths may also explain aspects of Neandertal femoral morphology. This hypothesis is explored through morphometric analyses of recent human hip variation and comparisons of a sample of Late Pleistocene and Holocene fossils with recent human patterns.

Using a Microscribe digitizer, the 3-D coordinate locations of 28 pelvic and 14 femoral landmarks were collected from a sample of 256 recent humans and 8 fairly complete fossil individuals. Given preservation differences, some fossils were excluded from certain analyses. Shape patterns in each of the hip elements were examined using a combination of Generalized Procrustes Analysis (GPA), Principal Component Analysis (PCA), and interactive computer visualization. Correlations between standard osteometric measurements and the principal components were calculated to examine allometry and so that published measurements on additional fossils could be incorporated into certain analyses.

Some preliminary results are: 1) individuals with high ratios of bi-iliac breadth to femur length tend to have femora with large relative joint sizes and lower neck-shaft angles; 2) wide bi-iliac breadths are associated with more posteriorly rotated iliac blades and longer pubic bones. Even though some fossil hominids have extreme body proportions, the shapes of their innominates and femora generally follow recent human allometric relationships.

Phylogeny of the skull of Ngawi (Java, Indonesia)

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The skull of Ngawi 1 was discovered in August 1987 on the left bank of the Solo River near the village of Selopuro (East Java, Indonesia). It is a complete well preserved calvaria. At this time the inferior-posterior part of the skull is still partially covered by hard sediments. The bone is very mineralized. We present the anatomical description of this specimen and compare it with Asian Pleistocene specimens. Even if its cranial capacity is weaker (about 870 cm³), the result of a cladistic analysis based on 123 morphological and 345 metrical characters shows that Ngawi effectively belongs to the same taxon as the specimens of the Ngandong-Sambungmachan series.