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The Origins and Antiquity of Stone Projectile Points

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Projectile weaponry is a human cultural universal, but its origins remain poorly understood. Projectile technology is generally seen as an emergent feature of the "Upper Paleolithic" behavioral revolution, but it has recently been proposed that projectile technology was in widespread use among *Homo sapiens* populations in Africa during Middle Stone Age (MSA) times. Questions have also been raised about the possible use of stone projectile points in Eurasian Middle Paleolithic contexts. One obstacle to researching the origins of projectile technology is that the criteria archaeologists usually employ for recognizing plausible and implausible stone projectile points are largely subjective (overall tool shape, microwear traces). Tip cross-sectional area (TCSA) is a ballistically-significant dimension that works well at discriminating North American stone projectile points from spear points. This paper compares the TCSA values of ethnographic North American stone projectile points to hypothetical Middle and Upper Paleolithic stone projectile points from Africa, the Levant, and Europe. The African MSA point types examined include symmetrical triangular flakes, unifacial points, bifacial points, and Aterian tanged points. Levantine point types examined include Levallois points, Emireh points, Ksar Akil points, and a variety of other Upper Paleolithic types. European point types compared include Levallois points, Mousterian points, bifacial points from Central and East European "Transitional" contexts, Font Robert points, and Gravette points, as well as various Solutrean point types. The results of this comparison do not support the hypothesis of the widespread use of stone-tipped projectiles in Africa, the Levant, or Europe prior to 40 Ka. Why stone-tipped projectile points appear around this time, and not previously, remains unclear. Ethnographic stone tipped projectiles were largely deployed when hunting large dangerous prey and in warfare. Either or both of these factors may have played a role in the development of projectile point technology.

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Morphological Constraints on Hominin Speech Production

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It is notoriously difficult to predict speech abilities in fossil humans. Reconstructions of speech capacity require estimates of supralaryngeal vocal tract (SVT) dimensions, which are difficult to obtain because key components of the vocal tract (the tongue, soft palate, and larynx) do not preserve in the fossil record. It is important to determine whether hominin species had SVTs like those of modern humans, in which roughly equal horizontal and vertical portions meet at a right angle. This 1:1 ratio, in combination with an SVT whose cross-sectional areas can be modified roughly ten-fold by the tongue, creates a two-tube filter capable of producing acoustically distinct vowels. Previous SVT estimates from basicranial morphology suggest that Neandertals and other archaic humans possessed vocal tracts with unequal vertical and horizontal portions incapable of forming acoustically distinct vowels.

New comparative data on SVT dimensions in non-human primates and humans are used in conjunction with functional considerations to establish upper and lower boundaries for the position of the hyolaryngeal complex. These boundaries are used to determine whether individual hominin skulls fitted with a 1:1 vocal tract would have been viable structurally and functionally. Results suggest that several hominin species, including Neandertals, could have possessed human-like SVTs. This and other results are discussed in terms of implications for the origin of human speech and language.

Patterns of Fracture Among Anatomically Modern Humans: Implications for Hunting Techniques

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One hypothesis regarding the behavioral differences between early humans and Neandertals is that *Homo sapiens* employed more advanced hunting techniques, giving them an adaptive advantage over Neandertals. High rates of trauma to the head and neck indicate that Neandertals may have practiced dangerous hunting techniques, attacking large ungulates while in close proximity, often becoming injured in the process (Berger & Trinkaus, 1995). While aspects of early human hunting practices have been inferred from their associated artifacts and faunal assemblages, early human fossils have not been evaluated for evidence of trauma, similar to that observed in Neandertal specimens. The hypothesis that anatomically modern humans employed less dangerous hunting techniques than their Neandertal contemporaries was tested using an analysis of fracture patterns.

A literature search of trauma among specimens of *Homo sapiens* of the MSA/MP and LSA/UP time periods was conducted and instances of fracture in each of seven anatomical regions were noted (head/neck, trunk, shoulder/arm, hand, pelvis, leg, foot). The frequency of traumatic lesions was then calculated for each anatomical region and compared to the frequency of fracture in Neandertals, several modern reference samples and three Holocene archaeological samples. The hypothesis that Neandertals would demonstrate higher rates of craniocervical fracture than early modern humans was not supported, as no significant differences in trauma frequency were found between these groups. Thus, more advanced hunting techniques by early modern humans were not supported as behavioral differences between early *Homo sapiens* and Neandertals. The hypothesis that later humans would show less trauma than earlier human specimens was also not supported, as the LSA/UP sample demonstrated significantly higher rates of head and neck fractures than MSA/MP humans.

Berger, T. D., Trinkaus, E. 1995. Patterns of trauma among the Neandertals. *Journal of Archaeological Sciences* 22, 841-852.

Population Size, Disease, and the Evolution of Aging

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Here, I develop the hypothesis that the extension of longevity in recent humans was caused by the changes in fertility and juvenile mortality associated with Upper Pleistocene population growth. According to Williams' classic evolutionary explanation of senescence, genes that affect longevity may be pleiotropic with advantageous effects early in life stabilizing the advantages of longer lifespan. Most growing populations are under selection for higher fertility (a combination of short birth interval and female reproductive lifespan) until environmental conditions limit their growth. But new Upper Paleolithic technologies and social systems relaxed the ecological constraints against further population growth. This larger population was organized in larger settlements with less population movement and greater contact between groups, causing increases in the virulence of human pathogens. Epidemic disease is a powerful selective factor for high fertility because it increases juvenile mortality. But such diseases also may cause selection toward an increased lifespan because they reduce the early benefits of pleiotropic genes that affect longevity. This hypothesis is consistent with recent results that show major increases in adult longevity in concert with Upper Paleolithic expansions in population size. It is also consistent with genetic evidence for a Late Pleistocene origin for some human epidemic diseases and immune adaptations. Although the hypothesis does not necessarily conflict with other explanations for human longevity, such as the "Grandmother hypothesis," it does provide a model consistent with a rapid and recent transition to modern human demographic structure in which both sexes play an important role.

The Use and Abuse of the *Chaîne Opératoire* vs. Reduction Sequence Debate in Paleolithic Archaeology

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The increasingly multinational discipline of Paleolithic archaeology is currently undergoing a “culture contact” event between competing scientific traditions of studying the evolution of human behavior through the remains of stone tools. This academic culture contact has not been as productive as it should, as researchers advocating an American processual “reduction sequence” approach react with increasing hostility rather than interest to the growth in popularity of the French “*chaîne opératoire*” approach. Despite productive discussions such as Dibble’s reanalysis of Boëda’s collection from Biache Saint-Vaast, the tone of the discourse is soured by less than productive discussions, such as Shott’s recent source exegesis on whether *chaîne opératoire* or reduction sequence was the earlier innovation. The present paper attempts to move past a limited discussion of differences in method and conceptual scope to advocate a hybrid analytical approach which recognizes the beneficial aspects, as well as disadvantages, of the method and theory within each scientific tradition. For instance, aspects of body technique theory from French sociology can be constructively combined with attribute analysis as well as style theory from Sackett to Carr to produce a credible technique for pursuing Paleolithic culture history. This application of some aspects of *chaîne opératoire* theory does not eliminate the great utility of an “organization of technology” approach so necessary for the understanding of mobility and adaptive change in lithic technology. Despite the fact that many researchers are gradually combining the two approaches in useful ways, the current nature of the discourse seriously limits the potential of any hybrid approaches, particularly through the pigeon-holing of researchers into camps. This paper represents the beginning of the required discussion of the relevant method and theory needed to construct a new level of discourse on this subject by means of a credible hybrid approach.

Postcranial Robusticity in a Carnivore: Implications for Understanding Skeletal Robusticity in Hominins

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Postcranial skeletal robusticity is variable throughout human evolution, fluctuating both temporally and geographically. A recent decrease in postcranial skeletal robusticity among early modern *Homo* has been attributed to technological advances that reduce the reliance on somatic energy for prey acquisition, thereby reducing the strains on the skeleton that would cause bone remodeling. Such anthropocentric models can be evaluated using nonhuman predators. Evidence of changes in robusticity over time in other animals suggests that there must be other ecological factors that influence postcranial skeletal robusticity that have not been fully explored. Very little quantitative data is available concerning the relationship between body size, prey capture, and measures of skeletal robusticity in nonhuman predators. This study begins to fill that critical gap by documenting variation in postcranial skeletal robusticity among red wolves, coyotes, and subspecies of gray wolves. All are ecologically similar in that they are predatory carnivores that engage in group hunting and provision other members of their group. However, there is great variation in the size of the prey that each canid species hunts. Morphologically, the three species of canids are very similar, differing mainly in body mass. Data on limb length and cross-sectional area from planar radiographs were collected for femora, humeri, tibiae, and fibulae for all species in the sample (N=60). RMA regressions of logged data suggest that femoral robusticity (as measured by J , the polar moment of inertia) scales isometrically with bone length. This suggests that skeletal robusticity scales with body size and possibly is associated with the increasing size of prey taken by the larger wolves.

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Taxonomic Integrity Above the Species Level in Primate Evolution and Systematics

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The second half of the last century eventually saw the agreement between molecular and paleontological researchers as to the timing of the cladogenesis which subsequently produced the lineages leading to modern chimpanzees and humans. This event occurred sometime in the late Miocene, some five to ten million years ago, most likely in Africa. This has led most to classify either all great apes or only the African apes in the family Hominidae. Recently, another disagreement has emerged between these disciplines over the generic placement of humans and chimpanzees. Some molecular researchers insist on placing both humans and chimpanzees (and perhaps the gorillas as well) in the genus *Homo* based on the small genetic distance between the two and their estimated time of divergence from a last common ancestor. On the other hand, most paleontological researchers recognize up to seven genera, excluding *Pan*, since chimpanzees and humans shared a last common ancestor. Here we examine the validity, usefulness and implications of each argument and utilize morphological and molecular distances within and between various primate taxa, both extinct and extant, as well as the first and last appearances dates for various primate fossil taxa. If paleoanthropology wishes to advance, researchers must consistently use the same language and classification criteria.

Early *Homo erectus/ergaster*: One or More Species?

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Discerning hominid species in the fossil record has been and remains one of the key areas of paleoanthropology. This study examines the case for early *Homo erectus/ergaster* using the biological and evolutionary species concepts as frames of reference. Ten individuals were chosen. These were: T2, S2, S4, S10, S12, and S17 from Java, along with OH 9, KNM-ER 3733, KNM-ER 3883, and WT-15000 from East Africa. These individuals were chosen because they offered at least five neuro-cranial measurements, allowing for credible estimates of encephalization.

Due to the fragmentary nature of even this sample, principal components analysis was used to create a usable data set. Linear regression was then used to calculate mean differences between the African and Asian fossils using PC 1 (Principal Component 1, a derived figure denoting overall cranial size), XCB (Maximum Cranial Breadth), and BPB (Bi-Parietal Breadth). This was done both with and without WT-15000 in lieu of the possibility that this individual's juvenal status may have artificially increased the fossil sample's variability. The mean differences were: -1.264 with WT-15000 and -0.971 without it for PC 1; -9.78 with WT-15000 and -6.56 without it for XCB; and -5.78 with WT-15000 and -3.23 without it for BPB. This data was then compared to the mean differences of 28 pair wise comparisons of eight modern human populations from William. W. Howells' study cited in his work *Cranial Variation in Man*. The populations used were the Teita, Dogon, Zulu, and Kung from Sub-Saharan Africa, along with the Andaman Islanders, Lake Alexandra Aborigines, Tasmanians, and Tolia Islanders of New Britain from Australasia. PC 1 was compared directly between the fossils and the moderns since it was compatible between *Homo erectus/ergaster* and *Homo sapiens sapiens*. XCB and BPB in the fossils were only compared to XCB in the moderns because the two figures are one and the same for *Homo sapiens sapiens*. Since a number of these comparisons generated mean differences greater than or equal to that of the fossils, the findings were suggestive of the fossils being from one species, *Homo erectus*.

The authors acknowledge the Peabody Museum for supplying the raw data on the Howells populations, and Dr. Fred Smith for allowing access to his *Homo erectus* casts.

Preliminary Analysis of Dental Microwear and Diet in Kenyapithecine Hominoids from the Middle Miocene of Fort Ternan and Maboko Island, Kenya

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Semi-terrestrial large-bodied hominoids from the middle Miocene of eastern Africa, including *Kenyapithecus wickeri* from Fort Ternan (ca. 12-14 MA) and *K. africanus* from Maboko Island (ca. 15 MA), are placed in the subfamily Kenyapithecinae. Arboreal large-bodied hominoids from Baragoi (*Nacholapithecus*) and Kipsaramon (*Equatorius*) may also belong to this subfamily. Kenyapithecines were once widely regarded as the earliest representatives of Hominidae. Recent collections, however, indicate that the phylogenetic affinities of the kenyapithecines lie near the common ancestry of African apes and humans. Consequently, kenyapithecines play a pivotal role in our understanding of the adaptations of the African ape and human clade prior to the divergence of Hominidae.

Until now, the dietary adaptations of the kenyapithecines have been reconstructed by analogy to form-function complexes among extant primates. Several features, including procumbent incisors, robust canines, and enlarged premolars, indicate that *Kenyapithecus africanus* was a sclerocarp forager (McCrossin *et al.* 1998). In this analysis, dental enamel microwear of *K. wickeri* from Fort Ternan is examined for the first time and compared with previous results for *K. africanus* from Maboko Island (Palmer, 2000). *Kenyapithecus wickeri* exhibits a significantly lower mean percentage of pits (13%) than was observed for *K. africanus* (38%). In addition, the average microwear feature width for *K. wickeri* (3.5 microns) is much greater than that observed for *K. africanus* (0.9 microns).

Although *Kenyapithecus wickeri* and *K. africanus* share a very similar pattern of dental and gnathic morphology, differences in enamel microwear suggest the former included more soft than hard fruits in its diet. Evidence from paleosols and associated fauna indicate that *K. wickeri* inhabited a closed woodland or forested environment while *K. africanus* lived in dry woodland. The microwear differences documented here may relate, therefore, to species-level dietary specializations arising from paleoenvironmental differences between Fort Ternan and Maboko Island.

Is Ouranopithecus macedoniensis a hominin? A critical assessment of evidence from canine and P3 morphology

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Ouranopithecus macedoniensis is a large-bodied, highly sexually dimorphic hominoid from the late Miocene of Greece. The fossil material from this species comprises multiple jaws, teeth and a face. Analyses of the cranial morphology of the specimens, specifically the morphology and inferred function of the canines and P3, have been used to support the inclusion of Ouranopithecus macedoniensis within the hominin clade. This study critically examined evidence from canine and P3 morphological data to evaluate this hypothesis. Using traditional (mesiodistal, buccolingual, and height) measurements of the canines and P3, as well as measurements derived from scaled occlusal photographs of the P3, we compared the Ouranopithecus macedoniensis dentition to that of various Miocene hominoids, Gorilla gorilla, Pan troglodytes, Pongo pygmaeus, Australopithecus anamensis and Australopithecus afarensis. Published descriptions and measurements of the canines and P3 of Ardipithecus kadabba and Ardipithecus ramidus were used to establish character polarity for the hominin clade. Our study concluded that Ouranopithecus does resemble hominins, particularly Australopithecus afarensis, in some morphological features. However, some character states that other authors have identified as synapomorphies of Ouranopithecus and Australopithecus are clearly the result of homoplasy, as these features are not found in the most primitive hominins. In addition, some of these purported synapomorphies are identifiable in non-hominin taxa. Our study reduces support for the inclusion of Ouranopithecus within the hominin clade based on these results.

Luminescence Chronology for Cave Sediments at the Atapuerca Paleoanthropological Site, Spain

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The earliest hominid fossils in Europe come from an infilled karstic cave site called Gran Dolina at Atapuerca, in the TD6 horizons ca. 1-2 m below the Brunhes-Matuyama (B/M) paleomagnetic boundary (780 ka). The 6-8 m of strata above the B/M boundaries at Gran Dolina and the nearby Galeria karstic infill site contain many fossil remains and stone tools, but have been difficult to date. We applied both thermoluminescence (TL) and the more-daylight-sensitive infrared-stimulated-luminescence (IRSL) dating methods to sediment-matrix samples from within both sites, and to samples from the present-day surface soils on the surrounding limestone hill-slopes.

The surface soils (generally <10 cm thick) yielded IRSL ages of circa 500–1500 years, suggesting that the karstic infill matrix would carry a negligible relict or inherited age. At Gran Dolina TL and TL-IRSL paired ages ranged from 174±18 ka (1σ) (upper part of unit TD11) through 240±44 ka (lower TD11) to 244±26 ka (mean, top 0.5 m of TD10). These TD10 and lower-TD11 results agree with ESR-teeth ages for these horizons. A 431±59 ka TL age for mid TD10 agrees closely with an ESR-tooth age for this horizon. Progressively deeper strata yielded TL ages culminating at 960±120 ka just below the B/M boundary in unit TD7. At Galeria, with one exception, TL/IRSL ages ranged from 185±26 ka (base of unit G4) to 422±55 ka at the base of the lowermost surface-inwash (“entrada”) facies (unit G2), with an apparent missing 300±400 ka record. We conclude that: (1) TL and (sometimes) IRSL, are useful dating tools for karstic inwash sediment; (2) a more accurate chrono-stratigraphic correlation is now possible among the main Atapuerca sites of Gran Dolina, Galeria, and the ca. 400 ka Sima de los Huesos record of hominid fossils. This dating work was sponsored mainly by grant NSF-9805174 to Berger.

Variation in Nasal Passage Surface-Area-to-Volume Ratios of Recent and Fossil Humans

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Most investigations into the adaptive significance of recent and fossil human nasal morphology have focused exclusively on size and shape of the external nose and skeletal nasal aperture despite the fact that the internal nasal passages play a more prominent role in the performance of the primary functions of the nose. This omission is due primarily to the complexity of internal nasal anatomy and the difficulty in measuring such structures. However, recent advances in imaging technology have made precise measurements of complex internal nasal structures possible, thus allowing for the first time a systematic analysis of variation in mucosal surface area and volume of the nasal passages. Theoretically, individuals whose ancestors evolved in colder climates should possess higher surface-area-to-volume (SA/V) ratios than individuals whose ancestors evolved in warmer climates. A high SA/V ratio allows relatively more air to come in contact with the mucosa, thereby facilitating more efficient heat and moisture exchange, whereas a low SA/V ratio allows for better heat dissipation. To test this hypothesis, we collected mucosal surface areas and nasal passage volumes from a sample of CT scans of patients of European and African ancestry from the University of North Carolina Hospital in Chapel Hill. Our results indicate that individuals of European descent do possess higher SA/V ratios than individuals of African descent. Importantly, the higher SA/V ratios are due to decreased nasal passage volumes resulting from narrower nasal cavity breadths at the level of the middle meatus rather than differences in the mucosal surface. This result indicates that internal nasal anatomy in fossil hominins can be meaningfully compared and functionally interpreted even in the absence of the taphonomically fragile turbinate bones. We relate these results to a series of unresolved issues regarding the adaptive significance of the nasal anatomy of Neandertals and other fossil humans.

Patterns of Intraspecific Variation in Dental Metrics in *Gorilla gorilla*, *Pan troglodytes* and *Homo sapiens*: A Comparison Using Wright's (1969) Fst Statistic

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Wright's (1969) Fst statistic is a measure of relative variation. It assesses variation among subdivisions of a population relative to the population's total variation based on theoretical expectations of random breeding. The application of this statistic to certain molecular and morphological data in modern humans has demonstrated that the diversity among modern humans is greater within populations than among them. Whether or not humans share this pattern with great apes, however, is not known. In this study the Fst is applied to linear dental dimensions to compare patterns of intraspecific variation in humans with those of their closest living relatives, *Pan* and *Gorilla*.

The sample includes 83 *Homo sapiens*, 200 *Pan troglodytes* and 194 *Gorilla gorilla*. Modern humans were divided into three major geographic regions: Africa, Europe and Asia. Chimpanzees and gorillas were divided into their three traditionally recognized subspecies. Length and breadth dimensions were obtained from one side of the dentition resulting in a total of 28 variables. Central incisors were often missing and were excluded from the analysis to maximize sample sizes. Heritability estimates were variously set at 0.5 to 0.7. Population sizes were estimated using modern census data, but analyses were also conducted assuming equal population sizes.

A heritability estimate of 0.5 and equal weights for populations returns an Fst of 0.05 for humans, 0.07 for chimpanzees and 0.14 for gorillas. With 95% of the total variation situated within world populations, this study supports the hypothesis that modern humans exhibit high intra-group variation. Chimpanzees, like humans, display most of their variation within the subgroups. Gorilla Fst values are higher indicating greater divergence among the subgroups, but they also show a considerable degree of variation within subgroups. We conclude that high intra-group variation is common for African apes and humans.

Robusticity and Sexual Dimorphism in the Postcranium of Modern Hunter-Gatherers from Australia

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Throughout much of prehistory, humans have practiced a hunting and gathering subsistence strategy. Ethnographic accounts of modern hunter-gatherers from Australia serve to identify the specific activity patterns that are associated with this mode of subsistence. However, much of our knowledge of the skeletal correlates (e.g., cross-sectional geometric properties of long bones) of hunting and gathering derives from populations (e.g., Native Americans) for which there are no firsthand recorded observations. Here we present the first quantification of structural rigidity properties from the postcranial skeleton of Australian aborigines. With these data, it is possible to directly assess behavioral indicators in the appendicular skeleton of a hunter-gatherer population without having to rely on inferring activity patterns from archaeological contexts or musculoskeletal stress markers (e.g., osteoarthritis or enthesopathies). Standard cross-sectional geometric properties for 167 skeletal elements, including humeri, radii, ulnae, femora, and tibiae were calculated. A minimum of 41 individuals were sampled, including at least 11 females and 19 males. Cross-sectional properties were standardized by body size in order to acquire measures of robusticity. Australian aborigines are less robust at the femoral midshaft than Holocene North American hunter-gatherers. Australian aborigines exhibit greater sexual dimorphism in the structural properties of the humerus than the femur and tibia. They surpass upper limb dimorphism observed in Holocene South Africans, but display less dimorphism in the lower limb than is observed in Holocene North Americans. Ethnographic sources document similarly high levels of mobility among female and male Australian aborigines, which is supported by the low level of sexual dimorphism in their femoral and tibial midshafts. These data are relevant to the interpretation of patterns of skeletal robusticity in Late Pleistocene hunter-gatherer populations.

Walking, Running, Climbing, and Jumping to Conclusions: Interpreting Locomotion in Early Humans

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Ever since Dart declared the Taung child bipedal, anthropologists have sought to explain the locomotor adaptation of our ancient ancestors. This paper examines the origin and evolution of human bipedality as a total motor repertoire rather than focusing on one component to the exclusion of others. In particular, I integrate anatomical findings of humans with those of apes and observations on their locomotion in the wild. My anatomical sample consists of 20 great apes from four species; dissections of whole animals yield data on body composition, body proportions, and individual muscle masses. Among the hominoids, modern humans at one extreme have the lightest forelimbs and heaviest hindlimbs (8% and 32%), whereas male orangutans at the other extreme have the heaviest forelimbs and lightest hindlimbs (19% and 14%), reflecting their particular locomotor specializations. The African apes, the group most closely related to humans, are intermediate in distribution of body mass and relative mass of major muscle groups. African apes most frequently engage in quadrupedal knuckle walking but they are also adept at climbing, suspension, reaching, and bipedal behavior. From the natural-selection perspective, overall anatomy and behavioral range are what count for survival. Overemphasis on one component, such as climbing or endurance running, neglects factors such as posture and movement that relate to foraging and other essential activities. Unless we wish to return to such retro archetypes as Man the Hunter or Man the Provisioner, our interpretations of locomotion should be based on a balanced consideration of the anatomy underlying the whole range of adaptive behavior in men, women, and children.

Tephrostratigraphy and regional correlations of the Artifact bearing Kada Hadar Member, Hadar Formation, Ethiopia

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The Hadar Formation of Ethiopia contains a record of hominin evolution spanning from approximately 3.5 to <2.3 Ma. A major erosional disconformity informally divides the Kada Hadar Member into lower and upper components just above the BKT-2 tuff (2.94 Ma). The lower Kada Hadar Member is comprised of fluvial sands, well-developed claystone paleosols, and several brief lacustrine phases, while the upper Kada Hadar Member is comprised primarily of cut-and-fill channel conglomerates and silt-dominated paleosols.

Numerous tuffaceous deposits exist within the upper Kada Hadar Member, but are often spatially limited, fine-grained and reworked. Earlier publications have identified several of these tuffs and assigned correlations both within Hadar and between Hadar and the adjacent Gona region, without geochemical analyses. However, within the complex and discontinuous post BKT-2 strata such identifications and correlations cannot be made from field observations alone. The first systematic analysis of tuffs from the upper Kada Hadar has shown that more than 20 distinct chemical compositions are preserved in a ca. 30 meter section.

Correlations within the Hadar region provide additional support for the complex nature of the deposits. Additionally, this study provides geochemically-based correlations between the Hadar and Gona regions above the BKT-2. While the Gona AST-1, AST-3 and Kuseralee tuffs are present at Hadar, AST-2, 2.5, and 2.75 (2.51 Ma) which are associated with the earliest artifact bearing deposits at Gona appear to be absent from Hadar. Similarly, the BKT-3 (2.33 Ma) associated with Hadar's artifact bearing Maka'amitalu Basin has yet to be found in the Gona sequence. Thus, while post BKT-2 correlations between Hadar and Gona are authenticated, the exact relationship and sequence between the earliest artifact sites in the two regions are still somewhat problematic and most likely the result of the complex depositional history and paleogeography during upper Kada Hadar Member times.

Functional morphology of the Neandertal Nose

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Neandertals have exceptionally broad nasal apertures. The Neandertal nose has been referred to as “the prime architect of the Neandertal face” (Coon 1962). Functional explanations for the size of Neandertal noses have historically considered them to be specializations for a cold, arid environment. The adaptive nature of human nasal form is suggested by some studies of modern skeletal samples documenting a positive correlation between nasal indices and climate. Others have cautioned that these indices may not be independent of non-adaptive variables affecting facial form, and that in many studies these other variables have not been controlled; Meyer et al. (2003) showed that in modern humans nasal breadth has a negligible relationship with climatic variables, and is more highly correlated with bi-canine breadth and especially palate breadth. Thus, the form of the nasal aperture is not independent of adjacent structures, contra Hylander (1977) and Carey and Steegman (1981), who argue that nasal form is subject to selection independent of the rest of the face.

We evaluate the form of the nasal aperture in relation to non-nasal measurements of facial breadth in ten Middle Pleistocene and Neandertal fossils, and use 460 modern human crania of known provenience to test whether the nasal aperture is constrained by other aspects of facial morphology. Then, we examine the relationship between non-nasal measurements of facial breadth and climate, using historical and ancient climatic data collected for each cranium’s locality to test the hypothesis that only the nasal capsule responds to selection related to climate. Our results indicate that nasal morphology is subject to functional constraints that affect other parts of the face, and that Neandertal nasal morphology may have a stronger association with masticatory or paramasticatory functions than with climate.

How Primitive Was the Postcranial Skeleton of *Australopithecus Africanus*?

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How primitive was the postcranial skeleton of *Australopithecus africanus*, especially relative to that of *Australopithecus afarensis*? Recent analyses of tibia morphology and limb proportions have concluded that, postcranially, *A. africanus* was clearly primitive relative to *A. afarensis*. However, an analysis of distal radii found *A. africanus* essentially identical to modern humans. Here, I test three hypotheses regarding the primitive/derived nature of the *A. africanus* postcranial skeleton based on a study of the relevant original fossils. The STW 514 tibia was described as "chimp-like" and said to have several primitive morphological features relative to *A. afarensis*. A systematic comparison of features, however, demonstrates that STW 514 is similar to the known sample of *A. afarensis* tibia, with the few differences indicating that STW 514 is the more derived specimen. An analytical comparison of isolated elements concluded that *A. africanus* had more primitive limb proportions than *A. afarensis*. Restudy of these elements shows that, while there is indirect evidence that limb proportions may have differed in these taxa, the polarity of this "trait" is unclear. In addition, the original analysis is compromised by inconsistencies in assignment of specimens to size classes. Casts of hominid distal radii have been used to argue for the retention of knuckle-walking traits in early hominids and the presence of a modern human-like morphology in *A. africanus*. Examination of the original fossils shows that damage unaccounted for in the original analysis fatally compromises this conclusion. Overall, there is little evidence that the postcranial skeleton of *A. africanus* was more primitive than that of *A. afarensis*.

Ontogeny and Proportions of *New Proconsul heseloni* tarsals and Metatarsals from the Kaswanga Primate Site, Rusinga Island, Kenya

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During the mid 1980s, teams from Johns Hopkins University and the National Museums of Kenya collected a minimum of ten *Proconsul heseloni* individuals from the Kaswanga Primate Site (KPS), Rusinga Island, Kenya. Five of the individuals have nearly complete feet, representing a range of developmental ages identified by tooth development, size, and ossification stages. The preservation and comparative anatomy of the tarsals and metatarsals of these five individuals are described here. Combining data from the KPS individuals with that from the holotype, the subadult partial skeleton KNM-RU 2036, a growth series of the foot was established for *P. heseloni*. The proportions of the bones of the foot and hindlimb, individually and as part of anatomical and mechanical units, were compared to *Macaca mulatta* (n= 115) and *Pan troglodytes* (n=175). Not surprisingly, the *P. heseloni* foot is a mosaic of monkey- and ape-like morphology. When compared with individuals of the same dental age, the infant *P. heseloni* foot (KPS Individual IV) resembles *P. troglodytes* in the relative length of the tarsus, but resembles *M. mulatta* in the relative lengths of the non-hallucal metatarsals and proximal phalanges. The same pattern of a chimp-like hindfoot and a macaque-like forefoot is evident in the adult female (KPS Individual III). Furthermore, the hallucal metatarsal and proximal phalanx together are longer relative to the hindfoot and body size than those of macaques and chimpanzees.

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Comparison of the Faunal Contexts of *Homo erectus* in East Africa and East Asia During the Early Pleistocene

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During the early Pleistocene, *Homo erectus* dispersed into East Asia where it adapted to the Eurasian fauna found in Chinese sites such as the Nihewan Basin, Lantian, and Yuanmou. Despite the biogeographic significance of the presence of *Homo* as an African-derived animal, little comparative work has been done to understand the faunal differences between the fossil mammals of this region and those of East Africa. The composition of the early Pleistocene large mammalian fauna in East Asia would have been important to an immigrant *Homo* in terms of feeding niches, potential prey and competition with established animals.

This research considers the large mammalian faunal context of the early Pleistocene dispersal of *Homo* from taxonomic and ecological perspectives. Factors such as the distributions of body sizes and feeding niches provide an ecological comparison and allow assessment of qualities related to dispersal in *Homo* and other animals. The order Carnivora is a particular focus since the consumption of animal products would have facilitated dispersal into temperate latitudes, but would also have placed *Homo* in competition with large carnivores.

Comparison of the faunas of hominin paleontological and archaeological sites in East Asia and East Africa shows that carnivores are one of the few taxonomic groups with shared genera between the regions. This research also considers whether taxonomic or ecological signals of competition result from the immigration of *Homo*, especially with members of the carnivore guild. Faunal differences between the regions imply a unique ability in *Homo* to modify its behavior in order to expand into new ecological settings.

Comparative Taxonomic, Taphonomic and Palaeoenvironmental Analysis of Hominid infills, Member 4 and Jacovec Cavern, within Sterkfontein, South Africa

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Two infills within the site of Sterkfontein, South Africa, Member 4 and Jacovec Cavern, share similarities and display marked differences in taxonomy, taphonomy and palaeoenvironment. Taxonomically, the most striking difference between the two deposits is the high number of taxa and species within a taxon represented within the Member 4 faunal assemblage than that in Jacovec Cavern faunal assemblage. There are nine bovid tribes represented in five subfamilies within Member 4 and five bovid tribes in four subfamilies within Jacovec Cavern. At least five primate species have been recovered from Member 4 while three have been recovered from the Jacovec Cavern. Twelve carnivore species are represented in Member 4 while eleven are represented in Jacovec Cavern.

Taphonomically, both assemblages are characterised by low frequencies of bone modification. These low frequencies may be a result of a culmination of various processes that impacted on the original deposited assemblage. The faunal assemblage in Member 4 was accumulated into the cave through a combination of voiding carnivores, "death traps" and natural deaths within the cave. The Jacovec Cavern faunal on the other hand was accumulated by carnivores, not into the cavern but on the surface above and within the vicinity of the cave entrance. Eventually fluvial action incorporated the faunal into the cave. Palaeoenvironmental reconstruction from Member 4 indicated a mix of forest and open savannah with more emphasis on woodland. A mosaic of open grassland and dense forest, equivalent to today's tropical forest in Africa, is suggested for Jacovec Cavern.

Large Mammal Differences Between Fossil and Modern Communities: Implications for the Reconstruction of Hominin Paleoenvironments

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The reconstruction of past hominin habitats is an important aspect of attempts to understand and interpret patterns of human evolution, since it provides the ecological context in which humans evolved. Paleoenvironmental reconstructions rely on modern faunal communities as models for fossil assemblages. While this is a valid and necessary aspect of paleoecology, it is important to explore any factors that may produce fundamental differences between modern and fossil faunal assemblages. To this end, community structure of the large mammal faunas of African Plio-Pleistocene hominin-bearing localities and modern communities was compared. The ecovariates employed in this analysis are locomotion and diet. A Principal Component Analysis (PCA) of the ecovariates revealed the distinctiveness of fossil assemblages compared with most modern large mammal communities. A detailed examination of these differences indicates that the lower abundance of non-terrestrial carnivores is a major factor in the separation between fossil and modern faunal communities. This may be due to inherent differences between fossil and modern carnivore communities, taphonomic factors, difference in ecovariate coding methods for modern and fossil animals, or a combination of all three. Results of the PCA also showed that, with the exception of forest communities, it is difficult to distinguish between modern large mammal faunal communities based on ecovariates. All modern non-forest communities group together to the exclusion of modern forest communities with little or no distinction. This indicates that faunal community structure based on ecovariates cannot be used to discriminate between different non-forest communities. These factors should be taken into account when considering the community structure of fossil assemblages and reconstructing hominin paleoenvironments.

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Oldowan Technology at Kanjera South, Kenya: The context of Technological Diversity

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The Oldowan Industrial Complex is marked by extreme variability. As the Oldowan may represent a significant adaptive event in the evolution of Pliocene hominins it is necessary to explain this diversity. Previous explanations have focused on the possibility of differing hominin behavioral or cognitive complexity. Other explanations focus on the variability of raw materials selected for artifact manufacture. Unfortunately, many of these explanations are developed without extensive contextual information about the nature of raw material availability and variation. This severely hinders our ability to answer larger scale evolutionary questions about the adaptive significance of the Oldowan.

Here we report on the first systematic study of technological forms at Kanjera South. Extensive excavation has provided one of the largest late Pliocene archaeological assemblages outside of Olduvai Gorge, Tanzania. Large sample sizes combined with the heterogeneous lithological composition of the assemblage make Kanjera South an ideal setting for investigating variation within the Oldowan. Technological variability across raw material groups that cannot be explained solely by differences in raw material physical properties suggests that contextual factors are a major influence on technological patterning. We present hypotheses about the effect of paleogeographic context on Oldowan variability and provide some preliminary insights into the impact of these factors on the Kanjera South industry.

A Fossil Hominoid Proximal Femur from Kikorongo Crater, Southwestern Uganda

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The proximal femur has been used as exemplary evidence that locomotor differences between bipedal hominins and the African great apes are preserved in the fossil record. The external morphology of a fragmentary right proximal femur from Southwestern Uganda is described here. The fossil is strongly aligned with the African apes, and in particular may be the first postcranial fossil of the genus *Pan*. Discovered in the Kikorongo crater of Queen Elizabeth National Park in 1961, this specimen was informally assigned to *Homo sapiens* (although never described) and tentatively dated to the late Pleistocene. However, the fossil lacks the suite of features typically associated with bipedal locomotion. Instead, the external morphology of the femoral neck aligns the fossil with the African great apes, although attempts to discern the internal architecture of the bone were not successful. The femoral neck is circular in cross section, and is not anteroposteriorly flattened like Plio-Pleistocene hominins. Like the African apes, the Kikorongo specimen lacks both an obturator externus groove, and intertrochanteric line. It has a short femoral neck with a narrow and deep superior notch. Using discriminant function analysis, the Kikorongo femur IS clustered with the genus *Pan* when compared to *Gorilla* and *Homo*. There are problems, however, with assigning this specimen to the genus *Pan*. If the Kikorongo proximal femur is from *Pan*, it would be extremely large for this taxon. Furthermore, there is such variability in the proximal femora of modern humans that, although it would be an unusual human, it still remains possible that this fossil is from *Homo sapiens*, and not an African ape. The likelihood that the Kikorongo fossil belongs to either *Pan*, or *Homo* is addressed by considering the allometry of the *Pan* proximal femur and by using resampling techniques on the human femora data set.

The Decoupling Hypothesis: A New Idea for the Origin of Bipedalism

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Bipedalism is regarded as the key adaptation for the foundation of the hominin radiation. After years of research, however, no single theory explaining the origin of bipedalism has gained widespread acceptance within paleoanthropology. A new idea called the Decoupling Hypothesis is proposed as a potential explanation.

Character decoupling is the emergence of independent characters from correlated ones during the course of evolution. Characters are particular genetic, anatomical, behavior and functional traits that have the potential to illuminate specific questions. The decoupling of locomotor characters has been used previously to explain the evolution of avian flight. Hominin bipedalism represents another instance of locomotor decoupling: the forelimbs decoupled from the hindlimbs, each evolving to function independently. The question of why bipedalism arose can then be posed as: Why did the forelimbs become decoupled from the hindlimbs?

Primate shoulders experience conflicting demands for stability and mobility. Extreme mobility facilitates suspensory locomotion and postures, while stability enhances above-substrate behaviors such as quadrupedal running. Traits that improve shoulder stability and mobility are incongruent. Features of stable shoulders include laterally positioned scapulae, relatively large glenoids and relatively flat humeral heads that do not rise above the tubercles, while mobile shoulders are characterized by dorsally positioned scapulae, small glenoids and highly curved humeral heads that rise above the tubercles. The inescapable tradeoff between mobility and stability dictates that the shoulder cannot simultaneously be highly effective at locomotor behaviors that generate conflicting demands. Because the early hominin niche may have required both effective above-substrate and suspensory behaviors, the inability of the shoulder to be effective at both types of behaviors would have resulted in a loss in fitness. Bipedalism may have resolved this problem by decoupling the forelimbs from the hindlimb allowing the shoulder to remain highly mobile for suspensory behaviors while the hindlimb became adapted for above-substrate locomotion.

Did/does Docosahexaenoic Acid Constrain Encephalization? Argument for an Alternative Evolutionary Role for Dietary DHA

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Docosahexaenoic acid (DHA), a primary constituent of membrane phospholipids within the brain and retina, is essential for the optimal function of enzymes, receptors, and other membrane bound proteins. Because humans are unable to synthesize n-3 fatty acids *de novo*, DHA must originate from the diet preformed or by synthesis from dietary precursors such as α -linolenic acid (LNA). As some studies indicate that intake of preformed DHA is more efficiently accrued within neural membranes than from intake and synthesis from LNA, a number of evolutionary theorists have speculated that preformed DHA must have been an integral dietary constituent throughout hominin evolution to facilitate growth of the encephalizing brain. However, studies investigating the relative efficiency by which preformed DHA versus LNA accrue as neural DHA are inappropriate for promoting hypotheses of constraint.

Investigations of several animal models as well as modern human populations support that dietary consumption of LNA in the absence of DHA is sufficient for the neural accretion of adequate DHA and maintenance of "normal" brain size. If so, hominin encephalization need not occur in proximity to an aquatic environment rich in preformed DHA as was previously proposed. Rather, it remains unconstrained within both aquatic and terrestrial environments.

Much evidence also exists to suggest that consumption of a ready source of preformed DHA, while not required for absolute brain growth, may provide for optimal cognitive function and visual acuity. Thus, DHA acted not as a constraint on encephalization but supported optimal function of an already encephalized brain. Those individuals or species with optimized cognitive function and visual acuity were best equipped to make use of a wide variety of resources. Thus, while access to and acquisition of preformed DHA may have played a key role in hominin evolution, it probably did not constrain the early stages of encephalization in *Homo*.

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Calibrating Paleoenvironmental Analysis Using Modern Micromammal Assemblages From Tanzania

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Micromammals (< 500g) are used to determine paleoenvironments at numerous paleoanthropological sites. However, most fossil micromammal assemblages are predator mediated. Proper use of micromammal data, therefore, must be calibrated against modern environments and adjusted for predator bias.

Large faunal collections made from owl roosts in various habitats within the Serengeti National Park, Tanzania are analyzed and the shifts in taxonomic abundance from one roost to the next are compared to the habitats that surround the roosts. The surrounding habitats are mapped in detail using satellite imagery in conjunction with ancillary data on hydrology, soils, and topography that is digitized into a geographical information system (GIS).

Significant differences are found in relative abundance of taxa along an ecological gradient of precipitation and woody vegetation cover. When controlled for habitat differences, taxonomic composition in the prey assemblages does not differ between two species of owl, *Tyto alba* and *Bubo africanus*, though biases of some prey items are found in relative abundance.

These results are the first to thoroughly establish the validity of interpreting changes in micromammal faunas as a response to regional ecological variables and are the first step to a comprehensive model of paleoenvironmental reconstruction that incorporates micromammals. The results also demonstrate the potential for different predator species to yield similar prey assemblages.

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Carnivore and Neandertal Interactions at the Les Pradelles Site, Charente, Southwest France

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Excavations at the collapsed cave site of Les Pradelles, Charente, France, have uncovered a series of Late Pleistocene stratigraphic levels containing a wide variety of Würmian age fauna, including reindeer, horse, bison, marmots, wolves, cave lion and cave hyena. Also discovered in these deposits have been numerous Middle Paleolithic artifacts (Mousterian of La Quina techno-complex) and more than 38 fragmentary Neandertal fossils, including cranial, dental and postcranial elements. Analysis of the artifacts and especially the human and animal bones, have revealed that over the course of time, the site was intermittently occupied, sometimes by Neandertals and at other times by cave carnivores. The human occupations have been interpreted as most likely those of a hunting camp where animal carcasses, mainly reindeer but also horses and bovids, were brought for processing.

Examination of teeth that had been provisionally identified as deciduous bovid or cervid teeth have now been shown to be maxillary permanent incisors of Neandertals. These teeth have been markedly modified by the gastric secretions of a carnivore, probably a cave hyena, and were subsequently regurgitated. This process has given these teeth the superficial appearance of herbivore deciduous incisors.

As determined from the number of occipital fragments, the MNI of Neandertals at the site is five, with the bones of four of five of these individuals showing evidence of cut marks, and incisions, moreover, that mirror those found on the faunal bones.

This evidence suggests that Neandertals treated some of their colleagues in the same manner as hunted animals, processing the eatable portions and leaving other parts to be scavenged by carnivores. The abundance of animal remains makes it difficult to interpret this treatment of the human bones as evidence of dietarily necessary cannibalism; other possible explanations will be assessed.

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Perikymata Number and Spacing on Early Modern Human Teeth: Evidence from Qafzeh Cave, Northern Israel

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Over the past two decades, many investigations have focused on the number and distribution by deciles of perikymata on the surface of enamel, most often of the anterior teeth. Variations in perikymata have been employed in the construction of phylogenetic relationships. Further, because perikymata are thought to be deposited in a regular, time ordered sequence, differences between living humans and various hominin fossil samples have been viewed as a reflection of the duration of dental maturation, and by implication, differences in overall growth and development. In this context, we report the results of an examination of the perikymata of four incisors that possess achieved crown complete status from two immature individuals from the Qafzeh Cave, northern Israel. The eight immature individuals recovered from this site is the largest number of immature Mousterian remains from one site in the Levant. An examination of the biology of these fossils can provide data on the anatomy of these early modern humans as well the range of variation present in a single sample.

A confounding problem in evaluating the data from the Qafzeh teeth is the range of conflicting results concerning perikymata numbers and distribution in living humans and fossil hominins. What is evident from a review of this work is that perikymata counts on the anterior teeth of fossil hominins and living humans are variable and these counts, by themselves, fail to distinguish species. Further, a pattern of perikymata compacting towards the cervical margins of the anterior teeth, while showing a general trend to increase in number in later-in-time hominins, also exhibits marked variability, especially in that part of the crown closest to the cervix. Perikymata counts and compacting on the Qafzeh immature teeth are within the range of variation of modern humans and Neandertals, and appear insufficient to provide assistance in making phylogenetic statements.

The Bony Labyrinth of Neandertals: Additional Results

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The Neandertal lineage plays a central role in the stormy debate over modern human origins; the fundamental divergence between studies lies in the ancestral relationship with modern humanity. Some paleoanthropologists believe that there is a regional morphological continuity between Neandertals and modern humans, or at least a significant contribution of Neanderthals to the European early modern human gene pool. On the other hand, the opposite hypothesis suggests that a reproductive barrier exist between the two groups, and that Neandertals and modern humans were distinct at the species level.

Hublin *et al.* (1996) published an article on an immature temporal bone from a Chatelperronian level of the French site of Grotte du Renne (Arcy-sur-Cure, Yonne). The authors provided the first comparative analysis of the bony labyrinth of a Neandertal specimen. They underlined a number of traits which appear to distinguish Neandertals from both *Homo erectus* and modern humans, and used these to establish the phylogenetic affinities of the temporal bone. A more recent study (Spoor *et al.*, 2003) confirms the initial findings of Hublin *et al.* (1996) but each of the identified labyrinthine traits characterizing Neanderthals shows an overlap between modern humans and Neandertals variabilities.

In the light of additional multivariate analysis and new computer-tomography study of the temporal bones of Spy1 and Spy2 Neandertals, we support a significant distinction between the Neandertal labyrinth features and the modern human morphology. The derived nature of the Neandertal labyrinth from both *Homo erectus* and modern humans seems evident and could be seen as an argument to distinguish Neandertals from modern humans at the species level. As the bony labyrinth attains an adult equivalent size between 17 and 19 weeks of gestation (Jeffery and Spoor, 2004), this structure provides a better potential than other skeletal or dental remains to assess phylogenetic affinities between Hominids groups, since postnatal individual history influences are absent or minim.

Regional Variation in Late Pleistocene Human Postcranial Robusticity

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European Upper Paleolithic modern humans exhibit chronological trends in postcranial biomechanical features, including an increase in upper limb robusticity and a decrease in antero-posterior lower limb strength despite stasis in femoral overall strength. It is unknown whether these are regional or global trends, given that there is little appropriately analyzed fossil material for the later Upper Paleolithic outside of Europe. As such, the postcranial anatomy of late Pleistocene modern humans from North Africa and Southeast Asia was evaluated to assess variation across the Old World in light of the trends in robusticity known from the European fossil record.

Upper and lower limb robusticity was analyzed primarily through cortical bone distribution, with supplementary data from analyses of muscularity and articular robusticity. Robusticity data were collected for all available fossil samples from the Late Upper Paleolithic (LUP) of North Africa, the Levant, and Southeast Asia and combined with existing data from Europe and Asia to examine regional variation. LUP samples were also evaluated relative to Early Upper Paleolithic (EUP) and Holocene samples to evaluate temporal changes.

In measures of upper and lower limb strength, Asian LUP samples are consistently less robust than African and European LUP samples. Although functional or behavioral differences may explain this variation, it is more likely related to the characteristic differences in body size between groups.

Temporal analyses demonstrate that there are no clear patterns of robusticity changes through time. Relative to the EUP, African and European LUP samples show increased upper limb robusticity and relative stasis in lower limb strength, as have previously been described for the European fossil record; however this pattern is not seen in the Asian LUP sample. Worldwide samples from the Holocene do not demonstrate a systematic decrease in robusticity in the upper or lower limbs at the Pleistocene-Holocene boundary.

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Integrative Biomechanical Geometric Morphometrics: A New Approach to Study the Evolution of the Hominid Locomotor Skeleton

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Understanding the nature of the postcranial skeleton features remains a key issue in the reconstruction of both locomotor abilities and phylogenies in the hominid clade. 3D and systemic approaches are relevant to this issue, especially to the study of a complex system such as the locomotor apparatus. Here we present a new approach: the integrative biomechanical geometric morphometrics (IBGM); the aim is to 3-dimensionally assess: 1- each element of the skeleton, 2- the skeleton as a whole, and 3- the mutual relations inside the complex.

The IBGM consists of both architectural and morphometric geometric 3D analysis. We use anatomical landmarks that we selected for their functional interest: joints area form, biomechanical axis, length and main direction. The bones of both the pelvic girdle and the lower limb are digitized separately. Thereafter, they are virtually articulated, following a process that is normalized and reproducible. From this articulated architectural chain, we then extract 3D coordinates of the joints centers, from the lumbosacral to the talocrural one. A geometric morphometric analysis is then performed using the Morphologika software.

We present the first results concerning the pelvic girdle and lower limb osteoarticular complex of 32 humans, 87 African apes (*Gorilla gorilla*, N=35; *Pan troglodytes*, N=38; *Pan paniscus*, N=14) and the *A. afarensis* specimens from Hadar (A.L. 288-1, A.L. 129-1). Architectural differences are quantified and interpreted in the frame of the locomotor functional complex system. The procrustean and PCA analysis clearly distinguish the human architecture on the one hand, and the great apes architecture on the other hand. Differences between these two architectures concern pelvic and lower limb bone proportions, and knee flexion and abduction. *A. afarensis* appears very close to the modern human condition in terms of pelvic and lower limb architecture, but slight differences illustrate a peculiar architectural pattern in the fossil specimens.

Fossil Collection Biases at Sterkfontein Cave and their Impact on Primate Taxonomy

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Recent research on the fossil cercopithecoid sample from Sterkfontein cave (South Africa) has confirmed C.K. Brain's (1981) suggestion that the collection is biased by analyst selectivity. Numbers of cranial and post-cranial element specimens were calculated for Members 2 (c. 4.0 – 3.0 million years old, Ma.), 4 (c. 2.8 – 2.6 Ma.) and 5 (c. 2.0 – 1.4 Ma.). Comparisons of values revealed a strong predominance of cranial specimens in the earlier (pre-1966) STS collections. Of the 884 primate specimens from the STS sample, only 50 are post-cranial. In comparison, the SWP sample (post-1966) contains 1446 cranio-dental specimens and 722 post-cranial specimens. When the isolated teeth are removed from both collections, the cranial to post-cranial ratio from the STW sample is 1:1, while a 1:0.05 ratio is observed in the STS sample. Neither ratio approximates the value expected from the deposition of complete primate skeletons. That divergence from the expected ratio in the SWP sample might be explained with reference to density-mediated attrition, while analyst selectivity is implicated in the clear bias for more easily identified skeletal elements (i.e. cranio-dental remains) that exists in the Sterkfontein STS sample. Importantly, we argue that this bias has significant implications for previously published taxonomies of fossil primates from South Africa. For example, we conclude that specimens attributed to large bodied species, such as *Papio robinsoni*, do not exist in the SWP sample, but only in the biased STS sample. Further, we present data that indicate specimens from the SWP sample previously attributed to *P. robinsoni* are simply misidentified. In light of these results, we argue that extreme caution should be taken in constructing and evaluating primate taxonomies based upon the biased STS sample. As a preferable alternative, we offer an updated taxonomy based on the re-identified SWP materials.

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EFTN HD2: A Mid-Pleistocene Artifact-and-Mammal-Bone Occurrence at Elandsfontein, Western Cape Province, South Africa

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In the early 1980s, Graham Avery excavated bones and stone artifacts on a paleosurface at EFTN HD2, at the northern end of the famous Elandsfontein (Saldanha/Hopefield) Acheulean site, 100 km north of Cape Town, South Africa. This assemblage is significant for investigating the extent to which Acheulean people commonly handled bones found at the same sites as stone artifacts, and the degree of carnivore involvement in accumulating these types of occurrences.

The mammal species and Acheulean artifacts imply a mid-Pleistocene age. Of the 827 identifiable bones, rhinoceros is the most abundant large mammal, and both white (*Ceratotherium simum*) and black (*Diceros bicornis*) rhino are present. Grysbok/steenbok (*Raphicerus melanotis* and *Raphicerus* sp.), zebra (*Equus capensis* and *Equus* sp.), and hares (*Lepus* sp.) are also common. Medium-size cats (*Felis caracal* aut *serval*) and black-backed jackals (*Canis mesomelas*) are the most common carnivores. Also, both black wildebeest (*Connochaetes gnou*) and greater kudu (*Tragelaphus strepsiceros*) are present. Since historic times, these two species have had separate ecological preferences. The presence of both species in the same assemblage suggests either time-averaging in the occurrence or that the animal communities of the Holocene do not resemble those of the past.

The 79 stone artifacts, made almost exclusively of silcrete and quartz, are mainly flakes and flake fragments. Several cores, core fragments and flaked chunks and pebbles indicate that tool manufacturing occurred on site. Retouched pieces include a handaxe and possible handaxe tip along with 2 denticulates and several flakes with denticulate-like retouch.

None of the bones is conspicuously cut-marked. Carnivore chew marks are more obvious, and hyena coprolites are abundant, suggesting a complex, multi-component occurrence. HD2 recalls other bone-artifact occurrences at Elandsfontein and at the nearby Acheulean site of Duinefontein 2. The sum supports the suggestion that Acheulean people had limited impact on the large mammals with which their artifacts are often associated.

Since When are Humans Different?

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It is widely acknowledged that modern *Homo sapiens* is ecologically disruptive. Fowler & Hobbs (2003, *Proc. R. Soc. Lond. B* 270:2579-2583) report our population size, biomass consumption, geographic range, and other factors related to ecological impact fall well beyond the range for other similarly-sized mammals. We survey the literature for data that might elucidate when, approximately, humans became ecologically abnormal. Specifically, we compare the caloric intake, range of floral and faunal species consumed, geographic range, and population density of modern and prehistoric hunter-gatherers to those of other mammals of comparable body mass. Our results indicate ecologically apposite mammalian models vary markedly according to the character compared. For example, in terms of range of floral species consumed, humans are similar to other apes; while in terms of prey species, humans fall outside the range of carnivores. Hunter-gatherer caloric intake values, however, fall within the range of both extant hominoids and similarly-sized carnivores. For nearly 30,000 years or more, human habitation ranged from 30° S to 70° N, spanning tropic, temperate and arctic latitudes, a character shared by no other similarly-sized mammal.

From our findings, we reject the hypothesis that humans departed radically from the mammalian norm only with the relatively recent acquisition of agriculture. Our results indicate that contemporary hunter-gatherers fall outside the ranges for similar-sized mammals. Further, we discuss archeological evidence of anthropogenic habitat degradation and extinction, indicators that Upper Paleolithic/Late Stone Age peoples were ecologically abnormal as well. It appears that, rather than being a consequence only of advanced resource extraction technologies and high population densities, our ecological uniqueness extends well into prehistory. The implications for selecting appropriate mammalian models for hominin evolution are discussed.

Isotopic Paleoecology of Plio-Pleistocene Mammals and Paleosols, Konso Formation, Southern Ethiopia

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The Konso Formation of the southern Main Ethiopian Rift Valley, Ethiopia, contains a sequence of fossil- and artifact-bearing fluvio-lacustrine sediments and paleosols, (1.4-1.9 mya). Hominid species include *Homo erectus* and *Australopithecus boisei*; Oldowan and early Acheulean sites are abundant. Stable carbon and oxygen isotope analyses of paleosol carbonates and mammal tooth enamel were performed to refine environmental reconstructions. Stratigraphic trenches were sampled at 12 localities. Floral habitats ranged from wooded grassland (~60% C₄ grass) to woodland (15-30% C₄). Systematic differences were observed between localities in proportions of trees to grass, and in temperature and/or humidity.

Third molars of 22 individuals from three localities were microsampled at varying intervals at right angles to the growth axis to reconstruct intra-tooth seasonal dietary and environmental variation in carbon and oxygen isotope ratios (2-8 samples per tooth). Species comprise two suid genera (6 species, 13 individuals), equids (2 individuals) and tragelaphines (3 species, 7 individuals). Tragelaphines had low seasonal variation in carbon and oxygen isotope ratios. One *Tragelaphus angasi* individual was a pure browser (C₃ feeder), possibly in a closed forest microhabitat. All others consumed small amounts (~25-35%) of C₄ grasses. Oxygen isotope ratios correlated with tragelaphine body size. Equids were predominantly grazers, with insignificant seasonal variation in carbon and oxygen isotope ratios. Suid species show systematic differences in carbon and oxygen isotope ratios, and substantial differences in amounts of seasonal variation in oxygen and carbon isotopes, reflecting complex diet and habitat niche partitioning. Low-crowned suids (*Kolpochoerus*) consumed more grass than expected from their tooth morphology, but less than most high-crowned species (*Metridiochoerus*).

The isotopic evidence suggests that Plio-Pleistocene hominids in the Konso paleobasin occupied a relatively well-watered mosaic of wooded grasslands and woodlands with muted seasonality, similar to the environments of modern lake basins in the central Rift Valley of Kenya.

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Ostrich Eggshells as Paleoenvironmental Indicators in the Pliocene Laetoli Succession, N. Tanzania

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In addition to their utility as a biostratigraphic tool, fossil eggshell fragments of ostriches have great potential for contributing to paleoenvironmental interpretations. Isotopic analyses of the organic and inorganic components of fossil eggshells provide an archive of diet and prevailing climatic conditions during the past. Eggshell fragments represent a ubiquitous component of the Laetoli fossil assemblages and >800 specimens have been systematically sampled from the sequence since 1998. Morphology of the eggshells and their taxonomic affinities indicates that two different species of *Struthio* are represented – *Struthio* sp. nov. in the Lower Laetolil Beds (~4.3-3.8 Ma) and Upper Laetolil Beds (~3.8-3.5 Ma) below Tuff 3 which is replaced higher in the U. Laetolil Beds by the modern species of ostrich, *S. camelus*. Preliminary isotopic analyses of 78 eggshell fragments from the Laetoli succession indicate a distinct dietary shift within the Upper Laetolil Beds correlating to this taxonomic change. Isotopic signatures of the older eggshell material indicate diets dominated by browse with a greater component of C₃ biomass in the diet than modern ostriches in the region. The earliest appearance of *S. camelus* in the sequence is marked by a 5-6% positive shift indicating a C₄ grazing component greater than modern ostriches at Laetoli and more comparable to extant ostriches in the Turkana Basin. Oxygen isotopic values also become more enriched, possibly reflecting the dietary shift. Samples of *S. camelus* from the overlying Upper Ndolanya Beds (~2.7-2.6 Ma) yielded isotopic signals consistent with the older *Struthio* sp. nov. material, indicating a reversion to earlier C₃ dominated diets. Relative to isotopic analyses of associated fossil mammalian herbivore taxa that retain overall uniform diets through the sequence, the eggshell data provide evidence of discrete dietary shifts in struthionids, which is linked to taxonomic and ecological change.

Precessional Forcing of Plio-Pleistocene Lake Levels from Koobi Fora, Kenya

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Marine records suggest that at 2.5 Ma the dominant periodicity of global climate change shifted from precession (19–23 Ka) to obliquity (41 Ka). Climate-based hypotheses of hominin evolution use marine records as a framework for late Neogene climate change in terrestrial Africa. These hypotheses predict that between 2 and 1 Ma obliquity-related climate change was a primary influence on hominin evolution in Africa; however, recent research suggests that marine paleoclimate data may not directly correlate with paleoclimate patterns from the terrestrial realm. Accordingly, it is necessary to generate paleoclimate records at specific hominin sites to comprehensively understand the influence of climate change on early hominin evolution.

Here we report on deposits, dated between 1.88 and 1.65 Ma, which bracket the rise of Early African *Homo erectus* in the Koobi Fora Region of Kenya. We use sedimentation rates, facies, and isotope analysis of pedogenic carbonates to construct a high-resolution record of oscillations in lake level from the deposits. In the record, lacustrine transgressions occur at the precessional periodicity, while a regressive tendency may occur at the eccentricity periodicity (100 Ka). Additionally, we infer an aridity trend from a major regression of lake level at about 1.8 Ma, in agreement with faunal and isotopic data from both the continental and marine realms of Africa.

We explain discrepancies between the periodicity of this terrestrial paleoclimate record and marine records of Plio-Pleistocene African climate by the sensitivity of inland climates of East Africa to precession-related changes in the latitudinal temperature gradient of the tropics. Published records of late Neogene sapropels from the Mediterranean Basin provide supporting evidence for a precessional origin of lake level oscillations in the examined deposits. We suggest that the environment of Early African *Homo erectus* in Koobi Fora was modulated by climate change related to the precessional periodicity.

The Biomechanics of Stone Toolmaking: Kinematics and Kinetics of the Arm During Oldowan/Mode I Knapping

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Techniques of stone tool manufacturing have long been a focus of experimental archaeological investigations, but relatively few studies to date have focused on the mechanical requirements such toolmaking imposes on the toolmaker. Although comparative anatomical and EMG work have elucidated the hand structures and musculature most important to stone knapping, the complete toolmaking arm swing has not yet been investigated from a biomechanical standpoint. The research reported here addresses arm biomechanics (kinematics and kinetics) during Oldowan/Mode I stone toolmaking (i.e., hard-hammer, freehand direct percussion); it represents a new application of a motion-analysis technique in widespread use among sports biomechanists.

Forty-nine human and two bonobo (*Pan paniscus*) subjects of varying experience levels were filmed with two high-speed motion picture cameras while flaking one greenstone and one chert core; approximately four useable strikes per core, per subject were obtained. Trials were digitized by hand, and three-dimensional body landmark coordinates were obtained using direct linear transformation (DLT). The resultant location-time data were then used to obtain biomechanical parameters for each trial, including hammerstone and landmark velocities and accelerations as well as torque patterns for each arm joint.

Analysis of the films reveals at least two distinct knapping techniques among the subjects. Further, patterns in the biomechanical data reveal differences among knappers of different experience levels which mirror intergroup variability already demonstrated statistically for the experimentally-produced artifacts. The basic stone-knapping arm swing characteristic of successful flake production is described, including muscle use patterns, and evolutionary implications are explored.

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The Search for the Real Missing Link: Finding the Genes that Influence Craniofacial Morphology

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Beginning with the descriptions of the black skull and Nariokotome skeleton, the past 20 years has been an unprecedented period of discovery of fossils relevant to human evolution. The hominin fossil record is now characterized by at least twenty forms spanning 7 million years and demonstrating tremendous morphological diversity. Despite hopes that each new find will elucidate the evolutionary trajectories of hominin ancestral lineages, these "missing links" are more frequently described as confusing than as clarifying.

Coincident with this increase in fossil recovery have been several significant advances in the study of human genomics. Since the diversity of ancestral forms has resulted from changes in the genetic underpinnings responsible for craniofacial variation, the search for genes influencing craniofacial morphology should be given a priority equal to that of the search for new fossils.

In this study, we examined nine quantitative traits taken from lateral cephalographs of 608 healthy participants from 73 families in the Fels Longitudinal Study. An initial set of 350 of these individuals has been genotyped for some 400 autosomal markers spaced approximately every 10 cM. A variance components-based linkage analysis (SOLAR; Almasy and Blangero, 1998) was used to locate chromosomal regions (quantitative trait loci; QTL) harboring genes that influence craniofacial variation.

Heritability estimates for all traits were significant and ranged from 0.22 to 0.77. Twelve suggestive linkages (LOD scores > 1.9) of the craniofacial measures posterior-anterior, sella-sphenoethmoidale, basion-nasion, sella-nasion, and the angles sella-nasion-point A and nasion-sella-pns, were found to markers on chromosomes 1, 2, 3, 4, 11, 12, 13, and 16. Additionally, two significant linkages (LOD scores > 3.0) of measures of cranial height (sella-vertex) were found to markers on chromosomes 3 and 12. Future work will seek to identify specific genetic polymorphisms that influence variation in the morphology of various craniofacial traits in both human and nonhuman primates.

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Thinking outside the Book: Escaping Traditional Representations of Hominin Evolution Through Computer Animation

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With the accumulation of new hominin fossils and taxa, it has become increasingly difficult to squeeze the hominin phylogeny onto one page of text. The resulting representations can be very misleading. For instance, on an 8.5 x 11 inch piece of paper, in a chart scaled to 6 million years and depending on the orientation, the word "*H. rudolfensis*" in twelve-point font can represent 55,000-70,000 years. Even if represented by a single diminutive icon, a single fossil can take up 100,000 years of space on a phylogeny. We hypothesize that the representational constraints inherent to books and journals are heavily influencing the way we think about hominin evolution.

As an attempt to overcome these issues, we created an alternative to the traditional phylogenetic diagram. First we built a database of every significant fossil hominin discovery up until about 25,000 years ago. Then we animated a timeline of hominin evolution. The clock starts at 6.5 Ma with the *Sahelanthropus tchadensis* cranium. Time ticks by on the screen at the chosen rate until 6 Ma when symbols representing the *Orrorin tugenensis* specimens flash into view, and so on until the proliferation of anatomically modern humans in the Late Pleistocene. Our animated timeline provides a new way to experience deep time. Watching the movie with a generation (20 years) represented by one second takes 90 hours, and it is very difficult to imagine the resulting representation as a bushy tree.

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Middle Pleistocene Faunal Change at the Acheulean to MSA Transition

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Hominin evolution during the middle Pleistocene (~790-130 ka) in Africa is poorly understood due to a number of factors, including sparse bone preservation, uncertainties in absolute dating for this interval, and differing interpretations of the archaeological and hominin fossil evidence. This time period saw a change in hominin behavior from the Acheulean to Middle Stone Age (MSA), yet it is unknown whether this transition was associated with either a taxonomic or ecological change in fauna. This analysis examines middle Pleistocene large mammals with two goals in mind: 1) to determine whether the change in hominin stone technology from Acheulean to MSA coincided with a change in fauna, and 2) to characterize the nature of faunal change – i.e. to determine if mammalian species show adaptive changes around the time of the technological transition and to identify the nature of these adaptations.

Faunal lists from twenty-three sites in East and South Africa associated with Acheulean, Transitional and MSA technologies were compared. Both detrended correspondence analysis and cluster analysis show that there is evidence of faunal change between different technological industries, which is interpreted as the transition from archaic to modern species. Examining changes in feeding adaptations between Acheulean and MSA assemblages reveals that grazers dominate in both assemblages, and the major change is that browsing decreases while mixed feeding and carnivory increase. The increase in mixed feeders is interpreted as an adaptation to increasing environmental variability, and it is proposed that fauna could have coped with an increasingly open environment coupled with an increasingly variable one by switching from browsing adaptations to mixed feeding. Further analyses will contribute to the assessment of when modern faunas emerged and became widespread in Africa and how hominin evolution fits with this pattern.

The Lokalalei Site Complex (2.3-2.4 Myr): The Oldest Evidence of the Genus *Homo* in the Nachukui Formation, Kenya

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Since 1987, the West Turkana Archaeological Project conducts intensive archaeological has worked in the Nachukui Formation in West Turkana, northern Kenya. This led to the discovery and excavation of one of the oldest archaeological site complex in Africa : the Lokalalei sites (2.3-2.4 Myr), that include Lokalalei 1 (Gajh5) and Lokalalei 2C (Gajh6C) (Kibunjia, 1994, 1998, Roche *et al.*, 1999). In June 2002, a new palaeoanthropological site, Lokalalei 1 alpha (LA1 alpha), was discovered 100 meters in the south of the archeological site Lokalalei 1 (LA1). The sites LA1 alpha and LA1 are located 3.2 and 7 meters above the Ekalalei Tuff respectively. They are considered chronologically equivalent, with an age slightly younger than 2.34 +/- 0.04 Myr old. The extension of the sieved area led to the discovery of a first right lower molar of a juvenile hominid (KNM-WT 42718). The relatively small size of the crown, the lack of C6, the mild expression of the protostylid, the arrangement of the cusps, and the existence of marked MD elongation and BL reduction, reinforced by metrical analyses point out the distinctiveness of this tooth compared to those of *A. afarensis*, *A. anamensis*, *A. africanus* and *P. boisei*, and its similarity to early *Homo*. This juvenile specimen is the oldest occurrence of the genus *Homo* in West Turkana. The Lokalalei sites bring valuable contributions to our knowledge of the first occurrence of the genus *Homo*, and of early hominids techno-economic capabilities.

Electron Spin Resonance Dating of the Neanderthal and Mousterian Site, Roc de Marsal, Dordogne, France

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Roc de Marsal, a rockshelter near Les Eyzies, Dordogne, France, contains a long-term Middle Paleolithic occupation associated with an infant Neanderthal skeleton. The age of the skeleton and of Mousterian artifacts from the burial pit is unknown. Although there are numerous hearths, the site is clearly older than the limit of C-14 dating. The skeleton, which was found in anatomical orientation, represents a 2-3 year old Neanderthal infant. It was found in LaFille's Couche I, associated with a burial pit that appeared to originate in Couche V.

Electron spin resonance (ESR) dating measures the damage caused by environmental radiation and converts the amount of damage to an age by determining the radiation dose rate in the sample and in its surroundings. For tooth enamel, samples as young as 10 ka and as old as 1-2 Ma yield valid ages.

Numerous herbivore teeth suitable for ESR dating were also found in the site. Of these, five teeth have been examined, two from Layer II-3, inside the cave at depths of approximately 1 m, and three from Layer I-4, in the terrace excavations at around 2 m in depth. Most teeth were large enough to provide multiple subsamples, yielding over 20 independent estimates of age. Since the uranium concentration in the teeth is low, the internal dose rate is negligible in comparison to the external dose rate from the surrounding sediment. Therefore, within the errors of measurement the age does not depend on the uranium uptake model. Preliminary results suggest average ages of 52 ± 4 ka for the inside samples and 79 ± 4 ka for the terrace deposits. One tooth may show evidence of geological reworking. These dates imply that the site was occupied from at least late OIS 5a to late OIS 4.

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New Evidence for Symbolic Behaviour by the Krapina Neandertals

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The Neandertal remains from Krapina (Croatia) have recently been re-examined using digital imaging microscopy. We used high resolution images to evaluate cut marks on bones and confirmed evidence for perimortem manipulation on some of the Krapina fragments. Here we concentrate on a remarkable group of deliberate marks on skull 3 (Krapina C). These consist of a series of about 35 almost parallel incisions running in the transverse plane across the frontal. Centered on the midsagittal plane, the cut marks extend from just above glabella almost to the bregma where the piece is broken away. They have been drawn from left to right using a stone implement and do not match marks typical of cannibalism or scalping. We suggest these marks and other evidence for perimortem manipulation of the corpses had symbolic intent. This evidence is relevant to debates about the origin of modern human capacities and in this respect it adds to a growing body of data which suggest that Neandertals were capable of such 'modern' behavior.

The New Skull of Bukuran from Sangiran Dome, Java, Indonesia

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In 1996, a new hominid skull was discovered by local people named Mawardi, then it was transferred to one of us (TJ), in the Sendangbusik, Bukuran area, in the Sangiran dome (Central Java). It consists of two parts, the parieto-occipital and the frontal regions, under very mineralized and well-fossilized conditions. Some mammal fossils, such as *Stegodon sp.*, *Rhinoceros sp.*, and *Cervidae*, were also discovered on the site. No lithic artifact was associated.

The Bukuran area is one of the richest zones of the Sangiran dome, situated almost in the center of the dome. The uppermost of the Pucangan and the overlaying Kabuh formations are exposed in the site, where the first mentioned layers (ca. 0.9 m.a.) had yielded the Hanoman' skullcap, while the Sangiran 38 skull was discovered in the Kabuh layers, dated at about 0.8 m. The new skullcap of Bukuran itself came from the loose fluvio-volcanic sand, only few meters above the border of Pucangan-Kabuh series. We note that there is no Grenzbank layer in the spot area, so we think that the fossil was coming from the lower part of the Kabuh formation.

This skullcap of Bukuran, at present housed at The Bioanthropology and Palaeoanthropology of Faculty of Medicine, Gadjah Mada University (Indonesia), under the care of Prof T. Jacob, is an adult specimen. A characteristic occipital torus, a metopic eminence, a bregmatic eminence, a sagittal keeling and an angular torus are well differentiated. A supra-orbital torus whose elements are fused is observed, there are no apparent frontal or parietal protrusions. The morphological characters show a low and elongated skull, with namely a sphenoidal type outline, and a maximal cranial breadth (situated in a low and posterior position at the level of the supramastoidea crests) distinct from the maximal biparietal one (situated on or near the torus angularis). All these characters are common to the Asian *Homo erectus* population. Procrustes analysis have been done by one of us (FD) to compare the shape characteristics of this fossil hominid with other Javanese fossils from the Trinil, Sangiran, Ngandong and Sambungmacan groups.

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New Radiocarbon Dates from Szeleta and Istállóskő Caves, Hungary

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The argument for an Aurignacian presence in Europe prior to ca. 36,500 B.P. has recently been challenged, as has the argument for the contemporaneity of the Aurignacian and “transitional industries”, such as the Central European Szeletian. Radiometric dates from the Hungarian Upper Palaeolithic sites of Szeleta and Istállóskő caves in the 1960's suggested that the Aurignacian and Szeletian material dated to between approximately 39,000 to 40,000 years B.P. These dates, together with controversial dates from other sites in the region, suggested an early appearance of the Upper Palaeolithic in Central and Eastern Europe, contemporaneous with Middle Palaeolithic material in the area. Based on this apparent contemporaneity, some have argued for the interaction between indigenous groups of Neanderthals and immigrating groups of anatomically modern humans, resulting in the creation of hypothesized “transitional” industries, such as the Szeletian. Recent work at Szeleta and Istállóskő caves has produced new chronometric dates which suggest that these sites are not as old as previously argued. The dates indicate that most of the material from Szeleta Cave, the eponymous site of the Szeletian industry, dates to between approximately 20,000 to 30,000 years B.P. The new data also indicate that deposits dating to approximately 40,000 year B.P. at Szeleta Cave are approximately 10,000 years older than the Early Szeletian material. New dates from Istállóskő Cave suggest that the Aurignacian I and II material dates to approximately 28,000 to 33,000 B.P. and support recent hypotheses that the Aurignacian is younger than 36,500 B.P. The new chronometric dates suggest that the Hungarian Szeletian and Aurignacian material is more recent than previously thought and confirm the acknowledged contemporaneity of Early Szeletian from Szeleta and Aurignacian I material from Istállóskő. This is further supported by the recent discovery at Istállóskő Cave of a fragmentary leaf point dating to between 28,000 and 33,000 years B.P. that is made from the same raw material used to produce the bulk of such artifacts at Szeleta Cave.

Shape of the Temporal Squama in Fossil Hominins: Relationships to Cranial Shape and a Determination of Character Polarity

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In his 1943 monograph of the *Sinanthropus* cranial materials, Weidenreich described the squamosal suture of *Homo erectus* as long, low, and "simian" in character, and suggested that this morphology was dependent upon the correlation between the size of the calvaria and the face. Many researchers now consider this character to be diagnostic of *Homo erectus*. The relationship between cranial size and shape and temporal squama morphology, however, is unclear, and several authors have called for detailed measurements of squamosal variation to be conducted before any conclusions are drawn regarding *Homo erectus* morphology.

Fourteen fossil and extant taxa were examined in order to address two questions: 1) do size and shape of the cranium predict the height or length of the squamosal suture; and 2) is the morphology seen in *H. erectus* truly plesiomorphic? To answer these questions, traditional craniometric measurements were collected and indices were calculated for squamosal suture height, length, and area in relation to a number of metric variables describing overall cranial size and shape. A 2-dimensional morphometric study was also completed using High Resolution Polynomial Curve Fitting to investigate correlations between the 2nd order component of the squamosal suture and the cranial vault (Deane *et al.* in press). Results of both analyses indicate that the length, height, and curvature of the squamosal suture are statistically significantly correlated with several variables of cranial size and shape.

Polarity of squamosal suture morphology was examined by mapping the results of this analysis onto a known phylogeny for the hominin lineage. The plesiomorphic condition for hominins was identified as a high, arched squamosal suture, whereas the long, low squama seen in *Homo erectus* is either secondarily derived or autapomorphic. It is suggested that this morphology is the result of increased cranial length, without a corresponding increase in cranial height.

The Skull IX (Tjg-1993.05) as One of the Variant Examples of Asian *Homo Erectus* from Indonesia

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In May of 1993 a hominid fossil skull was found accidentally by local inhabitant near the Tanjung village of Sangiran, Indonesia. There is no formal specimen number for this skull. However, Sartono and Tyler announced this find and provisionally labelled it as Skull IX in the International Conference on Human Paleoecology held at Jakarta, Indonesia in October 1993. Moreover, Larick et.al., (2001) labelled this skull as Tjg-1993.05.

Sangiran is one of the villages in a Kali Jambe sub-district, regency of Sragen, Central Java. It is located about 14.7 km north of Solo city. The name of Sangiran was chosen as a representative of those villages where a number of vertebrate and hominid fossils were discovered. Geologically, there are four formations identified in this area, in ascending order: Puren (Upper Kalibeng), Sangiran (Pucangan), Bapang (Kabuh) and Poh Jajar (Notopuro) Formations. Stratigraphically, the Skull IX (Tjg-1993.05) comes from the middle part of Bapang Formation. This is supported from the skull specimen itself because the bluish-grey to light brown colour, fragility, and sandy matrix attached to the skull is typical among vertebrate remains from the Bapang Formation above the Grenzbank zone.

The Skull IX (Tjg-1993.05) is one of the best-preserved *Homo erectus* cranium ever found from the Lower Pleistocene of Java. Presently, the specimen consists of three separate parts: most of the calvaria, a small portion of the left temporal, and a large part of the maxilla that includes some premolars and molars teeth.

The Skull IX (Tjg-1993.05) is compared with other Indonesian *Homo erectus* fossil hominid skulls as well as those from the Zhoukoudian Lower Cave of China. In general, its vault shows a similarity to the comparative specimens in both size and shape. Among the Asian *Homo erectus* materials compared, Skull IX (Tjg-1993.05) shows resemblance to the crania of the Sangiran-Trinil series. Nevertheless, morphologically it has some unique characteristics, which differ from the comparative specimens.

A Palaeoenvironmental Reconstruction of Laetoli, Tanzania Using a Bovid Community Ecomorphological Survey

K. Kovarovic¹, P. Andrews² and L. Aiello¹

There has been a renewed interest in the application of ecomorphological techniques to bovid postcranial remains as a way to infer past ecological conditions at sites pertaining to hominin evolution. However, the best habitat discriminators are often complete long bones that are rarely found intact in fossil assemblages, reducing the efficiency of this method. Only a handful of elements have been analysed in an ecomorphological context, and the remainder of the postcranial skeleton has been neglected, despite the relatively high occurrence of the complete recovery of some of the smaller and denser elements like the carpals and tarsals.

In order to increase the amount of material available for an ecomorphological approach to environmental reconstruction, the majority of bovid postcranial elements were assessed for their ability to discriminate between seven habitat types in a series of discriminant function analyses. A global sample of extant bovids (n=205), cervids (n=14) and tragulids (n=5) comprise this comparative dataset. The baseline of chance accuracy for the DFAs (i.e. the percentage of correct predictions that can be expected when habitat assignments are randomised) was determined. This baseline served as the cut-off point between good and bad habitat predictors. The good predictor elements from both the Upper Laetolil Beds and the Upper Ndolanya Beds at Laetoli were analysed. Summaries of the number of specimens predicted to belong to each habitat type indicate that at the time of the deposition of the Laetolil Beds, the area had heavy woodland-bushland cover with some lighter tree and bush cover and grass available. The results also indicate that during Ndolanya times the environment had become more open and the grassland component of the environment had increased significantly. Light woodland-bushland and an abundance of grass cover dominated the landscape, although tracts of land with denser vegetation likely existed, agreeing with earlier suggestions that the area was a semi-arid bushland.

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Experimental Use of Levallois Points as Projectile Points

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The recent discovery of a small Levallois point imbedded in the cervical vertebra of an equid at Umm el Tlel, Syria indicated that some of these artifacts could have been used as projectile armatures. Experimental archaeology can help to clarify if this mode of use is possible. The current study used a sample of 50 Levallois points replicated from Levantine flint. The points ranged in mass from 3-25 grams, in length from 3-8 cm, and in cross-sectional area from 0.5-2.0 cm². The points were hafted on wooden foreshafts using commercial adhesives and mounted on aluminum arrows. These arrows were used in two experimental trials with a 40 pound draw fiberglass bow. The first, to measure penetration depth was performed on a leather covered archery target. The second, designed to look at point breakage and use-wear, was performed on a simulated animal carcasses. In the initial trial, nearly all of the points functioned surprisingly well as arrowheads, penetrating at least as deep as their length into the archery target. Statistical analyses indicate that mass and cross-sectional area predict penetration (described as a ratio of point length vs. penetration depth) quite well. The second trial, however, demonstrated that when such points impact a target with variable densities (mainly bone) they tend to either fracture on impact or fail to penetrate. Only the smallest and thinnest of the points (those on the extreme range of archaeological points) penetrated the animal target sufficiently. Fractures seen tended to be "tongued," step, and burin fractures. Additionally a few points fractured in multiple places, resulting in small trapezoidal pieces reminiscent of the piece found in the equid vertebra. Thus, Levallois points as a group seem unlikely to have been used primarily as projectile points, but such use is certainly possible for smaller examples of such points.

A Test of Models Used for Estimating Total Body Surface Area in Hominins

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Previous models employed in anthropology to address issues of thermoregulation or the energetics of locomotion have predominantly used either the “cylindrical model” (Ruff, 1992) or the Dubois and Dubois’ (1915) equation to estimate body surface area. The cylindrical model utilizes stature and bi-iliac breadth as measures of cylindrical length and diameter. The most common equation used for estimating body surface area, the Dubois equation, uses weight and stature (often estimated by regression analysis of the femur or humerus) as predictive variables. A shortcoming of both models is that they do not consider morphological variation occurring in specific regions of the body, such as interlimb differences. Both models treat the body as a static, simple geometric shape and cannot appreciate that the body is actually a complex shape, with many individual components that follow distinct biomechanical patterns during gait. Consequently, neither the Ruff nor the Dubois method is suitable for analyses of a body in motion.

Cross (2002) has recently suggested using a summed segmented model of the hominin body to estimate surface area and the thermoregulatory capabilities of different hominin species. In this model, the basic premise of the cylindrical model is still employed, but each independently moving segment of the body is isolated and modeled as a separate cylinder. The surface area for each of the segments can then be determined using their circumference and length measurements.

In this study a 3D laser scanner is used to obtain an absolute value for body surface area. The results are compared with those produced using the cylindrical model, the Dubois equation, and the summed segment model. The predictive accuracy of each method is assessed and the differences are analyzed to determine the source(s) of the error. Finally, the potential applications of these methods to hominin thermoregulation will be discussed.

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Probabilistic Approach to Age and Sex Assessment in Human Fossils: Application to Burials from the Upper Palaeolithic in Italy and France

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No reliable method has been used for sex and age-at-death assessment of most human fossil remains. However, it is asserted that male individuals prevail and that old individuals are missing. Does this reflect a particular selection of prehistoric humans in burial context or a methodological error? Most current methods to determine sex and age are not reliable because of the specificity of the reference sample. Besides, methods are rarely tested on sex and age known osteological samples. In this study, age at death was assessed by the method developed by Schmitt (2001, 2002). It is based on the senescence modifications of the sacro-pelvic surface of the ilium. The method was elaborated from a multi-regional sample of known age and sex individuals ($n = 700$). Age is computed by the Bayesian approach and the results are given by posterior probability. For sex determination, two methods were used : (1) a visual determination from hip bone traits (Bruzek, 2002) and (2) a probabilistic sex diagnosis (Murail et al., 2000) based on hip bone measurements. The latter method has been elaborated on a pooled sample (of nearly 2000 hip bones) of adults of known sex from four continents.

Those methods were applied to adult individuals from 31 burials from the Upper Palaeolithic in Western Europe. It could be applied to 12 cases from Abri Cro-Magnon, Abri Pataud, Grottes des Enfants, Baoussou-da-Torre and Laugerie-Basse. This study enabled us to revise the sex determination of 3 cases (25%). In addition, 4 individuals were found to be older than 50 years. This study shows also that in the sample from Abri Cro-Magnon, the os sacrum of individual 4314 (CM1) actually belongs to the female 4316 who is over 50 years of age. We discuss the implications of our results on the interpretation of burial practices in the Upper Palaeolithic .

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Multivariate Approaches to the Lithics of Klasies River Mouth

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There is a long and prestigious history of investigation at Klasies River Mouth. Its deep stratified sequences have served as important witnesses to the Upper Pleistocene prehistory of South Africa. This paper uses Klasies River Mouth as a case study in examining the variability present in the later Middle Stone Age lithics assemblages of South Africa. The study uses factor analysis to look for patterns in the lithics data from Klasies River Mouth. This analysis uses a broad range of variables from several sources, mainly Singer and Wymer (1982) and Wurz (2002). The variables examined in this study relate to the frequency of lithic artifacts in three main categories: core types related to reduction strategies, flake types and assemblage characteristics, and categories of flake retouch. The factor analysis reveals that these variables load on two main factors. The variables that load heavily on the first factor mainly relate to aspects of core reduction, flake manufacture, and raw material economy. More specifically, these variables are related to the production of sharp unmodified flakes using centripetal, irregular, and blade core techniques. The variables that load heavily on the second factor relate mainly to prepared-core, or Levallois, core reduction strategies. This analysis then uses the factor loadings to examine the characteristics of the stratified lithics sequences at Klasies River Mouth. This reveals that Howiesons Poort levels associate strongly with the first factor, the MSA II levels associate strongly with the second factor, and the remaining levels (MSA I and MSA III/IV) associate much more weakly with both factors. This paper concludes by offering a few explanations of this patterning. The paper suggests that the variability present in these lithics assemblages mainly relates to changes in mobility and site use patterns over time. This is visible in the frequency of exotic raw material over time, as well as other variables concerning movement on the landscape.

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On Derived Characters That *Australopithecus afarensis* Shares with the Robust Clade

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Although the primitive facial topography of *Australopithecus afarensis* is well documented, the species appears to share numerous derived cranial and mandibular characters with the robust australopiths. These characters include the frontal bone topography, in which no separation exists between the supraorbital element and the frontal squama; the pattern of blood drainage from the brain, which differs from the common primate pattern; the steep, rather straight arcuate eminence of the temporomandibular joint; the dimensions of the dentition and the mandibular body; the steep, bulbous mandibular symphysis; and the mandibular ramus morphology, which differs from the common primate pattern. These apparent synapomorphies are of great significance in the reconstruction of our own phylogeny.

Are Hominin Fossils and Paleoenvironmental Data Precisely Associated in the Stratigraphic Records of Turkana and Olduvai?

Lynn Copes^{1,2} and Rick Potts³

This study investigated the stratigraphic relationship between hominin markers (fossils and archaeological material) and paleoenvironmental evidence in the Turkana and Olduvai Basins, East Africa. The precision of this relationship determines whether the environmental data directly reflect early hominin habitats and adaptive settings. We hypothesized that, ideally, the two data sets would be strongly correlated (hypothesis 1), and that all four major stratigraphic units (Nachukui, Koobi Fora, and Shungura Formations in the Turkana Basin, and Beds I and II at Olduvai) would show similar patterns of correlation (hypothesis 2). To determine how precisely the hominin-environment data sets match up, the hominin markers from the four stratigraphic units were plotted on detailed geologic sections. Next, all data points reported in previous analyses of stable isotopes, fossilized plants, and faunal assemblages were plotted. (We confined faunal data points to the ratio of alcelaphines to total bovids, due to the potential value of this ratio in paleoenvironmental analysis.) All data were gathered from the published literature (with the assistance of R. Bobe and A. K. Behrensmeyer) and recorded by meter. The number of exact associations between hominins and paleoenvironmental indicators was totaled for each stratigraphic unit, and chi-square tests were performed to determine if any statistically significant differences existed among the units. The percentage of hominins with environmental matches ranged from 7 to 50%. This left both hypotheses unsupported, as the stratigraphic units differed greatly in their percentages of hominins with exact matches, and in no unit were more than half of the hominins associated exactly with paleoenvironmental indicators. The results point to ways in which paleoanthropological and paleoenvironmental research can be better coordinated.

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Development, Decline, and Disappearance of the Howiesons Poort Industry

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We present the results of a technological analysis of Howiesons Poort (HP) and post-Howiesons Poort assemblages from three South African sites: Rose Cottage, Sibudu and Klasies River Mouth. Often discussed, the HP blade technology remained undefined; blade making was described as indicating indirect percussion (H.Deacon), soft hammer (S.Wurz), or hard hammer (L.Winter).

Our analysis, supported by experimental replication, shows that soft stone hammer was used at Rose Cottage and Klasies, while soft organic hammer was probably used at Sibudu. In all cases the method, based on abrading the core margin and striking it in a tangential motion, was directed to the production of straight blades with thin platforms, to be used as such or transformed into backed segments. Gradual evolution of debitage techniques within the HP is especially clear at Rose Cottage and Klasies; at both sites the final HP levels are characterized by a change from the use of soft hammer toward a classic hard hammer technique with production of flakes with a thicker platforms and more irregular blades. At Rose Cottage this change in the debitage style is accompanied by a decline of the production of backed pieces and an increase in the making of classic MSA types such as scrapers and unifacial points, as well as a reappearance of the Levallois technique.

The HP industry, with a very high proportion of blades and a tool kit dominated by backed pieces, is extremely original for its time and could almost be compared to Epipaleolithic assemblages of Western Europe. Yet by about 60-55 ka the internal evolution of the industry is completed, backed pieces are no longer a common element of the tool kit, blades are no longer predominant in the blank production, and formal tools are very similar to the classic Middle Paleolithic forms. Our three sites, all with an important series of late MSA levels directly above the HP assemblages, clearly show a total lack of continuity between the HP and the LSA assemblages.

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The Peștera cu Oase: Cave Bear, Canids, Caprids, Cervids and a Cranium

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Discovered in 2002 during speleological documentation, the Peștera cu Oase, Caraș-Severin, Romania initially yielded initially a largely complete human mandible (Oase 1) AMS ¹⁴C dated to ca. 35,000, and subsequently yielded portions of a similarly aged adolescent human cranium (Oase 2). They were found among abundant *Ursus spelaeus* remains, in part hydraulically displaced within the karstic galleries. Systematic mapping and excavation of the bone bed in the Panta Str  moșilor of the Peștera cu Oase during 2004 provided a preliminary stratigraphy consisting of three levels. The superficial Level 1 consists of a surface bone "pavement" of abundant adolescent and adult *U. spelaeus* remains, with rare cranial and postcranial elements of *Canis lupus*, *Capra ibex*, *Megaloceros giganteus*, a small cervid and human remains. Although a hydraulic jumble with disarticulation, there is excellent osteological preservation of fragile and large bones, minimal evidence of abrasion, and fine gritty sediments with some small pebbles. The underlying Level 2 consists mostly of a dense cailloutis of pebbles and cobbles in a coarse sandy matrix, very rich in small dimension immature cave bear bones, plus occasional *C. lupus* and *C. ibex* bones showing some abrasion and rare gnawing and punctures. Level 3 is a clay deposit, poor in pebbles, with large weathered limestone blocks and small bear remains. An excavation of <4 m² to 20-30 cm depth yielded >2,000 identifiable bones. Adjacent to the 2003 Oase 2 facial remains, co-mingled with bear bones, sufficient neurocranial pieces were found to largely complete the anatomy of the Oase 2 cranium, providing the oldest modern human cranium in Europe. The human remains continue to document the morphological mosaic of these, the best known representatives of the earliest "modern" human occupants of Europe.

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Maxillary Dentition and Hunting Strategies: Reindeer Teeth from the Magdalenian

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Mortality profiles are a valuable tool for investigating the taphonomic history of archaeological faunal assemblages and for understanding hunting strategies and tactics of prehistoric foragers. Studies of mandibular dentition of prey species have contributed greatly to the construction of mortality profiles. Maxillary dentition studies have been much less often utilized, but offer a substantial potential for confirming or complementing mandibular studies. Because of previous primary focus on mandibular teeth, correct identification of morphologically similar maxillary premolars and molars has often been neglected. Maxillary studies can help better define numbers of individuals in highly fragmented or greatly ravaged faunal assemblages. Reconstruction of individuals from both superior and inferior dental series can aid in the identification of spatial patterning that can contribute to an understanding of carcass processing and treatment, and can also give more realistic counts of minimum numbers of individuals and their mortality profiles.

An assemblage of reindeer maxillary dentition from the late Upper Paleolithic site of Verberie has been studied to expand the amount of information available in dental studies. Superior dental series were reconstructed from partial series and scattered individual teeth. Left and right series were paired to identify individuals. The superior dental series were matched with inferior dental series, already paired for lefts and rights, resulting in more precise counts of individuals. The maxillary materials were used to develop methods of determining mortality profiles. This was compared to existing mandibular studies from the same site. Conclusions for the interpretation of hunting strategies are drawn, offering a somewhat different perspective on late Magdalenian hunting.

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Levallois Lithic Technology from the Kapthurin Formation, Kenya: Acheulian Origin and Middle Stone Age Diversity

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The earliest fossils of *Homo sapiens* are found in Africa with late Acheulian and Middle Stone Age (MSA) artifacts. Understanding the relationship between the origin of our species in Africa and the major archaeological shift marked by the Acheulian-MSA transition is a key issue in human evolutionary studies that has thus far suffered from a lack of detailed comparative studies. In order to initiate exploration of differences or similarities among different Middle Pleistocene lithic traditions, we examine Levallois flake production from a sequence of dated Acheulian and MSA sites from the Kapthurin Formation of Kenya. Acheulian Levallois flakes and cores from the Leakey Handaxe Area and the Factory Site are among the oldest in Africa, dated to ~284,000-500,000 yr. Two MSA assemblages from the site of Koimilot overlie the Acheulian sites, and have an estimated age of 200,000-250,000 yr. Acheulian and MSA Levallois approaches to Levallois technology in the Kapthurin Formation differ in the types of raw material selected, the patterns of preparatory flaking used to shape the core, the number of Levallois flakes produced per prepared core surface, the shape and size of the Levallois flakes, and the extent of secondary retouch.

These differences relate to (1) the general loss of large cutting tools that characterizes the Acheulian-MSA transition, and (2) an increased emphasis on controlled methods of producing smaller flake blanks during the MSA. Size reduction of tool blanks is the most probable factor explaining the observed differences. We trace the origins of Levallois flake production to existing Acheulian methods of using large flakes as blanks for handaxes and cleavers, and argue for technological continuity across the Acheulian-MSA transition in how Levallois flakes were produced. Future study of how Levallois flakes were used and incorporated into hominin adaptive strategies may elucidate contrasts between Acheulian and MSA sites.

Faunal and Paleoecological Analyses of the Gondolin GD 2 Plio-Pleistocene Fossil Assemblage, North West Province, South Africa

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The Gondolin GD 2 faunal assemblage, originally excavated from *in situ* brecciated deposits in 1978, yielded a substantial faunal assemblage that was partially described by Watson (1993). However, nearly two-thirds of the faunal assemblage was not considered in this initial description. This presentation offers the final results of a comprehensive re-analysis of the complete GD 2 faunal assemblage, including all specimens recovered from the 1978 excavation. The resulting faunal listing differs significantly from that offered by Watson (1993), not only in terms of the numbers of identified specimens, but also taxon representation. The assemblage varies significantly from other contemporaneous South African faunal assemblages in terms of taxon representation and element composition, indicating primary carnivore involvement in assemblage formation. This reanalysis has removed and added several taxa from the original species list, including reclassification of the dominant bovid taxon from the assemblage from the extant *Redunca arundinum*, to that of a grazing reedbuck species similar to, but morphologically distinct from the modern *Redunca fulvorufula*. This presentation also offers a comprehensive paleoecological reconstruction for the Gondolin site based on ecomorphological and stable carbon isotope analysis of the GD 2 fauna. The results of these analyses indicate that local habitats during assemblage formation were generally consistent with the modern environments at the site, which is characterized by much greater topographic relief than exists in the more southern Sterkfontein Valley region. The paleoenvironmental reconstruction offered here, with a dominant paleohabitat of rocky outcroppings and grass-covered hillsides and only a modest distribution of more open habitats, is therefore consistent with the local geography and no longer necessitates the edaphic grassland paleohabitat suggested by Watson (1993).

Postcranial Robusticity in a Carnivore: Implications for Understanding Skeletal Robusticity in Hominins

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Postcranial skeletal robusticity is variable throughout human evolution, fluctuating both temporally and geographically. A recent decrease in postcranial skeletal robusticity among early modern *Homo* has been attributed to technological advances that reduce the reliance on somatic energy for prey acquisition, thereby reducing the strains on the skeleton that would cause bone remodeling. Such anthropocentric models can be evaluated using nonhuman predators. Evidence of changes in robusticity over time in other animals suggests that there must be other ecological factors that influence postcranial skeletal robusticity that have not been fully explored. Very little quantitative data is available concerning the relationship between body size, prey capture, and measures of skeletal robusticity in nonhuman predators. This study begins to fill that critical gap by documenting variation in postcranial skeletal robusticity among red wolves, coyotes, and subspecies of gray wolves. All are ecologically similar in that they are predatory carnivores that engage in group hunting and provision other members of their group. However, there is great variation in the size of the prey that each canid species hunts. Morphologically, the three species of canids are very similar, differing mainly in body mass. Data on limb length and cross-sectional area from planar radiographs were collected for femora, humeri, tibiae, and fibulae for all species in the sample (N=60). RMA regressions of logged data suggest that femoral robusticity (as measured by J , the polar moment of inertia) scales isometrically with bone length. This suggests that skeletal robusticity scales with body size and possibly is associated with the increasing size of prey taken by the larger wolves.

Modified Bone from Sterkfontein Cave: Implications for the Technological Behavior of Middle Stone Age Hominids in South Africa

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Bone tools have been reported from Eurasian Paleolithic and African Stone Age sites. Researchers have suggested that these bone tools were used in a variety of ways, including retouching stone tools, for extracting tubers and termites from underground, and for butchery and wood working. Our research on a Middle Stone Age (MSA) fauna from the post-Member 6 deposit at Sterkfontein Cave (South Africa) has identified damage on 15 fossil specimens indicative of direct stone-on-bone contact. The modifications occur as multiple pits distributed across flat surfaces of ungulate bones, which invade well deeper than the most superficial lamellae. Within each of these pits, superimposed on their floors, are deep linear features with broad cross-sections and which superficially resemble typical stone tool chopmarks. We refer to these linear features as gouge marks to distinguish them functionally from chopmarks—because these incidences of damage are definitively not chopmarks or any other modification related to butchery, such as cutmarks and hammerstone percussion marks. They do not result from insect boring, carnivore chewing, from use of the specimens as stone tool retouchers, or from recent excavation and preparation activities. Instead, our preliminary experimental research suggests that the modified bones might have served as passive forms of tools, such anvils or braces against which stone was worked, or used as forms of a punch. The consistent use of small bone pieces with flat, stable surfaces implies a strong selective preference among Sterkfontein hominids for these activities. So far, this type of damage is unrecorded elsewhere in the MSA of Africa. It is not clear whether this indicates a real absence, making the Sterkfontein materials an interesting anomaly, or if similar artifacts simply have not yet been recognized as such, suggesting a wider-spread technological component of the MSA.

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Major Gaps in the Early Human Occupation of Britain

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The conventional view of the fossil human record of Britain is that Middle Pleistocene hominins at Boxgrove and Swanscombe were followed by early Neanderthals at Pontnewydd, and finally by modern humans at sites such as Paviland and Gough's Cave. However, recent research suggests that this succession was actually the result of repeated colonization events, followed by local extinctions, and recolonisations. The unique palaeogeographic position of Britain meant that periods of low sea level with the maximum extent of land connection with continental Europe were also the least hospitable due to glaciation, while the establishment of the English Channel meant that at times of climatic optima, Britain became an island, isolating existing inhabitants, or preventing the arrival of new ones.

The Ancient Human Occupation of Britain project is a collaborative enterprise among archaeologists, palaeontologists and geologists to reconstruct the pattern of early colonisations, and investigate the factors controlling these. Approaches include excavation, faunal and archaeological collections research, stratigraphic and chronometric studies, and isotope analyses. Topics the project is investigating include whether Boxgrove (Oxygen Isotope Stage 13?) represents the earliest colonization; the nature of human occupation during OIS 11; evidence for population decline during the later Middle Pleistocene; human absence during OIS 5; the Middle-Upper Palaeolithic transition; and Late Glacial recolonisation.

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Shape of the Temporal Squama in Fossil Hominins: Relationships to Cranial Shape and a Determination of Character Polarity

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In his 1943 monograph of the *Sinanthropus* cranial materials, Weidenreich described the squamosal suture of *Homo erectus* as long, low, and "simian" in character, and suggested that this morphology was dependent upon the correlation between the size of the calvaria and the face. Many researchers now consider this character to be diagnostic of *Homo erectus*. The relationship between cranial size and shape and temporal squama morphology, however, is unclear, and several authors have called for detailed measurements of squamosal variation to be conducted before any conclusions are drawn regarding *Homo erectus* morphology.

Fourteen fossil and extant taxa were examined in order to address two questions: 1) do size and shape of the cranium predict the height or length of the squamosal suture; and 2) is the morphology seen in *Homo erectus* truly plesiomorphic? To answer these questions, traditional craniometric measurements were collected and indices were calculated for squamosal suture height, length, and area in relation to a number of metric variables describing overall cranial size and shape. A 2-dimensional morphometric study was also completed using High Resolution Polynomial Curve Fitting to investigate correlations between the 2nd order component of the squamosal suture and the cranial vault (Deane *et al.* in press). Results of both analyses indicate that the length, height, and curvature of the squamosal suture are statistically significantly correlated with several variables of cranial size and shape.

Polarity of squamosal suture morphology was examined by mapping the results of this analysis onto a known phylogeny for the hominin lineage. The plesiomorphic condition for hominins was identified as a high, arched squamosal suture, whereas the long, low squama seen in *Homo erectus* is either secondarily derived or autapomorphic. It is suggested that this morphology is the result of increased cranial length, without a corresponding increase in cranial height.
