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The latest Neanderthals of the southern Caucasus: new dates and new data from Ortvale Klde, the Georgian Republic

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The Middle Palaeolithic record of the southern Caucasus documents the persistence of Neanderthal populations in the region until approximately 35,000 years ago. Although research has been conducted within this region for many decades, our understanding of these archaic hominins and their relationship to populations in neighboring regions has suffered from a dearth of well excavated, analyzed, and dated sites. The recent re-excavation, analysis, and dating of the Middle–Upper Palaeolithic rockshelter of Ortvale Klde, located in western Georgia, has led to a clearer understanding of Late Middle Palaeolithic patterns of lithic reduction, land-use, and mobility. Preliminary analysis of lithic assemblages from this site indicates the persistence of lithic technologies geared toward the production of pointed blanks and retouched tools. Such traditions as well as particular aspects of tool production and modification demonstrate that Neanderthals here shared more technological affinities with their neighbors to the south than they did with those located elsewhere. These and other data suggest that Neanderthals occupying this region were members of a larger prehistoric social and mating network demarcated by the Caucasus Mountains to the north and the Zagros and Taurus Mountains to the south. This same study also indicates that Ortvale Klde occupied a strategic position in the landscape that Neanderthals repeatedly utilized after successful hunting forays in the deep, narrow Cherala river valley. The chronometric dating of Ortvale Klde via AMS, TL, and ESR suggests that Neanderthal occupation of this region came to an abrupt end just prior to the onset of the Denekamp Interstadial. These last Neanderthal occupations were followed closely in time by the appearance of Upper Palaeolithic industries dominated by finely retouched bladelets, end scrapers, and bevel-based bone points. There are no indications whatsoever that these local Neanderthal populations played any role in the development or appearance of this Initial Upper Palaeolithic.

Toward an understanding of artifact variability in the Stone Age: an ethnoarchaeological and archaeological perspective from Konso, Ethiopia

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This paper reviews the results of recent (2001) ethnoarchaeological, archaeological, and ethnographic studies of the flaked stone-tool using Konso hideworkers of southern Ethiopia. The goal of the project is to explore a number of hypotheses put forward by archaeologists to explain the meaning of artifact variability in the Stone Age. The Konso hideworkers are some of the last people in the world to make flaked stone tools (scrapers) on a regular basis and are even more unusual in that women are responsible for all aspects of scraper manufacturing, use and discard. The “Census” team identified and obtained demographic data on hide workers from all Konso villages, while the “Life Cycle” teams followed individual hide workers from procurement of raw materials through manufacturing and use of hide products, including clothing, to discard. The “Archaeology” team excavated a recently abandoned compound occupied by hide workers for at least one hundred years and over three generations, while the “Ethnographic/Ethnohistoric” team interviewed past and present hide workers and other members of the community for data on the internal socio-economic and political dynamics affecting the lives of hide workers and their material culture. The “Documentation” team digitally filmed all aspects of research, providing a visual analytical record as well as documenting a way of life for future Konso generations and the professional and general public. We conclude by discussing the significance of our project toward understanding stone artifact variability, spatial/activity patterning and gender roles in the archaeological record, particularly as it may relate to hide working in the Upper Paleolithic, Later Stone Age and PaleoIndian periods.

The emergence of modern human behavior during the Late Middle Stone Age in the Kenya Rift Valley

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Archaeological evidence suggests modern human behavior patterns emerged during the late Middle Stone Age (MSA) and early Later Stone Age (LSA) in Africa between 50 and

100 ka. Sites of this age are scarce and their chronologies are ambiguous. We report on excavations at new archaeological sites in the central and southern Kenya Rift Valley that contain late MSA and early LSA occurrences with stratified volcanic ashes (tephra) that are being dated by the $^{40}\text{Ar}/^{39}\text{Ar}$ technique and chemically fingerprinted for regional tephrostratigraphic correlation. Obsidian artifacts are being sourced to study mobility and interaction patterns.

Marmonet Drift (GtJi15) is located in the Naivasha-Nakuru basin close to the main obsidian sources. Four main MSA horizons and twelve tephra are stratified in a 21 m paleosol sequence. Assemblages from the three earliest horizons contain radial cores and faceted platform flakes. The youngest horizon contains retouched points and has the most distant obsidian sources.

Sites on the western margin of the southern Rift are 60-90 km from the major central Rift obsidian sources. Ntuka River 4 (Norikiushin, GvJh12) contains a 2.5 m sequence with large obsidian backed "microliths", blades with faceted platforms and points from radial cores, stratified above and between two tephra. Ntuka River 3 (Ntumot, GvJh11) contains a 9 m sequence with two stratified tephra. Obsidian bifacial points and narrow backed microliths are stratified 1-3 m below the lowest tephra. Three major LSA horizons lie 3-5 m above this tephra. The youngest LSA is dated 29,975 bp.

In the central and southern Rift the highest frequencies of non-local lithic raw materials occur in the youngest MSA and in MSA/LSA occurrences. Lithic source distance data indicate increased range size and/or intensification of regional exchange networks. Dramatic changes in socio-territorial organization may have accompanied the MSA/LSA transition.

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The Middle-Upper Paleolithic boundary in the Western Caucasus

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A joint field project begun in 1996 in Western Georgia, at the foothills of the Caucasus, was designed to provide, among other datasets, a sound chronology for the late Middle Paleolithic and early Upper Paleolithic of the region. Controlled excavations conducted over the last six seasons at Ortvale Klde rockshelter and Dzudzuana cave provided a series of artifacts, animal bones, and chronometric samples (AMS, TL, ESR). Available dates on bones, charcoal, and burned flint from Ortvale Klde indicate that the heavily retouched Mousterian industry represented here lasted until approximately 35 ka. The Initial Upper Paleolithic industry, characterized by the dominance of end-scrapers and bladelets with fine, abrupt retouch appeared by approximately 31 ka. Human occupations at the nearby site of

Dzudzuana cave begin at approximately the same time and represent an Upper Paleolithic sequence spanning another 20,000 years. Thus between the two sites we have established a chronology that currently represents over 35,000 years of Paleolithic occupation. The earlier part of this chronological sequence is similar to that established along the northern slopes of the Caucasus at Mezmaskaya cave. Here the latest Middle Paleolithic dates to approximately 35 ka while the earliest Upper Paleolithic follows by approximately 32 ka. This chronological boundary has direct bearing on issues concerning the survival of late Neandertals and the first appearance of modern humans in a region that lies north of the Levant, between the eastern European plains and central Asia. The absence of any evidence pointing to a local cultural transition supports the notion that the disappearance of Neanderthals in this region was followed closely by a reoccupation by *Homo sapiens sapiens*.

**Recent discoveries of Neandertal remains from Les Pradelles
(Marillac-le-Franc, Charente, France)**

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The site of Les Pradelles, or Marillac, is located near to the town of La Rochefoucauld (Charente, France). Discovered in 1898, it was only in the years 1967-1980 that controlled archaeological excavations were carried out under the direction of B. Vandermeersch.

These investigations identified 12 geological layers, with Mousterian artefacts recovered from the layers 7-12. The lithics in layers 9 and 10 have been identified as part of the Charentian Mousterian Tradition (Quina facies) with an associated fauna dominated by reindeer. Hominid fossils were also recovered in these excavations, including the posterior part of an adult skull and a major portion of the upper dentition of a young adult. Geological and faunal analyses suggest that a reasonable attribution of these layers is to Oxygen Isotope Stage 4.

In order to obtain additional data about the chronology and sedimentological processes at the site, as well as to increase the archaeological samples, excavations were resumed in the summer of 2001. Initial work has been focused on the cleaning of the profiles and preparing the site for a series of future excavations. During this labour, new Neandertal fossils were recovered from disturbed sediments. These include: a left M2, an adult right temporal bone, a left fragment of a mature occipital, the alveolar part of a right maxilla containing permanent canine through M³ and a left P4.

The morphology of these remains identify them as Neandertals and with the earlier discovered fossils represent a substantial sample of the bones and teeth of this Middle Paleolithic human. Planned field work at the Les Pradelles site in future field seasons will hopefully add to this sample, providing additional information about morphological variability in the Neandertal sample at this site.

**Complex settlement dynamics during the Upper Paleolithic of Central Portugal:
the case of Picareiro cave**

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Eight field seasons at Picareiro Cave documented a long archaeological sequence, starting with OIS 3 and ending in Mid Holocene times. The human occupations at this high altitude cave are most important during the Gravettian and Magdalenian periods. The data from a total of seven different occupations suggest a diverse subsistence base starting with the Gravettian. The faunal assemblage is dominated by red deer and rabbit supplemented by wild boar, roe deer, chamois, aurochs and fish. In addition, resource intensification is suggested by the extraordinarily high number of rabbit bones and the presence of bird, shellfish and fish. These species were the result of special hunting and fishing techniques that likely included traps and nets.

Land use data clearly point to complex settlement dynamics, with a large territory of resource exploitation, based on a logistical mobility pattern. Initial seasonality determinations suggest people were not using the cave year-round. Large fauna were hunted in Fall/early Winter while rabbit were probably taken in Winter or Summer. The marine resources, fish and shellfish, were likely caught during Summer and brought from the Atlantic coast located some 50 km away. Raw materials were brought from a diversity of sources, including inland secondary flint sources. The data, thus, show a complex and use of a large and very diverse territory, that likely included a total area of more than 4,000 sq. km in the Portuguese Estremadura.

**Different lithic raw material procurement strategies at the transition between
Neandertals and anatomically modern humans in Italy**

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In this paper I will discuss the different pattern of raw material distribution in the lithic industries in several Italian sites from the Late Mousterian up to the Early Aurignacian, including some really "transitional" industries usually called "Uluzzian" by Italian researchers. The raw material has been roughly classified in three broad categories: a) "strictly" local (within about 5 km radius from the site), b) "broadly" local (from about 5 to 40-50 km from the site) and c) "exotic" (from greater distances).

A preliminary analysis shows that the Neandertal lithic complexes are characterized almost exclusively by local material, while, on the other extreme, Aurignacian industries, besides the local materials, show an important variety of exotic flint, with an uneven distribution as regards the various classes of formal tools and debitage. The behavioral and cultural implications for the settlement and subsistence strategies of these human groups are briefly discussed at the end of the paper.

ESR dating using dentine: triumphs and tribulations

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In many sites, dentine is often much more abundant than enamel, especially for small species. Although enamel and dentine both contain hydroxyapatite (HAP), dentine contains 20-25% organic matrix, as well as much higher porosity and permeability which enables it to absorb secondary minerals which could complicate the ESR age calculations.

HAP signal sensitivity to radiation for dentine was much lower than for enamel. No species or environmental dependence was discovered for the teeth studied. While HAP signals showed no interference from organic radicals, high noise-to-signal ratios hampered HAP signal detection in young teeth, and reduced precision in the accumulated dose measurements. Preliminary annealing results indicate that the mean lifetime for the dentine signal is shorter than that in enamel.

ESR ages for dentine from mammalian teeth dated at 40 ka to 10 Ma were compared with ESR ages for enamel from the same teeth. For all samples in this time range, the ESR signals were not saturated. For dentine with accumulated doses less than 500 Gray, enamel and dentine gave identical accumulated doses, but significantly different ages. For teeth with higher accumulated doses, the dentine consistently produced accumulated doses that were 1.4 times higher than those in the enamel. Regardless of the uptake model applied, ages from the dentine differed dramatically from those in the enamel. Compared to enamel ages, the dentine ages were more sensitive to changes in Rn loss and U uptake model, but less sensitive for changes in external dose rate or sedimentary water concentration. In order to use dentine for accurate age determinations, signal stability (mean lifetime) must be determined, and the uptake processes must be fully characterized.

Chatelperronian/Aurignacian interstratification at Roc de Combe and Le Piage: lithic taphonomy and archaeological implications

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The apparent interstratification between Chatelperronian and Aurignacian levels at Roc de Combe and Le Piage (Southern France) is one of the strongest arguments for possible contacts between the last Neanderthals and the first anatomically modern humans of Western Europe. For the past thirty years the stratigraphic sequences at these two sites have

been considered as a major proof of the contemporaneity of the two populations. More recently, however, doubts have been expressed about their validity. Taphonomic analyses of the lithic industries, based on refitting, and technological studies confirm these doubts, showing that interstratifications do not reflect depositional events, but postdepositional processes, wrongly interpreted by the excavators. The same analyses indicate that parts of these sites are sufficiently well preserved to provide important information concerning the Middle to Upper Paleolithic transition.

Roc de Combe shows the classical sequence of Southwestern France: Mousterian, Chatelperronian, Early Aurignacian with split-based points, Late Aurignacian with twisted Dufour bladelets, and Gravettian.

In contrast, Le Piage contains an original Aurignacian facies unknown until now in the northern part of the Aquitanian basin but better documented in the earliest Aurignacian sites around the Mediterranean. Occurring above Mousterian and Chatelperronian levels and below Early Aurignacian layers, this assemblage is characterized by long and straight Dufour bladelets resembling Chatelperron points. The bladelets are not produced from carinated endscrapers but from prismatic cores often on flakes, a mode of production that is similar to that of Chatelperron points. These similarities could be interpreted as a Chatelperronian influence on the earliest Aurignacians, thus reviving the debate on the acculturation hypothesis.

Middle Stone Age adaptations at Aduma, Middle Awash Region, Ethiopia

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As part of the Middle Awash Research Project, a multidisciplinary team of investigators conducted six field seasons of survey and excavation in the Aduma region of the Middle Awash Valley. Highly dissected fluvial and colluvial sediments covering approximately 15 km² yielded multiple Early and Middle Stone Age horizons with abundant lithics and faunal remains, together with data on paleoenvironments. Despite non-concordance in results of multiple dating techniques, the majority of the eight intensely studied open-air “sites” clearly date to between 90 and 40 kyr. Two sites also yielded hominid remains.

A range of paleolandscape settings allows examination of human adaptive responses over time and space. On the one hand, riverine resources, especially hippopotamus, crocodile, and possibly fish, played a central role in subsistence throughout the sequence; other elements in the fauna suggest more or less access to arid savanna landscapes, depending on time and site location. On the other hand, typological inventories vary in accordance with microhabitat and/or sedimentary context. Raw material economy appears to have maximized the use of obsidian, whose patterning suggests variation in availability. We argue that the Middle Stone Age at all but the earliest sites reflects the presence of a single coherent set of behavioral principles, allowing a range of varied situation-dependent responses.

The later Aduma sites represent a single lithic tradition, characterized by complex Levallois and other technologies, and the presence of small, finely-made unifacial and bifacial points. The Aduma MSA, however, varies in important ways from lithic traditions described for the closest studied MSA sites in Ethiopia: at Porc Epic (Clark *et al.*, 1984), and K'one (Kurashina, 1978). This implies both relative isolation and population continuity over time. With the exception of a few, possibly fortuitous bladelets and bladelet cores in the latest sites, true microblade and geometric microlith technologies are absent, as is prismatic blade technology. Microlithic-size Levallois and Levallois-like cores and points, as well as small scrapers are characteristic of the Aduma sequence and their variety increases with time. We argue that the same lithic miniaturization process which led to the development of the Later Stone Age, also operated within the Middle Stone Age to produce a kind of micro-MSA. Some archaeologists have viewed the MSA as a monolithic entity, and have characterized the shift to LSA patterns as relatively abrupt and well-defined, and associated behaviors as “archaic” and “modern” respectively. We argue here for a more nuanced view of variability within the MSA.

A veil of stones and bones: spatial distribution analysis and site function at the Lower Paleolithic site of Holon, Israel

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The Lower Paleolithic site of Holon, Israel—dated to ca. 200,000 BP (OIS 7) based on ESR and OSL—provides an opportunity to look at associations between fauna and lithics across a broad, single period, horizontal exposure. Excavations at Holon carried out by Tamar Noy between 1963 and 1970 opened a total area of 260 m². Eight species were identified in the faunal assemblage with *Dama*, *Bos*, and *Palaeoloxodon* dominant. The lithic assemblage includes handaxes, choppers, and flake tools along with cores and unretouched flakes. Statistical analyses of the spatial patterning confirms the association of lithics and fauna, an association which was hinted at by the presence of cut marks on bones. No statistically significant association between remains of different faunal species was found which argues against the interpretation of the site as a base camp to which carcass elements were brought for redistribution. Rather, the distribution and nature of the faunal and lithic remains found at Holon supports the interpretation of the site as a palimpsest of individual carcass exploitation sites (i.e., Aridos or Barogali). The lithic and faunal evidence both suggest that other types of sites should be found in contexts contemporary with Holon. Handaxes and choppers were not produced on site suggesting that elsewhere on the landscape there were sites with a heavy emphasis on handaxe and/or chopper manufacture. There is also evidence that some faunal elements were transported away from the site

suggesting that one cannot rule out the possibility that base camps did exist in the vicinity of Holon at this time.

Hominid species diversity: an assessment using Bayesian statistical methods

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Reconstructions of human evolutionary history must be based on reliable hypotheses concerning the appearance, characteristics and fate of species groups. Unfortunately, however, the number of species represented in the known hominid fossil record is currently far from certain. Despite numerous well dated specimens and many methodological advances, researchers have failed to produce consistent estimates of hominid species diversity. Here, we argue that a major reason for the on-going uncertainty regarding the number of hominid species is the inability of the analytical approach normally employed in hominid taxonomic analyses to address the overlap between intra- and interspecific skeletal variation that is observable among primates and other vertebrates. We then outline an alternative analytical approach to the assessment of hominid species diversity that employs Bayesian statistical methods, and which directly confronts the ambiguity of vertebrate skeletal data with regard to species limits.

Thereafter, we report a study in which the Bayesian approach was applied to fossil hominid and extant primate mandibular data in order to evaluate the integrity of several fossil hominid species. The preliminary results of this study, based on corpus area measurements recorded on specimens of *Paranthropus boisei*, indicate that the Bayesian approach to hominid taxonomy yields easily interpreted results whose underlying assumptions are readily identifiable. The preliminary results also indicate that taking into account both within- and between-species skeletal variation can have a significant effect on the assessment of hominid species diversity.

The Early Upper Paleolithic in Swabia

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In recent years new data from the Swabian Jura have provided considerable evidence for early Upper Paleolithic occupation of the region. Alongside the classic work by Schmidt, Riek, Hahn, and others, the current excavations at Hohle Fels and Geißenklösterle combined with new dates and analyses point increasingly to the key role played by this region in the period when modern humans and the Aurignacian appear in Europe. Several years ago the author formulated the Danube Corridor and *Kulturpumpe* hypotheses to explain the observed phenomena.

The Danube Corridor hypothesis argues that the early presence of modern humans in the region, as is documented best by the skeletal remains from Vogelherd, can be accounted for by a relatively fast migration along the Danube into Central Europe. Sites in Austria, Bavaria and especially Swabia document this migration. Arguments including raw material transport along the Danube support this hypothesis.

The early appearance of Upper Paleolithic innovations in technology and symbolic communication form the basis of the *Kulturpumpe* hypotheses, wherein climatic change on the northern margin of the Alps, independent cultural evolution and competition between archaic and modern hominins are viewed as the driving forces for cultural innovation in the Upper Danube region. These factors combine to establish the Aurignacian by around 40,000 BP and the Gravettian by 29,000 BP. In the most radical formulation of the model, both the Aurignacian and Gravettian can be seen to originate in the Upper Danube Basin. While important changes were occurring in the Upper Paleolithic of Swabia, other regions of Europe were occupied by Neanderthals and the makers of Middle Paleolithic assemblages. The coexistence of these hominins in Europe appears to have lasted roughly 10,000 years, and the nature of the contacts between these hominins is one of the most hotly debated topics in paleoanthropology.

The Danube Corridor and *Kulturpumpe* hypotheses are readily refutable if the early dates for modern humans and Upper Paleolithic innovations can be shown to be wrong. With this goal in mind, the Tübingen research team has intensified excavations and obtained numerous new dates.

The available archaeological evidence from Swabia documents a cultural-stratigraphic break between the late Middle Paleolithic assemblages and the earliest Upper Paleolithic assemblages in the region. Thermoluminescence and radiocarbon measurements indicate that the start of the Upper Paleolithic, as represented by rich Aurignacian deposits, dates to about 40,000 BP. During the subsequent 10,000 years the number of Aurignacian find horizons increases, perhaps reflecting an increasing intensity of occupation in the region. In this time range methodological problems associated with radiocarbon dating remain to be solved, and independent dates from other methods are of central importance. The Aurignacian of the region is never interstratified with Middle Paleolithic finds and is characterized by diverse innovations in lithic technology, organic tools, ornaments, art and musical instruments that together provide all the hallmarks of cultural modernity in Europe. These innovations are documented in the Aurignacian deposits at Hohle Fels, Hohlenstein-Stadel, Geißenklösterle, Vogelherd and other sites. The Gravettian of the Swabian Jura follows immediately after the Aurignacian and is well established by 29,000 BP. The 2001 fieldwork at Geißenklösterle and particularly at Hohle Fels, where excavators finally reached well stratified Aurignacian horizons, provide new assemblages and new dates for testing the Danube Corridor and *Kulturpumpe* hypotheses.

Digital terrain models and open air Paleolithic survey in the French Midi-Pyrénées

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Archaeological survey has become increasingly sophisticated over the past decades and the systematic recovery of surface materials has become a useful way to carry out a regional

distributional archaeology, with the aim of integrating such distributions into a more comprehensive landscape model for the movements, emplacements and activities of prehistoric, especially mobile foraging, peoples. In the French Midi-Pyrénées we have long known about important Paleolithic cave sites, especially those with evidence for Paleolithic “art”, both cave wall art and mobile or portable art. However, almost no systematic work has been done that would place these decorated caves into a wider regional framework, save for the raw materials survey carried out by R. Simmonet. We have now surveyed (some replicatively) 310 different plowed fields in a 260 square km region in which one finds sites such as Le Mas d’Azil, Marsoulas, Enlène, Les Trois Frères, and Le Tuc D’Audoubert. As part of the survey project, we have analyzed the more than 3500 lithic artifacts recovered in relation to certain geomorphological phenomena. Based on digital elevation and hydrological data, we have applied a process-based model for inferring the soil diffusion and sediment transport rates since the late Pleistocene, thus providing several important parameters for understanding the distributions of materials recovered as well as for conducting future continued survey. For example, that many of the “rich” locations of Paleolithic materials are places where sediment transport has been minimal (7 meters or less), suggests these as viable locales for *sondages*, testing for possible *in situ* archaeological “sites”. These digital terrain data also allow the generation of shaded relief maps of the region, which confirm the fact that our survey to date has focused on a limited range of geomorphological contexts, which have, however, been very productive. We have identified many locations with lithics characteristic of Mousterian technologies, sometimes in palimpsests including characteristic Upper Paleolithic materials, and are thus able to evaluate some of the landuse patterns of some Paleolithic peoples, including the identification of several distinctly Upper Paleolithic locations, in stable sedimentary contexts, in some close relation to “art” sites, with the potential to inform on life “between the caves”.

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Executive functions of the frontal lobes and the evolutionary ascendancy of *Homo sapiens*

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A core question of cognitive archaeology is the evolution of modern thinking. We postulate that a cluster of specific cognitive abilities, “executive functions,” may have been one of the key acquisitions that led to the development of modern thinking. Executive functions are currently viewed as the ability to maintain an appropriate problem solving set for the attainment of a future goal. Although executive functions are presumed to rely on the cognitive domains of language, attention, and memory, they are not thought to be synonymous with them. Executive functions are also thought to consist of decision-making abilities, sequential memory, organization and planning, and retrospective and prospective thinking. Recent research (Coolidge *et al.*, 2001) suggests that executive functions are highly

heritable. Their neural substrate has been demonstrated to be the frontal/prefrontal cortex with intercortical and subcortical connections. Thus, a relatively simple mutation in the genes controlling frontal lobe architecture or functioning would have potentially profound effects on cognition, language, and emotional/social functioning. Monaco *et al.* (2001) found evidence for a genetic basis for language tense, although it is not known whether the gene is specific to language or represents a more general brain mechanism. Examination of the archaeological record reveals evidence of sophisticated sequential memory abilities and advanced organization and planning at least 40,000 to 60,000 years ago, and probably earlier (Coolidge & Wynn, 2001). Could the relatively sudden ascendancy of *Homo sapiens* (over approximately 30 to 100 millennia) have been due to a genetic mutation resulting in an enhancement in executive functions? Did the displacement capacity of language develop because it “piggybacked” upon this mutation? Was this the cognitive development that allowed fully retrospective and prospective thinking, i.e., modern thought? These speculations and evidence for them are expanded upon in the full paper.

**Systematic use of manganese pigment by Pech-de-l’Azé Neandertals:
implications for the origin of behavioral modernity**

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The systematic use of pigment is generally considered evidence for symbolic thinking and a hallmark of behavioral modernity. In recent years, the observed increase in the number of ochre pieces during the MSA has been used, along with other discerned changes in African hominid lifestyle, to support the hypothesis that modern cognitive abilities gradually arose in Africa in conjunction with the biological changes that mark the origin of our species. Neandertals are seen from this perspective as unable to fully develop symbolic behaviors in an autonomous way. Some aspects of their material culture, potentially symbolic in nature, are interpreted as resulting from long-distance cultural diffusion or contact with AMH migrants at the end of the Middle Paleolithic.

Although pigments, mostly manganese dioxides, are reported from at least 15 Mousterian sites in Europe, little is known about pigment use by Neandertals. Our analysis of the unpublished collection of 250 specimens of pigment found by F. Bordes at the Mousterian of Acheulean tradition site of Pech-de-l’Azé I demonstrates that Neandertal use of black pigment does not differ significantly from that known from MSA sites. The majority of these pigments clearly bear modification and use traces, namely scraping marks and, more frequently, single or multiple facets produced by rubbing against a soft material. Some pieces appear intentionally shaped into pointed crayons. Microscopic analysis of the worn tips and experimental reproduction of the traces suggest that they were used to draw linear designs. Two pieces bear an engraved abstract pattern produced with a lithic point.

In sum, early pigment use is not a peculiar feature of early AMH, and Neandertal production of pigment seems to contradict the popular single species model for the origin of behavioral modernity. Very close species may behave similarly and, in the case of our close ancestors, our shared features probably include many of the traits we have considered our monopoly.

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Too many young 'uns? Methodological problems in age determinations and construction of prey mortality profiles

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Prey mortality profiles have been used as a major source of information about Paleolithic hunting strategies and practices. These are most often constructed from dental remains of archaeological fauna. A variety of methods have been used to derive age class information, including most notably wear stages and crown height measurements. While the latter technique has generally come to be seen as more accurate, a number of methodological issues have arisen as more data sets are examined. Varied techniques have produced radically different results from a single data set. This paper compares several techniques for crown height measurement and age calculation. Data on reindeer teeth from six occupation levels at the late Magdalenian site of Verberie are used to examine potential analytical results. Theoretical quadratic equations are compared to empirically derived curves. Measures of single teeth are contrasted with averages from dental series. Taphonomic biases in age class representation are considered. The potentially variable results are discussed for their implications for over- or under-representing age classes that would be important for interpreting Paleolithic hunting strategies.

Neanderthal or modern human? The enigma of some Archaic and Early Aurignacian remains from southwestern Europe

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Numerous and important archeological sites from southwestern Europe are dated to the late Middle Paleolithic or the beginning of the Early Upper Paleolithic. Absolute and chronostratigraphic dates place them around 40,000 BP, with an overlapping period ranging from ca. 45,000 to 35,000 BP. Only a few of these sites have yielded human remains assigned to the late Mousterian, the Chatelperronian, the Archaic and Early Aurignacian and the Uluzzian. With the probable exceptions of the fossils assigned to the first two cultures, the other remains are fragmentary and their allocation to Neanderthals or to modern humans is highly problematic. Furthermore, in the past their interpretation was conditioned by the assumption that “. . . if humans are associated with Upper Paleolithic tools, . . . they must have been modern humans”. This dictum, no longer valid, has been clearly disproved by the Saint Césaire discovery.

Among these enigmatic remains, several were found in different French sites (e.g., La Ferrassie Grand Abri, Les Rois, Isturitz . . .); while others were discovered in Southern Italy (Cavallo) and in Northern Spain, at El Castillo Cave (old and new excavations). In these specimens numerous archaic morphological characteristics are found on the fragmentary mandibles and teeth. In addition, our review of dental dimensions demonstrates that these earliest Upper Paleolithic humans fall within the Neanderthal range of variation. In our opinion, it is impossible to identify these fossils unambiguously as Neanderthal or modern. However, we note that if most of these specimens had been discovered in Mousterian layers, they would have been unquestionably designated as Neanderthals. Our study complements

others which have shown evidence for continuity (or the blurring of taxonomic features) across the Mousterian/Upper Palaeolithic divide.

New directions and preliminary results from a landscape approach to the study of archaeological traces for the behavior of Plio-Pleistocene hominids at Koobi Fora

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Since 1997 collaboration between the National Museums of Kenya and Rutgers University has reestablished archaeological research in the Koobi Fora and Galana Boi Formations, east of Lake Turkana, Kenya. Here, we report on new archaeological traces found in the Upper Burgi (2.2-1.9 Ma) and KBS (1.89-1.65 Ma) Members of the Koobi Fora Formation. We compare and contrast the context of this new evidence with archaeological finds previously reported from overlying deposits of the KBS and Okote (1.65-1.39 Ma) Members, as well as contemporaneous archaeological traces from elsewhere in the Lake Turkana basin (Shungura and Nachukui Formations). Fieldwork conducted in October/November 2001 builds upon the pioneering efforts of Isaac and Harris begun in the 1970s to determine land use, ranging patterns, and foraging strategies of Plio-Pleistocene hominids with the ancient landscape as the frame of reference.

We specifically report on hominid modified bone, not associated with stone artifacts, found in the Upper Burgi Member. We also describe a small localized 'patch' or site (FxJj 82) of spatially associated bones and stone artifacts in the KBS Member adjacent to the outcrops which yielded KNM-ER 1805 and 1806. The results of this new survey indicates that the history of human carnivory extends back beyond two million years and complements recent finds of Late Pliocene hominid modified bone from the Middle Awash, Ethiopia. The nature, character and setting of the archaeological traces from the Upper Burgi Member stand in marked contrast to those published from the younger KBS and Okote Members. This indicates that the repertoire of Plio-Pleistocene hominid behavior included ranging into more open landscapes and curating stone artifacts, which in turn implies more sophisticated planning strategies, mental mapping of critical resources, and greater mobility. These behavioral traces provide the opportunity to examine hominid evolution against a background of environmental change induced by climatic fluctuations, volcanism, and tectonic activity.

Gas-liquid chromatography applied to the study of dietary lipids, tool use and evolution of the human brain

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Australopithecine brain size was quite similar to that of extant great apes, but the origin of *Homo* marked the beginning of an expansion in cerebral cortex that increased exponentially over time. At Bouri (Ethiopia), stone tools enhanced hominine access to high

lipid foods (meat, marrow) as early as 2.5 Ma, and many foods gained by extant great apes through tool use (insects, seeds, nuts) also appear to be relatively high in lipid. These observations suggest one possible mechanism associating an increased dependence on tools with an increase in primate brain size. Larger, more active brains may require relatively higher levels of certain brain-targeted fatty acids in the diet. Brain tissue is primarily lipid in composition (50-60%) and a supply of diet-derived 'essential' and long-chained polyunsaturated fatty acids is necessary for healthy brain growth/function. In this study, twelve foods of wild Bornean orangutans are characterized with regard to their fatty acid content using gas-liquid chromatography (GLC). Data show measurable levels of linoleic acid in all samples and α -linolenic acid in all but two of the samples. Linoleic and α -linolenic acids serve as biochemical precursors to arachidonic and ocosahexaenoic acids, important components of brain tissue. Total lipid levels were low in cambium (<1% of dry weight), but cambium proved to have more complex fatty acid profiles than seeds. The percentage of total fatty acids having at least two double bonds (polyunsaturated fatty acids) was higher than expected for all three categories of food studied: seeds (as high as 39%), fruit flesh (as high as 25%), and cambium (as high as 35%). This research lays the methodological foundation for future comparative work on brain-targeted fatty acids in primate foods derived through extractive methods such as tool use vs. those gained by other means.

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Initial Upper Paleolithic in Eastern Europe: new research at Kostenki

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After a hiatus of several years, field research resumed in 1998-2001 at the Kostenki sites, located near the city of Voronezh in Russia. These sites comprise 21 open-air localities associated with ancient side-valley ravines on the west bank of the Don River. At least 9 of them contain occupation layers dating to the Middle Pleniglacial (OIS 3). Among these occupations are the earliest known Upper Paleolithic industries and modern human remains in Eastern Europe. The new field research is focused on the excavation of the lowest levels at Kostenki 12 and 14. A major goal is the development of a new stratigraphic and geochronologic framework, and an improved understanding of site formation processes. The latter appear to have been complex, and may have included colluvial, alluvial, and aeolian deposition. A volcanic ash layer dated to 38,000-35,000 years BP represents a widespread stratigraphic marker horizon. Several Upper Paleolithic occupation levels underlie this horizon at Kostenki 12 and 14, and they appear to date to roughly 45,000-40,000 years BP. Efforts to achieve more precise dating of these levels and their correlation with climate oscillations during the first half of OIS 3 include application of luminescence dating (IRSL), paleomagnetism, palynology, and paleopedology. At least two Upper Paleolithic industries are present below the volcanic ash layer. One is characterized by blade technology and nonlithic implements and was apparently manufactured by modern humans. The other

exhibits technology and tools (including bifacial points) more typical of the Middle Paleolithic and may have been produced by local Neanderthals.

Late Pliocene archaeological sites in Hadar, Ethiopia

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Recent work in Hadar (the Afar region, northern Ethiopia) revealed the presence of archaeological occurrences in the upper Kada Hadar member of the Hadar Formation. These are clustered in close geographical proximity in the Makaamitalu Basin. To date, two localities—AL 666 and AL 894—have been explored. Both sites are overlain by the 2.33 ± 0.07 myr-old BKT-3 tuff, and are thus among the earliest archaeological sites presently known. The early occurrence of lithic artifacts in Hadar is concurrent with the appearance of *Homo*, as indicated by the A.L. 666-1 maxilla (Kimbel *et al.*, 1996, 1997), and with an ecological shift in the Hadar region towards a wooded grassland type habitat.

The lithic assemblages of A.L. 894 and A.L. 666 consist mostly of sharp-edged flakes and flake fragments. Cores and core tools, though present, are not common. Raw materials are exclusively cobbles of various volcanic rocks, probably derived from the local conglomerates. While the Hadar assemblages resemble in their typological composition those from Gona (Semaw, 2000; Semaw *et al.* 1997) and from West Turkana (Roche *et al.* 1999), they exhibit a different combination of techniques of core reduction than those seen in these broadly contemporaneous sites. Several hypotheses may be offered as an explanation of these differences in lithic technology, such as the effects of raw material shape and quality, or differences in the abilities of the tool makers. The information gained from the Hadar assemblages underscores the remarkable degree of technological variability observed already at this early phase of lithic resource exploitation and production.

Relocating the 1936 Perning/Mojokerto hominid site, East Java

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Uncertainty about the exact discovery location of the 1936 Perning (or Mojokerto) child's skull has raised questions about its geological context (see discussion in Huffman, 2001,

doi:10.1006/jhev.2001.0464). Since the 1930s, farming and forestry have modified the local landscape substantially, removing the discovery pit. Nonetheless, we recently used historic documents during fieldwork to relocate the site to within 10 m geographically (7°22'36.1"S; 112°29'01.5"E) and 2 m stratigraphically in the Plio-Pleistocene Pucangan Formation.

1936-1938 site maps, cross sections, descriptions, and photographs indicate that the skull was unearthed from gently dipping, vertebrate-bearing sandstone with andesitic gravel that outcrops north of a steep-walled, flat-bottomed, ca. 20 m-wide gully east of a prominent creek. Tuff and sandstone underlie this bed on the gully's north wall, and sandstone forms the south wall. The creek is seen in one photograph to flow through a broad valley bordered by a distinctive ridge.

Our relocation corresponds uniquely well to this documentary evidence. Kumai *et al.*'s (1985) location—near ours in the same bed—does not match old photographs. The broad valley seen west of the site excludes possibilities to the south since the creek there is narrow (ca. 50 m) and steep sided. T. Jacob's site near the commemorative monument (Swisher *et al.*, 1994, 2000) falls in the excluded area, faces the creek (not a gully), and lacks the tuff beneath the sandstone.

Other support for our relocation is provided by 74 vertebrate fossils excavated from 16 m³ of the relocated discovery bed. Most remains are durable skeletal elements and isolated teeth dispersed in sandstone and pebble conglomerate deposited at a river-channel margin. Others are as fragile and well preserved as the child's skull (e.g., a complete cervid antler, a mammalian vertebral process with spine, a little-abraded bovid cubonaviclar, a partial artiodactyl innominate, and much of a turtle carapace).

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Dental asymmetry in South African australopithecines: a preliminary analysis of odontometric and morphological components

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Elevated levels of odontometric and morphological asymmetry within modern human populations have been associated with genetic, epigenetic, dietary, and environmental factors. Previous studies of the australopithecine dentition have concentrated extensively on comparative metric and morphological analysis, and isolated teeth. There has been a limited focus on bilateral and unilateral asymmetries, due in part to the small existing sample of complete Plio-Pleistocene dental arches (i.e., that preserve antimeric tooth classes). The analysis of dental asymmetry in early hominids has potential to reveal conditions relating to environmental and biological stress.

For this study 71 paired observations (R-L tooth pairs) from 10 complete and partial dental arches allocated to *Australopithecus africanus* and 16 to *Australopithecus robustus* were analyzed for odontometric and morphological asymmetries. Metrical data were recorded as the mean of 3 trials for MD and BL diameters. Absolute left-right differences were analysed to establish directional (a)symmetry and then plotted against mean differences. Mesio-distal and bucco-lingual crown measurements reveal ca. 80% directional asymmetry over the entire sample, with R-L differences ranging from 0-1.4 mm. Discrete morphological traits were recorded for each tooth class and used to establish presence-absence symmetry or

asymmetry (scored as PP, PA, AP, or AA). Concordance for discrete traits in mirrored teeth was recorded at ca. 89%. Comparable levels of asymmetry are documented for each taxon separately, but the samples are very small for some tooth classes. These results are broadly similar to published studies in modern human samples.

The geology of a Middle Stone Age landscape in the eastern Free State, South Africa

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With few exceptions, all knowledge of South African Middle Stone Age hunter-gatherer life is from rockshelter sites. In order to gain a more holistic perspective, an intensive study of an interglacial open-air Middle Stone Age site is being conducted in the easternmost part of the Orange Free State, South Africa. Middle Stone Age hunter-gatherers occupied a series of open-air camps in what was then a valley lying perpendicular to the modern location of the Little Caledon River. Several sites have been identified in the walls of a gully that formed in reaction to 19th and 20th century over-grazing. The valley and the stream running through it provided water for game and wild plants that the Middle Stone Age hunter-gatherers could exploit. Phytoliths have been recovered from the occupation level, but they do not conform to any known species and have not yet been identified.

The Middle Stone Age occupation horizon begins at about 170 cm below ground surface. The occupation level is discrete with sterile silt to clayey silt matrix positioned above and below it. The more recent organic levels form a protective cap that probably accounts for some of the preservation of the site. A dolerite dike is located near the site and nodules of dolerite weathering in situ were found in the occupation layer.

Cryptocrystalline was the most common raw material of artifacts uncovered. The source was probably the nearby Little Caledon River. Quartzite was the other major raw material type for artifacts and an outcrop was located near the sites. Agates also were found at and near the sites. The Middle Stone Age knappers were not selective in the raw material they brought to the site. Cryptocrystalline nodules were carried to the site where they were minimally flaked to determine their suitability for tool manufacturing. Many nodules had internal flaws and were discarded after only one or several flakes were removed.

Pattern of brain size increase in Pleistocene *Homo*

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The increase of cranial capacity in hominid evolution is unarguably significant over the tenure of the genus *Homo*. However, consensus is yet to be reached regarding the

pattern of increase: some have used brain size evolution as a reflection of gradualism, some have claimed that certain portions of the human lineage were characterized by stasis, and still others have contended that brain size evolution in some geographical regions has proceeded at different rates than in others. In this paper, we address the problem of how human brain size has changed in the Pleistocene using a new approach.

We collected from the literature 92 hominid cranial capacities dated to between 50 ka and 1800 ka. To reduce error introduced by dates, we rounded the date estimates to the nearest 100 ka for specimens dated between 1800 ka and 300 ka, and to the nearest 50 ka for specimens between 300 ka and 50 ka. The final data set used in the analysis consists of 17 time samples. We developed a resampling algorithm using a distribution of increments to test the null hypothesis that a single process generated the observed increase pattern. The results of our analyses do not reject the hypothesis of a single cause of brain size change. It is concluded that the pattern of hominid brain size increase is not characterized by episodic changes.

A new hominid mandible from Dmanisi (Georgia)

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The Dmanisi hominids are now represented by 4 cranial remains: 2 crania (found in 1999) and 2 mandibles (found in 1991 and in 2000), accompanied by rich faunal collections and simple stone tools. The paleontological, archeological, geochronological, and paleomagnetic data from Dmanisi all indicate an Early Pleistocene age of about 1.7–1.8 Ma. The Dmanisi hominid remains are the first discovered outside of Africa that show clear affinities to African *Homo* rather than to a typical Asian *H. erectus* or to any Early-Middle Pleistocene European hominids.

The new human mandible (D-2600) was discovered in October, 2000 (Gabunia *et al.*, submitted). This specimen belongs to an old individual, which was almost certainly male. It is very large, with a long narrow alveolar arc and strongly developed masticatory region. The P4 is relatively small, with a double root. The molars are large, increasing in size from M1 to M3. Wear of the teeth is atypical (not helicoidal), with obvious predominance of vestibular wear.

D-2600 differs significantly from the mandible described earlier, both in terms of its dimensions and the morphology of the corpus and teeth. The specific combination of archaic features (characteristic of ancient African *Homo*), together with some signs of relatively advanced evolution, also distinguishes it from the mandibles of all other Early and Middle Pleistocene hominids. This specimen could support the view that hominid migration out of Africa took place even before the dispersal of the *Homo erectus/ergaster* group and indicates that there was quite possibly more than one hominid expansion out of Africa in the Early Pleistocene.

The Dmanisi project is funded by the Georgian Academy of Sciences, the National Geographic Society, the LSB Leakey Foundation and the American School of Prehistoric Research.

Exploring the geo-archaeological context of early hominid sites through soil micromorphology

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It is commonplace to state that the context and detailed nature of early hominid sites is poorly known. Two main reasons account for this observation: 1) The depositional and post-depositional processes that affect archeological and/or palaeoanthropological records are complex and; 2) there is a reluctance to look for the subtle features that would help to distinguish natural from anthropogenic contexts. Most of our knowledge about the nature of human occupations in Lower Pleistocene sites comes from zooarchaeology, lithic technology and palaeoenvironmental studies. Consequently, information about hominid activities exists but little is known about the detailed physical context in which they took place. In order to scrutinize the deep context of early hominid sites, we have employed soil micromorphology (the microscopic analysis of soils/sediments) to examine hominid occupations at Atapuerca (Spain), Dmanisi (Georgia), and 'Ubeidiya (Israel). Our goal is to isolate anthropogenic remains of human activities that have been identified at these sites.

Soil micromorphology has been successfully applied to several prehistoric sites, revealing details of activities and interpretations that escaped field observation and laboratory analysis. Preliminary results from the above sites show that there is intrasite variability in the sedimentary context containing the archaeological remains, a fact which deserves close attention before reaching any archaeological conclusions about spatial distribution of artifacts and bones. Generally, cave deposits (exemplified by those at Atapuerca) exhibit a wide range of diagenetic processes that can modify the vertical position of the remains, their original mineralogical composition, and state of preservation. Open-air sites (Dmanisi and 'Ubeidiya) undergo physical and biological disturbances in the form of animal burrowing and sediment translocation. Thus, the positions in which the archaeological and palaeontological remains are found may be significantly different from the original ones.

Human fossil remains from the Mousterian levels of Artenac (Charente, southwest France)

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In 1995 and 1996, a maxilla (Artenac 1) and a frontal (Artenac 2), were discovered in Mousterian levels of Artenac, near Angoulême (Charente). The two bones, from two individuals of different ages, are fragmentary, but sufficient detail remains to identify them as Neandertals.

The right maxillary fragment (Artenac 1) possesses a swollen, puffy appearance similar to the inflated maxillary regions of European Neandertals; there is no trace of a canine fossa. The four preserved teeth (right P³, P⁴, M² and M³), are heavily worn. There is abundant evidence for a variety of dental pathologies.

The Ardenac 2 frontal bone is from a younger individual. The forehead is preserved from the coronal suture to the edge of the supraorbital torus, the origin of which is marked by a gutter similar to that of western European Neandertals. The region anterior to this gutter, including the supraorbital torus, has been destroyed. In lateral profile, the curvature of Ardenac 2 describes a regular and continuous curve. The distance between the gutter and the coronal suture suggest that forehead length was somewhat shorter in comparison with Würm age western European Neandertals. These skulls also appear to possess a more convex shape, with pronounced bossing just above and behind the supraorbital gutter. In this, the Ardenac 2 frontal appears more similar to the curvature in the partial cranium from La Chaise (Charente), dated to the Eemian Interglacial. Biostratigraphic analyses at Ardenac place the Mousterian occupation at the very beginning of the Würm glaciation (Oxygen Isotope Stage 5).

These differences in forehead shape between Ardenac 2 and presumed later-in-time Neandertals are tantalizing, but whether or not the similarities between the La Chaise and Ardenac 2 fossils are indicative of subtle architectural changes in anterior cranial shape must await further discoveries of additional fossil material.

Pinnacle Point at Mossel Bay, South Africa: recent field investigations at a new hominid and Middle Stone Age locality

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The Middle Stone Age (MSA) in South Africa has gained increasing attention due to the discovery of bone tools at Blombos Cave, the abundance of ochre suggesting artistic expression, the presence of a variety of lithic assemblages with advanced technological characteristics, and debates over the interpretation of the fauna. Linked to these findings are debates over the antiquity of modern human behavior, with some researchers arguing that the South African evidence suggests an early origin of modern behavior, while others suggesting a late origin. Resolution of these debates relies on two advances: improvements in our theoretical approach, and an improvement of the empirical record in Africa. The latter is particularly significant here, as the sample of MSA sites with faunal preservation in Africa is very small, and the samples from many are small or excavated prior to the introduction of more modern techniques. We initiated fieldwork at Mossel Bay on the southern coast of the Cape to address the latter deficiency.

Our survey to date has covered a 2 km section of 8 km of coastal cliffs, penetrated 1 km inland, and discovered 28 archaeological sites, 21 of which are MSA, and 15 of those are caves/shelters. Test excavations were carried out at 3 of these caves, all at Pinnacle Point. Two (13A and 13B) yielded rich MSA horizons with outstanding preservation of fossil bone and lithic assemblages. Two hominid fossils were found. Cave 13A has an assemblage with high frequencies of silcrete and may be a Howiesons Poort occurrence. Cave 13B is particularly rich and resembles the classic Mossel Bay Industry. Cave 13B also yielded worked ochre. Large (size 3 and 4) mammals dominate the fauna, and unlike other MSA

sites, micromammals and small mammals are rare. Our analysis of the materials suggests spatial partitioning of activities, with domestic activities occurring in the front and discard of debris in the back.

Fireplaces in the Middle Palaeolithic: case studies of Kebara and Hayonim Caves

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From almost the second half of the Middle Pleistocene, humans have controlled fire. The best evidence for this was exposed in Middle Palaeolithic sites. Most frequently, the traces of hearths are sparse and are visible only in the form of the burnt residues of lithics, bones, and dispersed charcoal specks. However, in favourable conditions of preservation we can readily observe hearth features such as whitish-grey ashy areas, dark organic levels, a thermally altered substrate, and burnt stones. Middle Palaeolithic occupations in the Near East contain a strikingly plentiful number of well-preserved hearths in which stratified white/grey ashes overlay charcoal rich dark layers. Similar phenomena are described in several MSA sites in South Africa as well as other Middle Paleolithic localities such as Gorham's Cave (Gibraltar), and Grotte XVI (France). It has been unclear whether the observed good state of preservation solely reflects favorable conditions for it, or rather the effects of special activities, or the particular exploitation of various types of combustibles. Over last two decades, interdisciplinary research conducted at Kebara and Hayonim Caves (Israel) focused on the detailed study of numerous hearths. These investigations concerning spatial distribution, micromorphology, anthracology, phytolith analysis, and mineralogy at the sites provided a wealth of information. Apparently site formation processes which permitted relatively good or bad preservation, evidence for the choice of combustibles, the nature of occupations, and the degree of mobility may together explain the evidence related to the use of fire.

Chimpanzee-produced stone assemblages from the tropical forests of Tai, Côte d'Ivoire

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We report the results of the first archaeological excavation of a chimpanzee (*Pan troglodytes*) nut-cracking site. Previous researchers have conducted surface mapping and qualitative assessments of chimpanzee stone tools, and the results have been compared with

hominid archaeological remains. In some cases, the similarity of stone hammers and anvils used by chimpanzees and early hominids is striking. ‘Chimpanzee archaeology’ is a new field that has the potential to expand our understanding of hominid tool use prior to the earliest evidence of systematic stone flaking 2.5 Ma.

Our site, located in the Taï forest, Côte d’Ivoire, is called “Panda 100”, and lies on a platform formed by a meandering river. This place supported a single *Panda* nut source and at least five root systems that were used as anvils during recurrent and spatially constrained chimpanzee foraging activities. In the course of nut-cracking, stone hammers often experience unintentional damage and flaking. High rainfall triggers significant rainwash and sediment yield across the site, and a good potential for quick burial of behavioral remains. Archaeological excavation was in a fine matrix of well-rounded coarse sands that naturally does not include larger fractions. The thickness of the excavated deposit is more than 20 cm. Chimpanzees obtained raw materials from nearby igneous outcrops of granite and diorite, but also from lateritic sources. The artifactual evidence comprises 479 artifacts and includes stone by-products such as flakes, tabular pieces, edge fragments, shatter, and microdebitage. Chimpanzee-produced stone assemblages from “Panda 100” resemble some Early Stone Age industries from East Africa and provide new insights into the nature of early hominid technology.

Mousterian mobility and the significance of raw material transfers: A view from Artenac

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During the Mousterian of Southwestern France, only a small percentage of the transferred raw materials is located more than 30 km from the site. However, in the same time period, raw materials were moved over significantly larger distances in Central Europe. Nevertheless, these transfers are modest when compared with those recorded in the Upper Paleolithic. This suggested to some a substantial increase in the scale of mobility and has been interpreted by others as a demonstration that Neandertals lacked planning-depth.

The experimental replication of the chipped stone assemblage of layer 5 from Artenac, a Ferrassie Mousterian assemblage, is used to assess some of these propositions. At Artenac, none of the tools were transported over a distance longer than 30 km. However, the modest transfers documented in the site, as in most Mousterian sites, may in fact result from the abundance of flint and quartz in this region and a high residential mobility, a combination of causes that would have led to a high toolkit turnover. The planning ahead of raw material transfers may not have been necessarily lacking as a capacity in Neanderthals, and only the transfer of a very small toolkit may have been required. In that perspective, the raw material transfer increase in the Upper Paleolithic may actually signal a trend opposite to the one suggested by some authors, that is a reduction in the scale of mobility. Such a process would put fewer constraints on toolkit composition and weight, resulting in a lower toolkit turnover and therefore a higher frequency of exogenous tools in the archaeological sites.

Laetoli Pliocene landscape reconsidered: a reanalysis via functional morphology and taphonomic data

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Laetoli, a Pliocene paleoanthropological site in northern Tanzania, contains abundant fossil mammalian remains that enhance our understanding of the East African paleo-landscapes and hominid adaptive behavior. The presence of *Australopithecus afarensis*, the 3.5 Ma footprint impressions, and other faunal remains in the Upper Laetolil Beds offer a basis for understanding past ecological settings associated with the Laetoli bipeds. The distribution of various bovid and primate species at localities 8 and 9 as well as the taphonomic evidence point toward a complex, mosaic environment within the Upper Laetolil Beds. This is inconsistent with the popular open savanna-like environmental models previously suggested. Results from the classification of bovid femoral head and metapodial characters using *Probabilistic Neural Network (PNN)* place the Upper Laetolil bovids at localities 8 and 9 into an array of open country grassland, light cover, heavy cover, and forest habitats, thus indicating that Pliocene Laetoli was composed of mosaic-like environments different from the present day. Based on *PNN* classification, Laetoli paleo-landscapes were characterized by light cover vegetation with galleries of woodland and open country grassland most favorable to the Laetoli bipeds.

Interpreting Acheulean stone tool variability at Olorgesailie, Kenya

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Understanding early hominin technological competence and behavioral flexibility requires accurate interpretation of lithic industrial variability. 859 large cutting tools (LCTs) from nine excavated lithic assemblages at Olorgesailie, Kenya were analyzed to explore factors contributing to Acheulean morphological variability. Results indicated that LCT morphology changed as a function of size. Smaller LCTs were broader, had increased flake scar counts, and edge angles relative to larger LCTs. The increasing density of flake scars and higher edge angles with decreasing size, and the continuum of LCT sizes and shapes within assemblages supported the hypothesis that reduction through repeated flaking influenced morphological variability. Member 1 (0.99 Ma) LCTs had greater flake scar densities and higher edge angles than larger, elongate LCTs that were prevalent in Member 6/7 (0.78 Ma), suggesting that Member 1 tools were repeatedly flaked to a greater degree when compared to those in Member 6/7. These results were considered in light of ongoing research about the importance of hominid behavioral responses to environmental variability.

Final Paleolithic evolution at Öküzini (Turkey)

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A long Tardiglacial and Early Holocene sequence is preserved in the cave site of Öküzini (southern Turkey). It covers, in a nearly continuous manner, the entire period from 18,000 to 9,000 years (cal. BC).

The cultural traditions are first represented by backed points on bladelets (similar to the Kebaran). Hunting was primarily oriented towards wild goat (18,000 to 15,000 years BC). Next, microliths become dominant and hunting is oriented rather towards ovicaprines and fallow deer (15,000 to 13,000 years BC). Art appears in the form of schematic or zoomorphic engraved pebbles. Hunting persisted until quite recently, around 10,000 years BC. The Neolithic is late and intrusive, presenting a clear break with local traditions.

Male strategies and Plio-Pleistocene archaeology

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Archaeological data are frequently cited in support of the idea that big game hunting drove the evolution of early *Homo*, mainly through its role in offspring provisioning. This argument has been disputed on two grounds: 1) ethnographic observations on modern foragers show that although hunting may contribute greatly to the annual average diet, it is an unreliable day-to-day food source, pursued more for status than subsistence; 2) archaeological evidence from the Plio-Pleistocene, coincident with the emergence of earliest *Homo*, can be read to reflect low-yield scavenging, not hunting. Detailed review of the archaeology yields results consistent with these critiques: 1) early humans acquired large-bodied ungulates primarily by aggressive scavenging, not hunting; 2) meat was consumed at or near the point of acquisition, not at home bases, as the hunting hypothesis requires; 3) carcasses were taken at highly variable rates and in varying degrees of completeness, making meat from big game an even less reliable food source than it is among modern foragers. Collectively, Plio-Pleistocene site location and assemblage composition are consistent with the hypothesis that large carcasses were sought and taken not for purposes of provisioning, but in the context of competitive male displays. Even if meat were acquired more reliably than indicated by the archaeology, its consumption cannot account for the sharp changes in life history now seen to distinguish early humans from ancestral australopiths. The coincidence between the earliest dates for *Homo* and an increase in the

archaeological visibility of meat eating that many find so provocative instead reflects: 1) changes in the structure of the environment that concentrated scavenging opportunities in space, making evidence of their pursuit more obvious to archaeologists; 2) *Homo's* larger body size, which improved its ability at interference competition.

Taphonomy of lower vertebrates from Vindija cave (Croatia): delicacy on the Neandertal table or animal prey?

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This study deals with paleontology and taphonomy of lower vertebrates collected from the Pleistocene levels of the cave Vindija (NW Croatia) ranging in age from OIS 6 to OIS 1. Among 554 recently identified skeletal remains the majority belongs to fresh-water fish taxa and amphibians, reflecting different micro-habitat requirements but not short- or long-term changes in the immediate surroundings of the cave. At the same time, analysis of modifications (breakage, digestion) of bones shows a homogeneity of patterns for all studied samples which indicate a uniform accumulating agent and taphonomic trajectories as well as specific origin of the material. The majority of the identified remains belongs to the (also today economically, or better to say dietary) prized taxa such as trout, pikeperch or edible frog, and was found in sediments together with Neandertal bones as well as in association with Mousterian and Aurignacian artefacts dated to OIS 3. Thus, in contrast to previous theories of long-distance following of herbivores, a territorial model of exploitation of all animal sources is more plausible for Middle and Upper Paleolithic people, i.e. Neandertals, from Vindija cave.

The effect of bone size on the likelihood of modification by hominids and hyaenids, and its implication for interassemblage zooarcheological comparisons

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Zooarcheologists commonly compare frequencies of bone surface modifications between faunal data sets for the purpose of inferring various aspects of hominid behavior and ecology. To date, however, comparative analyses have been conducted following the assumption that frequencies of modification are directly comparable between assemblages produced by different behavioral agents (primarily hominids and hyaenids) and/or agents acting at differing intensities. Largely ignored is the degree to which frequencies of

modifications are correlated with specific taphonomic variables and whether specific procedures need to be undertaken to facilitate comparisons between assemblages.

Here we report the results of an analysis of a series of actualistic zooarcheological data sets that investigate the relationship between a bone specimen's "size" (as assessed via readable bone surface area) and its probability of being modified by different behavioral agents. We find that in general, larger specimens are significantly more likely to be modified than are smaller specimens, irrespective of the agents involved. This suggests that assemblages characterized by different modal specimen sizes may yield different assemblage-based frequencies of bone surface modifications simply as an artifact of differences in specimen size. We caution that a comparative analysis of such assemblages using the current methodology of total counts of modified specimens may produce inaccurate and/or misleading results. We present an alternative methodology that facilitates the comparison of frequencies of bone surface modifications by subdividing assemblages into taphonomically-comparable specimen size classes.

Further, we report that different behavioral agents (hammerstone-wielding hominids and hyaenids) create and modify bone specimens of different size classes at varying frequencies. We argue that a comparison of frequencies of agent-based modifications within specific specimen size classes provides a potentially profitable means to assess primacy of agent access. The resulting implications for the reconstruction of Early Stone Age hominid behavior and paleoecology will be discussed.

Parasites: an evolutionary pressure in Hominid evolution?

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Recent studies of the antiquity of parasitism has shown that many parasites have very ancient origins. These findings stand in contrast to the conventional wisdom that most human parasites are recently evolved. For example, the whipworms and ascarids of humans were once thought to have evolved since pig domestication. However, cladistic analysis of modern worms and direct finds of ancient eggs in archaeological contexts show that these parasites evolved in the Paleolithic or before. A similar case has been made for one of the hookworms, *Ancylostoma duodenale*. The pinworms of humans have a long term evolutionary association. The phylogeny of pinworm species of hominoids parallels that of their hosts. Some of the more serious parasite pathogens of humans also have a long association with hominids. Analysis of DNA from trypanosomes indicates that *Trypanosoma brucei* originated 5-15 Ma and co-evolved with hominids. Thus, sleeping sickness was a health threat for evolving hominids. Malarial vectors evolved at the Pliocene-Pleistocene boundary, and it is very likely that hominids had to contend with malaria throughout their evolution. The evidence accumulated thus far supports previous hypotheses presented independently by Desowitz and Lambrecht which suggest that parasitism was an evolutionary pressure on hominids for several million years.

**The past meets the future: 3D modeling technology and lithic analysis at
Wadi al-Hasa locality 623X**

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Locality 623X in the Wadi al-Hasa, Jordan, has yielded a substantial quantity of lithic material assigned to the Ahmarian. Some of this material comprises refitted blade, flake and core sequences, five of which have recently been analyzed using tridimensional imaging software provided by the Partnership for Research In Stereo Modeling (PRISM), housed at Arizona State University. The preliminary results of this new approach are presented, and the potential benefits of an automatic lithic refitting program are highlighted. It is clear that this kind of approach offers the potential to significantly reduce time investment involved in lithic refitting and yields results as accurate as traditional methods of lithic analysis. As well, further applications of 3D imaging for Paleolithic lithic analysis are discussed and promising future avenues of research currently pursued as part of this project are outlined.

**The Buia Project: a collaborative geo-paleontological and paleoanthropological
research project in Eritrea**

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The Buia Project is a collaborative research effort among the National Museum of Eritrea, the Eritrea Department of Mines and the University of Florence. Research field work began in 1994 with a Department of Mines and University of Florence joint project mainly focused on geological survey. This led to the identification of a Plio-Pleistocene fossil mammal-bearing succession located 20 km south of Buia village in the northern Danakil (Afar) depression. The huge potential of this area was demonstrated by the discovery of an almost complete human skull as well as several sites with widespread and abundant Oldowan and Acheulean tools. The two field seasons of December 1995 and February 1997 led to the definition of a local stratigraphy, the identification of several

different vertebrate-bearing levels, the collection by surface prospecting of about 600 fossil remains, and the paleomagnetic sampling of the entire succession. Since the discovery of fossil mammals and paleoanthropological remains, the collaborative project was enlarged to include the National Museum of Eritrea, which is in charge of safeguarding the national cultural heritage. Following the discovery, a new research proposal was submitted, aiming also to create a base for an adequate laboratory in the National Museum of Eritrea. The Buia Project was approved by the Research Committee of the University of Asmara, obtained an exclusive permit area delimited by Derawle stream (to the north) and Mahabale Wadi (to the south), and is currently fully operative.

The activity of the Buia Project, aimed at developing structure and capacity building and research, is considered pivotal for future research projects in Eritrea and for the management of paleontological, paleoanthropological, archaeological and geological heritage. The Project is supported by the Italian CNR (P.F. "Beni Culturali"), the University of Florence, the Italian Ministry for Foreign Affairs, and the L.S.B. Leakey Foundation.

Recent excavations at the Site of Erq-el-Ahmar, Judean Desert, West Bank

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Erq-el-Ahmar is a rock shelter located in the Wadi Khareitoun some 8 km southeast of Bethlehem. The site is situated at 555 m above sea level, and approximately 25 m above the thalweg of the Wadi, with a north-south orientation. It is 29 m in length, and approximately 6 m deep. Previous excavations toward the southern end of the shelter exposed deposits ca. 4 m thick, beginning with the Mousterian and terminating with an ephemeral Bronze Age utilization.

The importance of the Erq-el-Ahmar sequence for both Middle and Upper Paleolithic studies in the Levant is twofold: the site is situated at the juncture of several ecotones, separating the more northern central Levant from the currently semi-arid to arid southern Levant, and the shelter contains stratified Late Mousterian and Early Upper Paleolithic assemblages, as do some sites to the north, such as Kebara, el-Wad and Ksar Akil. The chance to be able to track and understand the development of the Levantine Upper Paleolithic from its inception ca. 44 ka (Phillips, 1994) led us to test the site in the summer of 2000.

The material from our excavations (4 m² and 1.8 m deep) appears to have a different signature, throughout the sequence, than that of the assemblages found in previous excavations toward the southern part of the shelter. There, Neuville (1951) discovered a sequence of Middle and Upper Paleolithic levels, capped by a thin Natufian layer with burials. Although a similar sequence was found in our excavations, the Upper Paleolithic assemblage recovered is radically different from that found to the south, indicating either spatial variability or that the sequence in the northern section represents only the earlier part of the Upper Paleolithic layers in the southern section. The assemblage excavated in our 2000 season from the Upper Paleolithic layers was mostly crude

débitage, while that excavated by Neuville contained mostly tools and laminar débitage. Fauna was found in good condition throughout the sequence and will be an important element for our interpretation of both cultural and climatic shifts throughout the utilization of the site.

El-Kherba: a Lower Pleistocene butchery site in northeastern Algeria

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Comprehensive investigations recently undertaken in the paleontological and archaeological area of Ain Hanech in northeastern Algeria have delineated additional Plio-Pleistocene horizons and have led to the discovery of new sites, including El-Kherba. El-Kherba is situated 400 m south of the classic site of Ain Hanech near the town of El-Eulma (administrative province of Sétif). The El-Kherba site is stratigraphically equivalent to Ain Hanech, and both were formed within the Ain Hanech Formation. Based mainly upon direct altimetric evidence, both localities are correlated with Unit T of that formation. The vertebrate fauna and the paleomagnetic evidence at El-Kherba indicate that Unit T is dated to the Olduvai subchron, ca. 1.77 Ma.

We carried out large-scale excavations in 1999. A total of 1291 archaeological remains were recovered, consisting of 361 fossil animal bones and 930 lithic artifacts including small débitage. The remains were contained in a silty deposit indicating a floodplain paleo-environment and likely were minimally disturbed. Animal bones were buried rapidly over a period of years. The artifacts are fresh and represent a coherent assemblage composition with small débitage (<2cm) very well represented.

The excavations uncovered a Plio-Pleistocene fauna taxonomically identical to that of the nearby Ain Hanech site, including *Equus tabeti*, *Hippopotamus amphibius*, *Kolpochoerus*, *Sivatherium maurusium*, *Gazella* sp. *Alcelaphinae*, and *Gorgon mediterraneus*. The faunal assemblage also incorporates a bovine cranium with complete horn cores assigned to a new species of *Pelorovis*. These faunal remains are associated with Oldowan artifacts made of limestone and flint. They include unifacial and bifacial choppers, polyhedrons, sub-spheroids, retouched elements, and whole flakes and fragments. Informal scraper and denticulate forms and notches characterize the retouched group. Preliminary data indicate that the site of El-Kherba represents a location for meat acquisition by early hominids. Microwear analysis made on several lithic specimens indicates that they were used primarily in meat processing as evidenced by the type of the polish as well as their longitudinal striae orientation indicating a cutting action.

New research at the Neandertal type site in the Neander Valley of Germany

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In August of 1856, workers quarrying limestone from the Neander Valley (Tal) recovered a partial human skeleton, represented by a calotte and 15 postcranial bones, from a small cave called “kleine Feldhofer Grotte.” This specimen played a critical role in early ideas concerning human evolution and became the type specimen for the group of ancient humans known as Neandertals. Since 1991, an interdisciplinary project of the Rheinisches Landesmuseum in Bonn, under the direction of RWS, has focused on comprehensive new studies of this specimen. To date, the best-known result of this project has been the isolation of the first mitochondrial DNA sequence from a Neandertal (Krings *et al.*, 1997 in *Cell*) and of a second sequence from the mt DNA hypervariable region 2 (Krings *et al.*, 1999 in *PNAS*).

The entire south wall of the Neandertal was destroyed by quarrying. Thus by 1900, the exact position of both the “kleine Feldhofer Grotte” and any possible sediments removed from the cave was unknown. After extensive research, a team led by RWS and his colleague Jürgen Thissen succeeded in locating the presumably lost sediments of the “kleine Feldhofer Grotte” and the neighboring cave of “Feldhofer Kirche.” In 2000, under auspices of the Rheinisches Amt für Bodendenkmalpflege, excavation of the combined sediments from these caves continued. These excavations resulted in recovery of stone artifacts, faunal remains and some 60 human skeletal fragments (including teeth and cranial, mandibular, and postcranial pieces). Both Gravettian/Perigordian V and Middle Paleolithic (Micoquian) lithic artifacts are represented. Three of the human skeletal pieces fit onto the original Neandertal specimen, while many others could also represent this individual. Some specimens duplicate elements present in the type specimen (right humerus, both ulnae), thus demonstrating the presence of a second adult individual. Morphological assessment of the second individual indicates distinct Neandertal affinities. Direct AMS ¹⁴C dating provides age estimates of 39,900 ± 620 BP for the type specimen and 39,240 ± 670 BP for the second individual. Mt DNA analysis of the second individual has also been conducted.

Recent discoveries from Gona, Afar, Ethiopia

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The Gona sites of the Afar region, Ethiopia, are known for yielding the oldest known stone artifacts dated to 2.6-2.5 Ma. The recent round of fieldwork initiated in 1999 has led to the discovery of more than 200 fossil and artifact-rich Plio-Pleistocene sites. The Gona sites have produced close to 10 hominid specimens. These include mandibles and hand/foot phalanges of *Ardipithecus ramidus ramidus* discovered from the Western Margin. The specimens were recovered in deposits which are dated between 4.5-4.0 Ma and contain a variety of fossilized fauna suggesting mixed habitats. Several Late Pliocene sites within the Ounda Gona and Dana Aoule drainage are now confirming that the first tool makers occupied an extensive geographical area, and the archaeological evidence suggests that the hominids skillfully exploited raw materials and other resources. Three Early Pleistocene sites yielded hominids and associated Oldowan and Early Acheulian artifacts and fauna. The Dana Aoule (DAN5) site yielded a nearly complete skull of an early *Homo* and the Busidima North site (BSN12) produced a partial skull of a *Homo erectus*. Associated fauna suggest an age ca. 1.5 Ma for these finds. A new Early Acheulian site was discovered this year from Ounda Gona South (OGS12). The tuff sampled <1 m below the excavated area was dated to 1.6 Ma, suggesting that OGS12 is possibly among the oldest Acheulian sites. The 1999-2001 field seasons have shown that Gona contains a wealth of palaeoanthropological information critical for studying the last 5 Myr of the biological and behavioral evolution of our ancestors.

Archaeological reconnaissance of the Omo Kibish Formation, Ethiopia

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The Omo Kibish Formation, southern Ethiopia, consists of sediments dated between 200-10 ka. Paleoanthropological reconnaissance of the Omo Kibish Formation in the 1960s

recovered both archaic and modern-looking human fossils from surface deposits. Our work focuses on the archaeological associations of these fossils. Thus far, we have re-located the sites that yielded the Omo I and Omo II crania and recovered additional fossil remains of the Omo I hominid. Kibish Formation sediments contain a variety of Middle Stone Age artifacts, including Hargesian bifaces, as well as large mammal remains with cutmarks. A series of barbed bone harpoons were also recovered in the 2001 field season. Future research will attempt to clarify the stratigraphic context and age of the various artifacts. This paper will present an overview of our research through our third field season (Jan.-Feb. 2002).

A southwest European Late Glacial settlement system: the Magdalenian and Azilian of the Río Asón Valley (Cantabria, Spain)

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The Cantabrian region of Atlantic Spain is characterized by high relief, with short rivers cutting steeply down from the Cordillera to the Bay of Biscay. Within 1-2 days walk, foragers could exploit the resources of mountain slopes, deep valleys, coastal hills and a narrow coastal plain. With glaciers in recession during the latter half of isotope stage 2, human settlement re-expanded into montane habitats, including the *meseta* of Old Castile, south of the Cordillera. The Asón River valley, which drains eastern Cantabria Province, provides a example of the high density of human settlement that developed in the Magdalenian and Azilian periods throughout the region. There is a major cluster of sites around the present river mouth, some of which were in position to dominate the narrow, now-inundated continental shelf. Both small (special-purpose?) and large (residential?) sites are included, along with cave art loci. The middle valley is dominated by the large cave site of El Valle, recently re-excavated and radiometrically dated. The upper valley is long known for its many cave art sites, at least one of which—Cullalvera—is stylistically attributable to the Magdalenian. However no sites had been excavated in the upland zone until the start of large-scale research at El Mirón Cave, followed by limited testing of nearby Horno Cave. These two sites combined attest to a major human presence in the interior throughout the Tardiglacial, from 17-10 ka. Occupation layers are densely packed with faunal remains (especially ibex and salmon), lithic debris, tools and weapon elements (on flint from limestone today outcropping at the shore), bone/antler artifacts (points, harpoons, needles, awls, wands), perforated shells and teeth. They also include red ochre patches and structures in dense palimpsest deposits testifying to long-term, repetitive human uses of these caves. The whole valley was exploited and, like others in the region, may have functioned as an effective band territory, even though its inhabitants maintained social contacts with other bands along the coast.

A computationally intensive statistical technique for analyzing interassemblage variability in lithic type frequency distributions, with an application to the Epipaleolithic of the Levant

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In Middle and Upper Paleolithic research, standard typologies can efficiently characterize variability in formal and technological attributes of chipped stone artifacts. Converting typological counts into frequency distributions facilitates comparison of artifact assemblages that differ in size. Analysis of interassemblage variability can often capture a few key types that delineate distinct assemblage clusters, defining archaeological facies, technocomplexes or cultures (Bordes, 1961). Such groups may usefully establish regional chronological markers, but if they exhibit complicated temporal and geographic distributions, they may raise deeper questions about the causes of variability in the chipped stone assemblages. Are the groups explained by environmental context, site activity patterns, raw material availability and regional mobility strategies, or social affinity and territoriality? This paper presents a “computationally intensive” approach for statistically analyzing type frequency data, focusing on the case of microlithic assemblages from earlier Epipaleolithic (Kebaran and Geometric Kebaran) sites in the Levant. The Epipaleolithic (ca. 20-10 ka) has been subdivided – according to differences in relative abundances of microlithic types (Bar-Yosef 1970, 1975; Goring-Morris 1987) – into archaeological cultures that have broad, well-defined chronological and spatial limits. The distinct strategies of microlith production are generally agreed to be underlain by cultural traditions. Yet, do the archaeological cultures also differ in production constraints generated by residential mobility patterns or in design constraints imposed by the utilitarian functions of compound tools with microlithic inserts? We assign Epipaleolithic microlithic assemblages to subgroups according to specific criteria (e.g., topographic setting or site size category). The average between-group differences in type frequencies are calculated, and the observed between-group values are compared to the distribution of values obtained by repeatedly permuting membership in the groups, holding group sizes constant. This paper thus aims to illustrate how “computationally intensive” hypothesis-testing techniques can aid in identifying causes of typological variability in regional Middle and Upper Paleolithic lithic datasets.

Site formation and taphonomy of the Lower Pleistocene site of Dmanisi, Republic of Georgia

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The Dmanisi site, with its well-preserved hominin and vertebrate fossils and Mode 1 stone tools, is an important source of information on the evolution and adaptations of early *Homo* during the initial biogeographical expansion beyond Africa. Here we report on the site

formation and taphonomy of Dmanisi, based on the 2001 field season. New excavations continue to recover fossils, stone tools and manuports within sediments with reversed polarity that date to about 1.7 Ma, as well as evidence for occupation within the earlier normal sediments, dating to between 1.84-1.78 Ma. Preliminary observations on the taphonomy of the vertebrates indicates an extraordinarily well preserved fauna: 70% of bones are in weathering stage 0 or 1, and none were in stages 4 or 5, indicating rapid burial after death. Some 30% of the fossils examined so far are unbroken, which is very high compared to other Oldowan sites. We estimate that approximately 90% of the specimens will be identifiable to genus and probably species, again a notably high proportion. Dmanisi contains a large number of skulls, and many vertebrae, although ribs are rare. There is much evidence for carnivore involvement in the Dmanisi site, in the high proportion of carnivores present, the variety of carnivore species, tooth pits and hyena coprolites. But the proportion of carnivore tooth scores is not high, perhaps suggesting that this is not a den, and/or that sabertooths were the most important carnivore contributing to the accumulation. A few bones with possible cut marks have been identified. Dmanisi has a complicated taphonomic history that clearly involves both carnivores and hominins, and several alternative hypotheses of the formation of the site can be made and tested. Other portions of the Dmanisi site have different taphonomic characteristics, and these areas will be excavated in the future.

A technological comparison of the stone tool-making capabilities of *Australopithecus* early *Homo*, *Pan paniscus*, and *Homo sapiens*, and possible evolutionary implications

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Detailed comparisons between technological patterns found at prehistoric archaeological industries and those generated in replicative experiments can best be made when there is good control over the raw materials being used. In this study, the stone artifacts produced by hominids at the world's earliest Palaeolithic archaeological sites at Gona, Ethiopia (dating to between 2.6 and 2.5 Ma and possibly produced by *Australopithecus garhi* or an early form of *Homo*) are compared to the lithic technological patterns produced by experienced knappers of two extant species, bonobos (*Pan paniscus*) and modern humans (*Homo sapiens sapiens*). In all of these samples, stone tools were produced using the same types of volcanic cobbles from Gona river gravels.

A detailed analyses of quantitative and qualitative attributes, as well as multivariate analysis, were conducted to ascertain relative levels of stone technological skill of these three species based primarily upon cobble reduction and flake production. Comparisons of the experimental samples of *Pan* and *Homo sapiens* with the prehistoric samples produced by the Gona hominids indicate some interesting and surprising results, which will be reported here. Means of assessing whether differences observed are due to cognitive or biomechanical differences are suggested.

The Middle Stone Age of the southern Kapthurin Formation, Baringo, Kenya.

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Modern humans (*Homo sapiens*) appear to have originated in Africa during the later Middle Pleistocene. During this period, the Acheulian Industrial Complex was replaced by diverse Middle Stone Age (MSA) industries, and it can be argued that this event heralds a shift to behavioral modernity. Few locations in Africa preserve a well-dated sequence spanning the Acheulian-MSA transition, hampering our understanding of the nature, tempo and context of this technological change.

The Kapthurin Formation, west of Lake Baringo, Kenya, contains a suite of sites within and beneath widespread layers of the Bedded Tuff member. Tephrostratigraphic correlation among these localities establishes the interstratification of Acheulian, Sangoan, Fauresmith, and MSA artifact horizons at sites such as GnJh-63, GnJh-15, GnJh-17 and GnJi-28. The Acheulian-MSA transition is thus a complex process, and $^{39}\text{Ar}/^{40}\text{Ar}$ dating of individual tephra beds demonstrates that it began prior to ca. 285 ka within the Kapthurin basin.

Fieldwork in 2001 focused on previously unexplored artifact-bearing sediments in southern exposures of the Kapthurin Formation. The site of Koimilot (GnJh-74), lies within the Bedded Tuff, and appears to be bracketed by $^{39}\text{Ar}/^{40}\text{Ar}$ dates of 284 ± 12 ka and 235 ± 2 ka, pending confirmation by geochemical tephra analysis. Koimilot is thus younger than most other Kapthurin Formation MSA sites, but substantially older than most known MSA sites in Africa. A 45 m² excavation at Koimilot produced two MSA horizons containing a variety of Levallois and non-Levallois cores, flakes and retouched tools. Over 2,000 artifacts were recovered from overbank silt and sand deposits, with size class distribution and refitting artifacts suggesting minimal post-depositional disturbance. Material from Koimilot and elsewhere in the Kapthurin Formation illustrates local technological change towards the close of the Middle Pleistocene in East Africa.

Fire and fireplaces in the Lower, Middle and early Upper Paleolithic of western EuropeP. Villa¹ and F. Bon²¹*University of Colorado Museum, UCB 265, Boulder, Colorado, 80309-0265, U.S.A.*²*Université de Toulouse-Le Mirail, Préhistoire, 5 Allées A. Machado, 31058 Toulouse, France*

As in the case of habitation structures, the study of the use of fire and fireplaces in the early Paleolithic has suffered from various forms of advocacy, from the exercise of uncritical imagination, to that of excessive scepticism, due to incomplete reporting and lack of detailed observations. In recent years TL dates on burned flints, systematic water-screening and collection of organic materials, botanical and taphonomic analyses have been carried out at several western European sites, providing important new data.

Although the colonization of western Europe is generally tied to the use of fire, evidence for the Lower and early Middle Pleistocene is extremely weak. No evidence of fire has been reported from Gran Dolina and earlier sites in the Orce basin, from Venosa Notarchirico or the early levels at Arago. Evidence of fire from Isernia, Boxgrove and other early sites must also be considered as absent. Absence or non-systematic use of fire may be one of the reasons why the settlement of Europe took a rather long time. Between 1.0 Ma and 400 ka,

in fact, the total number of known sites is quite small, suggesting sporadic and discontinuous settlement patterns. Only from OIS 11 or about 400 ka is the utilization of fire documented at some sites with burnt stones and artifacts or charcoal concentrations. However, fireplaces are often not preserved or are very simple, flat and unlined charcoal concentrations. By OIS 4 and 3, there are at least 17 sites in France with evidence of fire; four Mousterian sites have stone-lined or stone-delimited fireplaces, and at least three have several fireplaces in the same layer. Current work based on refitting suggests that site structuring around fireplaces is present at Aurignacian as well as late Middle Paleolithic sites. At most Aurignacian cave and open-air sites, traces of fire and use of bone as fuel are a consistent and abundant feature of the record, although well-preserved fireplaces are still rare.

**Relative cerebellar and cerebral hemisphere volume in Pliocene and Pleistocene
Homo: a complex trajectory**

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In the course of hominid evolution, both the cerebellum and the neocortex have expanded, but they have done so at different rates. Differences in relative cerebellar volume with respect to overall brain and body size among Pliocene and Pleistocene hominids correlate with archeological and skeletal indicators of cognitive evolution. The present study used integrated data from Magnetic Resonance Images of living human and non-human primate endocrania and three-dimensional virtual models of 18 hominid endocrania. Reduced major axis and least squares regression were used to calculate actual/predicted cerebellar volume with respect to brain volume (“cerebellar quotient” = “CQ”) for a sample of living primates, including recent humans, and of fossil hominids.

The evidence supports a three-stage model of hominid cerebellar evolution. In the first stage, brain mass expanded non-allometrically with respect to body mass (encephalization). CQ increased in parallel with encephalization, as *Homo habilis* and *H. erectus* gradually developed a high level of technological competence. Behaviors indicative of well-developed procedural cognitive processes and cultural mechanisms for disseminating technological information are more consistently represented in the archeological record. In the second stage, represented by Middle Pleistocene, late archaic, and perhaps early modern *Homo sapiens*, absolute cerebellar volume increased only slightly, accompanied by a dramatic expansion of the neocortex, resulting in a marked decline in CQ. This neocortical expansion accompanied the appearance of an increasingly rich repertory of artifacts and activities related to their manufacture and use. In the third stage, absolute brain and body mass have declined in anatomically modern humans; but cerebellar volume has increased both absolutely and relatively, suggesting that greater computational efficiency has been accomplished without an increase in overall brain mass.

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How should we sample teeth for stable isotope analyses? Cues derived from microprobe analyses and histology

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Stable isotope analyses (SIA) of fossil teeth are often performed in the context of paleo-environmental studies because the biogenic isotopic ratios in dental enamel are presumed to be relatively stable during postmortem diagenesis. Based on the incremental growth structure of dental tissues, teeth are increasingly used for the investigation of dietary or habitat variability on a short, i.e. seasonal, time scale. However, it is still unresolved what kind of sampling strategy is optimal for the purpose of an accurate analytical time resolution. This problem arises because on the one hand, short period lines (cross striations) and long period incremental structures (Striae of Retzius) are visible in histological thin sections of teeth. On the other hand, there is evidence for different phases of enamel mineralization. These mineralization waves might result in averaging the amplitude of variability of a dietary signal that is recorded during tooth crown formation and finally preserved when the enamel is completely mineralized.

In order to address this question we performed microprobe analyses in modern dental enamel of different herbivores (sheep/goat and horse) in conjunction with examination for incremental structures using histological techniques (PLM, laser confocal microscopy). This permits us to superimpose and compare the dental growth structure that is visible in histological sections with microprobe line-analyses, as well as maps of elemental distribution for calcium, phosphorus, carbon, magnesium, and chlorine. In order to estimate the degree of enamel mineralization we calculate the proportional element abundance relative to the Ca/P ratio in any given area. The relative abundance of carbon is taken as an indicator for the amount of organic matter and follows the incremental structure observed in histology. Magnesium is measured because its abundance decreases during the mineralization process of enamel.