The Early–Middle Pleistocene Settlement of Northern Armenia

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Northern Armenia and southern Georgia, divided in the Haghtanak-Bagratashen area by the Debed River, witnessed considerable volcanic activity between ~2.1 and 1.6 Ma, towards the end of which the earliest evidence of *Homo* outside Africa is found at Dmanisi, Georgia (~1.77 ma). The rich assemblages of lithic, faunal, and human fossil materials found at Dmanisi have fundamentally altered our understanding of the hominin morphological attributes and technological capabilities upon which this expansion was based. Thus, the region is now well established as an important archive of early paleoanthropological data. Research conducted at Haghtanak-3 (HAG3) since 2017 suggests that the base of its stratigraphic sequence is coeval with Dmanisi as it sits atop a 1.95 Ma basalt flow. Unifacial cores/choppers, non-hierarchical cores, simple flakes, and hard hammer percussion dominate the artifact assemblage. A combination of volcanic, chronometric, stratigraphic, and technological parallels exists between Dmanisi and HAG3, providing an opportunity to expand our understanding of the earliest expansion of *Homo* out of Africa with new, highly contextualized geoarchaeological and paleoenvironmental data. HAG3 also contains a stratigraphic sequence that continues into the Middle Pleistocene, thus providing information on later phases of technological development and hominin behavior.

Sexual Selection for Neanderthal Versus Modern Human Craniofacial and Vocal Tract Morphology

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Neanderthal skulls are low and long, with pronounced facial prognathism. Modern humans have smaller faces, retracted under high, rounded skulls. Neanderthal prognathism has been explained as a function of nasal sinus expansion for heating cold air, anterior dentition mechanical loading, ontogenetic growth differences, and genetic drift. Biomechanical and cold stress hypotheses have been rejected. Doman et al. (2013) proposed that sexual selection can explain differences in craniofacial morphology. They observed that strong sexual dimorphism in craniofacial dimensions of great apes is associated with intergroup aggression and mate competition, and with high testosterone levels. They suggest that Neanderthals and craniofacially robust early modern humans had elevated levels of male-male competition and high testosterone compared to recent modern humans. Cieri et al. (2014) independently reached this conclusion. Testosterone is associated with enlargement of the suprapharyngeal vocal tract (SVT) and deeper vocal pitch. Deep pitch is associated with perception of large body size, strength, and dominance in mammals, including humans. The long SVT and enlarged nasal sinuses of Neanderthals suggest lower vocal pitch compared to modern humans. Gokhman et al. (2020) have identified differences in regulation of genes that affect vocal and facial anatomy by epigenetic analysis of ancient DNA of modern humans, Neanderthals, and chimpanzees. They conclude that down-regulation in this network of genes can account for facial reduction in modern and fossil *H. sapiens*. These differentially methylated genome regions suggest higher vocal pitch and lower levels of male-male competition in modern humans. Ancient DNA thus provides strong support for the role of sexual selection rather than biomechanical or climatic selection in the evolution of modern human cranio-facial morphology. Moreover, aggressive competition inferred among Neanderthals is consistent with high levels of skeletal trauma, archaeological evidence for small home ranges, and genetic evidence for high levels of inbreeding.

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Wrist Morphology and Artifact Form: An Experimental Approach

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The link between the evolution of the human hand and the production of stone tools has long been a focus of research. This has primarily been focused on understanding the impact of stone tools on the origin of modern human hand morphology through investigations of hominin hand fossils. Recent studies have used the study of the wrist to explore the biomechanics of stone tool production. The wrist and the associated flexion of this joint have an impact on the ability to create precise movements such as that seen in the production of stone tools. Many previous studies have not focused on the intersection of biomechanics and artifact form. Here, we replicate Oldowan artifacts under experimental conditions that emulate a hominin with a reduced wrist flexion. These experiments simulate flake production associated with primitive hominin hand morphology. Four types of raw materials (basalt, ignimbrite, chalcedony, and quartz), were used. Two individuals with over 20 years of knapping experience produced a total of 309 flakes. We explore artifact variation using measurements that are relevant to understanding the connection between stone tool production and hand morphology. Experiments suggest that the angle of blow of a hammerstone and the external platform angle of the core surface have an influence on flake formation. These variables can be controlled by the knapper and it is possible that they are linked to the range of movement at the wrist joint. Preliminary results show that it may be possible to distinguish flakes made with different degrees of wrist flexion.

The Paleolithic of Jordan: Research to Date and Future Directions

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Research on the Paleolithic in Jordan has been overshadowed by the glamorous architectural remains from the historical periods (e.g., Petra, Jerash). Despite this, it is now clear Jordan's Paleolithic archaeological record has much to offer in terms of increasing our understanding of hominin behavior. For example, discoveries in the last two decades suggest that the region probably played an important role in the dispersal of hominins out of Africa and into Eurasia. This poster provides an up-to-date synthesis of the Paleolithic of Jordan, from the Lower Paleolithic to the Epipaleolithic (ca. 2.5 ma – 10 ka). It draws on data from surveys and excavations over the past 75 years and explores the geographic and temporal patterns associated with occupation in the region. In addition, it considers how the different ecozones of Jordan may have affected the nature of mobility, subsistence, and technology during the Paleolithic. The poster ends by outlining some potential future directions for Paleolithic research in Jordan and showcasing a project we are in the process of initiating, the Jordanian Cave Predictive Paleoanthropology Project.

The Distinct Mortuary Practices of the Magdalenian and Epigravettian (~20,000 to 12,000 years BP) in Europe: Combining Archaeological and Genetic Evidence

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The Magdalenian and Epigravettian are the two major cultural complexes that emerged in western and southern Europe after the Last Glacial Maximum around ~21,000 cal BP. They are characterized by a rich archaeological record with behaviors common across groups including complex artistry on cave wall and the production of portable objects through modification of stone, bone, and antler. Distinction between the two complexes can be seen in the lithic industry, alongside site location, with the Epigravettian being constrained to the glacial refugia of Northern Italy and the Magdalenian to Northern Iberia and Southcentral France. In this presentation, we will focus on the different expression of mortuary behavior practiced by these two groups. We review over 40 human osteological collections associated either with Epigravettian or Magdalenian deposits. Results suggest that Epigravettian sites are more often characterized by the primary burial deposition of human bodies. Magdalenian human collections, on the other hand, are more often represented by scattered and fragmented anthropologically modified remains, raising questions regarding the type of mortuary rituals practiced by the Magdalenians. Given the pervasiveness of cannibalistic evidence, we suggest that mortuary cannibalism, defined here as the consumption of a human body by individuals often belonging to the same group, culture, or tribe, as a form of ritualistic funerary behavior, was the Magdalenian way of disposing bodies. Although burials are found in few Magdalenian contexts that mirror those seen at Epigravettian sites, we argue that given the recent genetic evidence for mixing between the two populations, such evidence for burial in the Magdalenian is restricted to those groups that would have encountered Epigravettian populations. Funerary cannibalism, on the other hand, was extensively spread among groups of sole Magdalenian ancestry (GoyetQ2).

Preliminary Paleoecological Results of the New 2021 and 2022 Campaigns in the Early Pleistocene Site of 'Ubeidiya, Israel

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'Ubeidiya, in the southwest Asia Rift Valley, is one of the earliest prehistoric sites outside of Africa (Bar-Yosef and Belmaker, 2017). Extensive excavations carried out between 1960–1999 revealed c. 80 sedimentological layers ascribed to four depositional cycles (Limnic Inferior [Li], Fluviatile Inferior [FI], Limnic Upper [LU], and Fluviatile Upper [FU]). Most fossiliferous and archaeological strata are within the FI cycle, which includes 15 archaeological horizons. The site is dated to 1.6–1.2 Ma, based on biochronology supplemented by regional stratigraphy (Tchernov, 1988; Martínez-Navarro et al., 2009). While the lithic and faunal assemblages of 'Ubeidiya were comprehensively analyzed and published (Bar-Yosef and Goren-Inbar, 1993, Belmaker, 2010), aspects of the paleoclimate of the site are still debated. Here we present preliminary results of the new campaigns conducted in 2021 and 2022 (Barzilai and Belmaker, 2022) focusing on paleoecological analysis. Fieldwork included systematic documentation and sampling along three trenches (Ia, IIb, and III). The lithic assemblage from the new excavations confirms the presence of lithic assemblages attributed to the early Acheulean tradition throughout most of the sequence. Fauna from the recent excavations and reanalysis of material from earlier excavations indicate increased species richness, with new species appearing for the first time in the southern Levant. Paleoecological analysis of fauna and pollen point to surrounding habitats of dense oak forests in a warm and humid environment. Seasonality proxies indicate summer rains. Ostracod distribution suggests lake salinity and water temperatures similar to those of the Sea of Galilee today and markedly different from the Pliocene Erq el Ahmar Formation and the early Middle Pleistocene Benot Ya'aqov Formation. The paleoenvironmental reconstruction differs from that of Dmanisi, Georgia, and along with differences in lithic assemblages and hominin skeletal morphology between 'Ubeidiya and Dmanisi (Barash et al., 2022), supports two distinct waves of hominin migration out of Africa.

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New Insights into the Chert Sources of Southern Portugal: A Macroscopic and Petrographic Approach

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Hunter-gatherers relied strongly on lithic raw materials, making these key aspects to understanding many aspects of their lives, including mobility and land use, cultural and social dynamics, and technological and tool use preferences. Currently, only a few studies exist on raw material exploitation during the Upper Paleolithic (UP) in southwesternmost Iberia, and much about the technology, economy, and mobility of those populations is unknown. With one of the most complete UP sequences in the region, large lithic assemblages, and recent archaeological excavations, the site of Vale Boi (southern Portugal) is ideal to explore how the hunter-gatherer groups throughout the different UP phases explored abiotic resources and moved across the landscape. However, since raw material selection has to do with its adaptive benefits but also its availability/dispersion in the natural environment, it is always a fundamental step to provide a detailed characterization of the geological vicinities and of the raw material sources available in the territory. This poster presents the results of the macroscopic and petrographic characterization of geological samples recovered from southern Portugal. This allowed us to characterize all known chert sources from southern Portugal, a key objective of a Ph.D. project aiming to characterize the silicious rock exploitation at Vale Boi through the UP levels.

Living by the Land, Gazing at the Sea: Hominin Occupation of Near-Coastal Inland Plains on the Western Periphery of the Red Sea

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The western periphery of the Red Sea is an ideal region for testing various scenarios regarding hominin engagement with seashore and near-coastal landscapes due to featuring channelized plains bounded by mountainous terrains on the west and a sea on the east. Using recently discovered Acheulean and Middle Stone Age archaeological occurrences in near-coastal landscapes in the Agig and Khor Baraka districts of the Red Sea region of Sudan as case-in-point (Beyin, 2021; Beyin et al., 2019), this paper highlights the importance of inland plains situated between hilly terrains and a seashore for hominin survival by acting as independent ecological hotspots and as a staging ground for exploiting aquatic resources. Using *Viewshed* analysis in ArcGIS software, the study demonstrates that the presence of the seashore would have been perceivable from most of the sites in the focal area during conditions similar to or wetter than today, thereby signifying that the coast would have remained an integral part of the landscape exploited by the hominins that left archaeological evidence in the inland plains. The implication is that terrestrial plains situated between mountainous terrains and a shoreline hold great potential for examining hominin adaptive plasticity in different climatic scenarios.

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Kvemo Orozmani, Georgia: A New Lower Paleolithic Archaeological Site in the Southern Caucasus

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The Southern Caucasus represent one of the hubs for the earliest range expansions of hominins during the Early Pleistocene, as evidenced by the extensive archaeological site at Dmanisi, Georgia. Here, we present findings from a new Lower Paleolithic archaeological site in Georgia—Kvemo Orozmani, which is located approximately twenty kilometers west of Dmanisi. Previous dating and analyses of phytoliths and sedimentology correlated the Kvemo Orozmani and nearby Zemo Orozmani sequences to the Dmanisi stratigraphy, indicating roughly contemporaneous localities (Messager et al., 2011). A recent revisit to the Kvemo Orozmani profile revealed Oldowan-like stone artifacts along with faunal remains. Subsequent excavations began in 2020 and have produced more lithic artifacts, faunal remains from numerous carnivores and ungulates, and a hominin tooth. The latter find doubles the number of hominin-bearing Early Pleistocene localities in the Southern Caucasus and offers potential insights into the hominin populations who expanded into this region. Here, we present our initial findings on site formation, archaeology, taphonomy, and paleontology and how this site fits into the greater context of the earliest hominin expansions into Eurasia.

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Aridity Index of the Emergence of *Homo* in East Africa

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The first appearance of the genus *Homo* is restricted to ~2.8 Ma from the Gurumaha fault block of Ledi Geraru, Ethiopia, but contemporaneous sediments of the Hadar Formation and Koobi Fora Formation in the Turkana Basin also offer fossil evidence pertinent to the transition from *Australopithecus* to *Homo*. Changes in climate and aridity affect vegetation structure, which paleoanthropologists consider to be a major factor in human evolution, but few studies explicitly evaluate aridity in the fossil record. This project explicitly investigates aridity at Ledi Geraru between the Gurumaha fault block dated to ~2.8 and the consecutive Lee Adoyta fault block in comparison to contemporaneous sites in the Turkana Basin. Like the Turkana Basin, I predict that Ledi Geraru becomes more arid through time between the Gurumaha and Lee Adoyta fault blocks. This shift towards more arid conditions with expanding grasslands at Ledi Geraru could have influenced early *Homo* populations. Values of aridity were calculated from previously reported isotopic values of fauna from the Gurumaha and Lee Adoyta fault blocks. Both fault blocks plot close to published aridity values of fossil sites within the Turkana Basin of relatively the same age. Gurumaha is reconstructed to have a water deficit (WD) of -225.73 mm/yr (mesic climate) while Lee Adoyta is reconstructed to have a positive WD of 186.5 mm/yr (arid climate). While there is a signal of increasing aridity through time, the small sample sizes of both ES (evaporative sensitive) and EI (evaporative insensitive) taxa (Gurumaha: EI=4, ES=20; Lee Adoyta: EI=4, ES=2) should limit strong conclusions. Future work will increase isotopic sample sizes at Ledi Geraru and include additional samples from the Koobi Fora and Hadar Formations, targeting the time intervals before the first appearance date of *Homo* to further elucidate the influence of aridity on the evolution of the genus *Homo*.

Early Hominin Site Formation Processes and Landscape Use Viewed Through a Chimpanzee Kaleidoscope

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Long-term research of savanna dwelling chimpanzees in southeastern Senegal at Fongoli provides an unduplicated record of their technological activities that includes wood spear manufacture and hunting of small mammals. GPS data of technological behaviors collected from 2005 through 2014 and artifact mapping though 2019 provide a large database from which technologically associated activities can be used to model technologically mediated landscape use and site formation processes. The distribution of this physical evidence across the landscape provides a unique perspective that may shed light on early hominin landscape use and help explicate their site formation processes. The analysis of these patterns assists in identifying possible biases in the early hominin behavioral record and may provide insights into social organization that can be contrasted with early hominin evidence.

Incisor Ecomorphology of Serengeti Muridae: Implications for Paleoecological Reconstruction

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Micromammals (i.e., mammals under ~300 grams) are pervasive, diverse, and occupy small home ranges; they are also commonly preserved in owl pellets, making their remains excellent paleoenvironmental proxies for hominin-bearing sites (Reed, 2007; Monadjem et al., 2015). Currently, taxonomic-based methods (e.g., presence/absence or relative abundance of given species) are typically employed in these types of studies (Comay and Dayan, 2018). Teeth, especially incisors, are some of the most commonly preserved elements, and exhibit morphology sensitive to selection under changing environmental conditions (Paine et al., 2019). Because they are frequently found within pellets *ex situ*, we present a pilot study with the goal of establishing a taxon-free method for inferring paleoenvironments based solely on incisor morphology. The study sample consists of micromammal remains collected from pellets accumulated near two owl roosts, a grassland and woodland locality, respectively, within the Serengeti ecosystem. Using precision calipers and ImageJ, measurements of upper incisors (n=60) which lack a phylogenetic signal were collected, and a principle component analysis (PCA) was run on the data. The resulting PCA space showed separation between points associated with the woodland roost versus grassland roost, driven by the degree of curvature, mesiodistal breadth, and anteroposterior depth of the incisors. We suggest this may be caused by differences in diet or digging behaviors employing the teeth. Ultimately, further work in this area may produce a preliminary method to infer past conditions from unidentified micromammal remains at a site without prior knowledge of the local paleoenvironment.

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Gruta do Escoural: New Data on the Middle Paleolithic Occupation of Southwestern Iberia

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Although Southern Iberia has often been at the center of debates about Neanderthal adaptations, it is accepted that currently available archaeological data from south of the Ebro River are fragile and that the Middle Paleolithic record of these regions is significantly underexplored. In the case of Portugal, this is aggravated by the fact that very few excavations were carried out using modern archaeo-

logical methods. Additionally, sequences with good organic preservation, which can provide comprehensive diachronic approaches to the Middle Paleolithic archaeological and paleoecological records, are particularly rare. The cave of Escoural is one of these few sites. Accidentally discovered in 1963 due to quarry blasts, the site was intermittently excavated until the early 1990s, when the last series of archaeological testing occurred in passages today accessible through multiple entrances located at the southern end of the cave system, revealing a set of occupations attributed to the Middle Paleolithic. These occupations span close to 1.5 meters of the stratigraphy and were dated, with only one U-Th age, to 48,900±5,500 BP (Otte and Silva, 1996). The excavators hypothesized that the Middle Paleolithic artifacts were deposited by colluvial processes, originating from outside the cave. However, limited information was published about the site's lithology, its archaeological assemblages, and its chronology. To achieve a better understanding of the formation and archaeological contents of the Middle Paleolithic deposits of Escoural, we re-investigated the southeastern chambers and the area outside its entrances by expanding previous test pits and collecting new archaeological, faunal, anthracological, and sedimentological materials. This poster presents the outcomes of the analysis of these materials and new OSL and ESR/U-Th dating results for one of the very few cave sites known in southern Portugal with Middle Paleolithic occupations.

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In the Palm of Our…or Their Hand? A Comparative Analysis of *Pan* and Human Grips During Percussive Activities

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Reconstructing the mechanisms underpinning the origins of flaked stone tool technologies is fundamental to understanding diverse aspects of human evolution. Based on observations of non-human primate nut-cracking, it has been proposed that percussive behaviors led to the emergence of stone tool manufacture in the hominin lineage. However, there is a lack of comprehensive cross-taxa studies looking at the diversity of hand grips involved during foraging percussive behaviors and early percussive techniques. Here, we present a comparative analysis of the grips recruited by *Pan* species and humans during percussive activities. Nut-cracking data were obtained from chimpanzee (*Pan troglodytes*) groups at Bossou (Guinea) and the Taï Forest (Côte d'Ivoire), as well as bonobos (*Pan paniscus*) from the Lola ya Bonobo sanctuary (Democratic Republic of the Congo). Comparative data concerning the earliest stone tool technologies were obtained from experiments performed by present-day humans replicating passive hammer, bipolar, and freehand knapping. We recorded grips independently for both the active (holding the hammerstone) and subordinate hand (not holding the hammerstone) to control for variability in hand use. Hand preference or laterality was also measured as the relative frequency of right versus left active hand use between and within individuals. Given the frequency of bimanual grips, and grips using one or two hand(s)/one foot in the data, these variables were also included in the analysis. Results show clear distinctions between the grips recruited to crack nuts and those involved in the manufacture of early stone tools. However, the degree of distinction between grips used during passive hammer knapping and nut-cracking is not as pronounced. Regarding laterality, results suggest that directional asymmetry in bipolar and freehand knapping could have played a relevant role in the development of brain hemispheric specialization during human evolution.

Did Territoriality Between Central-African Foragers Affect Hunter-Gatherer Mobility in Terminal Pleistocene Malawi? A Case Study from Hora-1 Rockshelter

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Ancient DNA (aDNA) evidence shows that one of the oldest cases of human population divergence occurred in central Africa between 80–20 kya. One hypothesis to explain this is that reduced population interactions, and consequently reduced gene flow, led to the formation of genetically distinct central-African foraging groups. These foraging groups likely maintained territorial boundaries in response to changing resource availability, similarly to modern hunter-gatherer groups. We expect that territorial boundaries would have discouraged hunter-gatherers from moving large distances into others' home ranges, which implies that territoriality reduced hunter-gatherer mobility. To test this hypothesis, we reconstruct hunter-gatherer mobility patterns by analyzing a Terminal Pleistocene (17–9.5 k cal BP) quartz flaked stone assemblage from Hora-1 rockshelter in Malawi, which preserves central Africa's oldest aDNA. In

particular, we use cortex (the unmodified red-orange or white film on exterior flake and nodule surfaces) from both archaeological and modern raw material samples within a 1.5km radius of Hora-1 to model lithic raw material transport (a proxy for forager mobility) in and out of Hora-1's lithic assemblage. We found crystalline and opaque milky quartz at 10 of 14 randomly sampled locations within our raw material survey boundary, suggesting a high abundance of locally available raw material. However, we find underrepresented values of cortical surface area in Hora-1's lithic assemblage, implying humans imported decortified raw materials into or transported cortical materials away from the site. Thus, territoriality may have affected raw material transport patterns and hunter-gatherer movements at different scales in Terminal Pleistocene Malawi.

New Results from Early Upper Paleolithic Excavations in Western Romania: Implications for Early Modern Human Expansions into Europe

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The Protoaurignacian is one of the first technological traditions commonly associated with the expansion of modern humans in Europe. Early modern human demographics across the continent are therefore typically inferred using the distribution of (Proto-) Aurignacian assemblages. Western Romania has long been used as a tie-point to connect the well-researched lithic assemblages from the eastern Mediterranean and Western Europe through its early modern human fossils, most notably at the Peștera cu Oase (The Cave with Bones). However, Romania's archeological record remains underexplored thereby hindering our ability to directly connect better understood regions through time and space. Here we present new excavations from the region including the open-air Middle/Upper Paleolithic site of Românești-*Dumbrăviţa* I in southwestern Romania. There, three stratified Paleolithic assemblages were excavated within a 1-m-thick eolian-deposited sequence. Spatial, geochemical, raw material, techno-typological, and use-wear analysis of the site reveal patterns of artifact configuration, resource exploitation, fire history, knapping objectives, and functionality. Taken together, these excavations provide the first well-contextualized archaeological sites in close spatiotemporal proximity to many early, well-preserved human fossils and in East-Central Europe. They also provide insights into the distributions of other regional transitional industries.

The Home as an Archaeologically Visible Space for Cultural Transmission

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The dynamics involved in social learning and the transmission of culture are of increasing interest to paleoanthropologists as we attempt to reconstruct the evolution of human culture. Much work on social learning and cultural transmission understandably focuses on living people from a variety of cultures. Finding ways to translate these findings to the archaeological record is challenging and mostly revolves around the transmission of technologies, such as stone tools, and the ways cultural information and innovations spread across a social network. Archaeologists typically approach issues of cultural transmission through artifacts and generally neglect other aspects of the material record such as the physical locales where these interactions took place. In this presentation, I will explore the ways we can learn about social learning from one commonly used, and archaeologically visible, locale—the home. The home creates an unprecedented opportunity space contingent on the number of individuals present, the duration of their interactions, and how features of the home mediate these interactions. This presentation will address several related questions: What changes do we see in archaeological sites that increase opportunity? Are there clues in the archaeological record that we can use to infer who (i.e., various subsets of the group based on age and gender) was present? And based on what we know from the growing literature regarding social learning, innovation, and cultural transmission, what implications might changes in the home have for our understanding of the evolution of human culture?

The Middle to Upper Paleolithic Fauna from Sefunim Cave (Mt. Carmel, Israel): Preliminary Results

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We present results from the taxonomic and taphonomic analysis of faunal remains from Sefunim Cave spanning the Middle to Upper Paleolithic transition. These derive from Layer VII, associated with the Mousterian; Layer VI, associated with the MP-UP transition, and Layer V, associated with the Levantine Aurignacian. A majority of the identified sample comes from Layer V (NISP=2,259), with

smaller samples from Layers VI (NISP=193) and VII (NISP=450), which have been exposed over a smaller area. While ungulates dominate the assemblage, there is marked variation in taxonomic representation. The three most common ungulate taxa in Layer VII are fallow deer (53.6% of the ungulate assemblage), gazelle (21.9%), and goat (11.4%). In Layer VI, gazelle is most common (43.4%), followed by fallow deer (34.6%), and goat (11%). Layer V shows a further increase in gazelle (56.9%), followed by fallow deer (25.8%), and roe deer (9.2%). Layer V preserves a higher frequency of small game (11.9% of NISP, mostly tortoise) than Layers VI (2.6%) or VII (1.6%). Taphonomic data also show temporal variation. Evidence for carnivore activity is higher in Layers VII and VI (17% and 11% of the analyzed assemblage, respectively) than in Layer V (1.5%). In contrast, Layer V preserves a higher frequency of burned (17%) and cut-marked bone (2.1%) than Layer VI (7.9% burned, 1.6% cut-marked) and Layer VII (2.6% burned, 0.4% cut-marked). The available data suggest that carnivores played a significant role in accumulating the fauna from Layers VII and VI, while Layer V appears primarily human derived. While the complex depositional history hinders our ability to explore variation in human hunting behavior across the MP/UP transition, our results are consistent with those from a recent geoarchaeological study, which proposed that human occupation was more intensive in the Levantine Aurignacian than in earlier phases (Friesem et al. 2022).

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Micromorphology and Site Formation Processes at FxJj20 AB, Northern Kenya: Insights on 1.5 Ma Evidence of Fire

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The use of fire by humans is of tremendous adaptive significance, with argued cognitive and physiological consequences. However, the identification of early fire use in the archaeological record is difficult as certain indicators of fire, such as charcoal and ash, do not preserve well in open-air environments. Indications of combustion associated with human activities have been recovered from 1.5 Ma sediments at FxJj20 AB in the Koobi Fora Formation, northern Kenya. Here, burned sediment, rock, and bone are clustered in a spatial pattern reminiscent of a hearth. A paleomagnetic anomaly spatially associated with the dense cluster of archaeological materials suggests the presence of a contained fire. Preliminary sedimentological analyses suggest that the site did not undergo major post-depositional alteration that significantly affected the distribution of the assemblage and burned materials. However, important questions remain relating to the nature of the fire evidence, in particular, whether the site reflects one or multiple occupation levels, and the extent of minor post-depositional disturbances. Here we use micromorphology to investigate depositional environment and site formation processes at FxJj20 AB at the microscopic scale. Thin sections covering the entire area and stratigraphic profile of the site are analyzed using petrographic microscopy, and Fourier Transform Infrared (FTIR) spectroscopy is used to identify and characterize burned materials. Depositional processes are inferred from soil characteristics, particle size analysis, and paleoenvironmental indicators observable in thin section. Post-depositional alteration processes are investigated considering potential effects of the distribution of burned materials. The results are discussed with attention to the preservation and interpretation of fire evidence from FxJj20 AB. This project has important implications for the study of early hominin fire use, particularly in recognizing archaeological indicators in early open-air sites, and will contribute to a fuller understanding of the developmental trajectory of fire use in the ancient past.

Labial Striations on Human Teeth from the British Upper Paleolithic, Mesolithic, and Neolithic

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Labial striations on human teeth are well recorded throughout the Pleistocene and have been suggested to result from the use of the mouth as a third-hand when working and processing different materials during daily activities, such as cutting meat or working hides with stone tools. Recent work on the Sierra de Atapuerca human remains collections (ranging from the Lower Paleolithic to the Bronze Age) have suggested an apparent decrease through time in the occurrence of scratches on human teeth (Lozano et al., 2017). As labial striations have been less often studied in more recent prehistoric human remains compared to the Lower and Middle Paleolithic fossil record, we tested this hypothesis through the analyses of over 1,100 teeth from 22 sites across England and Wales dating from the Upper Paleolithic, Mesolithic, and Neolithic. To record and quantify the scratches, we used macroscopic and microscopic techniques of analyses, such as focus-variation microscopy combined with SEM imaging. Our results, based on a larger sample of diachronic sites,

show that labial striations are still found on Neolithic teeth, although at a decreased frequency when compared to Upper Paleolithic and Mesolithic human samples. We suggest that this may be partly due to changes in technology and manual handling brought on by the inception of the Neolithic in Britain.

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Considering the Visual Strategies for Communicating Paleolithic Concepts to Museum Audiences at the NMNH Hall of Human Origins

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This presentation considers the success of strategies in communicating Paleolithic concepts to museum audiences at the National Museum of Natural History by looking at data derived from the Hall of Human Origin's 2011 Summative Evaluation and comparing it to current literature on the best methodology for interpreting deep time concepts created since the exhibit's opening. Conversations with exhibit developers and educators at the National Museum of Natural History, American Museum of Natural History, and Iziko Museums of South Africa revealed gaps in exhibit evaluation since the opening of the two largest human origins halls in North America in 2007 and 2010. This overview analysis considers the benefit of future evaluation of visual interpretation tools like phylogenetic trees and artistic depictions of ancient hominins in diorama form considering contemporary literature on deep evolutionary time learning in formal education settings and interpretation of reconstructed hominin depictions in museums. Analysis serves to highlight areas that museum professionals evaluating deep time exhibits might look at more closely during future needed evaluative undertakings.

Human Adaptations to a Semi-Arid Desert During MIS 3: Evidence from Spitzkloof Valley, South Africa

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Africa's Middle Stone Age (MSA) is an important period of human adaptation and innovation, when *Homo sapiens* developed an extraordinary level of behavioral plasticity as Late Quaternary ecosystems fluctuated sharply within and beyond the continent (Kandel et al., 2016; Roberts and Stewart, 2018). Our understanding of how our species became adaptively proficient in challenging habitats, those characterized by low productivity and predictability, demanding solutions that tested human creativity, remains extremely patchy. In this light, the inland Namaqualand semi-desert of northwest South Africa offers an exceptional case study. Our recent work at two adjacent Namaqualand rock shelters, Spitzkloof A and B, suggests that MSA humans were present when the region was arid ~52 ka. The lithics reflect an expedient quartz industry but discoid and Levallois cores and flakes with faceted platforms, reflect an MSA presence (Dewar et al., in press). The lack of unifacial points (post-Howisons Poort) mirrors the assemblage at Varsche River 003 in southern Namaqualand (Steele et al., 2016) and may reflect a less mobile group and/or one belonging to a less expansive social network. However, one ostrich eggshell (OES) bead, numerous preforms, multi-colored OES, and flask mouths, reflect the presence of social and technological innovations. Together, these innovations enhanced the behavioral flexibility necessary to reduce or distribute risks of resource scarcity occurring within any individual group's territory, across a broad population and geographical range. Finally, integrating the data with the subsistence strategy focused on small animals (Dewar and Stewart 2012, 2016) and the presence of grindstones suggests a desert adaptation (cf. Veth et al., 2005) or specialization was already developing within Africa during MIS 3 (Roberts and Stewart, 2018). These datasets enumerate the technological and social innovations that human societies devised to survive and eventually flourish in southern Africa's deserts and beyond.

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Umhlatuzana Rockshelter Through Time: New Research into the MSA-LSA Transition in South Africa

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The site of Umhlatuzana presents an opportunity to study the long-term developments in Late Pleistocene human behavior in South Africa. A stratigraphic sequence covering the last 70,000 years has been documented at the sites, with only minor hiatuses. Still Bay and Howiesons Poort assemblages have been recovered from the site, as well as later Middle Stone Age and Pleistocene Later Stone Age materials. Importantly, rescue excavations conducted in the 1980s reported a transitional phase between the Middle and the Later Stone Age. However, some doubts about the stratigraphic integrity of the site were raised (Kaplan, 1990). We conducted a re-investigation of the sequence and present the results of geoarchaeological analyses clarifying the assemblage integrity of the lithic assemblages. As the timing of a major technological reorganization in the archaeological record—the transition from the Middle Stone Age to the Later Stone Age—remains unclear, we present preliminary results of our application of OSL dating to develop a chronology for the late MSA and the early LSA sediments. The deposits at Umhlatuzana are rich in sand-sized quartz, producing a bright OSL signal. Single aliquot (2mm) quartz ages range from 32 to 58 ka, and show moderate overdispersion (12%–22%), but in some cases are old given associated artifacts. Single grain quartz analyses suggest moderate to substantial overdispersion (36%–75%), although their central ages are largely consistent with the single aliquot results. We examine the results with micromorphological and geochemical data and evaluate the accuracy of these ages, highlighting formation processes as sources of inter-aliquot and inter-grain equivalent dose variability.

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Temporal Trends in Faunal Exploitation from Mousterian Layers at Kobeh Cave (Zagros Mountains, Iran)

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Kobeh Cave is an archaeological cave site located in the Zagros Mountains, Iran, with well-preserved faunal remains associated with Mousterian stone tools. We conducted a taphonomic and zooarchaeological analysis on the vertebrate remains. Previous analysis of the Kobeh Fauna by Marean and Kim (1998) treated all fauna from Mousterian levels as a single assemblage and found a dominance of size 2 bovids, likely *Ovis* or *Capra*, as well as a dominance of high utility limb bones. Here, we expand on this previous research by investigating temporal trends evidenced in the stratified fauna. We defined four stratigraphic units from the site through natural breaks in faunal density. Our findings indicate changes in Neanderthal faunal exploitation through the occupation. Notably, an increase in diet breadth through time is evidenced by the addition of novel prey types and an increase in the exploitation of small (size 1) taxa. The Mousterian deposits at Kobeh have not been successfully dated, and thus correlating this pattern with paleoenvironmental records is not currently possible. However, Paleolithic research in the Kermanshah region around Kobeh Cave has seen a reemergence recently, and potential for the dating of this sequence will allow for these results to be put into a broader context.

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Investigating Aurignacian Technological Variability and Population Connectedness South of the Alps and Along Peninsular Italy

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The Aurignacian is generally acknowledged as the most secure evidence for a successful migration of modern humans into Europe (Djakovic et al., 2022). It is thus not surprising that several studies have looked into its chrono-cultural variability to model the timing of human dispersal across a range of environments as well as mechanisms of cultural transmission. The regions south of the Alps and along peninsula Italy are particularly interesting in this framework due to their marked ecological variability. In Italy, the earliest Aurignacian appears to be contemporaneous with the Uluzzian if evidence from the north is contrasted with the data in the south. The Uluzzian is a debated cultural unit that, according to Benazzi et al. (2011), represents an earlier migration of modern humans. Recently, we reassessed the rich archaeological evidence linked to the Aurignacian to explore cultural dynamics and better frame the response of modern humans to climate change and environmental shifts related to the onset of the Heinrich Event 4 (H4) and the Campanian Ignimbrite (CI) super-eruption. We thoroughly analyzed the lithic assemblages from high-resolution stratified sites (e.g., Bombrini, Castelcivita, Fumane) combining attribute analysis with quantitative data deriving from 3D scanning technology (e.g., Falcucci et al., 2022). Overall, we found that human populations were rather connected in the earliest stages of the Aurignacian with regional differences that were mostly related to the underlying geological settings. This situation changes slightly before the CI when at the site of Castelcivita we detected a sharp technological shift, resulting in a marked lithic miniaturization (*sensu* Pargeter and Shea, 2019). Our results are particularly important to test hypotheses of cultural change related to the combined effect of the CI and H4 (Banks et al., 2013; Giaccio et al., 2017), and they will allow us to critically discuss events of population coalescence and fragmentation.

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Neotaphonomy of a "Common Amenity" on the Serengeti Plain, Tanzania

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Numerous sites in and around Olduvai Gorge in Tanzania have yielded rich fossil assemblages that allow paleoanthropologists a glimpse into the lives and diets of Early Pleistocene hominins. The questions remain then, (1) how did these assemblages form; (2) what factors contributed to which bones are deposited and preserved; and, (3) why are some bones more prevalent than others? Neotaphonomic analyses of modern landscapes can be a useful tool for answering these questions. Local Maasai groups herd livestock and carnivores hunt through and around Olduvai Gorge, leaving faunal remains on the landscape. Olduvai Transect 2 (OT2), a seasonal waterhole surrounded by trees and bushes, was surveyed, and the bones were collected and analyzed. Two sub-assemblages were identified: (1) an abandoned Maasai boma and (2) a carnivore kill-site. The bones from the boma assemblage showed signs of both human- and carnivore-induced damage, while carnivore kill-site showed signs of exclusively carnivore-induced damage. The majority of both assemblages showed only slight weathering (stages 1 and 2). Most of the long bones from the boma assemblage retained most of their original circumferences, whereas the long bones from the carnivore kill-site showed a relatively even distribution of circumference types. The boma assemblage consisted primarily of the upper hind anatomical region, whereas the carnivore kill-site consisted primarily of the lower front anatomical region. These findings may provide insights into how fossil assemblages formed, by emphasizing (1) how hominins and humans modify bones; (2) how carnivores modify bones; and, (3) how modified bones are deposited on the landscape. OT2 may be an insightful example of and model for G. Ll. Isaac's "common amenity" concept for the formation of fossil assemblages.

Zooarchaeological perspective on Neanderthal fire use at Roc de Marsal (France)

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Researchers have recognized evidence of fire in many Neanderthal-associated contexts. Yet, presence of fire alone does not inform on the role of pyrotechnology (including its absence) in social and economic behaviors. To increase our understanding of the types of Neanderthal pyrotechnology, and its variability, the properties of fire proxies relevant to fire-using behaviors must be considered. Because bones are commonly associated with hearths and their structure and chemistry are permanently changed by heating, faunal remains provide an opportunity to document aspects of burning atmosphere and temperature. Here we use several scales of zooarchaeological analysis (piece-plotted and screened fauna, and fauna within micromorphological slides), combustion indices, infrared analyses (FTIR-ATR, mFTIR), and spatial analyses to draw inferences of Neanderthal fire technology in the faunal assemblage of Layer 9 of Roc de Marsal (RDM; SW France). In this assemblage, the majority of the burned zooarchaeological remains are from coarse screens (6–25mm), demonstrating the importance of screened materials for the identification and study of archaeological fire. Patterns in bone burning and tissue composition indicate that bone was burnt either as a fuel or as a site maintenance strategy. We observe bone burnt after butchering throughout several combustion features. In one combustion feature we additionally describe bone which had been previously diagenetically altered and subsequently burned, suggesting accidental burning and/or debris removal. Clusters of temperature intensity that correspond to combustion features dominated by > 700 °C fires are found within the cave; those dominated by lower temperatures, ~500–300 °C, are outside of the cave dripline. Neanderthal fire technology in Layer 9 of RDM is consistent with bone purposefully incorporated into combustion features. Our results demonstrate the utility of a multimethod study of faunal remains as an additional tool to highlight aspects of fire technology relevant to understanding Neanderthal behaviors.

The Shape of Technology to Come: A Cross-Regional Exploration of Evolutionary Relationships Between Biface and Core Technologies at the Lower–Middle Paleolithic Boundary in Eurasia

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This research examines and compares the origins of Levallois technology and its relationship with underlying Lower Paleolithic lithic production systems in the Armenian Highlands and the United Kingdom. Landmark-based geometric morphometrics (GM) is applied to 3D scans of lithic artifacts from sites in the two regions dating to MIS 11–9, a period during which prepared core technology was developed. More traditional quantitative and qualitative analyses are also used to contextualize variation and continuity documented by GM methods. As this research is focused on morphological characteristics, alternative explanations for shape variation, e.g., raw material and reduction intensity, are accounted for. It has been argued that Levallois technology is fundamentally embedded in the underlying Acheulian and is realized through a combination of systems of *façonnage* and debitage. It has been further suggested that Levallois is the outcome of both conceptual evolution and an actualized morphological evolution from handaxes to cores. Finds from Late Acheulian contexts in multiple regions are argued to represent transitional forms, presenting as handaxes with preferential removals and/or simple prepared cores with minimal maintenance of distal and lateral convexities. Two sites in this study, Purfleet (UK) and Nor Geghi-1 (Armenia), contain evidence for transitional forms, along with Acheulian bifaces and Levallois technology. Other sites in both regions are included to provide context and explore long term morphological trends. Results from the quantitative methods used here are interpreted through the lens of cultural evolutionary theory. We argue that the appearance of Levallois prepared core technology is the outcome of different processes in different regions, but still ultimately results from elements embedded in the Acheulian. These results support the growing body of research that argues for multiple origins of Levallois and other prepared core technologies.

Spatial Patterns and Trends of Middle Paleolithic Human Settlement Systems in Southern Iberia

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Currently available data on the Pleistocene human occupation of the territories of Iberia attest to the presence of Middle Paleolithic industries from c. 240 ka until c. 37 ka cal BP. Previous studies focusing on this time frame have suggested that Middle Paleolithic populations were highly mobile and predominately utilized locally available raw materials, with many cave and open-air sites being located near fluvial settings. Other than these observations, no specific studies have focused on exploring the factors influencing human site location choice during that time range. Employing a Geographic Information System (GIS) approach, Ripley's function, and Monte Carlo simulation, this poster provides an initial assessment of spatial patterning and trending in human settlement during the Middle Paleolithic of southern Iberia, Europe.

Fracture Mechanics Show Variability Within Skilled Knappers

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Stone tools are an essential part of human evolutionary studies, as they provide direct evidence of hominin activity and culture over time. However, aspects of the mechanics of ancient stone tool-making remain unclear. Previous studies have proposed platform depth (PD) and exterior platform angle (EPA) as the primary variables influencing flake shape. A greater understanding of fracture mechanics will provide more information about individual behavior, allowing researchers to address questions regarding within-group interactions and identities. This study's goals are twofold—to determine whether expert knappers' flakes are morphologically distinguishable, and to what extent EPA and PD predict individual morphological differences. The experiment used eight skilled knappers who were each asked to repeatedly replicate their own target flake on basalt. We predicted that EPA and PD would influence flake morphology. We also sought to test the null hypothesis that there would be no between-knapper shape differences. To test this, we created 3D models of 68 resulting flakes, virtually measured EPA and PD, and conducted a geometric morphometric analysis using Artifact Geomorph Toolbox 3-D. This analysis captured within-subject mean flake shape and shape differences between the experts. The results show that expert knappers were able to copy their ideal flakes with minimal variability; however, there were statistically significant differences between experts. Each knapper was consciously aiming for their own distinct flake shape and was able to replicate that shape consistently. Between-subject platform variability was minimal, indicating that EPA and PD did not drive flake shape differences. Among expert knappers, with working knowledge of fracture mechanics, the main drivers of individual differences in flake shape shift to other variables, such as force or angle of blow. These findings shed light on the role of individual decision-making, providing further context for the cognitive processes involved during prehistoric tool-making.

A Landscape Perspective on the Archaeology of Fire

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The increasing evidence for the presence of fire at Early and Early-Middle Pleistocene sites, like Wonderwerk Cave, Gesher Benot Ya'kov, and Koobi Fora, leads to questions about how this technology fits into the cultural lifeways of our early ancestors. These sites may be single, isolated instances or evidence of the innovation and spread of a critical technology. To understand how fire factors into the lifeways of Early Pleistocene hominins, we must first understand the 'background' of fire in a region and situate the fire evidence within the broader fire ecology of our human ancestors. The Koobi Fora Fire Project explores how fire-using behavior fits into the broader fire ecology of the eastern Turkana Basin through a landscape approach to understanding both the background levels of fire from natural sources and the potential for anthropogenically influenced fire regimes by combining site-based archaeology with non-archaeological landscape survey. We use multiple proxies, including paleomagnetism, sedimentary micromorphology, Fourier

Transform Infrared (FTIR) spectrometry and microscopy, phytoliths, polycyclic aromatic hydrocarbons (PAHs), spatial analysis, and computer modeling to understand background fire levels on the landscape, and how this may relate to hominin fire use. We seek to detect the anthropogenic influence on the landscape fire regime. Field and lab work has detected signals of combustion in both archaeological and non-archaeological localities. Modeling efforts indicate that even small increases in the prevalence of fire on the landscape may leave geologically visible impacts on ecosystems.

Between Land and Sea: First Results of the Early Occupation of Sicily (EOS) Project

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Sicily is the largest island in the Mediterranean basin, which, like most other Mediterranean islands, appears to have been initially colonized substantially later than mainland Europe, as recently as 16 ka and possibly through a land bridge connecting it to mainland Italy during the last Ice Age (~26–12 ka). The Early Occupation of Sicily (EOS) project was developed to address: (1) The poorly understood nature and age of the earliest Upper Paleolithic (UP, Epigravettian) archaeological sites on Sicily, (2) the human contribution to dramatic ecological changes that characterize the island after ~16 ka, and, (3) the potential for submerged sites that could alter our understanding of the timing and pattern of human expansion across the Mediterranean basin. EOS is focused on the southeastern portion of the island, Siracusa province, which has the least amount of intensive Paleolithic research but was most impacted by Ice Age sea level changes and was home to now extinct taxa such as *Equus hydruntinus*. Through archival and field surveys on land and underwater, we constructed a database of known fauna and artifacts, as well as identified and assessed minimally studied museum collections and sites recorded only in self-published volumes between the1870s–1960s. We relocated eighteen caves and rockshelters, including one partially submerged example containing extinct animal bones and anthropogenic layers and three on land with promising UP remains. Our preliminary analyses of 2,538 flakes and flake fragments from the Pedagaggi excavation suggests a complete reduction sequence geared towards the production of bladelets, endscrapers, and backed points. Lastly, we identified several MIS 5 beaches with fossils of extinct pygmy elephants and *Strombus bubonius* shells. This work is the first step towards answering essential questions on (1) the global pattern, timing, and mode of dispersal of *Homo sapiens*, and (2) human-environment dynamics on a large island (a traditional 'natural laboratory').

Observing Hominin Skeletal Element Representation at Hadar, Ethiopia Using Uberon Ontology

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Skeletal element representation and preservation are essential for understanding the taphonomic history of fossil assemblages. Quantitative estimates of individual and element abundance such as the Number of Identified Specimens (NISP), Minimum Number of Elements (MNE), and the Minimum Number of Individuals (MNI) are the basis for interpretations of site formation processes, carnivore activity, and other taphonomic factors that may bias or influence the preservation of a paleoanthropological assemblage. Estimates of skeletal element representation across large paleontological samples require a standardized, systematic method for encoding what elements are present in a manner that works across a wide range of scenarios, contexts, and use-cases including situations where specimens may be fragmented or have multiple elements as part of a composite (e.g., a mandible with teeth such as A.L. 333w-60). In this paper, we present a new method for systematically encoding fossil element preservation in paleoanthropological and paleontological assemblages using a modified version of the Uberon multispecies anatomy ontology. Ontologies are an important and widely used tool in information science for systematically representing knowledge in a specific domain, in this case, anatomy. Uberon documents all the vertebrate anatomical elements (bones, muscles, organs, etc.) and the relationships between elements, for example, the articulations between bones. Uberon provides a comprehensive atlas of anatomical parts that we extended to include annotations for completeness and the portion present. For our analysis, we constructed a database of published Hadar hominin fossils through the Origins project on the Paleo Core data integration platform. For each of the 310 cataloged fossils, we encoded the Uberon ID for the most specific skeletal element representing the fossil. Out of this dataset, we identified the most common paleoanthropological use-cases while refining a methodology to review them. We addressed seven of these use-cases encompassing element member location, skeletal region, and side distributions.

The Impacts of Wildland Fire and Campfires on Bone for Better Identification and Differentiation Within the Archaeological Record

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Naturally occurring wildland fires and anthropogenic campfires have shaped landscapes and human behavior for millions of years. However, gaps remain in our understanding of how contrasting characteristics of each fire type affect archaeological materials. This limits our ability to interpret indicators of past fire use or occurrence in the archaeological record. Here, we carried out field experiments at the Silas Little Experimental Forest (New Lisbon, New Jersey) to simulate and explore how forest fires versus campfires may have impacted archaeological bone. We used prescribed burns of the forest undergrowth as a proxy for low intensity wildfire effects. These prescribed burns were combined with experimental fires designed to simulate a simple open hearth. The final color of the bones, cracking patterns on the cortical surface, and Fourier Transform Infrared Spectroscopy (FTIR) data were collected in ALMA at Rutgers University-New Brunswick. The data from these experiments highlight that the intensity of fire type, the placement of bone samples, and the meteorological conditions on the day of the experiment play a vital role in the extent of the modification of faunal archaeological remains. In this poster, we summarize the results of these experiments and their implications for identification of fire exploitation in the archaeological record.

The ROCEEH Out of Africa Database (ROAD) and its Importance to Quaternary Scientists

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This poster introduces viewers to a comprehensive database about prehistory created by "The Role of Culture in Early Expansions of Humans (ROCEEH)," a transdisciplinary research project studying human expansions across Africa and Eurasia over the last three million to 20,000 years. The "ROCEEH Out of Africa Database" (ROAD) is a dynamic tool that integrates archaeological, paleoanthropological, paleontological, paleobotanical, and paleogeographical data. So far, the team has incorporated over 2,300 Plio-Pleistocene localities containing more than 22,000 assemblages into ROAD. These come from over 4,800 publications written mainly in English, French, German, Italian, Spanish, Portuguese, Russian, and Chinese. Our team developed ROAD and its web-based applications to support its own research into the origins of culture and the expansions of humans across the Old World. The entry of data relies on the development of a standardized vocabulary, which the team applies within the project and its publications. The database allows the standardized retrieval of information using queries and enables further quantitative analyses. Some useful functions of ROAD include the generation of Site Summary PDFs for each locality; interactive profiles showing the cultural attribution and assemblages associated with each geological layer; the ability to conduct time series analyses; a map interface to visualize and explore data; the ability to link external databases and maps, and much more. Here we present an overview of the database structure and describe some of the functionalities of ROAD. These help Quaternary scientists access and analyze datasets from disparate regions and fields which span from the social sciences into the natural sciences. We believe ROAD is an indispensable tool for researchers of archaeology and its related disciplines and encourage you to visit ROAD (https://www.roceeh.uni-tuebingen.de/roadweb/) to discover what it has to offer. Should you wish to explore further, we provide expanded access to anyone interested.

Did Hominins Control Hammer Strike Angles While Knapping?

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Studying the knowledge and skills that early knappers possessed to make the stone artifacts we discover today is essential for understanding the origin and evolution of hominin tool use. While we already have a good understanding of hominins' knapping strategies from a wide range of aspects such as raw material selection, core and platform management, and hammer choice (Roche et al., 1999; Delagnes and Roche, 2005; Braun et al., 2009), there is still much to learn about how hominins manipulated their knapping gestures. In this study, we aim to connect an archaeologically invisible knapping variable—the hammer strike angle—with measurable lithic attributes. We developed a new method to measure the hammer strike angle on flakes based on the basic principles of conchoidal fracture. Drawing on information from relevant fracture mechanics literature, we found that changes in the hammer strike angle affect the orientation of the Hertzian cone—a key component of conchoidal fracture. Using an experimental approach, we demonstrate that a feature of the flake's bulb of percussion, which we term the bulb angle, can reflect changes in the hammer strike angle and can be used as a reliable proxy for it (Li et al., 2022). We use the bulb angle method to analyze a series of Early Pleistocene assemblages (1.95 Ma~1.4 Ma) to study how hominins managed their hammer strike angles. We find evidence of increased control over the hammer strike angle through time, suggesting that the early hominins might begin to gain a more comprehensive understanding of the role of hammer strike angle in flake production towards the Oldowan-Acheulean transition. Our study highlights the importance of linking the basic flaking mechanics to knapping actions to study the technical decisions made by hominins and the evolution of their technical understanding over time.

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Differentiating Core Types Using Core Scar Orientation Analysis

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The patterning of core scar negatives is one of the most important sources of information for reconstructing past reduction techniques and flaking trajectories. Lithic researchers typically characterize core scar arrangements using descriptive categories (e.g., unidirectional, bidirectional, bifacial, etc.). However, the application of these qualitative units often faces issues of subjectivity, due in large to a lack of formal, objective definitions. Moreover, the use of discrete classification carries the risk of masking important complexities in the continuous variation of core scar patterning. To address this issue, we explore the usefulness of flake scar orientation as a quantitative means to summarize variation among core scar arrangements. The workflow involves delineating flake scars as 3D vectors and computing the orientation of the vectors relative to a best-fit plane of the core volume. Using both standardized and flintknapped core models of different geometries, our results show that major core types can be effectively differentiated by the scar orientation eigenvalue ratios. We further apply this method to examine an archaeological sample of 'multiplatform' cores, showing that these artifacts exhibit a range of patterns in scar arrangement and volume exploitation that are otherwise difficult to detect using conventional classifications. This proof-of-concept study demonstrates core scar orientation analysis as a promising approach for quantifying variation in lithic reduction technology.

Shell Beads of the Middle Paleolithic: Misliya and Qafzeh as Case Studies

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Beads made of mollusc shells form an integral part of modern humans' material culture. Middle Paleolithic sites in Africa and the Levant demonstrate that non-utilitarian shells, in particular complete *Glycymeris* valves, were collected from at least 160 ka. Two sites, Misliya Cave in Israel and Pinnacle Point in South Africa, yielded such shells. The earliest known perforated gastropod shell beads are from around 140 ka in North Africa. At Qafzeh Cave, Israel, naturally perforated *Glycymeris* shells were shown, using use-wear analysis, to have been suspended on string. We conclude that between 160 ka BP and 140 ka BP there was a shift from collecting complete valves to perforated shells, which reflects both the desire and the technological ability to suspend shell beads on string to be displayed on the human body.

Pliocene Paleolandscapes in the Koobi Fora Formation, Northern Kenya

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A critical change in hominin behavior and evolution is the appearance of stone tool technology. Recent investigations in the Turkana and Afar basins suggest this technology may extend back to sediments in excess of 3 Ma. Thus far, Oldowan localities are only known from the Afar basin (Ethiopia) by 2.65 Ma. Some eastern African localities indicate that there are ecological changes that occur around the time of this behavioral transition. However, sediments of this age are relatively rare throughout eastern Africa. Here we explore a sedimentary sequence that ranges in age from 3.4 to 2.0 Ma in the Koobi Fora Formation to explore changes in paleogeography, geomorphology, and paleoecology at this critical time frame. We reconstructed the paleolandscape in Area 40, at the northern extent of the Koobi Fora Formation. Magnetic susceptibility readings, combined with paleomagnetism sampling, refine the chronology of this sequence to an unprecedented resolution. Our results reveal a cyclical alternation of rivers and dry plains between 2.8 and 2.2 Ma. As this cyclicity fades near 2.2. Ma, the region transitions to a large lake phase, likely resulting from climate change, tectonic reorganization of the basin, or a combination of both. Our results indicate that the landscape changes are associated with dramatic climate and environmental shifts that parallel the record described elsewhere in eastern Africa. We outline how the novel use of combined paleomagnetic and paleoecological data can be used to explore variation in ecosystems at critical timeframes in the paleoanthropological record.

Why Hunt Cooperatively? Reevaluating the Evolutionary Significance of Communal Hunting

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What animals do we expect hunter-gatherers to harvest and how should they acquire them? These questions—framed in terms of environmental context and prey characteristics, size of the hunting group, its methods and technologies, and the benefits and costs of the resources acquired—have evolutionary implications, particularly for the development of prosocial behavior and cooperation. While contemporary ethnographic works have documented encounter hunting, we know much less about acquisition of prey *en masse* through collective efforts. Because communal hunting methods likely were common in the past, exploring them from a cost-benefit perspective may help us to understand when and why they became a significant part of the human hunting repertoire. Here we analyze a global sample of communal drive hunts (CDHs) targeting a wide range of species. Among our key findings: i) in specific contexts, CDHs achieve higher return rates and/or lower odds of failure than encounter hunting; ii) CDHs increase the rate of success for large ungulates that cluster and have long flight initiation distances and high predator escape velocities; iii) CDHs engage the benefits and problems of collaborative, sometimes community-wide behavior at scales from the small and opportunistic to the large and institutionalized; iv) although formerly commonplace, CDHs largely had disappeared by the late 19th century due to colonial impacts on Indigenous societies and the adoption of repeating rifles and dogs, favoring encounter hunting; v) cooperative hunting by great apes and indirect archaeological evidence suggest that collaborative hunting is potentially a practice of considerable antiquity, thus important in the evolution of hominin prosocial behavior; and, vi) while HBE has robust models for analysis of social distribution of subsistence resources, development of complementary models for social production is just beginning.

Revisiting the Earliest Evidence for Silcrete Heat Treatment Technology at Pinnacle Point 13B, South Africa Using a New Multi-Proxy Approach

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Heat-treated silcrete was a key technological feature in the toolkit of early humans living on the south coast of South Africa. Some of the earliest evidence for this transformative pyrotechnology is found at Pinnacle Point 13B (PP13B) around 162,000 years ago (ka) (Brown et al., 2009). Researchers have argued that heat treatment technology can help shed light on debates regarding the origins of complex cognition and special forms of social learning exhibited by modern humans. Recently, the evidence for heat treatment at PP13B has come under question (Schmidt et al., 2020). Here, we revisit the silcrete assemblage at PP13B using a multi-proxy approach that combines qualitative and quantitative heat treatment methods. The PP13B silcrete assemblage comprises approximately 125 silcrete artifacts across multiple stratigraphic aggregates. We analyzed each silcrete artifact for qualitative heat treatment attributes such as pre-heat treatment area, heat-induced non-conchoidal fractures, and tempering residue. Additionally, we applied the 3D surface roughness method (Murray et al., 2020) and the quantitative color method (Murray et al., 2022). These two quantitative methods were developed using an empirical experimental reference dataset. Our preliminary results suggest that heat treatment occurred at PP13B but was used in low frequencies until much later in time when there is an explosion of silcrete use at the nearby rock shelter site of Pinnacle Point 5-6 about 72 ka. This suggests that heat treatment may have originated as early as 162 ka and this knowledge was retained over a long span of time even when being used infrequently. Our results have implications for the timing and evolution of lithic heat treatment technology and its relationship to the emergence of modern human behavior.

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Going the Distance: Ungulate Migratory Dynamics and Behavioral Responses to Shifting Late Pleistocene Environments in Southern Africa's Maloti-Drakensberg Mountains

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Prehistoric hunter-gatherers in southern Africa's highest mountain system—the Maloti-Drakensberg—faced unique choices about mobility and subsistence strategies relative to other human populations on the subcontinent. This was never truer than during glacial periods, when mean annual temperatures in mountain zones dropped, primary productivity plummeted, snow coverage increased, and vegetation belts descended in altitude. Evidence reveals that hunter-gatherers in the Maloti-Drakensberg addressed these ecological predicaments through technological, subsistence, and social networking changes, but questions remain about the full extent of the impacts of shifting vegetation boundaries on the faunal communities exploited by afromontane foragers. Here we isotopically analyze faunal enamel from archaeological assemblages spanning the Late Pleistocene (30.6–12.5 ka) at Sehonghong Rockshelter in highland Lesotho. Comparisons of carbon and oxygen isotope values between the colder Last Glacial Maximum and Antarctic Cold Reversal with warmer interstadial periods shed light on potential changes in ungulate diet in response to regional vegetation changes associated with glacial periods. Our findings are consistent with past evidence of the persistence of some bush and shrub communities during glacial periods, and with past hypotheses that cold periods would have favored more flexible mixed browsing/grazing behavior rather than obligate browsing. How grazing behavior tracked shifting vegetation boundaries remains difficult to parse in bulk samples. These data suggest that our previous understanding of faunal abundances and behaviors during glacial and stadial phases of human occupation at the site are too simple and highlight the need for more comprehensive data about how seasonality patterns mediate animal migrations and resource availabilities during these potentially challenging times for hunter-gatherers living in the Maloti-Drakensberg.

How Surprising are Contents of Lithic Assemblages? The Information Entropy of the Stoneworking Modes A-I Framework

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How surprising are the contents of lithic assemblages? If an archeologist excavated an archeological site somewhere in Eurasia and uncovered evidence of Levallois core technology, how surprising would it be? The surprise in the content of a new assemblage is a function of what is underground as well as our prior knowledge about prehistory. How improved is our understanding of the past when another site is excavated? The answer is a measure of the information contained in lithic assemblages. We present a primer on information theory, which provides tools necessary to conceptualize, measure, and analyze information. We then apply the theory by measuring the information contained in a large comparative dataset describing the presence or absence of stoneworking modes across Late Pleistocene assemblages. We find that stoneworking modes tend to have little conditional dependency with one another, suggesting that lithic assemblages do have relatively high information content. This method also highlights unusually surprising assemblages that may represent cases of mixing with later phases. Quantifying the information content of lithic assemblages measured using similar standardized methods helps us to better understand what kinds of questions data from Pleistocene assemblages are suited to answer.

EARLYDECISIONS Project - Deciphering Early Hominin Decision-Making Behavior: High-Resolution Analysis of Percussive Stone Tools from the African Acheulian

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Technological choices were key factors in the emergence of early human behavioral dynamics. Studying when and why hominins intentionally modified and used different raw materials and tools is crucial to reconstruct the character of their adaptive mechanisms. Percussive technologies and raw material selection are the first direct evidence for early human decision-making processes. While we can identify such variability in the early archaeological record, several questions remain unanswered, such as: w*hy were specific raw materials chosen over others? What were they used for?* The EARLYDECISIONS project is devoted to exploring these and similar questions using groundbreaking analyses combined with reproducible experimental workflows. The early Acheulian site-complex of Melka Wakena (MW) in the Ethiopian highlands is the core study case and the project's starting point. While numerous percussive items made of pyroclastic rocks were identified at MW, the correlations between raw material properties and tool functions are unknown. This project focuses on percussive artifacts used by early hominins, combining microscopic and other analytical approaches including the application of 3D technology to characterize raw materials' mechanical properties, and experimentally links these with diagnostic use marks using ground-breaking experimentation. By exploring synchronic and diachronic variability of lithic selection processes and tool functions at the various localities within the MW complex, this project elucidates aspects of land-use and ecological dynamics of early Pleistocene hominin populations in eastern Africa, establishing a base for comparative studies as well with other key regions. This approach helps to understand major triggers that led early humans to develop key behavioral strategies enabling. This poster presentation focuses on the major research questions and the methodological workflow designed to begin addressing them.

Early LGM Environments Accelerated Uptake of Bladelet Technology at Melikane Rockshelter, Lesotho

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Melikane, a large sandstone rockshelter in the Maloti-Drakensberg Mountains of highland Lesotho, preserves an 80,000-year-old archaeological sequence including two layers dated to the onset of the Last Glacial Maximum (LGM), ~24 kcal BP. LGM-aged occupations are rare in southern Africa, but genetic evidence points to the period as one of demographic growth and dynamism. Although Melikane lacks organic remains, it preserves an abundance of lithic material. An analysis of >17,000 lithic artifacts combining attribute analysis and morphometric approaches reveals subtle, gradual change from a microlithic industry characterized by heavy bipolar reduction (layer 5) to a Later Stone Age (LSA) Early Robberg industry (layer 4) with more formalized freehand bladelet production. Paleoenvironmental proxies also indicate that this Early Robberg assemblage is associated with increasing aridification and the coldest

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conditions ever sustained by foragers at Melikane. We argue that the accelerated adoption and standardization of bladelet technology in layer 4 was the consequence of modifying and expanding existing technologies to function in a high-stakes LGM environment. Intra-site continuities and gradual changes in flaking systems, typology, and metrics support a primarily *in situ* development of the Robberg at Melikane rather than its arrival via population replacement or migration. However, shared flaking systems with Early Robberg sites hundreds of kilometers away, including Nelsons Bay Cave and Boomplaas, imply at least some technological influence from outside of the Lesotho highlands. We suggest that at Melikane, intrasite continuity alongside the introduction of new, shared technological forms indicates an ongoing cycle of connectivity and isolation in the southern African mountains during the LGM, possibly linked to seasonality of site use or the changing severity of environmental conditions.

Expanded Geographic Distribution and Dietary Strategies of the Earliest Oldowan Hominins and *Paranthropus:* Evidence from Nyayanga, Kenya

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The earliest Oldowan sites at ca. 2.6 million years ago (Ma) have been limited to the Afar Triangle of Ethiopia. Artifacts at Nyayanga, Kenya, dated to 3.032–2.581 Ma by U-Th)/He dating of apatite crystals, magnetostratigraphy, and biostratigraphy, expand the distribution of the earliest Oldowan by more than 1300km. Stone tools are found in low density occurrences, including two hippopotamid butchery sites, in a C_4 grazer-dominated mosaic ecosystem near a stream. The high *in situ* frequencies of animals preferring near-water habitats (e.g., hippopotamids, turtles, crocodilians, cane rats) reflect the riparian depositional context. The diversity of primates is suggestive of woodland near the water course. Oldowan tools (n=330) show flaking proficiency comparable to other Oldowan assemblages but exhibit more evidence of percussive activity. Use-wear on artifacts, and bones damaged by stone tools, indicate that hominins were processing both plant and animal tissue. Two *Paranthropus* sp. molars, including one spatially associated with Oldowan tools, are the first found in southwestern Kenya, among the oldest and largest known, and demonstrate a diet rich in C4 foods early in the evolutionary history of the genus. Nyayanga archaeological sites show that the earliest Oldowan was more widespread than previously recognized, was used to process a wide array of animal and plant foods, including megafauna, and overlapped spatially with early *Paranthropus*.

Oxygen Isotopes and Paleoaridity in Relation to the Paleogeography of the Pliocene Turkana Basin, Kenya

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Stable oxygen isotopes from herbivore enamel are proxies for drinking behavior and aridity. These isotopic studies have become an integral part of reconstructing hominin paleoenvironments. However, most studies have focused on temporal change in hominin environments rather than regional variation. Temporal trends in isotopic studies are important for reconstructing climatic variation in hominin evolution. However, this focus limits our understanding of the relationship between macroecological processes and paleogeography in the fossil record. Here, we examine regional scale variation and apply Blumenthal and colleague's revised Aridity Index to the paleogeography of the Pliocene Koobi Fora Formation, Kenya. The Aridity Index is based on physiological differences that affect oxygen isotopes in evaporation insensitive (e.g., Elephantidae) and evaporation sensitive (e.g., Tragelaphini) mammals. Variation in differences between these data are used to reconstruct water deficit from oxygen isotopes in mammal enamel. Our study analyzes sta-

ble oxygen enamel isotopes from Pliocene (3.4–3.6 Ma) East Turkana herbivores (n=>140) to reconstruct paleoaridity (i.e., water deficit). Specifically, fossil mammal enamel was collected from contemporaneous sediments in Area 129, which is closer to the basin margin, and Area 117, which is closer to the axis of the basin. Furthermore, we present a compiled dataset of oxygen enamel isotopes (n=>600) for the Plio-Pleistocene of the Turkana Basin by combining published and unpublished data from this study. Our study thus examines how paleoaridity varies in relation to the axis of the Turkana basin and how this variation compares to changes through time. Preliminary isotope analyses suggest water deficit may increase as distance from the basin axis increases. This paleolandscape analysis suggests that regional variation in aridity is an important consideration when interpreting hominin environmental variation through time.

In with the Old, In with the New: Integrating Archival and Modern Digital Methods at Kisese II, Tanzania

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Many archaeological projects are based at sites first excavated decades ago. To understand these sites, archaeologists must ensure that their own excavations employ practices that collect as much contextual data as feasible, while digging into archives to understand how modern data can be integrated with the work of earlier researchers. Due to changes in data collection standards and a loss of physical documents over time, archival records can be sparse and difficult to interpret. In this talk, we discuss how we use new digital methods to better understand and contextualize both historic and ongoing excavations at the site of Kisese II, one of a series of painted rock shelters and localities in the Kondoa region of Tanzania, collectively recognized by UNESCO as a World Heritage Centre. It has been excavated by Louis and Mary Leakey in 1951, by Ray Inskeep in 1956, and by the Kondoa Deep History Partnership since 2017. The historic excavations reached a depth of ~6m from the 1950's ground surface and show evidence of Late Pleistocene and Holocene activity including abundant lithic artifacts, beads, ochre, fauna, ceramics, and burials. We demonstrate our integrative workflow, which employs a suite of digital tools including photogrammetry, DStretch, and 3D modeling software (Blender), along with point-provenienced archaeological data and newly discovered historic photographs and documents. Examples of this integrative work include measuring historic and modern-day erosion (Patania et al., 2022), planning the construction of a shelter to protect the rock art, developing a virtual reality site visit, and devising alternative point-provenience methodology to work around a malfunctioning total station. While every project is unique and our own practice is still evolving, our case study provides examples of the ways new tools can be used as an augmentation to, and in concert with, established archaeological methods at Kisese II and elsewhere.

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A Magnetic Investigation of Paleofire on Three Early Pleistocene Sites

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The oldest evidence for hominin-controlled combustion comes from the early Pleistocene site, FxJj20 AB (~1.5 Ma) of the Okote Member, located in the Koobi Fora Formation of the Turkana Basin, in northern Kenya. Evidence of fire, at this site, has been detected through a multi-proxy approach. Magnetic susceptibility can detect magnetic anomalies that may be reflective of previous instances of burning. Magnetic susceptibility allows insight into the spatial variation of magnetic properties of rocks and insight into the spatial characterization of magnetic susceptibility anomalies. Here we compared three Early Pleistocene archaeological sites from the Koobi Fora Formation, FxJj20 AB (1.5 Ma), FxJj1(1.87 Ma), and FxJj50 (1.5 Ma) across time and space to investigate the presence of ancient combustion in association with archaeological horizons. Both FxJj1 and FxJj50 are excavation surfaces that have been exposed over the last several decades. We collected magnetic susceptibility measures across a 30cm grid at the same stratigraphic level of the previous excavation surface. Geospatial techniques were used to identify spatial patterning across the excavation surface. Evidence of ancient combustion features is present in the localities where sediments were recently exposed. However, on those localities where excavation surfaces have been exposed for decades, the magnetic signatures are modified by post-depositional processes. This investigation illustrates the potential of magnetic susceptibility to investigate ancient combustion features by identifying magnetic anomalies in ancient

sediments. This technique will continue to be implemented at FxJj20 AB and applied to newly excavated archeological sites to identify magnetic anomalies indicative of past burning events.

A New Method for the Quantification of Microcharcoal in the Archaeological Record

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The quantification and study of microcharcoal is an important tool for reconstructing prehistoric fire regimes and studying anthropogenic fire exploitation. Traditionally, the quantification of microcharcoal is executed by counting individual particles within a sample that has been processed for pollen or phytolith analysis. The chemicals and methods used in the extraction protocols combined with an array of taphonomic processes tend to fracture charcoal pieces, artificially inflating their particle count. This process of fragmentation can skew the results of quantification, causing incorrect interpretations. Our research has found that the quantification of microcharcoal particles using the sum of the surface area is a more accurate method for analyzing and interpreting the presence of microcharcoal in the archaeological record. Here, we report on a new method of microcharcoal quantification using the sum of particle surface area and apply our results to the analysis of microcharcoal assemblages from modern-day experimental fires at the Silas Little Experimental Forest (New Lisbon, New Jersey), and archaeological samples from Abrigo de la Boja (Mula, Murcia, Spain).

Statistical Methods for Species Delimitation in Middle Pleistocene *Homo*

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The Middle Pleistocene (MP) is a frequently used but poorly defined period of interest in the hominin fossil record. Generally, the term is understood to be bookended by classic *Homo erectus* fossils and the emergence of Neandertal morphologies. The fossils that occur in both the temporal (~700–200 ka) and geographic (northern Africa, southwest Asia, eastern Europe) interim are poorly taxonomically diagnosed, and their place among hominin phylogeny is unclear. Both *H. erectus* and *H. neanderthalensis* are well represented in the fossil record, and their species descriptions, while not entirely uncontroversial, have a much stronger degree of consensus than other MP *Homo* taxa. The many species (*H. heidelbergensis, H. rhodesiensis, H. antecessor, H. cepranensis, H. longi, H. bodoensis,* etc.) that have been proposed to have existed between *H. erectus* and Neandertals are contentious, and their delimitations and phylogenetic relationships are frequently disputed. I propose an alternative to the agglomerative approach of delimiting species and assigning fossils to pre-existing hypodigms. Using morphological data from MP *Homo* fossils, I suggest a reassessment of species hypodigms based on the results of clustering analyses, irrespective of historical species diagnoses. This exploratory work contributes toward the long-term goal of establishing a statistical basis for species delimitation in order to improve on previous qualitative assessments of species hypodigms.

New Excavations of the Rockshelter of Ain Difla in Jordan and the Regional Initial Upper Paleolithic

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Situated in the middle of the Wadi al-Hasa in Jordan, the rockshelter of Ain Difla has been known as a rare place east of the Dead Sea that has stratified deposits of the later Middle and Late Pleistocene. The rockshelter was excavated by G. Clark in the period from 1984 until 1993 (Clark et al., 1997). By combining ESR and TL chronology, Clark and his colleagues placed the deposits below level 5 between

160 and 90 ka and classified the sequence as the "late Tabun-D" Middle Paleolithic. At the same time, comparative studies (Mustafa and Clark, 2007; Rose and Marks, 2014) showed that the non-dated lithic record from the upper deposits (levels 5–1) is technologically related to the Initial Upper Paleolithic (IUP) of the lower levels at Boker Tachtit in the Negev, currently the earliest known IUP record (Boaretto et al., 2021). In 2012, we re-opened Ain Difla, primarily to check its preservation and estimate the potential for dating by OSL. In 2019, we excavated these upper deposits and observed two formation horizons. Based on technological features such as the predominance of bidirectional flaking, hard-hammer production of pointed blades with facetted platforms, the use of cresting surface preparations, etc., the two lithic aggregates from these two horizons are technologically identical and they confirm their technological relation to the IUP of the lower levels at Boker Tachtit. The faunal material is scarce and not well preserved. The OSL ages of the younger horizon place it at around 50 ka. At the moment, the analysis of OSL samples from the horizon below is still in progress. Here we present these renewed excavations and the results within the context of the regional emergence of technological diversity known as the "IUP."

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Landscape Evolution and Early Pleistocene Hominin Expansions in the Armenian Highlands

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Understanding the chronology and environmental context of the earliest hominin expansions into Eurasia is of considerable interest in paleoanthropology. Several Early Pleistocene archaeological sites in the Armenian Highlands and wider Caucasus region have demonstrated the importance of the region for understanding the morphology of early Eurasian *Homo* and their technological capabilities. However, little is known about the broader landscapes and climatic framework in which these sites lie. The Debed Valley (located in the Lori Depression, northern Armenia) offers a unique opportunity to investigate the linkages between landscape, climate, and hominin demography. This is due to the close association of readily datable volcanic products and sedimentary sequences which have yielded archaeological remains and paleoenvironmental proxy material. Here we present findings from ongoing geoarchaeological investigations in the Debed valley. We will first present a chronological model of landscape evolution during the Early Pleistocene based on a combined geological and chronometric study ($^{40}Ar/^{39}Ar$ and paleomagnetism) of deposits exposed in the valley. We will discuss this model in the context of newly discovered Paleolithic sites in the valley. We will then go on to describe preliminary results from Dzoragyugh paleolake, a 30m thick fluvial-lacustrine sequence dated to 2.1–1.6 Ma. These results will be summarized in the context of the Early Pleistocene archaeological record of the Armenian Highlands and wider Caucasus region, highlighting the importance for understanding the nature and environments of early hominin expansions into Eurasia.

The Development of Paleoanthropology as an Interdisciplinary Science: A Visualization Using Science Mapping

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Paleoanthropology is a prime example of a discipline located at the intersection of a number of other scientific disciplines. These include evolutionary biology, anthropology, archaeology, and environmental science. With the dramatic growth in numbers of science personnel and the outputs of their research, it has now become increasingly difficult to understand and communicate the nature of this discipline using the traditional techniques of reading and narrative text. A search on the Web of Science, for example, currently identifies more than 44,000 documents published in this area since 1960. This poster will present a visual history of the growth and development of the discipline of paleoanthropology from 1960 to 2022 using science maps created using bibliometric data from the full set of available documents extracted from the Web of Science. Bibliometric data includes titles and abstracts for individual documents, authors and their affiliations, dates of publication and source titles, funding information, and, most importantly, the lists of cited reference data creating a set of networked links from any one study back to its influences. Science mapping software can identify the relationships created between authors and institutions through co-authorship, or the links between source titles, and between authors through patterns of citation. It can chart the growth in language through keywords or extract key terms through natural-language processing. For this poster, specific maps will highlight the growth of networks of scholars, the interactions between institutions, the pattern of citations of sources that inform paleoanthropological research, and finally the development of a vocabulary with which to communicates its research findings. The poster will also provide an opportunity for viewers to examine and interact with online versions of these maps using a smart phone or tablet and a QR code.

Addressing Techno-Temporal Periods in Mozambican Archaeology Through Database and Archival Research

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In southeastern Africa, the cultural period known globally as the Iron Age encompasses a diverse set of archaeological and historical events. When applied to the archaeology of Mozambique, this "Iron Age" refers as much to the pre- and post-colonial periods of the nation's history, the introduction and origins of agriculture, the period of sultanate rise, and Indian Ocean exploration, as it does to the settlement of affluent coastal foragers. This wealth of cultural diversity has one thing in common, while they take place contemporaneously with the globally recognized "Iron Age" period, there is a notable lack of overarching iron use across these groups and events. In lieu of referring to this time as the "Iron Age," researchers in Mozambique have begun promoting the use of *Chifumbaze* as an alternative all-encompassing cultural-time period. Additionally, usage of LSA technologies commonly persists through 1000 cal BP making the distinction of an Iron Age, Chifumbaze phase, or LSA impossible on anything but a restrictive local scale. Similarly, certain northern sites display interbedding of LSA-MSA materials. This trend of archaeological material acting beyond the confines of traditional techno-temporal periods persists from the later MSA to the present in Mozambique. By compiling a working database, we present a preliminary timeline of archaeological sites in Mozambique. All sites included have associated radiocarbon dates, OSL dates, or have been dated using ceramic seriation, and discrepancies in nomenclature are addressed. The present results illustrate the consistent interplay between traditionally restrictive techno-temporal periods in Mozambique's archaeology.

Problems with *Paranthropus*

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Carbon isotopic analysis has challenged our ideas about hominin diets for nearly 30 years. The first study in 1994 revealed that *Paranthropus robustus* from South Africa consumed principally C_3 foods (e.g., tree fruits and leaves) but also about 25% C_4/CAM resources (e.g., tropical grasses and sedges). This result was largely consistent with morphological and dental microwear evidence suggesting *P. robustus* had a diet that included hard objects like nuts and seeds. Decades later, however, *P. boisei* from eastern Africa was shown to have eaten nearly 80% C_4/CAM plants like the contemporaneous grass-eating primate *Theropithecus*. Moreover, dental microwear revealed no evidence of hard object consumption in *P. boisei*, suggesting a diet of tough foods such as grass or sedge leaf and stem. So *Paranthropus* presents us with two central problems: 1) Why do dietary proxies suggest different diets for the two robust australopiths despite their morphological congruity? and, 2) How could *P. boisei* have consumed tough foods with teeth that seem unsuited to the task? Here, I address these questions with a particular focus on insights that can be gleaned from mammals outside the haplorrhine primates. Possible digestive strategies for *P. boisei* are also discussed in light of its morphology, dietary proxy data, food mechanical properties, and comparative data on mammalian digestive kinetics.

The Middle Paleolithic of North Macedonia: The Site of Uzun Mera and Beyond

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The country of North Macedonia is located in the center of the Balkan peninsula, the likely entry point for hominins migrating between Europe and Southwest Asia throughout the Pleistocene. The Middle Paleolithic occupation of nearby countries like Croatia, Bulgaria, and Greece is well-documented, but the Neanderthals of North Macedonia are less known. The exploration of the Paleolithic in the country began in 1999 and has focused primarily on one site: Golema Pesht. In 2017, the new open-air, Middle Paleolithic stone tool site of Uzun Mera was identified across agricultural fields in the center-east of the country. Because of plowing, the majority of the 200+ artifacts have been surface finds. Excavation trenches have been placed across different fields every year since. All steps of the stone tool production process are present and are primarily from different forms of jasper. Levallois typology is present without microlithicization and a few denticulates suggest a late MIS 7 to early MIS 5 date based on patterns seen in Serbia and elsewhere in the Balkans (Mihailović, 2014). OSL dates are pending. Two artifacts appear to be Upper Paleolithic, suggesting this site was visited for millennia by hominins seeking out the raw materials present. Uzun Mera is also now host to a field school with the Balkan Heritage Foundation, and the first field season was held in Summer 2022. Since 2019, we have been surveying for additional Paleolithic sites in the country, primarily cave/rock shelter sites. Test excavations at Toplata cave were sterile below the Copper Age, but work at Peshka cave in Summer 2022 uncovered dense Medieval through Copper age layers with obvious potential for much deeper stratigraphy and remains

from earlier prehistory. We hope to identify Paleolithic layers at Peshka cave during a field season 2023.

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Getting to 'Big Data' in the Paleolithic, or, When and How Can We Reliably Aggregate Lithic Information? First Results from the Comparative Analysis of Middle Stone Age Artifacts in Africa (CoMSAfrica) Research Project

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Stone tools and their associated manufacturing debris are among the most abundant, widespread, and durable Paleolithic artifacts, used for over 2.5 million years. In theory, these factors make them well-suited to testing large-scale hypotheses about behavioral shifts, social choice, and adaptation in human evolution. In practice, assembling large datasets from lithic artifacts to assess change across long expanses of time or among multiple regions can be difficult because lithic analysts differ widely in their theoretical approaches, the kinds of data they collect, and the specific ways in which they record attributes and take measurements. As a result, the extent to which observed differences among lithic data relate to prehistoric behavioral variability, rather than to differences among archaeologists today, remains unknown, especially when data synthesized from multiple researchers are combined. The CoMSAfrica project was initiated in 2018 to address issues of data comparability within a specific part of the world (Africa), kind of site (those attributed to the Middle Stone Age) and time period (Middle and Late Pleistocene), but our questions bear directly on any lithic analysis from any period or location. To assess inter-analyst reliability in data collection, we collaboratively assembled and defined 38 ratio, discrete, and nominal attributes, and applied them to an experimental lithic assemblage of 100 chert flakes. We chose flakes because they are one of the most abundant lithic artifact types, and therefore most amenable to the creation of large datasets suitable for quantitative analysis. Mixture models suggest strong inter-analyst repeatability for 17 variables that we consider to be reliable for compiling datasets collected by different individuals for comparative analyses. Demonstrating this kind of repeatability is a crucial first step in tackling more general problems of data comparability in lithic analysis and assessing our confidence in conducting large-scale meta-analyses that combine multiple datasets.

Mammal Size Across the Late MIS 3 Contexts of Sehonghong Rockshelter: Insight into Hunter-Gatherer Use of Animals in the Highlands of Lesotho

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This study examines the mammal fauna from terminal MIS 3 (~32,000-36,000 BP) contexts of Sehonghong Rockshelter, an interior highland site in the Kingdom of Lesotho, southern Africa. The faunal assemblage originates from renewed excavations by the Adaptations to Marginal Environments in the Middle Stone Age project in 2009–2011, which extended the earlier Mitchell trench (Plug and Mitchell, 2008). Prior study of fauna from the Mitchell trench (~1,000–31,000 BP) showed fluctuating but mostly consistent abundance of medium-sized ungulates, particularly reduncines like reedbuck (*Redunca* sp.) and rhebuck (*Pelea* sp.), and the antilopine springbok (*Antidorcas* sp.) (Plug and Mitchell, 2008). The later periods see increased representation of small relative to large taxa (Plug and Mitchell, 2008), likely influenced by improvement in primary productivity of the environment—and potential concurrent human population increases that may have led to modified hunting strategies to include greater numbers of lower-ranked small species—during regional warming. For this study, long bone remains were identified, and cortical thicknesses measured and categorized following Reynard et al. (2014). Preliminary results of the MIS 3 contexts mirror that seen particularly for the Middle to Later Stone Age transition period contexts, with more medium-sized animals, although all size categories are represented. Additionally, the impact of humans and other taphonomic agents on the assemblage is evaluated, including fracture patterns, burning, cutmarks, percussion notches, animal digestion, and subaerial weathering. The remains are heavily altered by weathering, yet evidence for human processing has been preserved with frequent burning, percussion, and occasional cutmarks. There is little evidence of gnawing and acid etching indicative of contribution from animals other than humans. This study advances understanding of hunter-gatherer use of animals during late MIS 3 in interior southern Africa, a comparatively less explored period and region (Mitchell, 2008).

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Howiesons Poort Lithic Technology from Nelson Bay Cave, South Africa

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The Howiesons Poort technocomplex has been central to discussions of the evolution of our species' cultural and cognitive capabilities during the late Pleistocene. Backed artifacts, bladelets, and geometric forms are characteristic of HP assemblages across southern Africa and are argued to encompass early composite tool technology and may represent some of the earliest projectiles. The site of Nelson Bay Cave, on the southern coast of South Africa, has a long sequence extending from the Holocene into the late Pleistocene. Descriptions of the lithics were foundational to the first comprehensive descriptions of the Middle Stone Age, but no publications reflect developments over the past 40 years. Here we discuss preliminary results from a sample that is part of a larger study. We provide overall assemblage descriptions and characterization of technological production methods used in Level 6, the oldest unmixed HP layer, and address questions related to lithic provisioning and technological decision making. Results from this study demonstrate three notable features. First, lithic data from Nelson Bay Cave suggests a focus on place provisioning and use as a residential site. Second, the presence of cores-on-flakes indicates independent, intentional production of small blades and bladelets separate from sequences used to produce large blanks. Finally, features present in the lithic assemblage suggests large blades were intentionally fragmented to produce truncated forms and the characteristic Howiesons Poort segments and geometrics. Preliminary results from Nelson Bay Cave fit with data from other sites across southern Africa indicating utilization of place provisioning across multiple biomes and increased logistical mobility patterns during Howiesons Poort.

Stones That Bleed: Pliocene Hominin Lithic Raw Material Selectivity at Lomekwi 3, West Turkana, Kenya

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Lomekwi 3 (LOM3), West Turkana, Kenya is currently the oldest known direct evidence of hominin behavior at ~3.3 million years old (Harmand et al., 2015). This site predates the earliest known appearance of the genus *Homo* by nearly 500 ky (Villmoare et al., 2015) and the next oldest known technology, the Oldowan, by at least as much (Braun et al., 2019) and thus offers insights into hominin behavior and technology prior to the emergence of our genus. Here we present the results of a techno-economic analysis of archaeological material from LOM3 compared to contemporaneous raw material sources and its implications for hominin techno-behavior and cognition in the Pliocene. While exploiting locally abundant volcanic raw materials, hominins at LOM3 exhibit clear preferences for raw materials of particular sizes and differential use of certain rock types for particular tool production activities/needs correlated with aspects of their lithological properties. This indicates a relatively high degree of anticipatory behavior, selective bias, understanding of material properties, and technological complexity and has serious implications regarding the development of stone technology and the evolution of hominin behavior prior to the emergence of the genus *Homo*.

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Paleoenvironmental Context of Early *Homo* Evolution in Eastern Africa

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While the evolutionary origins of the genus *Homo* are believed to be in eastern Africa, the exact date, location, and nature of the emergence of *Homo* is still a topic of considerable debate. Much of this debate is due to a relative paucity of fossil assemblages across eastern Africa from 3.0–2.0 million years ago (Ma), a period of 'transition' between the genus *Australopithecus* and *Homo*. This transition is significant because the genus *Homo* is a descendant of a still unknown species of *Australopithecus*, meanwhile archaeological evidence suggests significant leaps in behavioral and social abilities took place during the period of this hypothesized *Homo* ancestor. To contextualize this transition and provide insights into the ecological pressures that may underpin the emergence of our genus, we present new paleoecological analyses of sites across eastern Africa dating to this time period that have yielded early *Homo* or *Australopithecus* remains. Faunal assemblage data from existing databases were supplemented with novel fossil collections from the 2022 Koobi Fora Research and Training Program field season to assess paleoecological signals between sites and through time using correspondence analyses. The Ledi-Geraru locality where the early *Homo* LD 350-1 mandible was found had an arid signal, while the site of the taxonomically ambiguous, but possibly con-generic or con-specific, KNM-ER 5431 teeth had a more seasonally wet signal. This suggests that early *Homo* evolution may have been characterized by variable environments. Further geological and paleoecological investigations of hominin-bearing sites and comparative analyses of hominin remains dating to 3.0–2.0 Ma may shed further light on the origins of our own genus. In particular, the late Pliocene-early Pleistocene sites of the Turkana Basin may be critical for understanding evolutionary selective pressures underpinning the transition from *Australopithecus* to *Homo*.

An Early Upper Paleolithic Blade Assemblage from the Hinterland of the Tibetan Plateau

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Increasing studies have suggested that human population history of the Tibetan Plateau is much longer than previous recognized and could be as early as Marine Isotope Stage 6. However, human behavioral patterns during the late Pleistocene still largely remain unknown. Such as, where did the early hunter-gatherers come from? How did they cope with the harsh high-elevation environment? How did highland populations interact with lowland human groups? Here, we present our study on an early Upper Paleolithic site—Nwya Devu—to help understand human activity in the hinterland of the Tibetan Plateau during late MIS 3. The Nwya Devu site provides important clues not only about human behaviors in the highlands but also the distribution of blade technology in East Asia. Our analysis shows that the Nwya Devu assemblage is mainly characterized by macro-blade production, which is consistent with a systematic Upper Paleolithic blade technology. Core preparation and management were observed at the site, although in low frequency. The relatively low technological investment in preparation is likely associated with the site function as a lithic workshop near the raw material source. Moreover, both blade technology and related technological antecedents are rarely identified in the highland and neighboring lowland areas. It therefore suggests an exotic origin for the technology on the high-altitude Tibetan Plateau, which likely connects with the blades excavated at the Shuidonggou site in northwest China and macro-blade assemblages widely found in the Siberian Altai, Trans-Baikal region, and North Mongolia. It illustrates a plausible scenario of broad-scale technological transmission and population movements between highlands and lowlands.