

Late Homo Foodways: Antecessor & Rhodesiensis

Homo Antecessor

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Homo Antecessor

INTRODUCTION

Homo antecessor (1.2 to 800k years ago) more robust than Heidelberg, smaller brain 1000cc, found remains and stone tools, flint, stone knife, at several places

“The name antecessor is the Latin word meaning “explorer,” “pioneer,” or “early settler.” Assigning this name, they emphasized that these hominids belong to the first population as yet known in the European continent.” (Birn 2006).

“H. antecessor and H. heidelbergensis are regarded as competing with each other for the same phylogenetic position, as seen in alternative proposed scenarios of human evolution. H. antecessor is claimed by the Spanish workers (after Bermúdez de Castro et al., 1997) as the stem-species that was ancestral to the evolutionary divergence between the evolutionary lineage of the Neanderthals in Europe and to the origin of our species in sub-Saharan Africa. Nonetheless, H. heidelbergensis has also been considered as pertinent in the same crucial role (Stringer, 1983; Rightmire, 1996).” (Manzi 2012).

“The nuclear DNA, Meyer’s team reports in Nature on 14 March, shows that the Sima hominins are in fact early Neanderthals. And its age suggests that the early predecessors of humans diverged from those of Neanderthals between 550,000 and 765,000 years ago — too far back for the common ancestors of both to have been Homo heidelbergensis, as some had posited. Researchers should now be looking for a population that lived around 700,000 to 900,000 years ago, says Martínón-Torres. She thinks that Homo antecessor, known from 900,000-year-old remains from Spain, is the strongest candidate for the common ancestor, if such specimens can be found in Africa or the Middle East.”(Callaway 2016).

“...considered the earliest known human form of Europe.” (Birn 2010).

“H. antecessor is probably the ancestor of Homo heidelbergensis in the Homo neanderthalensis lineage. Since H. antecessor also has intermediate characteristics between H. ergaster and H. sapiens, it is also considered a link between both species. Although the only known fossils of H. antecessor come from Atapuerca (Spain), some other specimens in Europe and northeastern Africa may also belong to this species. One of these is the fossil human identified in Ceprano (Italy), called Homo cepranensis, and nicknamed Ceprano Man. It lived between 0.8 and 0.9 million years ago, and its features seem to be also intermediate between H. ergaster and H. heidelbergensis.” (Birn 2010).

FOSSILS

From Spain:

(The TD6 level of Gran Dolina (Sierra de Atapuerca, Burgos)):

“To date 165 remains have been recovered that correspond to a minimum of 11 individuals of different ages. Specifically, six individuals have been identified as children, four of which are 0–4 years old and two of which are between 5 and 9 years old; two adolescents 10–14 years old; and three young adult individuals 15–20 years old (Bermudez de Castro et al. 2006, 2008, 2010). Although the assignment of sex is very problematic with incomplete remains, the size of the mandibular body enabled us to identify two male individuals (hominids 1 and 10) and a female individual (hominid 7; Bermudez de Castro et al. 2008; Carbonell et al. 2005). Human remains recovered include teeth and cranial and postcranial elements. The majority of human remains are very fragmented. In fact, there are no complete cranial elements, and axial wholes are scarce.” (Carbonell et al. 2010).

From Sima del Elefante in the Atapuerca Mountains of Spain:

“Here we report the discovery of a human mandible associated with an assemblage of Mode 1 lithic tools and faunal remains bearing traces of hominin processing, in stratigraphic level TE9 at the site of the Sima del Elefante, Atapuerca, Spain^{6, 7, 8}. Level TE9 has been dated to the Early Pleistocene (approximately 1.2–1.1 Myr)...The Sima del Elefante site thus emerges as the oldest, most accurately dated record of human occupation in Europe, to our knowledge. The study of the human mandible suggests that the first settlement of Western Europe could be related to an early demographic expansion out of Africa.” (Carbonell et al. 2008).

From Northern Europe (UK):

Flint artifacts dating to ~700,000 ya found in Suffolk, England

“The colonization of Eurasia by early humans is a key event after their spread out of Africa, but the nature, timing and ecological context of the earliest human occupation of northwest Europe is uncertain and has been the subject of intense debate¹. The southern Caucasus was occupied about 1.8 million years (Myr) ago², whereas human remains from Atapuerca-TD6, Spain (more than 780 kyr ago)³ and Ceprano, Italy (about 800 kyr ago)⁴ show that early Homo had dispersed to the Mediterranean hinterland before the Brunhes–Matuyama magnetic polarity reversal (780 kyr ago). Until now, the earliest uncontested artefacts from northern Europe were much younger, suggesting that humans were unable to colonize northern latitudes until about 500 kyr ago^{5, 6}. Here we report flint artefacts from the Cromer Forest-bed Formation at Pakefield (52° N), Suffolk, UK, from an interglacial sequence yielding a diverse range of plant and animal fossils. Event and lithostratigraphy, palaeomagnetism, amino acid geochronology and biostratigraphy indicate that the artefacts date to the early part of the Brunhes Chron (about 700 kyr ago) and thus represent the earliest unequivocal evidence for human presence north of the Alps.” (Parfitt et al. 2005).

“In 2005, flint tools and teeth from the same strata as fossils of the water vole *Mimomys savini*, a key dating species, were found in the cliffs at Pakefield near Lowestoft in Suffolk. This suggests that hominins existed in England 700,000 years ago, potentially a cross between *Homo antecessor* and *Homo heidelbergensis*.” (Wikipedia “*Homo antecessor*”).

Footprints dating to the time of *Antecessor* were found in the UK, suggesting this hominin may have also expanded to northern Europe:

“Investigations at Happisburgh, UK, have revealed the oldest known hominin footprint surface outside Africa at between ca. 1 million and 0.78 million years ago. The site has long been recognised for the preservation of sediments containing Early Pleistocene fauna and flora, but since 2005 has also yielded humanly made flint artefacts, extending the record of human occupation of northern Europe by at least 350,000 years...The surface was recorded using multi-image photogrammetry which showed that the hollows are distinctly elongated and the majority fall within the range of juvenile to adult hominin foot sizes. In many cases the arch and front/back of the foot can be identified and in one case the impression of toes can be seen. Using foot length to stature ratios, the hominins are estimated to have been between ca. 0.93 and 1.73 m in height, suggestive of a group of mixed ages. The orientation of the prints indicates movement in a southerly direction on mud-flats along the river edge. Early Pleistocene human fossils are extremely rare in Europe, with no evidence from the UK. The only known species in western Europe of a similar age is *Homo antecessor*, whose fossil remains have been found at Atapuerca, Spain. The foot sizes and estimated stature of the hominins from Happisburgh fall within the range derived from the fossil evidence of *Homo antecessor*...Overall the estimated foot size, foot area and stature of the Happisburgh hominins correspond with the estimates for *Homo antecessor*...Happisburgh has the earliest evidence of hominin footprints outside Africa...The analyses suggest a group of at least five adults and juveniles walking along the mudflats of a large river.” (Ashton et al. 2014).

ENVIRONMENT

Environment/Habitat of *Homo Antecessor* in Europe (Atapuerca, Spain)—warmer, temperate open woodlands, significant humidity, meadows and/or lagoons, and some periods where steppes dominated.:

“The first phase includes the oldest occupations, found at the lower levels of Sima del Elefante and Gran Dolina TD3-TD4. These are low intensity occupations, characterized by very simple knapping strategies, very low raw material diversity and an apparently opportunistic behavior. Temperate open woodlands seem to have dominated the landscape at this time. This was probably one of the most humid periods at Atapuerca, since several proxies point towards a significant presence of meadows and/or lagoons...by Dolina TD6-1 and TD6-2 assemblages and chronologically corresponding to the end of the Early Pleistocene...Open woodlands also dominated the landscape coinciding with this cultural phase, although more Mediterranean in character than in the previous phase (Table 9). In addition, some periods within this phase were probably dominated by steppes...

The evidence shown here supports the prevalence of temperate habitats at Atapuerca during much of the time between the earliest human arrival and about 0.5 Ma, when *Homo heidelbergensis* and Mode 2 appeared. This suggests that Southern Europe may have been continuously inhabited during this period of about 0.7 Ma duration and reflects the ecological preferences of *Homo antecessor* for the warmer and more equitable conditions of Southern Europe as suggested by several authors (Roebroeks, 2001; van der Made, 1999).” (Rodriguez et al. 2011).

“The Sima del Elefante cave, in the Sierra de Atapuerca (Burgos, Spain), is famous for the fact that level TE9 of its Lower Red Unit recently delivered the oldest hominin remains of Western Europe, identified as *Homo antecessor* and dated by biostratigraphy and radiometric methods to ca 1.2 Ma...during the hominin presence the mean annual temperature (MAT $1/4 10e13$ C) was always slightly warmer than at present and the mean annual precipitation (MAP $1/4 800e1000$ mm) was greater than today in the Burgos area. The landscape had open habitats in the vicinity of the Atapuerca caves throughout the sequence, with wet points in the surrounding area, and a predominance of humid meadows and open woodlands...*H. antecessor* may have thus lived under a warm-humid climate in a patchy landscape mainly composed of humid meadows and riparian woodlands. Such a landscape may have provided favourable conditions for a high diversity of large mammals, as well as for hiding and escaping from large carnivores.” (Blain et al. 2010).

“Between 1.2 and 0.8 Myr ago, the paleoenvironmental records of Sierra de Atapuerca indicate a rich and stable ecosystem. Woodland areas with conifers and mesic Mediterranean trees dominated the region, and the hominids lived in open landscapes with an abundance of humid meadows and woodlands.” (Perez-Perez et al. 2017).

MORPHOLOGY & LOCOMOTION

“Its physical traits are intermediate between the oldest *Homo ergaster* and the most modern *Homo heidelbergensis*.” (Birn 2010).

“...the *Homo antecessor* population was of similar average stature to modern humans and fully bipedal, but with longer, more slender arms and wider chests.” (Roberts 2011).

Estimated Stature: men average 5 foot 7 in (ranging 5 ft 6-9 in) and weighing 150-200 lbs.; women 5 ft 6 in (5 ft 2-6 in) and weighing 130-150 lbs.; taller than the average Neanderthal at 5 ft 4 in; shorter than the European Early Upper Paleolithic at 5 ft 9 in

“The resultant mean stature is 173.0 +/- 2.7 cm (~5 foot 7 in) from six male equations and 171.0 +/- 5.8 cm (~5 ft 6 in) from two female equations...Interestingly, the predicted stature of one *H. antecessor* individual based on the metatarsal length (173.0 for a male, 168.9 for a female, with a mean of 170.9 cm; Lorenzo et al., 1999) is also quite similar to the one reported here based on the radial and clavicular lengths.

The stature estimation of one hominid from the SH based on a complete humerus is 174.7 cm using the male formulae, and 171.5 cm using the female formulae, with a mean of 173.1 cm (we have used the Trotter & Gleser (1952) formulae for blacks and whites that were averaged; Carretero et al., 1997). This value is similar to those of the TD6 individuals, and all of them are between the mean of Western European Neandertals (165.3 +/- 5.1) (5 ft 4 in) and European Early Upper Palaeolithic (178.4 +/- 8.4) (~5 ft 9 in) reported by Vandermeersch & Trinkaus (1995).” (Carretero et al. 1999).

“Adult males were approximately 1.70 m to 1.80 m [5 ft 6 in. to 5 ft 9 in.] in height and 70 to 90 kg [150-200 lbs.] in weight, and adult females were 1.60 to 1.70 m [5 ft 2 in. to 5 ft 6 in.] in height and 60 to 70 kg [132-154 lbs] in weight.” (Birn 2010).

Limb proportions appear to have resembled those of tropical dwelling African ancestors: “A cautious assessment of the new, but still scarce evidence from Gran Dolina hominids suggests that the first European immigrants (*H. antecessor*) probably possessed limb proportions close to those seen in their ancestral climate, i.e., in Sub-Saharan Africa.” (Carretero et al. 1999).

“...long forearm compared to Neanderthals and modern humans...long collar bone suggests broad, powerful shoulders...” (Roberts 2011).

H. antecessor's shoulder morphology displays a shift towards increased shoulder mobility. While the reason for this shift is not definitively known, it is tempting to link these changes to the advantages associated with being able to throw projectile weapons. Transformations allowing for increased shoulder mobility continued to evolve in the *Homo* lineage following *H. antecessor* as is seen in *H. heidelbergensis* and *H. neanderthalensis*.

“If the proposal put forward here that early *H. erectus* is characterized by a relatively short clavicle, low humeral torsion, and a more protracted scapula position, is verified by future discoveries, when might the clavicular elongation, dorsal repositioning of the scapula, and concomitant increase in humeral torsion leading to the shoulder configuration of more recent hominins first occurred? The lower Pleistocene site of Gran Dolina, Sierra de Atapuerca, Spain has yielded a variety of post-cranial remains attributed to *H. antecessor*, including a complete adult clavicle (ATD6-50), as well as one complete and one partial subadult clavicle. Although no humeri are known from the site with which to calculate a claviculohumeral index, the adult clavicle ATD6-50 is absolutely quite long, falling at the upper fringes of size ranges for modern human samples. It is possible, therefore, that *H. antecessor*, which has been proposed to represent the last common ancestor of *H. sapiens* and *H. neanderthalensis*, exhibits the clavicular elongation that is seen in both later taxa.” (Larson, S.G. 2007).

FACIAL FEATURES

“[*H. antecessor*]...had a rounded cranium with a protruding occipital bun, a single supraorbital ridge, and a long, vertical face with hollow cheeks (in contrast to the flat face of *H. ergaster* and *H. erectus*).” (Birn 2010).

“*Homo antecessor*'s face would have had a remarkably modern appearance, including a prominent nose, but receding chin.” (Roberts 2011).

“...the *Homo antecessor* skull shows some of the following defining features: 1) a fully modern mid-face with a cheekbone that attaches high on the upper jaw, and cheek bone surface that faces front and slightly downwards; 2) a single brow ridge molded in an arch above each eye...” (Sawyer & Deak 2007).

Hand & Wrist—

“gracile (lightly built) hand and wrist bones similar to those of modern humans...but gracile compared to Neanderthals and *Homo heidelbergensis*.” (Roberts 2011).

“Hands and feet of *H. antecessor* were similar to those of modern humans, therefore indicating modern locomotor and manipulative behaviors.” (Birn 2010).

“The feet of *Homo antecessors* were similar to those of modern humans, although the bone of the big toe may have been more rounded in shape...kneecaps are relatively narrow, more like modern humans than Neanderthals...” (Roberts 2011).

CAPTURE

“The TE9 Unit at the Sima del Elefante site (1.2 Myr) has yielded a broad range of medium and large-sized mammals and even tortoises that show anthropogenic modifications, which indicate that they were part of the hominin diet^{1,2}. Moreover, the TD6 level at the Gran Dolina site (0.8–0.96 Myr) has provided evidence not only of hunted and scavenged mammals³ but also of butchered and eaten human remains, which is the most ancient evidence of human cannibalism⁴.” (Perez-Perez et al. 2017).

“The wide spectrum of animals that were consumed has been interpreted as an opportunistic subsistence-behavior.” (Perez-Perez et al. 2017).

Mammals of a wide range of body sizes were consumed, from rabbits to large bovids, suggesting opportunistic dietary habits (Huguet, 2007). Other evidence points to an early access to the carcasses, although it is not possible to determine if the animals were hunted or scavenged.” (Rodriguez et al. 2011).

“The high taxonomic diversity of the assemblage, eight ungulate species and six carnivores plus *H. antecessor* is remarkable and points towards a non selective hunting behavior.” (Rodriguez et al. 2011).

“These hominins preyed on a wide range of species (herbivores, carnivores and *H. antecessor*) (Saladie et al., 2011). Besides *H. antecessor*, species displaying anthropogenic modifications include *Eucladoceros giulii*, *Dama nestii vallonensis*, *Cervus elaphus*, cf. *Bison voigtstedtensis*, *Equus* sp., *Stephanorhinus etruscus*, *Cercopithecidae*, *Ursus dolinensis* and *Vulpes praeglacialis*.” (Saladie et al. 2012).

“The archaeological evidence at Atapuerca indicates exploitation of large, medium and small game including other humans, suggesting that early hominins displayed complex social and economic behaviour associated with foraging activities, and were opportunistic hunters (Carbonell et al., 2010; Saladie et al., 2011; Blasco et al., 2011).” (Allue et al. 2015).

DIET

Consumed Tortoises and other small game including faster moving small game such as birds.: “Several tortoise remains identified in the Sima del Elefante site present sufficient evidence to attribute their presence to human activity...Tortoises, however, are not the only kind of small prey that were used for food at the TE site. One cut-mark on the proximal metaphysis of a bird radius is documented at Level TE9a, and two cut-marks on the middle diaphysis of a leporid radius are identified at TE12a (Huguet, 2007). In this manner, the use of lower-ranked fast small game is documented during the Early Pleistocene at this site...The evidence of anthropogenic processing of small animals (slow and fast small prey), along with the large game identified in the site (Huguet, 2007 and Carbonell et al., 2008) (Table 3), points to the generalist behaviour of the Early Pleistocene human groups...In conclusion, the TE site provides sufficient proof to document the human consumption of tortoises in the European Early Pleistocene. This fact, together with the cut-marks identified on fast small prey, contributes new data on the subsistence strategies based on small game, and demonstrates the generalist behaviour of the first European hominins.” (Blasco et al. 2011).

PLANT FOODS

A large accumulation of Hackberry seeds were found in association with *H. antecessor*. The seeds were found while suggesting that the hominins who consumed the berries, spit out the seeds, or at least some of the seeds. North American groups were known to consume these berries, but ate both the fruit pulp and seed, sometimes pounding and mixing them with meat or fat and corn.—

“In this paper we present the archaeobotanical record from level TD6 of the Gran Dolina site (Burgos, Spain). The results show the presence of mineralized *Celtis* (hackberry) seed remains — concentrated primarily in the area where most of the archaeological material was found. Spatial distribution data indicate that the seeds are associated with archaeological remains resulting from human occupation of the cave. *Celtis* remains were preserved due to biomineralization of seed endocarps. The results presented here contribute to analysis of archaeobotanical *Celtis* remains as part of the Pleistocene human plant food consumption.”(Allue et al. 2015).

“The occurrence of *Celtis* during the Plio-Pleistocene is recorded in several Eurasian sites (Table 1). Early and Middle Pleistocene sites such as Zhoukoudian, China; Dmanisi and Akhalkalaki, Georgia; Terra Amata, Lazaret and Arago, France; and Karlich, Germany have yielded biomineralized *Celtis* seeds (Chaney, 1935; de Lumley, 1976; de Lumley in Laville and Renault-Miskovsky, 1977; Bittmann, 1992; Ljubin and Bosski, 1996; Messager et al., 2008). These authors consider that *Celtis* could have contributed to hominin diet...The most conclusive evidence is that the archaeological position of most seeds, associated with archaeological materials, corresponds to human occupation. Their position indicates a larger accumulation of seeds associated with TD6-2 (see Figs. 4 and 5), directly associated to *H. antecessor* remains...Therefore, the presence of whole seeds in TD6-2 suggests that had humans consumed them they probably spat them out again after consumption. According to Lambert

(1999), chimpanzees (*Pan troglodytes*) can swallow *Celtis* seeds, whereas red-tailed monkeys usually spit them out although they can also swallow them.

Human consumption of *Celtis* seeds is not exceptional, and probably the presence of such seeds in other archaeological sites is related to human consumption. *Celtis* contains oils, proteins, fibre and minerals and has nutritional and medicinal properties (Demir et al., 2002). Furthermore, ethnographic evidence shows that due to the low proportion of flesh in this fruit (*Celtis occidentalis*) both pulp and stones were eaten by North American Indians, as well as by other human groups (Yanovsky et al., 1932; Simchoni and Kislev, 2011). ” (Allue et al. 2015).

“The tree's pea-sized berries are edible, ripening in early September. Unlike most fruits, the berries are remarkably high in calories from fat, carbohydrate and protein, and these calories are easily digestible without any cooking or preparation.^[8] Omaha Native Americans ate the berries casually, while the Dakota used them as a flavor for meat, pounding them fine, seeds and all. The Pawnee also pounded the berries fine, added a little fat, and mixed them with parched corn.” (Wikipedia “*Celtis occidentalis*”).

CANNIBALISM

“Human cannibalism is currently recorded in abundant archaeological assemblages of different chronologies. The TD6 level of Gran Dolina (Sierra de Atapuerca, Burgos), at more than 800 ka, is the oldest case known at present. The analysis of cranial and postcranial remains of *Homo antecessor* has established the presence of various alterations of anthropic origin (cut marks and bone breakage) related with exploitation of carcasses. The human remains do not show a specific distribution, and they appeared mixed with lithic tools and bones of other taxa. Both nonhuman and human remains show similar evidence of butchering processes. The stratigraphic evidence and the new increment of the collection of remains of *Homo antecessor* have led us to identify a succession of cannibalism events in a dilated temporal sequence. These data suggest that hunting strategies and human meat consumption were frequent and habitual actions. The numerous evidences of cannibalism, the number of individuals, their age profile, and the archaeo stratigraphic distribution suggest that cannibalism in TD6 was nutritional. This practice, accepted and included in their social system, is more ancient cultural cannibalism than has been known until now.” (Carbonell et al. 2010).

“...percussion marks seen on *H. antecessor* skulls suggest the removal of the brain...” (Saladie et al. 2012).

“The analysis of the cranial and postcranial remains of *Homo antecessor* has established the presence of several damages of anthropic origin (cut marks and bone breakage) related to the exploitation of carcasses (fig. 3; table 3).

Cut marks (slicing, chop, and scraping marks) on the cranial segment are abundant on the base of the temporal bones, face, and zygomatic bones: segments with a large amount of muscular attachments and ligaments. Cut marks found on the face indicate skinning and defleshing activities. Cranial fragments also display abundant evidence of breakage (percussion pits and

adhered flakes) mainly located on the lower part of the cranium. The majority of zygomatic bones are broken in a similar manner to those documented in Native American cannibalized remains (Turner and Turner 1999; White 1992) and Neolithic individuals (Fontbre'goua; Villa et al. 1986a, 1986b).

In the axial segment, ribs, vertebrae, and clavicles exhibit cut marks and peeling. On the limbs we found cut marks and bone breakage by percussion and bending. Phalanges and metapodials are smashed, indicating intensive exploitation of human remains (Saladie' 2009). Cut marks, peeling, and percussion marks show that the corpses of these individuals were processed in keeping with the mimetic mode used with other mammal carcasses: skinning, defleshing, dismembering, evisceration, and periosteum and marrow extraction. The butchery techniques exhibited in TD6 show the primordial intention of obtaining meat and marrow and maximally exploiting nutrients. Once consumed, human and nonhuman remains were dumped, mixing them together with lithic tools...

We could rule out a situation of nutritional stress, because the TD6 hominids had a high diversity of vegetal and animal resources available, and they could perform raising strategies to exploit prey of different sizes. Cannibalism in TD6 cannot have been an isolated event because it has been documented in different archeo stratigraphic units (fig. 2)...The abundant evidence of cannibalism, the number of individuals, their age profile, and the archeo stratigraphic distribution suggest that the motive for cannibalism in level TD6 was nutritional...

Evidence shows that these hominids had primary and immediate access to the corpses of other hominids because the anatomical segments providing the most amounts of meat were those consumed... The exploitation sequence rules out the scavenging of corpses abandoned by carnivores because the carnivore tooth marks found on these remains were always made after anthropic activity (Dir'ez et al. 1999; Fern'andez-Jalvo et al. 1999; Huguet 2007; Rosell 2001; Saladie' 2009)." (Carbonell et al. 2010).

"In TD6, cannibalism has been included as a subsistence strategy of *H. antecessor*. This strategy was incorporated as successful behavior against another group to compete for resources and territories. The cannibalistic behavior was valuable for the species, and it was transmitted between generations because we can observe cyclic episodes of cannibalism in the different sublevels of TD6. Such strategies can be related to the competition between different human groups for territorial resources... The represented ages of *H. antecessor* (infants and juveniles) suggest that individuals that would have posed a lower risk for hunters and that would have been effective in the strategy of controlling competitors were sought out. The pyramid of mortality suggests exocannibalism as *H. antecessor* would have been limiting the reproductive capabilities of the competitor group." (Carbonell et al. 2010).

"The cannibalism documented in level TD6 mainly involves the consumption of infants and other immature individuals. The human induced modifications on *Homo antecessor* and deer remains suggest that butchering processes were similar for both taxa, and the remains were discarded on the living floor in the same way This finding implies that a group of hominins that used the

Gran Dolina cave periodically hunted and consumed individuals from another group. However, the age distribution of the cannibalized hominins in the TD6 assemblage is not consistent with that from other cases of exo-cannibalism by human/hominin groups. Instead, it is similar to the age profiles seen in cannibalism associated with intergroup aggression in chimpanzees. For this reason, we use an analogy with chimpanzees to propose that the TD6 hominins mounted low-risk attacks on members of other groups to defend access to resources within their own territories and to try and expand their territories at the expense of neighboring groups.” (Saladie et al. 2012).

PROCESSING & INGESTION

Tools & Animal Butchery:

“The mammal species diversity at Gran Dolina-TD6 (0.96–0.8 Myr), including herbivores, carnivores and cannibalized hominins, along with evidence of skinning, defleshing, marrow extraction and bone chewing activities suggest that hominin subsistence strategies included systematic hunting and corpse exploitation with a more developed Mode 1 technology than TE9” (Perez-Perez et al. 2017).

“Several hundred stone tools have been found associated with Homo antecessor at Gran Dolina. These hammerstones, small flakes, and cores were made from locally available raw materials including flint, quartzite, sandstone, and limestone. Similar to the Oldowan technology from Africa, the assemblage is characterized by small tools such as scrapers and notches, but lacks the hand axes of later stone-tool technologies. The presence of tiny stone fragments produced by snapping demonstrates that some of the artifacts were made on site. Studies of the microscopic wear along the cutting edge of these tools suggest that they were for defleshing carcasses and woodworking.”(Roberts 2011).

“The presence of a mandible fragment attributed to Homo antecessor in TE9 (Carbonell et al., 2008a), allows us to consider this species as the hominin inhabiting the Sierra de Atapuerca at that time. A Mode 1 lithic assemblage composed of 32 artifacts made of Neogene and Cretaceous chert has been recovered from TE9... Knapping strategies were simple and aimed at producing simple flakes using unidirectional knapping. Some long bones of large herbivores from TE9 show evidence of hominin processing in search of bone marrow or other nutritional resources. Several bones with cut marks and/or percussion marks have also been recovered at other Early Pleistocene stratigraphic units of Sima del Elefante.” (Rodríguez et al. 2011).

“A very different picture is shown at TD6-2 (“Aurora stratum”) where several episodes of high intensity occupation are represented. The lithic assemblage is also of Mode 1 technology but a high diversity of knapping strategies has been observed and seven different kinds of raw material have been identified, although almost half of the artifacts are made of Neogene chert (Carbonell et al., 1999d; Rodríguez, 2004a)...The increased complexity that characterize the technological behavior of the Homo antecessor population represented at TD6-2 is paralleled by a more complex trophic behavior, as evidenced by the bone assemblage recovered at the “Aurora stratum” (TD6-2). High levels of anthropization characterize the assemblage, and all the

stages of carcass processing have been documented (Díez et al., 1999; Rosell, 2001; Huguet, 2007; Saladié, 2009), from skinning to bone marrow extraction and including defleshing and visceral removal. Primary and early accesses to animals by hominids is reported by Díez et al. (1999), suggesting hunting activities. A different treatment of the carcasses consumed depending upon the animal body size is also evident. Skeletal elements of small sized prey species (up to 100 kg) are evenly represented, suggesting they were transported to the site as complete carcasses. On the other hand, axial elements of the largest mammals are scarce, since they were probably butchered far away and only some parts were taken to the cave...Nevertheless, the most striking feature of the behavior of Homo antecessor documented at TD6-2 is probably the practice of cannibalism (Fernández-Jalvo et al., 1996). More than 150 human fossil remains belonging to a minimum of 10 individuals including children, juveniles and young adults have been recovered (Bermúdez de Castro et al., 2008). The butchering techniques observed on the hominin bones, aimed at meat and marrow extraction, and the pattern of post-processing discard of these remains, identical to the treatment observed for animal bones, is an argument against a ritual significance of this behavior. In addition, the large amount of biomass represented by the TD6-2 bone assemblage contradicts the hypothesis of an incidental behavior in response to a starvation episode. Thus, this behavior has been interpreted as “nutritional” or “gastronomic” cannibalism associated with long periods in which humans were feeding on other humans as part of their regular diet (Fernández- Jalvo et al., 1999; Bermúdez de Castro et al., 2006).” (Rodríguez et al. 2011).

DENTAL ADAPTATIONS

“One of the most outstanding features of H. antecessor is the primitive morphology of its teeth. This morphology is similar to that of hominids from Africa 1.8 and 1.4 million years ago (Bermudez de Castro et al. 1999, 2001). These hominids also share many of their dental characteristics with Asian Homo erectus and other African forms at periods a little more recent than that determined in TD6.” (Carbonell et al. 2010).

“It had less robust mandibles, smaller molars, and premolars...Its teeth had primitive characteristics that resembled H. ergaster, but its dental eruption pattern had the same developmental stages as H. sapiens.” (Birn 2010).

“...postcanine teeth are smaller and within the range of H. ergaster, H. erectus, and Homo heidelbergensis. The maxillary incisors are shovel-shaped.” (Birn 2006).

“...a jaw that is not as thick as that of Homo ergaster or Homo habilis...lower front teeth that are wider from front to back than H. ergaster and H. habilis...lower canine that is narrow from front to back...premolars that are wide from side to side...Similarities in Homo antecessor teeth to those of Homo heidelbergensis suggest a similar diet. Their cheek tooth and lower jaw size dimensions indicate this diet probably included abrasive foods.” (Sawyer & Deak 2007).

Microwear analysis indicates the consumption of hard and brittle foods...

“Here, we report for the first time the direct effect of dietary abrasiveness as evidenced by the buccal microwear patterns on the teeth of the Sima del Elefante-TE9 and Gran Dolina-TD6 Atapuerca hominins (1.2–0.8 million years ago – Myr) as compared with other Lower and Middle Pleistocene populations. A unique buccal microwear pattern that is found in *Homo antecessor* (0.96–0.8 Myr), a well-known cannibal species, indicates dietary practices that are consistent with the consumption of hard and brittle foods. Our findings confirm that the oldest European inhabitants ingested more mechanically-demanding diets than later populations because they were confronted with harsh, fluctuating environmental conditions.” (Perez-Perez et al. 2017).

“The buccal microwear of the earliest hominins from Atapuerca stands out among other Pleistocene hominins for the higher total scratch density

(NT = 254.13 ± 25.98 ; $\pm \sigma$) compared with the samples of *H. ergaster* (NT = 198.43 ± 81.19), *H. heidelbergensis* (NT = 151.71 ± 67.16) and Iberian Neandertals (NT = 141.50 ± 75.61) (Fig. 1b) (extended data Tables S1–S3)...The clearly distinct position of the earliest hominins from Atapuerca supports the hypothesis that their dietary habits included higher amounts of fracture-resistant foods.” (Perez-Perez et al. 2017).

COOKING

“Current archaeological evidence indicates no regular use of fire for cooking in the European Middle Pleistocene until approximately 300,000–400,000 years ago²³. Because of the absence of fire evidence at both Atapuerca sites, ATE9-1 and Gran Dolina-TD6 hominins have been assumed to have consumed food items raw^{2,24}. This assumption is consistent with the presence of features on human and other animal bone surfaces that are caused by human chewing in Gran Dolina-TD6. This assumption is also consistent with microwear fabrics (pits and chipping) on the occlusal surfaces of the anterior teeth of ATE9-1 and *H. antecessor* that resulted from highly demanding dietary regimes with a heavy loading bite that is compatible with bone crushing to access the marrow^{24,25}. Thus, non-thermal processed foods, including tough and/or hard items, as well as contaminant grit from the soil, are expected to have been part of the diets of *H. antecessor* more than *H. heidelbergensis*. Both *H. heidelbergensis* and Neandertals show a clear reduction in microwear densities compared with *H. antecessor* that may relate to the differences in food-processing techniques concerning the use of more advanced tool technologies (Modes 2 and 3 might be more efficient than Mode 1)...Accordingly, the distinct microwear patterns of *H. antecessor*, characterized by high microwear densities, suggest that it might have specialize in the consumption of harder and/or tougher foods (more mechanically-challenging) than *H. ergaster* and Neandertals...the highly abraded buccal surfaces of *H. antecessor* could indicate the ingestion of a large amount of grit-laden foodstuffs.” (Perez-Perez et al. 2017).

“The highly abraded enamel microwear patterns that have been observed in the earliest Atapuerca hominids (1.2–0.8 Myr ago) are clearly distinct from Iberian Neandertals and *H. heidelbergensis*. Our findings suggest that *Homo antecessor* could have specialized in the exploitation of tough, hard and brittle foodstuffs with adhered grit particles, which may include underground plants (including grit), collagen or connective tissue, and bone. This

mechanically-demanding diet would have required strong shearing and grinding processes during food consumption, although unprocessed meat breakdown requires less chewing force than tough plant foods that increase the scratch formation rates²⁹. Thus, hunting or scavenging to obtain animal resources³⁰ may also be consistent with the highly abrasive microwear pattern that is observed...Furthermore, not-fully developed tool technologies for food preparation, either lithic or otherwise, may have resulted in scarcely processed foods that included high amounts of abrasives that would also contribute to the highly abraded enamel surfaces that were observed.” (Perez-Perez et al. 2017)

ENCEPHALIZATION

“A high-quality diet including meat consumption may have not only fueled the energy gain that is needed to support an enlarged brain³¹, which is the case of H. antecessor with a brain size of approximately 1,000 cc compared with H. ergaster (764 cc)...” (Perez-Perez et al. 2017).

“The cranial capacity of H. antecessor was 1,000 to 1,150 cm³ (1,050 cm³ on average).” (Birn 2010).

LIFE HISTORY

“Homo antecessor fossil material suggests...crown formation times that are not yet modern, though there is some evidence of modern human-like timing of tooth formation and eruption.” (Robson & Wood 2008).

“Studies of dental development that have been carried out on the Atapuerca hominids have revealed that H. antecessor and H. heidelbergensis both had a pattern of dental development like that of modern humans. Because of Smith’s predictions that an essentially modern human life-history schedule would appear once cranial capacity reached over 1000 cm³ (e.g., Smith 1991), the Atapuerca hominids were reasoned to have had a life-history pattern like modern humans.” (Thompson, Krovitz & Nelson 2003).

CLOTHING

“The earliest colonizer of southern Europe was by the smaller-brained H. antecessor who deployed a simple flake-based technology, lacked the technologies of thermal buffering through hide acquisition and controlled use of fire, relying instead on functional body hair...The brief incursions into northern Europe prior to c. 600 ka might be regarded as pioneering phases, which succeeded for short periods until climate cooled. It would seem that the earliest pioneers found it difficult to cope with the cyclical changes in climate and the successive depopulation or extinction and subsequent recolonization required (Hublin and Roebroeks 2009; Dennell et al. 2011; Roebroeks et al. 2011).

By contrast, the larger-brained H. heidelbergensis first arrived in Europe at the end of the early Middle Pleistocene (Wagner et al. 2010; Stringer 2011b; 2012; Olle et al. 2013). They quickly

colonized both southern and north-western regions...” (Coward, Hosfield, Pope, Wenban-Smith 2015).

SEXUAL DIMORPHISM

“The sexual dimorphism of *H. antecessor* was the same as in its European successors *H. heidelbergensis* and *H. neanderthalensis*, but less than in its probable ancestor *H. ergaster* or *H. georgicus*.” (Birn 2010).

Homo Rhodesiensis

INTRODUCTION

Who was *Rhodesiensis*?

—controversy surrounding the classification of this *Homo*

“Most scientists now regard *Homo rhodesiensis* as to be the local (African) representative of *Homo heidelbergensis* and as such the direct ancestor of anatomically modern humans.” (Wikipedia, ‘*Homo rhodesiensis*’).

“Most scholars agree on a speciation event in Africa about 800 ka ago when *Homo erectus* gave rise to a new species (e.g., Hardt and Henke, 2007). Some call this new species *H. heidelbergensis* (Rightmire, 1998), while others have proposed *Homo rhodesiensis* (McBrearty and Brooks, 2000) or archaic *H. sapiens* (Brauer, 1984). The new species expanded around 700–600 ka ago to Europe, and its first definite fossil evidence is the type-specimen from Mauer, where it was already in 1908 named *H. heidelbergensis*. It is generally believed that this Middle Pleistocene species is the ancestor to the Neanderthal lineage in Europe, whereas in Africa *H. rhodesiensis* evolved into *H. sapiens*.” (Wagner et al. 2011).

“*Homo rhodesiensis*, nicknamed Rhodesian Man and sometimes classified as *Homo sapiens arcaicus*, is a possible direct ancestor of *Homo sapiens* that lived in Africa between 125,000 and 450,000 years ago (and probably even longer ago). Their fossil remains show some primitive traits shared with *H. ergaster* and *H. antecessor*, and other traits that allow us to link them to *H. heidelbergensis*, but they also had other traits that relate them to *H. sapiens*...Most current paleoanthropologists believe this archaic human group to be within the variability of *H. heidelbergensis*.” (Birn 2010).

FOSSILS

“*Homo rhodesiensis* is known from three skulls, each found at different localities at a considerable distance from each other. The Kabwe skull is nearly complete, missing only a portion of the skull base. The Saldanha skull consists of only the braincase, with no face or skull base, and the Bodo skull, with only the face and the top of the braincase.” (Sawyer & Deak 2007).

“Another African cranium is known from Broken Hill (now Kabwe) in Zambia, where it was discovered by miners in 1921. Quarrying for lead and zinc ore had already removed most of a small hill when the miners broke into the lower part of an extensive cavern. Published reports do not all agree on this point, but apparently the cranium was picked up by itself, not in clear association with other hominin remains. The fossil is in remarkably good condition (Fig. 1). The face is massive, with some of the heaviest brows on record. The frontal is flattened with slight midline keeling, and the vault is low in profile. Shortly after it was found, the Broken Hill fossil was attributed to the new species *Homo rhodesiensis*. In its overall morphology, however, Broken Hill resembles *Homo erectus*, and indeed it has been classified this way on more than one occasion. At the same time, it shares apomorphic features with later humans.”(Rightmire 2008).

“A cranium quite similar to that from Broken Hill comes from the farm Elandsfontein, near Saldanha Bay on the Atlantic coast of South Africa...The reconstructed Elandsfontein skullcap is composed of the frontal and parietal walls and some of the occipital. The bones are cracked and heavily weathered, but the braincase is not distorted. There are some similarities to *Homo erectus*, but certainly the better match is with Broken Hill. These two Middle Pleistocene specimens are alike not only in overall proportions, but also in many anatomical details (Table 1). The Elandsfontein brow is almost as thick as that of Broken Hill, and the frontal contours are the same.” (Rightmire 2008).

MORPHOLOGY & LOCOMOTION

“In many respects, these skulls are similar to those of *Homo heidelbergensis*. As characteristic of *H. heidelbergensis*, the bridge of the nose in both the Kabwe and Bodo skulls is markedly depressed and very wide, widely separating the eyes. In Kabwe, however, the nose opening is smaller, and the cheek bones are narrower, attaching much higher on the upper jaw than in either *H. heidelbergensis* or Bodo...The skull bone is characteristically thick. The Kabwe palate is large...The open skull sutures indicate a relatively young adult. Its heavy tooth wear suggests this individual ate abrasive foods.” (Sawyer & Deak 2007).

“At Kabwe two-thirds of the lower half of a right arm bone, a right and left hip bone, the lower portion of the backbone articulating with the pelvis (sacrum), a right and left thigh bone, and a complete left shin bone are all preserved...In most respects, the bones are similar to those of modern humans. The shin bone joint surfaces, however, were oriented in such a way that the foot would have been markedly pigeon-toed when the knee cap faced forward. Overall the long bones appear to have relatively thick shafts, thicker than those of Africans presently living in the same region, but within the modern human range...Assuming human proportions and based on shin bone length (416 mm), the Kabwe individual would have been 165 cm tall [5 ft 4 in].” (Sawyer & Deak 2007).

PROCESSING & INGESTION

Tools/Animal Butchery—

“Tools associated with the Kabwe remains are made of chert and quartz and are worked on both sides. There is a granite ball that seemed to be shaped into a sphere with worked ivory, bone, and horn. Some of the bone and horn appears to have been used as digging tools. It has been suggested that the sphere shaped ball may have been used for grinding food. The Saldanha dunes and the Bodo deposits both have a rich tool assemblage, which includes bifaces (hand axes) and specialized tools.” (Sawyer & Deak 2007).

Potential Cannibalism?

“Cut marks on the Bodo skull suggest it was defleshed after it died. It is not certain whether this was done as part of a burial ritual or for food.” (Sawyer & Deak 2007).

DENTAL ADAPTATIONS

“None of these fossils preserve jaw bones, and only the Kabwe remains preserve teeth. Unfortunately, these are too heavily worn with dental caries for comparing measurements. An upper jaw fragment of another small Kabwe individual preserves only a wisdom tooth and fragment of the second molar, so it too has a limited value for comparisons.” (Sawyer & Deak 2007).

ENCEPHALIZATION

“The mean brain case volume for the three individuals is 1267 cc (range 1325 cc to 1225 cc).” (Sawyer & Deak 2007).

Homo Heidelbergensis

AUTHOR NOTE

Before exploring this theory—and its significance to diet—I first want to mention other forms of Archaic humans—especially the ones that inhabited Europe. Again nobody knows with any certainty; but one possibility is that hominid, called Heidelbergensis, split from Erectus perhaps 800k years ago and, indeed, stayed in Africa but also migrated into Eurasia. This migration likely occurred during one of the Sahara Pumps—which is basically a period of climate change when the Sahara receives rains and becomes covered in grasslands, allowing for the migration northward of people who were probably following herds of ruminants. Heidelbergensis was similar to Erectus, except that his brain was bigger, expanding from about 900 to 1200cc, close to the size of modern humans. The evidence, which is sparse, suggests the he hunted large mammals such as horses, probably stampeding them into lakes and then killing them; they also used wooden spears, and probably were dependent upon the use of fire to keep themselves warm and to cook their food. However, because the prey bones of animals at their site were generally not marked with lithic tools, it has generally been assumed that, though they hunted, they were not necessarily all that successful. In an environment that was cold—and devoid of plant foods for much and even most of the year—their lack of skills probably limited them greatly; indeed some sites suggest that they resulted in cannibalism for their survival.

Furthermore, their numbers seemed to never really expand and within time, they likely evolved into another species called Neanderthals; indeed, some remains have been found that suggest hominids that were in the midst of that evolution, possessing characteristics of both species.

INTRODUCTION

Position in Hominin Lineage & Genetic Analyses—
(Buck & Stringer 2014).

—likely ancestor of Neanderthal (no) and Homo Sapiens in Africa: he himself evolved from Erectus

There are two main hypotheses for Homo Heidelbergensis' place within the hominin evolutionary tree. One is that Heidelbergensis was a species widespread in Europe, Africa and mainland Asia who descended from Erectus and was the last common ancestor of modern humans, Neanderthals, and Denisovans. In contrast, the other hypothesis proposes that Heidelbergensis was strictly a European species ancestral to the Neanderthals and the Denisovans. In turn, this hypothesis suggests that Homo sapiens descended from a different African Middle Pleistocene species such as Homo rhodesiensis. With this hypothesis, the last common ancestor of modern humans and Neanderthals would have existed farther back in time around the time of Homo antecessor whose fossil remains have been dated to about 800-900,000 years ago. Currently there is a lack of fossils from the time range that the last common ancestor of modern humans and Neanderthals is thought to have existed, preventing researchers from reaching a consensus on the location and particular hominin from which Neanderthals and modern humans diverged from.

Support for the hypothesis that Heidelbergensis was strictly a European species ancestral to the Neanderthals and Denisovans has come mainly from the fossils of one site in Spain known as Sima de los Huesos. The 28 hominins found at Sima are unique among fossils designated as Heidelbergensis in that they display certain Neanderthal-like characteristics. In line with these observations, an analysis of the nuclear DNA of the Sima hominins published just recently in 2016 revealed that these hominins were indeed either early Neanderthals or closely related to the ancestors of Neanderthals and existed around 430,000 years ago.

Unlike the Sima hominins, other fossils classified as Heidelbergensis from Africa, Asia and elsewhere in Europe do not display Neanderthal features. These fossils present a combination of primitive and derived features that would be expected of a species that evolved from Homo Erectus/Ergaster and was ancestral to Neanderthals and modern humans. Those features which are derived do not appear to be specific to Neanderthals as those observed among the Sima hominins, nor are they clearly those of modern humans.

Thus, taken together, with the Sima de los Huesos hominins removed from the Heidelbergensis taxon, the current assemblage of fossils representing Heidelbergensis support the contention that this species was the last common ancestor to the Neanderthals and modern humans. However, to add another layer of complexity, the nuclear DNA analysis study of the Sima

hominins mentioned before proposed a much earlier date of divergence between Neanderthals and modern humans based upon their results and an average rate of genetic mutation. The new estimate of divergence ranging around 550-765,000 years ago calls into question whether Heidelbergensis who is currently estimated to have existed from about 800,000 to 200,000 years ago could have been the common ancestor to both. As stated before, a fossil found in Spain dating to 900,000 years ago known as Homo antecessor may be a better candidate, but so far the only remains of this largely unknown species are from Spain.

“The concept of Homo heidelbergensis remains at the center of such discussions, as this species represents the probable ultimate ancestor of these three daughter taxa: sapiens, neanderthalensis, and Denisovans.” (Stringer 2012).

“Some researchers propose H. heidelbergensis as an Afro-European taxon that is ancestral to both modern humans and Neandertals whereas others think it is a strictly European species that is part of the Neandertal lineage...our additional data and evidence do not entirely discount the “European hypothesis,” according to which H. heidelbergensis was ancestral to Neandertals while another African form led to AMH (Arsuaga et al., 1993, 1997), given the similarities of the European middle Pleistocene specimens with classic Neandertals.” (Mounier et al. 2009).

“As a matter of fact, we do not know when and from where the humans that were ancestral to both the Neanderthals in Europe and Homo sapiens in Africa originated (Rightmire, 1998, 2008).” (Profico et al. 2016).

“The hominin Homo heidelbergensis, which lived between about 800,000 and 200,000 years ago, has long been considered a candidate for the common ancestor of Neandertals and modern humans. But the species is controversial, because whereas some researchers think it lived in Europe, Africa, and Asia, others see it as a European species only (and give other names to similar hominins on other continents).” (Balter 2014).

“The big-brained H. heidelbergensis has claimed an important perch in the human evolutionary tree: It's regarded by many as the common ancestor of modern humans and our extinct closest cousins, the Neandertals. Dating to roughly half a million years ago, it is thought to link those species and the earlier H. erectus, which had spread across Africa, Asia, and Europe beginning 1.8 million years ago. But based on a new look at the incomplete fossil evidence, some scientists argue that the picture was much more complicated, and that the transition between small-brained H. erectus and larger brained hominins occurred multiple times. If so, the concept of a single, multicontinental, intermediary species could dissolve into a plethora of hominin specimens with no single name to unite them.” (Balter 2014).

“What is H. heidelbergensis' position in the human family tree? Because of the presence of some claimed Neanderthal traits, such as in the morphology of the teeth and the shape of the face, in European Mid-Pleistocene specimens, some researchers have argued that H. heidelbergensis is the ancestor of Neanderthals to the exclusion of the African fossils and H. sapiens (Figure 1A). In this scenario, similarities between African and European

Mid-Pleistocene hominins are merely primitive traits inherited from *H. erectus*; *H. sapiens* is descended from a separate African Mid-Pleistocene species (possibly *H. rhodesiensis*), and the last common ancestor of *H. sapiens* and Neanderthals would lie chronologically further back, perhaps in the form of *H. antecessor*, thus far only recognised from the site of Gran Dolina at Atapuerca (Spain) at ~800 ka. The hypothesis of *H. heidelbergensis* as uniquely ancestral to the Neanderthals is highly dependent on the inclusion of the remains from another site at Atapuerca, the controversial Sima de los Huesos ('Pit of the bones'), which is where most of the fossils with claimed Neanderthal affinities come from. The more than 6000 fossils from that site show distinctive Neanderthal features, but have often been included in the *H. heidelbergensis* taxon because of their supposed great age (up to 600 ka). Further research has now suggested that the material looks too Neanderthal and is too young (~400 ka) to represent *H. heidelbergensis*, making these fossils early Neanderthals instead. However, adding extra complexity, recent findings reveal the Sima people's mitochondrial DNA to be more similar to that of the Denisovans (see below) than Neanderthals. Are they our ancestors? African *H. heidelbergensis* material, such as Broken Hill, shares numerous features with European fossils such as Petralona, leading many to group them together. As long as Mauer is also included, this taxon can be named *H. heidelbergensis*. Proponents of this wide concept of *H. heidelbergensis* assert that the mosaic of primitive and derived features shared by this group of fossils is unique, with few traits linking them exclusively to either modern humans or Neanderthals (Figure 1B). *H. heidelbergensis* is thus hypothesised to be the last common ancestor of both Neanderthals in Eurasia and *H. sapiens* in Africa. This scenario is probably the most popular and well supported at present." (Buck & Stringer 2014).

The Sima de los Huesos hominins from Spain previously classified as *H. heidelbergensis* have recently been shown to either be early Neanderthals or closely related to the ancestors of Neanderthals who had diverged from a common ancestor shared with Denisovans. The dating of the Sima hominins to 430,000 years ago pushes back to the date of divergence between the Neanderthals and Denisovans, and further pushes back the divergence of the Neanderthal and modern human lineages to between 550,000 & 765,000 years ago. This new dating based upon genetic data and the average rate of genetic mutation is too far back for *Homo heidelbergensis* who lived from 800,000 to 200,000 years to have been the common ancestor of modern humans and Neanderthals. An older hominin such as *Homo antecessor* whose only remains as of yet were found in Spain may be a more probable candidate for the common ancestor of both lineages.:

"*H. heidelbergensis* got a big boost when researchers working at the site of Sima de los Huesos in Spain attached the name to the remains of 28 hominins found there. But in a paper last month in *Science* (20 June, p. 1358), the Sima team, led by Juan Luis Arsuaga of the Complutense University of Madrid, argued that these 430,000-year-old hominins were more closely related to Neanderthals and don't belong in *H. heidelbergensis*." (Balcer 2014).

"The nuclear DNA, Meyer's team reports in *Nature* on 14 March, shows that the Sima hominins are in fact early Neanderthals. And its age suggests that the early predecessors of humans diverged from those of Neanderthals between 550,000 and 765,000 years ago — too far back for the common ancestors of both to have been *Homo heidelbergensis*, as some had posited.

Researchers should now be looking for a population that lived around 700,000 to 900,000 years ago, says Martínón-Torres. She thinks that *Homo antecessor*, known from 900,000-year-old remains from Spain, is the strongest candidate for the common ancestor, if such specimens can be found in Africa or the Middle East.”(Callaway 2016).

“Seventeen Middle Pleistocene crania from the Sima de los Huesos site (Atapuerca, Spain) are analyzed, including seven new specimens. This sample makes it possible to thoroughly characterize a Middle Pleistocene hominin paleodeme and to address hypotheses about the origin and evolution of the Neandertals. Using a variety of techniques, the hominin-bearing layer could be reassigned to a period around 430,000 years ago.

The sample shows a consistent morphological pattern with derived Neandertal features present in the face and anterior vault, many of which are related to the masticatory apparatus. This suggests that facial modification was the first step in the evolution of the Neandertal lineage, pointing to a mosaic pattern of evolution, with different anatomical and functional modules evolving at different rates.” (Arsuaga et al. 2014).

“The chronology established for LU-6 and LU-7, on the basis of several independent techniques with reproducible results, provides a minimum age of ~430 ka for the SH human fossils, which is some 100 ka younger than previously reported (37). With this new age, the SH hominins are now the oldest reliably dated hominins to show clear Neandertal apomorphies. Notably, the improved chronology for the SH assemblage is compatible with the latest dental and genetic evidence for Middle Pleistocene evolutionary divergences (38, 39) and enables us to state with certainty that the modern human/Neandertal most recent common ancestor dates to sometime before ~430 ka (pre-MIS 11).

The considerably enlarged SH cranial sample is morphologically quite homogeneous. In addition to some plesiomorphic traits in the cranial vault (such as the low position of the maximum cranial breadth), derived Neandertal traits are present in the midfacial projection, morphology of the supra-orbital torus, and the glenoid cavity. Although the occipital morphology is not Neandertal-like, there is a flat supratotal surface that may be derived in the direction of the Neandertals. Finally, the SH mandibles and the dentition also show a derived Neandertal pattern, together with some distinctive dental features. In sum, the SH sample shows a constellation of derived Neandertal facial, dental, mandibular, and glenoid features that appears to represent a single functional masticatory complex. At the same time, the cranial vault lacks Neandertal specializations. This mosaic pattern fits the prediction of the accretion model for the first stage of Neandertal evolution.” (Arsuaga et al. 2014).

“Concerning the taxonomy of the SH fossils, we have long maintained that the SH hominins are members of the Neandertal lineage (16, 40). Based on the cranial evidence, we have proposed that the SH fossils, as well as the rest of the European early and middle Middle Pleistocene specimens, should be assigned to the species *Homo heidelbergensis* defined in a broad sense to include fossils with a generally more primitive morphology than the late Middle Pleistocene and Late Pleistocene Neandertals, even if they exhibit some derived Neandertal traits (19). However, the difficulty with identifying derived Neandertal features in the Mauer mandible, the

type specimen of *H. heidelbergensis*, contrasts strongly with the presence of numerous Neandertal apomorphies in the SH mandibles (41). On this basis, we suggest that the SH sample be removed from the *H. heidelbergensis* hypodigm. An alternative view of *H. heidelbergensis* is as a Middle Pleistocene taxon that includes only fossils that lack any Neandertal apomorphies, and, in this restricted sense, the species is seen as the stem group for Neandertals and modern humans (7)...Some authors have, indeed, recommended that the SH fossils be included in *H. neanderthalensis* (5, 7) as early members of this evolutionary lineage. However, although we agree that the SH hominins are members of the Neandertal clade, the present analysis has shown that they differ from Neandertals in several cranial regions that are considered taxonomically diagnostic of *H. neanderthalensis*. We argue that the SH p-deme is sufficiently different from that of *H. neanderthalensis* so as to be considered a separate taxon... Finally, the finding that these derived Neandertal features are functionally related with the masticatory complex suggests that the origin of the Neandertal clade coincides with a masticatory specialization.” (Arsuaga et al. 2014).

“In addition, the new evidence presented here based on cranial morphology confirms that the SH population differs from some other European MPHs, such as Ceprano and Arago, that do not exhibit the suite of derived Neandertal features seen in SH. Thus, more than one evolutionary lineage appears to have coexisted during the European Middle Pleistocene (42), with that represented by the SH sample being phylogenetically closer (i.e., a sister group) to the Neandertals.” (Arsuaga et al. 2014).

“A unique assemblage of 28 hominin individuals, found in Sima de los Huesos in the Sierra de Atapuerca in Spain, has recently been dated to approximately 430,000 years ago¹. An interesting question is how these Middle Pleistocene hominins were related to those who lived in the Late Pleistocene epoch, in particular to Neanderthals in western Eurasia and to Denisovans, a sister group of Neanderthals so far known only from southern Siberia. While the Sima de los Huesos hominins share some derived morphological features with Neanderthals, the mitochondrial genome retrieved from one individual from Sima de los Huesos is more closely related to the mitochondrial DNA of Denisovans than to that of Neanderthals². However, since the mitochondrial DNA does not reveal the full picture of relationships among populations, we have investigated DNA preservation in several individuals found at Sima de los Huesos. Here we recover nuclear DNA sequences from two specimens, which show that the Sima de los Huesos hominins were related to Neanderthals rather than to Denisovans, indicating that the population divergence between Neanderthals and Denisovans predates 430,000 years ago. A mitochondrial DNA recovered from one of the specimens shares the previously described relationship to Denisovan mitochondrial DNAs, suggesting, among other possibilities, that the mitochondrial DNA gene pool of Neanderthals turned over later in their history.” (Meyer et al. 2016).

“The nuclear DNA sequences of femur AT-5431 and the incisor show that they belonged to the Neanderthal evolutionary lineage, and the limited data available for the molar suggest that the same is true for this specimen. Thus, the results show that the SH [Sima de los Huesos]

hominins were early Neanderthals or closely related to the ancestors of Neanderthals after the divergence from a common ancestor shared with Denisovans.” (Meyer et al. 2016).

“Although it is difficult to determine the age of Middle Pleistocene sites with certainty, geological dating methods¹, as well as the length of the branches in trees relating the mtDNAs from femur XIII and an SH cave bear to other mtDNAs^{2,12}, suggest an age of around 400,000 years for the SH fossils. This age is compatible with the population split time of 381,000–473,000 years ago estimated for Neanderthals and Denisovans on the basis of their nuclear genome sequences and using the human mutation rate of 0.5×10^{-9} per base pair per year⁷. This mutation rate also suggests that the population split between archaic and modern humans occurred between 550,000 and 765,000 years ago. Such an ancient separation of archaic and modern humans is difficult to reconcile with the suggestion that younger specimens often classified as *Homo heidelbergensis*, for example Arago or Petralona, belong to a population ancestral both to modern humans and to Neanderthals¹⁵...Retrieval of further mtDNAs and, if possible, nuclear DNA from Middle Pleistocene fossils will be necessary to comprehensively address how Middle and Late Pleistocene hominins in Eurasia were related to each other.”(Meyer et al. 2016).

“...the existence of a taxon of the Middle Pleistocene, rather polymorphic and dispersed on a wide geographical horizon, that should be referred to *Homo heidelbergensis*. Despite controversial (Stringer, 2012; Arsuaga et al., 2014; Balter, 2014), the species named after the discovery in 1907 of the Mauer mandible, near Heidelberg in Germany (Schoetensack, 1908), has been resurrected as a proper, crucial and widespread taxon toward the end of the last century (Rightmire, 1996, 1998), pointing out to the existence of a species appeared in the late Early Pleistocene, largely distributed during the Middle Pleistocene and antedating the speciations of both *Homo neanderthalensis* and *Homo sapiens*...Nevertheless, the origins of *Homo heidelbergensis* are still unclear...We do not know the provenance of those archaic humans that spread geographically at the beginning of the Middle Pleistocene, evolved regional lineages and were ancestral to both Neanderthals and modern humans (Rightmire, 2008; Hublin, 2009; Stringer, 2012)...Looking at the hypodigm of *Homo heidelbergensis* as a whole, a considerable amount of variability is apparent, suggesting that populations of *Homo heidelbergensis* bore regional features (in Africa, Asia, and Europe respectively) because a phenomenon known as “isolation by distance” (Wright, 1943)...Combining the various available elements, *Homo heidelbergensis* may be considered as a single taxon (see Fig. 5), which probably originated in Africa and was both geographically widespread and morphologically diversified.”(Manzi 2016).

FOSSILS

Fossil Remains suggest widespread geographic distribution ranging from Africa, mainland Asia, and Europe including northern locations in England and Germany and southern locations in the Mediterranean at sites in Italy, Spain and France.

“There is at present a relatively rich fossil record that may represent the hypodigm of *Homo heidelbergensis* (Fig. 5). It embraces hominins scattered in both Africa and in Eurasia: a) in Africa, a possible list includes the fossil record of the middle of the Middle Pleistocene (e.g.,

Bodo, Kabwe, Elandsfontein), but also the more derived and relatively more recent samples that are close to the emergence of *Homo sapiens* (e.g., Florisbad, Ngaloba, Omo Kibish II, Eliye Springs, Djebel Irhoud); b) in Europe, there are relevant samples that range from northern latitudes (e.g., Swanscombe in England; Mauer, Bilzingsleben, and Steinheim in Germany) to the Mediterranean regions (e.g., the impressive material from Atapuerca Sima de los Huesos in Spain; Arago in Southern France; Petralona in Greece; Venosa and Visogliano in Italy); c) in mainland Asia, we may include all the “non-erectus” specimens formerly considered by some workers as “archaic *Homo sapiens*” (e.g., Narmada, Dali, Jinniushan).” (Manzi 2016).

“Yes, the type specimen for *H. heidelbergensis* (against which other specimens must be compared to judge their inclusion in the species) is a mandible found in 1907 at Mauer, near Heidelberg in Germany. Without the inclusion of this fossil, no group of specimens can formally be called *H. heidelbergensis*. The mandible (now dated to ~610 ka) shows features of an earlier human species (*Homo erectus*) in its size, robusticity, and lack of chin. It also shows features that ally it with later species, such as the relatively small teeth. While initially suggested as an ancestor for the Neanderthals, similarities were later noted between Mauer and remains from Arago (France), which are in turn often grouped with comparable Mid-Pleistocene fossils from Europe and Africa which are candidates for the last common ancestor.” (Buck & Stringer 2014).

Author notes: Examples: boxgrove man, close to English channel about 500k years old, had been eaten by predator evidently or at least gnawed upon after he died

“Previous research (Stringer & Trinkaus, 1999, Stringer et al., 1998) identified carnivore gnawing around the ends of the hominin tibia from Boxgrove. These modifications do not suggest that this individual was directly hunted by carnivores rather opportunistically scavenged at this location.” (Smith 2012).

“The Boxgrove 1 tibia has been assigned to *Homo cf. heidelbergensis* (Roberts et al., 1994), largely on the basis of its temporal and geographical proximity to the type specimen of that species, the Mauer 1 mandible (Schoetensack, 1908)... Thus no definitive taxonomic allocation beyond *Homo sp.* can yet be made for the tibia, although we will at times refer to the multiple species taxonomy preferred by the first author.” (Stringer et al. 1998).

“...it is possible that the apparently pronounced diaphyseal robusticity of Boxgrove 1 is a product of that individual having had relatively cold adapted body proportions like the Neanderthals.” (Stringer et al. 1998).

Sima De Los Huesos—550 human bones, dated to 350 k years ago, northern Spain, 32 individuals

-fancy axe for ritual offering?

-shared common ancestor with the Denisovans, rather than Neanderthals (though looks more like Neanderthals)

Author Note: WIKI “*Homo Heidelbergensis*” In an article of 2015, Matthias Meyer of the Max Planck Institute for Evolutionary Anthropology states: “Indeed, the Sima de los Huesos

specimens are early Neanderthals or related to early Neanderthals,” after his team had scanned this DNA for markers found only in Neanderthals, Denisovans or modern humans, they found that the nuclear genomes of those specimens were significantly more similar to Neanderthals. “And that suggests the Neanderthal-Denisovan split happened before 430,000 years ago”.

“Sima de los Huesos is one of the most complex Pleistocene sites at Sierra de Atapuerca (Burgos, Spain). This pit has yielded a number of 28 hominids dated around 400 kyr. This is the most complete collection of Middle Pleistocene *Homo heidelbergensis* around the world... This site is now well known for the exceptional number of fossils attributed to *Homo heidelbergensis* recovered from systematic excavations. These specimens make up about 80% of the Middle Pleistocene hominid remains in the world [3], [4], [5] and [7]. Recent radiometric dating situates the hominid deposit as between 400 and 600 kyr ago [11].”(Carbonell & Mosquera 2006).

Kabwe (rhodesian Man) Zambia--tooth cavities, in ten of the upper teeth (may have died of infection related to teeth)

In Germany 8 throwing spears, 300k old and 16k animal bones

Bodo (Ethiopia)—600,000 ya, likely evidence of postmortem butchering representing ritual defleshing or cannibalism—

“A nearly complete cranium, Bodo has been dated to relatively early in the Middle Pleistocene (estimated at 600,000 ya), making it one of the oldest specimens of *H. heidelbergensis* from the African continent (Clark et al. 1994). The Bodo cranium is particularly interesting because it shows a distinctive pattern of cut marks, similar to modifications seen on butchered animal bones. Researchers have thus hypothesized that the Bodo individual was deflected by other hominins, but for what purpose is not clear. The deflection may have been related to cannibalism, though it also may have been for some other purpose, such as ritual. In any case, this is the earliest evidence of deliberate bone processing of hominins by hominins (White 1986)...A recent reanalysis of hominin cranial remains originally discovered in the early 1970s from Gombore II, located in the Upper Awash region of Ethiopia, suggests the presence of *Homo heidelbergensis* in Africa around 850,000 ya (Profico et al. 2016). Although these fragments represent a very incomplete cranial vault, they provide the earliest potential evidence of *Homo heidelbergensis* in Africa.” (Jurmain, Kilgore, Trevathan, Ciochon, & Bartelink 2017).

ENVIRONMENT

**more on climate and potential adaptations to cold under Social Dynamics

In Spain:

“During the early Middle Pleistocene (~0.6–0.4 Ma), as compared to earlier, environmental conditions were relatively more stable, with longer climatic cycles alternating between open and forested landscapes. During this interval, humans spread successfully providing an important number of fossil sites where fossils or tools are reported. The Atapuerca-Sima de los Huesos (Burgos, northern Spain) site (Atapuerca-SH) is one of the earliest localities with hominin evidence in the European Middle Pleistocene, with the most important accumulation of *Homo heidelbergensis* so far...The timing of the spread of *Homo heidelbergensis* is dominated by a

relative climatic and environmental stability and points to a landscape dominated by savannah-like open woodland.” (Garcia & Luis Arsuaga 2011).

“At the end of the Early Pleistocene, around 0.8 Ma, the southwest-European climate grew significantly drier, which continued through subsequent interglacial periods (Suc et al., 1995 and Bertini, 2000)...This savannah-like open woodland, were likely the same hunting territories of *H. heidelbergensis*.” (Garcia & Luis Arsuaga 2011).

The environment of *Homo heidelbergensis* at the Galeria and Gran Dolina sites in Atapuerca, Spain dating to about 500-200 ka consisted of open landscapes with some trees that transitioned to more open woodlands at times.: “...open although not tree-less landscapes dominated throughout this cultural phase (Table 9). A particularly open landscape may correspond to TD10-4 and, especially to TD10- 3, where Poaceae pollen is extremely abundant, Mediterranean species are scarce in the pollen spectra and the small mammal assemblages are devoid of woodland species. However, other periods inside this phase were dominated by open woodlands similar in character to those inferred for the two previous cultural phases.” (Rodriguez et al. 2011).

The paleoenvironment at Mauer Germany where the mandible used to define *Heidelbergensis* was found consisted of a forest covered floodplain punctuated with areas of dense forest set amongst more open landscapes including open woodland. The climate was warm to temperate with mild winters.:

“Due to their stratigraphic association with the mandible of *H. heidelbergensis* the analysis of the mammal fauna from the ‘lower sands’ allows – within limits – the reconstruction of his palaeoenvironment. In the large mammal fauna several taxa are climate-sensitive and indicate the presence of temperate-climate conditions. These are hippopotamus (*Hippopotamus amphibius*), wild boar (*Sus*), roe deer (*Capreolus*), straight tusked elephant (*E. antiquus*), forest rhino (*Stephanorhinus hundsheimensis* and *Stephanorhinus kirchbergensis*) and red deer (*Cervus*). The presence of hippopotamus indicates open waters that did not freeze permanently in wintertime and therefore the existence of higher mean annual temperature or other factors, which cause milder winters than today. The finds of deer, stag and elk point to a wooded landscape with open spaces. Bison (*Bison schoetensacki*) and especially horses (*Equus mosbachensis*) indicate open habitats.” (Wagner et al. 2011).

“Cold and/or continentally adapted species are completely missing among both large and small mammals. Therefore, the environment can be described as a forest-covered floodplain, forest at the hillside slopes and more open wooded areas on the hills. Thus, *H. heidelbergensis* lived apparently in a warm-temperate climate, with a mean annual temperature only little above that of the present day (Koenigswald, 1997). The landscape, accessible to *H. heidelbergensis* at Grafenrain, was a wide river plain near the southern tip of a meander. In the meandering riverbed there were active sand bars that would occasionally become flooded. As the artefact finds indicate, humans inhabited and used the floodplain, probably for hunting and fishing as well as for manufacturing tools from flint pebbles (Loscher et al., 2007). At the riverbank, in the forests and in the open areas, habitats were available with their rich game and wood resources.

Contemplating also the mild climate conditions it appears that the site was quite a favourable environment for early humans.” (Wagner et al. 2011).

At Boxgrove, England:

“The landscape which *H. heidelbergensis* inhabited consisted of a coastal lagoon, surrounded by grassland and salt marshes. Inevitably, this location would have attracted a range of fauna from the surrounding habitats...red deer, wild horses, and boar...bison, elephants, lions, hyenas, rhinoceros and wolves...The most obvious sign of the presence of *H. heidelbergensis* consists of around 300 flint handaxes which have left their mark on the bones of a range of large mammals including deer, horse, bison and rhinoceros. Geological analysis demonstrates that the handaxes were produced locally, the flint obtained from nearby cliffs. The presence of suitable flint nodes and substantial numbers of large mammals must have made this a favored habitat for *H. heidelbergensis*...The period between 400,000 to around 100,000 years ago was characterized by a series of extreme climatic events which made most of Britain completely inhospitable to archaic humans. Evidence for the presence of archaic humans in Britain at this point is scant. We can expect that the descendants of *H. heidelbergensis* and related species retreated southwards to refuges on the continent...advancing glaciers marred any attempt at prolonged colonization.” (Eaton 2014).

“Boxgrove is especially important, because it was occupied primarily during a warm interglacial period (when plant foods were most abundant) at the time that humans first appeared above 42 degrees North.” (Hoffecker 2005).

SENSES

HEARING

auditory sensitivity closer to humans than chimps

“Here we use a comprehensive physical model to analyze the influence of skeletal structures on the acoustic filtering of the outer and middle ears in five fossil human specimens from the Middle Pleistocene site of the Sima de los Huesos in the Sierra de Atapuerca of Spain. Our results show that the skeletal anatomy in these hominids is compatible with a human-like pattern of sound power transmission through the outer and middle ear at frequencies up to 5 kHz, suggesting that they already had auditory capacities similar to those of living humans in this frequency range.” (Martinez et al. 2004).

“Thus, our analysis shows that the skeletal anatomy of the outer and middle ear in the SH [Sima de los Huesos] hominids is compatible with a human-like sound power transmission pattern, clearly different from chimpanzees in the critical region of ≈ 4 kHz. Because the SH hominids are not on the direct evolutionary line that gave rise to our own species, but form part of the Neandertal evolutionary lineage (19–21), it is conceivable that this condition was already present in the last common ancestor of modern humans and Neandertals. Analysis of Neandertal mtDNA suggests that this last common ancestor probably lived at least 500 thousand years ago (40–42), and it has been argued to be represented among the

800,000-year-old fossils from the TD6 level at the site of Gran Dolina (Sierra de Atapuerca, Spain) attributed to the species *Homo antecessor* (43, 44)...From this point of view, our results suggest that the skeletal characteristics of the outer and middle ear that support the perception of human spoken language were already present in the SH hominids.” (Martinez et al. 2004).

MORPHOLOGY

Author notes: size—similar to *Erectus*: males about five nine and 136 lbs; females 5 and 2 and 112 lbs; only slightly taller than Neanderthals (and average about 5 and 7)

some population suggests they were giants in South Africa, over 7 feet between 500 to 300 k years ago

weight—claims thinner than *Erectus* but seem pretty damn thin to me

muscle attachments suggest that he was heavily muscled

“We know from their long bones that they were tall, strong people.” (Buck & Stringer 2014).

“Physically, some *H. heidelbergensis* individuals are the most massive-bodied in the human fossil record. The thick, bony walls of their limb bones, strongly marked muscle attachment sites, and very broad pelvic bones suggest large, powerfully built bodies for some of them. This implication is echoed for some *H. heidelbergensis* individuals by the large size of joints which are, in living humans, highly correlated with body weight. *H. heidelbergensis* has added a few more modern features to the bauplan visible in its presumed ancestor *Homo erectus*. The shoulders have modernized. Gone is the peculiar combination of low-torsion humeri and short clavicles, implying more forward facing shoulder joints in some more primitive hominins.” (Gurche 2013).

H. heidelbergensis displays shoulder morphology allowing for increased shoulder mobility and greater forward range of motion of the upper limbs. It is tempting to link these derived characteristics that appear to have begun with *H. antecessor* to the advantages of having increased shoulder mobility for throwing projectile weapons. Range of motion continued to evolve in the *Homo* lineage, with modern humans have the greatest shoulder mobility and associated range of motion.:

“A total of fifteen clavicular fragments, seventeen scapular fragments, and thirty-three humeral fragments are known from the middle Pleistocene site of Sima de los Huesos, Sierra de Atapuerca, Spain. Unfortunately, only one of these specimens from the shoulder region of *H. heidelbergensis* is complete: Humerus II (Fig. 1). This humerus is very long, falling well above mean values for both Neanderthals and modern human samples. The humeral head is wider than it is long, like that in later Neanderthals and unlike that in modern humans. Carretero, Arsuaga, and Lorenzo reported a humeral torsion value of 142 degrees, which is considered somewhat low for modern humans, but again similar to Neanderthals (Fig. 7)...Overall, the morphology of the shoulder region in *H. heidelbergensis* appears to be most similar to that of later Neanderthals...Following early *H. erectus*, clavicular elongation formed the basis for a second major transformation in the hominin shoulder, possibly occurring as early as the lower Pleistocene, judging from the very long clavicle known for *H. antecessor*. I suggest that this

clavicular elongation pushed the scapula to a more dorsal position so that the glenoid fossa faced laterally, which concomitantly required an increase in humeral torsion. Such a shift in scapular position would have dramatically increased the range of upper limb motion, particularly in the posterior direction. It is interesting to speculate about the selective factors that may have brought about this change. One potential selective force favoring such an increase in shoulder mobility is throwing, which entails a significant component of posterior motion of the abducted arm during the cocking phase. As long as people have been attempting to explain the origins of upright posture and bipedalism, the throwing of objects for self-defense and hunting has been included as a significant factor contributing to the survival and success of the human lineage.^{83–86} Unfortunately, there is little physical evidence of when and where throwing skill might have evolved. Preuschoft recently noted, in reference to the potential influence of throwing in hominin evolution, that “at present, the claims reach further than the facts.” However, the discovery of 400,000-year-old throwing spears suggests that it had developed by at least the middle Pleistocene. The anterior position of the shoulder postulated here for early *H. erectus* would not have permitted the abducted arm posture that is an integral component of the form of overhand throwing we are familiar with today. It is interesting, in this context, to note that one incidental complaint of people with short clavicle syndrome is that they cannot throw well.^{48,49} Effective throwing, therefore, could have been an important selective influence in transforming the pectoral girdle/shoulder complex from the condition in *H. erectus* to that resembling modern humans.” (Larson, S.G. 2007).

“...*H. heidelbergensis*, is a large, robust-bodied descendent of *H. erectus*...*H. heidelbergensis* was characterized by relatively large body mass with wide pelvises that had flaring iliac blades and long pubic rami compared with modern humans, indicating a wide body shape.” (Begun, Ed. 2013).

“The hand bones lack the apelike features of the hand of *H. habilis*. In many of these postcranial features—as well as others found in clavicles, scapulae, and humeri—the postcranial anatomy of *H. heidelbergensis* resembles the morphology seen in *H. neanderthalensis*...” (Begun, Ed. 2013).

“The Boxgrove hominid specimens have been assigned to *Homo heidelbergensis* and the size of the tibia suggests a robust individual at least 175 cm in height [5 ft 7 in] (Trinkaus et al., 1999).” (Bello et al. 2009).

“The human tibia found at Boxgrove has been described as robust, similar to those of Neanderthals, but more robust than those of modern humans (Roberts et al., 1994; Stringer et al., 1998; Trinkaus et al., 1999), with a morphology interpreted as an adaptation to greater activity and the relatively harsh climatic conditions in Northern Europe during an interglacial that was probably cooler than the Holocene (Stringer et al., 1998; Stringer and Trinkaus, 1999).” (Bello et al. 2009).

“The Boxgrove tibia is currently thought to have been 15-16 in total length (375-400 mm) and to have belonged to an adult male roughly 6 feet in height (1.77-1.82 m). This suggests a relatively tall individual with long limbs—more typical of modern people from southern latitudes

and comparable even to the early *Homo erectus* skeleton from Nariokotome in Kenya. At the same time, the large circumference of the Boxgrove tibia shaft suggests a total body weight of more than 200 lbs (80 kg), which is substantially heavier than the mean for adult males among tropical peoples. The Boxgrove specimen thus delivers a mixed message. Adaptation to cold climate in *Homo heidelbergensis* is not evident so far in limb dimensions, but might be reflected in increased body mass. However, a much larger sample of postcranial remains is required to assess properly the role of morphology in the early settlement of Europe. Furthermore, it should be kept in mind that morphological adaptations to northern climates could have included soft parts—such as a thicker coat of body hair—that are not preserved in the fossil record.”(Hoffecker 2005).

“The SH hominins could be included within the “wide Homo” bauplan due to their absolutely and relatively large and ML-wide biotype consisting of a large thorax with broad shoulders and pelvises, above-medium-height body, thick bones, and great musculature and body mass. This body shape is also largely present in other early and middle Pleistocene individuals and in Neandertals.” (Arsuaga et al. 2015).

“Systematic excavations at the site of the Sima de los Huesos (SH) in the Sierra de Atapuerca (Burgos, Spain) have allowed us to reconstruct 27 complete long bones of the human species *Homo heidelbergensis*. The SH sample is used here, together with a sample of 39 complete *Homo neanderthalensis* long bones and 17 complete early *Homo sapiens* (Skhul/Qafzeh) long bones, to compare the stature of these three different human species. Stature is estimated for each bone using race-and sex-independent regression formulae, yielding an average stature for each bone within each taxon. The mean length of each long bone from SH is significantly greater ($p < 0.05$) than the corresponding mean values in the Neandertal sample. The stature has been calculated for male and female specimens separately, averaging both means to calculate a general mean. This general mean stature for the entire sample of long bones is 163.6 cm [5 foot 3.6 in, mean for male and female] for the SH hominins, 160.6 cm for Neandertals and 177.4 cm for early modern humans. Despite some overlap in the ranges of variation, all mean values in the SH sample (whether considering isolated bones, the upper or lower limb, males or females or more complete individuals) are larger than those of Neandertals. Given the strong relationship between long bone length and stature, we conclude that SH hominins represent a slightly taller population or species than the Neandertals. However, compared with living European Mediterranean populations, neither the Sima de los Huesos hominins nor the Neandertals should be considered 'short' people. In fact, the average stature within the genus *Homo* seems to have changed little over the course of the last two million years, since the appearance of *Homo ergaster* in East Africa. It is only with the emergence of *H. sapiens*, whose earliest representatives were 'very tall', that a significant increase in stature can be documented.” (Carretero et al. 2012).

“The individual analyzed here (Jinniushan) from northeastern China at 260,000 years ago is the largest female specimen yet known in the human fossil record and has body proportions (body height relative to body breadth and relative limb length) typical of cold-adapted populations elsewhere in the world...Body size in *Homo* appears to peak in the Middle Pleistocene with

specimens such as Boxgrove and the Atapuerca sample (1, 10), and Jinniushan is consistent with this pattern. Her large estimated body mass is also again consistent with ecogeographic principles (Bergmann's rule), i.e., a tendency among geographically widespread species to increase in body size in higher latitudes, probably as an adaptation to decrease surface area to body mass in colder climates (4, 28). It is also consistent with the observation that Middle Pleistocene humans, who were presumably less culturally buffered from the environment by such technological adaptations as insulating clothing and fire, may have had a steeper clinal distribution of body proportions than more recent humans (6)...Jinniushan's geographic location in the far north of China suggests a cold-adapted population. We see this reflected in her large body size, wide trunk, and relatively short limb length. She thus adds to the growing body of evidence for ecogeographic clines in body size and shape among Early and Middle as well as Late Pleistocene Homo(4, 9, 10, 29)." (Rosenberg, Zune, & Ruff 2006).

"It was the first early human species to live in colder climates; their short, wide bodies were likely an adaptation to conserving heat." (Smithsonian 2016).

Although African Heidelbergensis also was taller and more massive with a stockier build suggesting that the cold climates of the north were not the only factor in the selection for this body type.: "Fragmentary fossils (variously attributed to Homo heidelbergensis, H. rhodesiensis and H. helmei) from across Africa suggest that these archaic humans were both taller and more massive than their extant modern human descendants in this region, and perhaps had a body shape that was stockier and less 'nilotic' than seen among extant sub-Saharan Africans... The available fossil evidence suggests that large body size was the norm in Middle Pleistocene Africa, as well as in Europe (e.g. at the Sima de los Huesos site in Spain: Arsuaga et al. 1999) and Asia (e.g. at Jinnushan, China: Rosenberg et al. 2006). Human body size may have reach its apogee in Middle to early Late Pleistocene times, with a pan-Old World sample of 550,000 to 400,000 year old fossils having a mean estimated mass some 16.7% larger than the worldwide mean of living humans (Ruff et al. 1997)...This suggests a shift away from the 'nilotic' body proportions seen in the Early Pleistocene Homo ergaster skeleton from Nariokotome and that characterize equatorial Africans today. Although on average taller, the African archaic humans are most similar in body build to Neanderthals (and most likely other European and Asian archaic humans), which is surprising given that the wide bodies of Neanderthals are generally interpreted as a reflection of thermoregulatory adaptation to cold climates.

While it is clear that mean annual temperatures dropped across Africa during glacial periods (Hostetler and Clark 2000) and that upland areas may even have seen glacier formation, it is unlikely that Middle Pleistocene Africans experienced the extreme cold endured by their European and Asian contemporaries. It is more likely that the stocky build inferred for archaic Middle Pleistocene Africans is a reflection of the combined effects of foraging ecology and thermoregulation. Archaic humans across the Old World were part of a large-bodied fauna (and can themselves be seen as the large-bodied versions of humans), which in Africa included a number of now extinct giant herbivores, such as the giant buffalo (*Pelorovis antiquus*), giant hartebeest (*Megalotragus priscus*), giant Cape zebra (*Equus capensis*) and various large-bodied warthogs (*Metridiochoerus andrewsi* and *M. compactus*) (Klein 1984). The Middle Pleistocene ancestors of extant taxa were also larger than modern forms by 20% or more (Anderson 1984;

Peters et al. 1994; Brink 1993). Larger body size was likely selectively advantageous in cooler and drier Pleistocene environments with lower productivity, as larger animals have greater day-journey lengths and can better utilize lower quality food sources, and thus they monopolize a disproportionate amount of the energy in local ecosystems (Brown and Maurer 1986). Perhaps, more importantly, increased aridity and seasonality during glacial cycles (deMenocal 2004) may have favored larger individuals, since within species individuals with larger body sizes have greater fasting endurance (see review in Reynolds 2007). During periods of reduced productivity, carnivore size would also be expected to increase due to thermoregulatory factors, increased prey size, intensified aggressive interactions within the carnivore guild, and demands for both greater mobility and greater fasting endurance as carrying capacity diminished and secondary biomass was reduced. Carnivore body size is a key variable in prey body size selection and in success rates with prey of varying size, and for humans who were most likely engaged in close-range hunting of large-bodied herbivores (see Churchill, 1993, 2002; Schmitt et al. 2003), body size—especially mass and muscularity—was no doubt critical to hunting success (Churchill and Rhodes, 2006). Thus, to the extent that AMP archaic humans were predatory, they would have experienced selection pressures for larger size similar to those experienced by other members of the carnivore guild (see discussion in Churchill and Rhodes, 2006).” (Churchill, Berger, Hartstone-Rose, & Zondo 2012).

HEAD & FACE

“*H. heidelbergensis* skulls differ from those of modern people in having thicker walls, larger and more projecting faces, and well-developed brow ridges...the brow ridges are more massive than in any living human, the forehead more sloped, the upper jaw taller, and the face more robust.” (Gurche 2013).

LOCOMOTION

“The biomechanics of bipedalism had reached an essentially modern state in *H. erectus* in the Early Pleistocene [108], so any changes in pelvic morphology during the Middle Pleistocene are unlikely to reflect major locomotor adaptations.” (Gruss & Schmitt 2015).

“Pelvic anatomy in *H. heidelbergensis* (sometimes referred to as ‘Archaic *H. sapiens*) is known primarily from high-latitude individuals from Europe and Asia (figure 3; [37,97,116,119,120]). These pelvises are very large overall and remarkably wide: the specimens from Atapuerca (Spain) and Jinniushan (China), for example, have the largest bi-iliac breadths in the human fossil record, and are wider than the average for any modern human population studied by Ruff [2]. This great overall breadth reflects both a very wide transverse diameter of the birth canal and a high degree of iliac flare in *H. heidelbergensis*—although generally less than in earlier *Homo* [2,37,100,116,119,120]. Again, these two aspects of pelvic breadth are probably linked biomechanically [2,60].” (Gruss & Schmitt 2015).

“The limb bones are robust with large joints capable of resisting high joint forces associated with running and long-distance walking...The wide body shape and robust build of *H.*

heidelbergensis suggests that they were not particularly well-designed for endurance running, but were fully committed bipeds capable of traveling long distances.” (Begun, Ed. 2013).

“H. heidelbergensis...its postcranial skeleton suggests that its robust long bones and large lower limb joints were well suited to long-distance bipedal walking.” (Klenerman & Wood 2006).

Larger Home Ranges due to living in larger groups and the more restricted resources in northern European climates:

“A fourth significant difference arising from Fig. 4 and associated statistics is between H. erectus and Homo heidelbergensis ($Z = -3.426$, $p = 0.001$). Here the larger area requirements of the latter species are due to a combination of larger groups and the expansion of this species into Europe at various times over the last 750,000 years (Gamble, 2009).” (Grove, Pearce, & Dunbar 2012).

DIET

ANIMAL FOODS

CAPTURE

TOOLS

Author Notes: 500k years ago hafted stone points for spears, in south Africa mostly same tools as used by Erectus, bifacial stone axes, cleavers and carvers as Mode 2 technology, also later populations made tools from deer antlers, bone and wood, into scrapers, hammers and throwing spears
wooden spears, with ten butchered horses in Schoningen Germany

HUNTING

Author notes: remains of wild deer, horses, elephants, hippos and rhinos with butchery marks have been found with Heide bones

At Boxgrove, England:

“The number of Lower Paleolithic sites with clear evidence of hominin modification of skeletal material, however, is limited. One of the few and most important Lower Paleolithic localities is the early Middle Pleistocene site Boxgrove (UK; MIS 13), which yielded well-preserved fossil material of butchered carcasses of different larger mammal species (Ursus deningeri (Deninger's bear), Cervus elaphus (red deer), Megaloceros sp., Equus ferus (wild horse), Stephanorhinus hundsheimensis (Merck's rhinoceros), and Bison sp.; Parfitt and Roberts, 1999).” (Van Kolschoten, Buhre, & Verheijen 2015).

“Recently published results from Boxgrove suggest that the early Europeans were probably consuming significant quantities of meat and marrow obtained from large mammals...Impact features were also observed on a number of bones—presumably smashed open to extract the marrow.” (Hoffecker 2005).

“Boxgrove offers a few clues for understanding what *H. heidelbergensis* was doing at the site. There are no traces of the consumption of small mammal species here, despite their obvious presence within the landscape, nor is there any evidence for habitation at the site. This suggests that *H. heidelbergensis* was moving meat elsewhere, perhaps to a base camp further inland...Considerable debate has raged for more than a century over the extent to which archaic humans were capable of hunting prey species, rather than just scavenging kills made by predators. Some of the animal bones at Boxgrove do indicate that they were gnawed by large mammals such as lions and hyenas, as well as being marked by the handaxes of *H. heidelbergensis*. Yet close examination reveals that these mammalian teeth marks almost always overlie the marks left by flint tools. This suggests that lions and hyenas were scavenging kills left by *H. heidelbergensis*, rather than the other way round. The absence of evidence for the consumption of small mammals by archaic humans at Boxgrove indicates an element of selectivity in the meat they consumed, symptomatic of hunting rather than scavenging behavior. Circumstantial evidence supports this view. It is unlikely that rhinoceroses had any natural predators at Boxgrove. Scavengers would therefore only have access to animal which had died of natural causes. Yet the carcasses preyed upon by *H. heidelbergensis* mainly belong to relatively healthy individuals who appear to have died in the middle of their life expectancy, rather than the weak, diseased or old. It can be assumed that *H. heidelbergensis* was consciously selecting rhinoceroses to predate on the basis of their size and weight for consumption. Hunting and killing large mammals must have required planning, teamwork and a considerable amount of risk. *H. heidelbergensis* may not necessarily have relied upon handaxes for this difficult task. A shoulder blade belonging to a wild horse killed by *H. heidelbergensis* contains a noticeable hole which may have been caused by a spear point. Such a weapon would have consisted of a flint spearhead mounted on a wooden shaft. The successful deployment of a spear designed to kill a wild horse would demand skill, strength and experience. *H. heidelbergensis* was not a primitive form of human, but rather a species capable of sophisticated hunting behavior enabling them to thrive...” (Eaton 2014).

At Schöningen site in Germany:

“...the faunal evidence from Schöningen provides clear arguments that late Lower Paleolithic hominins at the site were successful hunters of large ungulate prey. This is based on the accumulation of dozens of extensively butchered large-bodied equids, mainly prime-aged adult and juvenile animals, found alongside the wooden hunting implements (Thieme, 2000, Thieme, 2005, Thieme, 2007a, Thieme, 2007b, Voormolen, 2008, van Kolfschoten et al., 2012, van Kolfschoten, 2014 and Julien et al., 2015a; Starkovich and Conard, 2015). This is particularly the case at Schöningen 13 II-4, 12 II-4, and 12 B. It is clear that the Schöningen hominins were able to anticipate the behavior of prey to the extent that they knew that equids and other ungulate taxa would be repeatedly drawn to this spot on the landscape for its reliable supply of water. The diverse hunting equipment recovered from the localities at Schöningen, most notably the Horse Butchery Site, was clearly produced well in advance of its use and represents curated personal gear rather than expedient technology produced spontaneously immediately prior to executing a hunt...Nearly all of the evidence for prey selection and butchery indicates that

hominins had primary access to the carcasses while the carnivores had secondary access...We further hypothesize that successful hunts could only occur through well-coordinated activities and that successful kills of single large prey or multiple animals in one event would provide the subsistence base for social aggregation and high levels of social engagement and communication.” (Conard et al. 2015).

“Excavations at the Spear Horizon site also revealed a paleo landscape with a high concentration of remains of *E. mosbachensis* (horse), *C. elaphus* (red deer), and large bovids (*Bison priscus* and *B. primigenius*), with clear indications of hominin modification either related to the production of knapping tools and hammers or with butchering activities related to the exploitation of meat and marrow.” (Van Kolfshoten, Buhrs, & Verheijen 2015).

WIKI—“A 300,000 years old archeological site in Schöningen, Germany contained eight exceptionally well-preserved spears for hunting, and various other wooden tools. Five-hundred-thousand-year-old hafted stone points used for hunting are reported from Kathu Pan 1 in South Africa, tested by way of use-wear replication.” (Wikipedia “Homo heidelbergensis”).

“Here I describe some wooden throwing spears about 400,000 years old that were discovered in 1995 at the Pleistocene site at Schöningen, Germany. They are thought to be oldest complete hunting weapons so far discovered to have been used by humans. Found in association with stone tools and the butchered remains of more than ten horses, the spears strongly suggest that systematic hunting, involving foresight, planning and the use of appropriate technology, was part of the behavioral repertoire of pre-modern hominids...All three spears, although of different lengths, were manufactured to the same pattern, with the maximum thickness and weight at the front; the tails are long, and taper towards the proximal end. In all of these respects they resemble modern javelins, and were made as projectile weapons rather than thrusting spears or lances.” (Thieme 1997).

These spears were carefully made and were not made on the spot or right before a hunt. They would have required significant time to make and were made from the wood of a tree not thought to have grown within the area. Their design suggests sophistication that could only have been arrived at with experimentation.:

“The preferred raw material for spears was slow-growing spruce that grew under dry or otherwise unfavorable conditions. The trunk and main stem of these small trees constituted ideal material for making hard and strong spears. The point of the spears was placed off center so the tip would be carved from hard wood with very close growth rings, rather than from the soft center of the tree. We argue that the characteristics of the spears were the result of experimentation, optimization, and the exchange of information within and between generations. More specifically, it is inconceivable that the spears were made in an expedient manner after a group of hominins decided to hunt. The spears almost certainly reflect curated gear, as one would expect for sophisticated and valuable hunting gear. Both the time needed to make a spear, which has been estimated to be a several hours and the fact that small, slow growing spruce trees would not be expected in the near lakeshore environment constitute arguments

against claims that the wooden hunting tools reflect expedient gear made on the spot as a result of an immediate need. Were this the case, the target prey would not be available to hunt by the time the hominins made their equipment and geared up. The far more likely scenario is that these hominins made their equipment well in advance of using it, and curated the hunting weapons beyond the impetus to make them.” (Conard et al. 2015).

“...in the town of Schöningen in Germany...Although no hominin fossils were found at the site, the location and age of the site suggests that *Homo heidelbergensis* was present. One of the sites contained flint tools, evidence of fire, and the remains of 19 horses, including many bones that show stone tool cut marks associated with butchering. The distribution of the butchered horses suggests a planned hunt of an entire herd at one time. Incredibly more than half a dozen wooden spears were found at the site...The wooden spears at Schöningen are roughly 1.8 to 2.5 meters (6 to 8 feet) in length. The spears were made from spruce or pine, and each shows signs of having been cut and shaped from small trees. The balance of the spears has the maximum thickness and weight about one third of the distance from the tip, which is similar to that of a modern-day javelin.” (Relethford 2017).

“Multiple lines of evidence indicate that ~500,000-year-old stone points from the archaeological site of Kathu Pan 1 (KP1), South Africa, functioned as spear tips. KP1 points exhibit fracture types diagnostic of impact. Modification near the base of some points is consistent with hafting. Experimental and metric data indicate that the points could function well as spear tips. Shape analysis demonstrates that the smaller retouched points are as symmetrical as larger retouched points, which fits expectations for spear tips. The distribution of edge damage is similar to that in an experimental sample of spear tips and is inconsistent with expectations for cutting or scraping tools...Behavioral traits common to both modern humans and Neandertals could represent shared traits inherited from their last common ancestor, commonly held to be *Homo heidelbergensis* (1, 2). The fossil record for *H. heidelbergensis* begins during the early Middle Pleistocene, and genetic studies situate the divergence of *H. sapiens* and Neandertal lineages at between ~800 and 400 thousand years ago (ka) (3). Because Middle Stone Age (MSA) hominins and Neandertals probably both had stone-tipped hunting equipment, it is possible that *H. heidelbergensis* also possessed this form of technology.

By ~780 ka, hominins were regularly killing large game, based on evidence of repeated in situ processing of complete carcasses of fallow deer at Gesher Benot Ya'kov in Israel (4). At the English site of Boxgrove, a horse scapula with a semi-circular perforation is consistent with spear-aided hunting by ~500 ka (5). Wooden spears dating to ~400 ka have been found in association with butchered horses at Schöningen, Germany (6). Hafted spear tips appear to be common in the MSA and Middle Paleolithic (MP) sites of Europe and Africa after ~300 ka (7–20)...Two chronometric methods situate the KP1 stratum 4a lithic assemblage in the early Middle Pleistocene ~500 ka, coeval with *H. heidelbergensis* (25) and the genetic divergence of *H. sapiens* and Neandertals (3)...Evidence for hafted hunting technologies ~500 ka is consistent with the evidence that both Neandertals and MSA hominins used hafted hunting tools and implies that this knowledge was also held by their common ancestor.” (Wilkins, J. et al. 2012).

“Boxgrove is an exceptional Lower Palaeolithic locality. Fine grained deposits that contain large quantities of lithic tools and modified fauna have been identified and excavated over a large area. These large data sets allow for a unique discussion of hominin-carnivore interactions at a landscape scale. Modifications identified and reported in this study demonstrate that hominins had primary access to most carcasses and products. This primacy can be tracked across the site and relates to animals of different sizes and that inhabited different environmental niches. Where carnivore and hominin modifications have been identified on the same specimen, the former frequently overlie the latter... At Boxgrove there is evidence for direct hominin-carnivore interaction. There is a high intensity and quantity of hominin butchery signatures compared to carnivore modifications. The Boxgrove faunal assemblage clearly indicates that by 500 kya *H. heidelbergensis* was a top predator in this environment and capable of acquiring and securing prey, of various sizes, against other carnivores such as lion and hyena... Detailed analysis of bone-surface modifications suggests evidence for primary access to a range of carcass sizes from rhino to roe deer... The ability to tackle prey species that inhabit different environmental niches and have varying predator avoidance techniques would have required a significant investment in forethought and planning.” (Smith 2012).

“The impact notch on the horse scapula from GTP 17 (Boxgrove) suggests that this individual may have been actively hunted by Lower Palaeolithic hominins. Corroborating evidence for this type of behaviour can also be drawn from the site of Schöningen (Germany) where wooden artefacts appear to have been used by hominids as spears to hunt horse (Thieme, 1997, 2005; Voormolen, 2008)... The quantity and distribution of hominin modification at GTP 17 highlights primary access to all carcass nutrients including meat, tongue, brain and marrow. The limited carnivore modification and the scapula impact point suggest an active procurement strategy, possibly through hunting... The recovery of wooden implements from Schöningen, interpreted as projectiles, suggests more active meat procurement behaviour by these hominin groups (Thieme, 1997, 2005; Voormolen, 2008)... However, horses are a strong and fast moving species not easily intercepted, and even with the use of spears like those from Schöningen, these animals first had to be cornered and caught. Levine (1999) suggests that the most suitable method for capturing horses would be through ambush or corralling of multiple individuals. Thus, the spears could have been used to wound the animals before waiting for them to expire through exhaustion, similar to modern Kung San pursuit hunters (Lee & Devore, 1968). Alternatively if groups of horses, or other animals, were returning to a known location such as a waterhole or lakeshore (as at both Boxgrove and Schöningen) then this would have presented the opportunity to track and surprise a larger group... Voormolen (2008) has suggested this as an explanation for the presence of multiple horse individuals at Schöningen, which includes foals... It is possible that GTP 17 represents the end of a pursuit hunt that started with the animal being ambushed near a known location and chased until it eventually collapsed and died.” (Smith 2012).

SEAFOOD

“The current evidence places coastal resource use back to the Middle Pleistocene during which a significant leap in the encephalization quotient occurred with the appearance of *H. heidelbergensis* (Ruff et al. 1997)... In Europe, the Middle Pleistocene sites Clacton-on-sea and

Boxgrove (Roberts and Parfitt 1999) are located in coastal settings but no direct evidence of marine resources use has been documented. So far, the oldest evidence for shellfish consumption (de Lumley et al. 2004; Villa 1983) comes from Terra Amata (400 ka) and Grotte du Lazaret (250 ka) associated with *H. heidelbergensis*.” (Bicho, Haws, & Davis).

“If coastal resources supplied this “brain-specific nutrient (DHA) at the time of major relative brain size increase, evidence for coastal settlement and subsistence should date to roughly 500,000 years ago with the appearance of archaic *Homo sapiens* or *H. heidelbergensis* (Parkington 2001; Ruff et al. 1997). In Europe, the importance of coasts to early humans has been difficult to ascertain given the rarity of coastal Pleistocene sites. Despite this problem, the available evidence shows that early humans occupied coastal zones. The Lower Paleolithic site of Boxgrove is located in a coastal setting, but marine resource utilization by *H. heidelbergensis* is not evident (Roberts and Parfitt 1999). In her taphonomic appraisal of Terra Amata, Villa (1983) reported the recovery of burned *Mytilus* shells that would appear to confirm their collection and consumption by humans. At Grotte du Lazaret, shells from several species of marine gastropods, bivalves, echinoderms, brachiopods, and bryozoans provide evidence for transport and use of marine resources (de Lumley et al. 2004).” (Bicho, Haws, & Davis).

PLANT FOODS

While there is no direct evidence of plant consumption at the Schöningen site in Germany, there are many plant foods in the region that may have been consumed, both as food and possibly even as medicine.:

“At this stage of research, despite the locality's remarkable preservation, there is no direct and unambiguous evidence for the use of plants in the diet of the Schöningen hominins. The environment of the locality, however, contained a large number of plants potentially useful for hominins, including a range of sedges and vitamin-C-rich pine and birch bark, bearberries, elder, raspberry, and *Ranunculus* or *Chenopodium* leaves (Bigga et al., 2015). Indeed, many plants found at Schöningen are commonly used by modern foraging groups (Densmore, 1974, Usher, 1974 and Turner and Szczawinski, 1979). A particularly good source of carbohydrates that would have been amply available in a lakeshore environment are underground storage organs (Jones, 2009), which are also eaten by our closest primate relatives such as chimpanzees (Hernandez-Aguilar et al., 2007). Unfortunately, despite their utility and our speculation that the Schöningen hominins were skilled gatherers as well as skilled hunters, remains of these kinds of plants rarely preserve archaeologically and are absent from the site. Hominins at Schöningen would also have had access to medicinal plants with mild antiseptic effects, and those that soothed injured skin or upset stomachs, such as alder bark, bearberries, and various parts of birch trees (Bigga et al., 2015). Yet, however likely the use of such plants may have been, claims for the use of medicinal plants, while plausible, remain speculative.” (Conard et al. 2015).

PROCESSING & INGESTION

The Enigmatic Handaxe:

“The handaxes made by *H. heidelbergensis*, and other pre-modern species such as *H. ergaster* and *H. neanderthalensis*, were markedly different from Oldowan artifacts because a specific form was frequently imposed onto the nodule of the stone. They required more time and skill to manufacture, especially if one accounts for the acquisition of good-quality stone and preparation of hammers from a variety of materials. Handaxes are the first types of artifacts made by *Homo* to have an aesthetic quality. This may relate to their use in social strategies for acquiring mates. Yet, like Oldowan tools, handaxes appear to have been general-purpose artifacts with a predominant use in animal butchery. Of all the artifacts that archaeologists consider, these remain the most enigmatic—as does the type of mind that created them.” (Mithen 2007).

“...imagine watching what is undisputedly a human being at a locality that will become known as Boxgrove in southern England. He is using a piece of deer antler to strike a nodule held firmly between his knees...He had begun by selecting a nodule of flint from the base of a nearby cliff and then shaped it into a rough oval by using a quartzite pebble as a hammerstone. He then switched tools to use the antler, as he knew that this would remove thinner flakes. The artifact is gradually shaped amid many pauses to assess where and how he should strike next. The result is an almost perfectly symmetrical ovate tool, one that he is pleased to show off to his companions...These hominids are known as *heidelbergensis*, and the artifact being made is a handaxe, perhaps the most enigmatic type of artifact from the whole of human prehistory.” (Mithen 2007).

Also employed simple stone flakes and tools/weapons made from wood—

“In addition to the large bifacial tools, *Homo heidelbergensis* produced simple stone flakes that were used—according to microscopic analysis of their sharp edges—to cut meat, hide, and wood. Some flakes were retouched into simple scraping and cutting tools, and these were also used on a variety of materials, including hide, wood, nonwoody plants, and bone. Compared with the finely made bifaces, the flake tools are less standardized, and the retouching of edges was often—it appears—designed to make them easier to hold in the hand...

The German site of Schoningen yielded three spears or sharpened poles of spruce (5.9-7.5 ft [1.8-2.3 m] in length) and a shorter stick sharpened at both ends. Many years ago, the broken shaft of a possible spear, with a pointed end, was found at Clacton-on-Sea in England. This specimen was fashioned from yew and exhibits traces of microscopic working along the point. Wood is rarely preserved in deposits of such age (400,000—300,000 years old), and the fact that a specimen was found, combined with the microscopic evidence of woodworking on flakes and flake tools, suggests that wooden tools—at least of simple design—were common.” (Hoffecker 2005).

Development of the Levallois technique:

“...at first glance, a look at stone tool typology might suggest that not much alteration has occurred between the tools of *Homo erectus* and those of early *H. heidelbergensis*. The same types of tools (hand axes and cleavers) were still being made generation after generation. The evidence for change is faint.

A closer look, according to some archaeologists, reveals some significant improvements in the way stone tools are made, even if the types of tools seem constant. One stone tool method invented during the time of *Homo heidelbergensis* is notable because it involves advance visualization of the tool. This prefabricated tool method, called the Levallois technique, involves shaping a tool while it is still attached to the stone core, then striking the result off as a finished tool. This technique gave the tools maximum edge per unit of weight. Manufacture of stone tools using soft hammers, perhaps made of wood, was introduced during the time of *H. heidelbergensis*. The use of soft hammers allows the production of thinner, sharper flakes. Tools made from long stone blades appear during this time as well.

During the time of later *Homo heidelbergensis*, a new type of archaeological assemblage, called the Middle Stone Age, appears in Africa, replacing the hand-axe dominated Acheulean tradition in many places. Several new types of tools appear with the Middle Stone Age, including points which may have been hafted onto spear shafts.” (Gurche 2013).

“The Acheulian technology of *H. erectus* carried over into the Middle Pleistocene with relatively little change until near the end of the period, when it became slightly more sophisticated...Some of the later premodern humans in Africa and Europe invented a method—the Levallois technique—for controlling flake size and shape, resulting in a “turtle back” profile. The Levallois technique required several complex and coordinated steps, suggesting increased cognitive abilities in later premodern populations.” (Jurmain, Kilgore, Trevathan, Ciochon, & Bartelink 2017).

“Acheulean tools are also interesting because they represent the longest existing type of stone tool, found not only with *Homo erectus*, but also with populations of *Homo heidelbergensis*. For many hundreds of thousands of years, *H. heidelbergensis* continued to use Acheulean tools in Africa and Europe. It is not until about 300,000 years ago that *H. heidelbergensis* invents a new type of stone tool manufacture known as the Levallois technique. These Levallois tools are also known as prepared-core tools, which is an apt description of how they are made. The tool-maker prepares the initial core by removing small flakes around the perimeter of the stone core to get a particular shape. Small flakes are then removed from the front surface of the core and then a sharp blow is used to strike off the finished tool from this surface. The surface is then reflaked and a second blow is used to strike off another tool identical to the first. This is essentially the start of mass production, allowing a number of identical tools to be made from a single core. It is also an efficient method because you can get more mileage out of a single stone core. Because it is hard work to move stones from where they are found to where you need to use them, the more use you can get out of individual stone cores, the better. Making these tools requires considerable skill and foresight to be able to see the final product emerge from a number of intermediate steps. It is worth noting that Neanderthals, who are descended from *Homo heidelbergensis*, also used tools that were made using the Levallois technique.” (Relethford 2017).

(Jurmain, Kilgore, Trevathan, Ciochon, & Bartelink 2017).

Handaxes from Boxgrove, UK were used primarily for butchery to slice through large mammal carcasses. The production of the handaxes involved the use of bone or antler hammers to thin and finish the tools. Use wear analysis also indicates that these tools were continually resharpened in order to maintain a sharp cutting edge.:

“The handaxes are typically between 80 and 150 mm long, flaked on both faces and knapped to maximise cutting edges. During the final stages of knapping, bone or antler hammers were used to thin and finish the tool and the tips of many of the hand axes are characterised by the removal of a sharpening (‘tranchet’) flake from their tip (Bergman and Roberts, 1988; Bergman et al., 1990)...Retouched flakes and scrapers were extremely rare at the site and this supports the hypothesis that acheulean handaxes functioned primarily as butchery tools...Microwear analysis of a sample of the ~400 handaxes from Q1/ B has identified use traces resulting from butchery tasks (Mitchell, 1997). Significantly, these traces, together with the morphology of the cut marks, indicate that the handaxes were used with a slicing action to process large mammal carcasses. Although use traces have been found along the edges of the Boxgrove handaxes, the tranchet tip was the focus of re-sharpening thus implying that the maintenance of this cutting edge was of primary importance...From the anatomical location and orientation of cut marks, it has been predicted that specific cut marks can be linked to specific kind of butchery tasks, such as skinning, cutting, boning and dismembering (Binford, 1981, 1984; Bunn, 2001).” (Bello et al. 2009).

Bone Tools found at Schoningen site in Germany used as knapping tools and hammers:

“Detailed investigation of the large collection of knapping tools showed that Paleolithic hominins opportunistically collected bones to produce knapping tools (Van Kolfschoten et al., 2015). Fresh bones, as well as weathered ones (for example, the humerus of a saber-toothed cat and the radius of a bison), were used.” (Van Kolfschoten, Buhrs, & Verheijen 2015).

“Sima de los Huesos has yielded a single lithic item: a finely flaked handaxe on quartzite (Fig. 3), which again permits the scientific community to confirm a relation between *H. heidelbergensis* and Acheulean (or Mode-2) technology...This artefact must be ascribed to an Acheulean (or Mode 2) technology, which was the first to produce good quality, large tools made through different stages of extraction, knapping and retouching. Another example of association between Acheulean handaxes and fossils of *H. heidelbergensis* occurs at the Galería cave site, in the Trinchera locality, Atapuerca [14].” (Carbonell & Mosquera 2006).

Stone tools found at the Galería cave site in Spain: “As for the stone artifacts, they present the characteristics typical of Mode 2 techno-complex...Large shaped tools are well represented, many of them on flakes, such as handaxes and cleavers...Diversity of raw materials is high, although all could be found inside a 2–5 km radius around the site (Gabarró et al., 1999; García-Antón et al., 2002). That different raw materials were selected to make different instruments is evidence of complex behavior (Mosquera, 1998)...Use-wear analyses carried out on stone tools support the zooarchaeological data (Ollé et al., 2005), and have documented mainly butchering activities, some hide working and the sporadic work on plant material (Marquez et al., 1999, 2001; Ollé, 2003). Regarding the hominin species that carried out these

activities, the mandible found in the lower levels has been attributed to *Homo heidelbergensis* by Bermúdez de Castro and Rosas (1992).”

right handed

Butchery & Processing of Animals at Boxgrove, UK: “Modifications recorded across all these species indicate the entire range of processing activities including skinning, dismemberment, filleting, marrow extraction and removal of brain and offal. Also, various bone surface modification, indicating different carcass processing techniques, were recorded on the same specimen. Importantly, where both hominin and carnivore modifications were present on specimens, the former are consistently overlain by the latter...”

The range of processing behaviour combined with the location on the specimens in relation to other carnivore modifications indicates that hominins had primary access to these carcasses. Indeed, the quantity of modification on some specimens not only indicates evidence for intensive butchery and meat removal but also an ability to keep other scavengers at bay... There is evidence for skinning marks on the skulls of medium-sized species such as deer and horse (see Figure 6 & 7). Similarly, there is evidence for the disarticulation of the carcasses of animals of all sizes (see Table 6; see Figure 7) as evidenced by cut marks on around the scapula and pelvic girdles and around the long bone joints along with removal of the cranium as evidenced by the cut marked atlas and axis. The filleting and removal of large meat packages, from various anatomical locations, and various animal size classes can be clearly illustrated at this locale... Alongside the removal of large muscle and meat packages there is clear evidence for the exploitation of other non-meat based products including marrow, offal, and tongue; this can be clear illustrated by the cut marked mandibles and teeth of horse, rhino and cervids (see Figures 6, 9, 10).” (Smith 2012).

Butchery & Processing of Animals at Schöningen, Germany (same site where wooden spears were found):

“After hominins hunted or scavenged ungulates at Schöningen, they went to work processing the animals. A lack of caudal (tail) vertebra provides evidence for skinning, and extensive cut marks and impact fractures indicate that hominins removed meat, disarticulated the carcasses, and extracted nutrient-rich marrow from long bones (Voormolen, 2008, van Kolfschoten, 2014, Van Kolfschoten et al., 2015a and Van Kolfschoten et al., 2015b). Patterns of cut marks suggest that Schöningen hominins were skilled butchers with an intimate knowledge of the anatomy of their prey... Food storage, although not demonstrated, would be a valuable adaptation under such conditions of surplus following kills.” (Conard et al. 2015).

“The encountered wooden spears, stone artifacts, and the huge amount of bones with evidence for hominin inference indicate the presence of Lower Paleolithic hominins at the Spear Horizon site... Marks on the bones display, for example, the use of bones as knapping tools to curate stone artifacts and/or bone hammers that were most probably used to smash other bones for marrow exploitation (Van Kolfschoten et al., 2015). The humerus of the saber-toothed cat (*Homotherium latidens*) has been used as a knapping tool (Serangeli et al., 2015; Van

Kolfschoten et al., 2015); this sample shows clear scraping marks and two distinct areas of knapping damage. Long bones of *E. mosbachensis*, *C. elaphus*, *Bison priscus*, and *Bovidae* indet. have also been prepared and used as knapping tools. In addition, two horse ribs were used as a knapping tool and a horse innominate as an anvil (Van Kolfschoten et al., 2015). At least 14 horse metapodials (metacarpal and metatarsal bones) and one metacarpal bone of a bison display signs of battering, indicating their use as hammers (Van Kolfschoten et al., 2015). Six of the horse metapodial hammers (Fig. 15) and the bison metacarpus also show percussion damage that indicates that the bones were used for multiple tasks: knapping, as well as hammering. Other artificial marks on the bones are related to butchering activities such as skinning, defleshing, and marrow extraction...Skinning of the carcasses is, according to the present study, one of the major butchering activities...It is obvious that most of the horse carcasses have been taken apart. Numerous short marks that resulted from cutting joint ligaments during the process of dismembering or disarticulation are observed on the mandible, atlas, axis, scapula, humerus, ulna-radius, metacarpus, pelvis, femur, tibia, tarsal bones, and metatarsus...The marrow bearing skeletal elements (humerus, radius, femur, and tibia) in particular show a high percentage of filleting/defleshing marks (Voormolen, 2008)...The large number of impact notches (Tables 1 and 3), as well as the high degree of fragmentation of the long bones (Table 5), indicate intensive marrow procurement...Artificial breakage of bones is encountered in all four butchered larger mammal taxa. This breakage is part of the process to gain access to the enclosed marrow (Voormolen, 2008)." (Van Kolfschoten, Buhrs, & Verheijen 2015).

"The majority of the encountered butchery traces on the horse remains point to extensive defleshing or filleting. Voormolen also concluded that the high percentage of artificially modified large bovid bones "points to extensive butchering of bovid leg long-bone elements, which dominate the bovid skeletal element spectrum" (2008: 222)." (Van Kolfschoten, Buhrs, & Verheijen 2015).

DENTAL ADAPTATIONS

Author notes: human like teeth: larger than our own, but smaller than *Erectus* (according to Austral museum but jaw was large and heavy boned with strong muscles)
shape; c3 and c4; enamel; nitrogen

"In the fossil-rich Mauer sandpit near Heidelberg, Germany a massive jaw with disproportionately smaller teeth came to light in 1907...Dentally, like *Homo erectus*, *Homo heidelbergensis* had taurodont teeth. But different from earlier species, *Homo heidelbergensis* tended to have smaller posterior teeth (premolars and molars) and large anterior teeth (incisors and canines)...In addition to being smaller, *Homo heidelbergensis* molars also tended to be simpler, with a reduced number of cusps...Generalizations about *Homo heidelbergensis* belie the diversity of this species, which shows extensive variation in cranial, facial and dental form. Dentally there seems to be a divide between Asian and African *Homo heidelbergensis* on the one hand and European *Homo heidelbergensis* on the other." (Guatelli-Steinberg 2016).

“...in Europe, especially from a site in the Atapuerca mountains of Spain called “Sima de Los Huesos” (translated “Pit of Bones”), dated to 430,000 years ago *Homo heidelbergensis* has strong cranial, facial, and dental similarities to the Neanderthals that succeed them in the European fossil record...In the summer of 2014, Juan Luis Arsuaga and colleagues published a new analysis of these remains. They found that the Sima de Los Huesos remains are different from other European *Homo heidelbergensis* specimens and so derived in the direction of Neanderthals that they should be considered to form the base of the Neanderthal clade as the earliest members of that lineage. The Sima de Los Huesos hominins do not share all the derived traits of later Neanderthals, although they appear to be dentally nearly identical to them...The divergence of Neanderthals and modern humans has been estimated at more than 500 KYA based on analysis of Neanderthal DNA. Arsuaga and colleagues point out that including these specimens dated to 430,000 years ago as part of a Neanderthal clade is consistent with that evidence.” (Guatelli-Steinberg 2016).

The dental morphology of Sima de Los Huesos hominins resembles that of later Neanderthals in the pronounced shoveling of the anterior teeth. However, the SH hominins display smaller teeth than Neanderthals. “Martinon-Torres and her colleagues describe the large sample of Middle Pleistocene hominin teeth from the site of Sima de Los Huesos (SH) in northern Spain. In many respects, the 400,000 to 500,000-year-old teeth from this site show close parallels to later Neanderthals. For example, the classic anterior tooth combination of pronounced shoveling, labial convexity, and tubercular dental typifies both groups. However, in SH, there is more dental reduction than in Neanderthals, and this involves both tooth size and the loss of cusps. How SH shares some characters with Neanderthals and others with modern humans is an intriguing finding that should stimulate new lines of analysis.” (Scott & Irish, Eds. 2013).

“The data were obtained for the hominin sample of the Sima de los Huesos site in Atapuerca, Spain. The fossil record belongs to a minimum of 28 individuals of the same biological population, assigned to the species *Homo heidelbergensis*. We have estimated the original and the preserved crown height of the mandibular incisors (I1 and I2) of 11 individuals, whose age at death can be ascertained from the mineralization stage and tooth eruption. Results provide a range of 0.276–0.348 and 0.288–0.360 mm per year for the mean wear rate of the mandibular I1 and I2, respectively, in individuals \approx 16–18 years old. These data suggest that incisors' crowns would be totally worn out toward the fifth decade of life. Thus, we expect the life expectancy of this population to be seriously limited...The results show a high wear rate for incisors in the population represented by the SH hominins. This high value could be the result of a highly abrasive diet (6), the edge-to-edge occlusion, and/or some non masticatory activities, as has been suggested for other Pleistocene populations (23–25)...The strong wear also noticed in posterior teeth (26) of SH hominins suggests that teeth of European Middle Pleistocene populations would cease being operative during the fifth decade of life. Consequently, the potential longevity of this population would necessarily be limited by this circumstance. This might partially explain the low number of hominins older than 40 years of age from the European Middle Pleistocene fossil record (27).” (de Castro, J.M.B. et al. 2003).

Microwear:

From the Heidelberg jaw from Germany—

“...microscopic analysis of wear on the teeth of the Heidelberg jaw indicates that abrasive plant foods were still a major part of the diet.” (Hoffecker 2005).

Teeth from Spain—

“Casts of nonocclusal enamel surfaces of 190 teeth from the Middle Pleistocene site of Sima de los Huesos have been micrographed by scanning electron microscopy...a characteristic dietary striation pattern can be observed in most of the teeth analyzed. Most likely the diet of the *Homo heidelbergensis* hominids from Sima de los Huesos was highly abrasive, probably with a large dependence on hard, poorly processed plant foods, such as roots, stems, and seeds. A highly significant sex-related difference in the striation pattern can also be observed in the teeth analyzed, suggesting a differential consistency in the foods eaten by females and males...The sex-related differences observed suggest that females are probably eating more variable or even different food resources than males since they have significantly longer striations than males and can be clearly discriminated from the striation pattern. Sex-related differences in diet and dietary behavior among hunter-gatherer populations have been ethnologically documented for numerous modern aboriginal groups around the world...” (Perez-Perez, De Castro & Arsuaga 1999).

Teeth from Boxgrove England—

“The physical remains of a single *H. heidelbergensis* were also found at Boxgrove, in the form of a tibia from a left leg and two front teeth...The front teeth of this individual carry considerable tartar deposits, suggesting that he existed on a diet which contained a significant amount of meat. This is, of course, reinforced by the cut marks on the animal bones found nearby. Chemical analysis has found no evidence that seafood played a part in the diet of this individual. This is somewhat surprising given the original close proximity of this site to the coast. We must assume that *H. heidelbergensis* was attracted to Boxgrove by the presence of large terrestrial mammals rather than marine creatures. The two remaining teeth of this individual are heavily worn, suggesting that considerable damage was caused to them during his lifetime. The cause of this dental damage most likely lies in the method utilized by *H. heidelbergensis* to cut meat. It appears that he held animal flesh between clenched teeth whilst slicing through it with a flint handaxe. This rather dangerous technique inevitably took its toll on his dental health. Remarkably, we can even tell from a close examination of the surviving teeth that our *H. heidelbergensis* was right handed when using his stone tools.” (Eaton 2014).

“The Boxgrove incisors are a valuable addition to the British fossil hominin record and, although they are unlikely to represent the same individual as the Boxgrove 1 tibia, they derive from an adult of comparable maturity at death (cf. Streeter et al., 2001). They provide important behavioural information in the labial surface damage to the crowns and roots, indicative of heavy usage of the teeth in the processing of materials or food. Morphologically and metrically (allowing for their heavy wear), they compare well with other European middle Pleistocene lower incisors, including the Mauer mandible, type specimen of *H. heidelbergensis* (Schoetensack 1908).” (Hillson et al. 2010).

“One reasonable interpretation for the non-masticatory scratches is that food and other materials were held between the jaws whilst being cut with a stone tool, which occasionally penetrated into the material or slipped, and hence scratched the teeth. The high frequency of vertically-oriented scratches on the crowns of the teeth is consistent with observations of modern human groups of hunter gatherers described by Bax and Ungar (1999). Scratches on the Boxgrove incisors are characterised by their great number, wide distribution across much of the labial surfaces, and overlapping relationships, which suggest that the use of the front teeth as tools included regularly repeated activities undertaken through the life of the individual...The non-masticatory scratches on the roots were also produced by one or more stone tools...Their predominantly “right oblique” orientation is consistent with a right-handed tool user cutting obliquely...The heavy wear on the Boxgrove teeth, like that on all other Pleistocene hominin teeth, suggests that the forces applied to the dentition greatly exceeded those normal in people today.” (Hillson et al. 2010).

Homo heidelbergensis of all ages and genders commonly used their teeth as a third hand: “Labial striations on the teeth of the SH [Sima de los Huesos] Middle Pleistocene Homo heidelbergensis population were caused by the interaction between a lithic tool, one hand and the anterior teeth. These striations occurred when a material was held tightly with the anterior teeth and one hand, using the other hand for cutting the material with a stone tool. During this process, the edges of the stone flake can cut the enamel of the teeth, leaving characteristic cutmarks with specific shapes and orientations...our results emphasize that activities depending on the use of the teeth as a third hand represent a common behavior among Middle Pleistocene hominin populations, since striations are present on the teeth of all the SH individuals, including those of a 3- to 4-year-old.” (Lozano et al. 2009).

“In this study we examine the labial and occlusal surfaces of incisors and canines of hominins recovered from the Sima de los Huesos (SH), middle Pleistocene site, in order to establish the possible extra masticatory use of anterior teeth. We have compared the microwear of these fossils with microwear from the anterior teeth of Australian Aborigines, a population characterized by ethnographic evidence of the use of their teeth as a third hand. These two samples of teeth were microscopically analyzed using Scanning Electron Microscopy (SEM). Our results support the “cultural” origin of microwear observed on fossil teeth: we conclude that the SH hominins used their anterior teeth as a “third hand” for para- or extra-masticatory activities...Certain dental wear features are consistent with the processing of some of these resources for manufacture of clothing, cordages, and wooden implements.” (Lozano et al. 2008).

The use of anterior teeth as a third hand among the Australian Aborigines & Eskimos: “The presence of vestibular-lingual striations, enamel flakes, and polished enamel on the occlusal surface of SH hominins support the hypotheses that the anterior teeth were used as a tool. We also found these wear features in Australian Aborigines, a population known ethnographically to use their anterior teeth as tools (Barrett, 1977; Collier, 1983; Brown and Molnar, 1990). Australian Aborigines use their anterior teeth for many activities such as holding, slicing, cutting,

and pulling different kinds of materials, such as vegetable fibers, dry emu, and kangaroo sinews. One of the tasks frequently carried out is the removal of the bark from branches in order to manufacture digging sticks (Barrett, 1977). The bark is usually dry and this causes a great deal of abrasion on the occlusal and labial surfaces of the teeth. The formation of vestibular-lingual striations must mainly be related to the handling of flexible materials. Several Eskimo groups have been seen to perform certain activities with their anterior and/or posterior dentition. The most widely documented of these activities is the chewing and pulling of the dry skins of caribou and seal in order to soften them (Ryan and Johanson, 1989). Eskimos also prepare threads from the sinews of these animals. This procedure involves holding one end of the sinew with the anterior teeth and separating the various threads with the hands. The threads are used to sew furs, holding them between the anterior teeth and a hand, and sewing them with the other...All of the SH individuals had vestibular-lingual striations, which implies holding and stretching materials between the anterior teeth was a habit common to the entire group...The processed materials must have been sufficiently abrasive to wear down the dental enamel. Sinews, nerves, skins, and vegetable fiber strips such as barks and branches can cause this type of wear. SH hominins had access to the sinews, nerves, and skins of the animals they hunted and scavenged (Huguet, 1997; Rosell, 2001; Ciceres, 2002)...All the microfeatures we have documented imply that SH hominins used their anterior teeth as a tool...This type of behavior would have been generated with *Homo heidelbergensis* and reached other species, such as the Neandertals. We do not have documented evidence of vestibular striations in earlier *Homo* species, such as *Homo erectus*. Using their anterior teeth as a tool for holding and cutting material must be understood as a way that these hominins adapted one part of their body to compensate for a lack of certain tools. These hominins must therefore have attained a higher degree of behavioral complexity than earlier *Homo* species (i.e. they must have developed the ability to exploit their environment beyond the basic objective of consuming food in order to survive).”(Lozano et al. 2008).

Dental Caries:

“Kabwe (Zambia) 1: This skull is one of the oldest known to have tooth cavities. They occur in 10 of the upper teeth. The individual may have died from an infection related to dental disease or from a chronic ear infection.” (Smithsonian 2016).

FIRE

Author notes: evidence of fire use 790k years ago Gesher Benot Ya-agove Israel, fire altered tools and burnt wood
do not know if fire was controlled

“The most widely accepted earliest confirmed date for the use of fire comes from the site of Gesher Benot Ya’aqov (GBY) in Israel, dating to almost 790,000 years ago. Here, researchers found burned pieces of flint, as well as burned fruits and wood. When flint is burned at high temperature it leaves characteristic features that can be identified. These burned artifacts were not distributed uniformly throughout the site, but instead occurred in several clusters, which were suggested to have corresponded to the location of hearths. Although wildfires can reach

high enough temperatures to burn flint, such fires would be widespread and not clustered. At the GBY site, less than 2 percent of the flint and wood was actually burned, too low for a wildfire but consistent with a controlled fire. There are Acheulean tools at the GBY site but no hominin bones, which makes it difficult to identify who used the fire. Acheulean tools are associated with both *Homo erectus* and *Homo heidelbergensis*. The date of 790,000 years ago fits with *H. erectus*, but also with early *H. heidelbergensis*. To date, *H. erectus* has not been found conclusively further west in Eurasia than the Dmanisi site in Georgia, while *H. heidelbergensis* did live as far west as Spain and England. Perhaps the GBY site marks the movement of early *H. heidelbergensis* populations out of Africa and through the Middle East into Europe. On the other hand, western expansion of *H. erectus* into the Middle East is not unreasonable. We will need hominin fossils from the area to provide more insight into the specific ancestor, but for the moment, we can see that the GBY site gives strong evidence for controlled fire by some species of *Homo*.” (Relethford 2017).

“The beginnings of hide use could reflect differences in scavenging and hunting; being first to the kill would have been an imperative for the recovery of undamaged hides. Therefore the evidence for hunting at Boxgrove at 500 ka (Roberts and Parfitt 1999a) also indicates prime access to hides and their potential use.” (Coward, Hosfield, Pope, Wenban-Smith 2015).

“Evidence for the scraping of hides from microwear studies of tools from Hoxne and Clacton-on-Sea may indicate the presence of protective clothing. Because evidence for tailored fur clothing in the form of eyed needles and other items associated with its production among tribal peoples is confined to modern humans, the clothing of *Homo heidelbergensis* must have been simple—probably limited to wraps, ponchos, blankets. Such clothing would have provided little protection against very low temperatures (except perhaps while sleeping)...Overall, technology related to clothing and shelter seems to have been very limited.” (Hoffecker 2005).

“...an equally plausible possibility is that *Homo heidelbergensis* developed one or more novel adaptations to higher latitudes that have yet to be teased out of the fragmentary record. These novel adaptations could have included:

1. Increased body size and thicker body hair.
2. Physiological responses to low temperatures.
3. Increased consumption of meat (related to intensified hunting)
4. Expanded wood and hide technology (including hunting weapons and clothing)
5. Expanded use of controlled fire

Such adaptations seem more likely—if not inevitable—if *Homo heidelbergensis* managed to sustain itself in Europe during the two major cold intervals that occurred between 500,000 and 300,000 years ago. Mean winter temperatures would have fallen significantly below those of today during these glacial episodes.

Although the majority of sites date to phases when climates were as warm as or warmer than present, there are at least several significant exceptions. Traces of occupation during the earlier glacial interval are reported from the upper levels at Boxgrove in England and from the lower levels at Cagny-Cimetiere in northern France. Occupations dating to later glacial periods are thought to be present at Arago, Ariendorf on the Rhine, and also at Markkleeberg in eastern

Germany. If additional evidence for glacial-phase habitation accumulates, the case for cold adaptations in *Homo heidelbergensis* will become stronger.” (Hoffecker 2005).

COMMUNICATION

Author notes: perhaps prelinguistic system of communication, one of the first to vocalize (Smithsonian 2016).

“Regarding language, studies about both hyoid bones and mid-ear bones [19] of *Homo heidelbergensis* from the Sima de los Huesos seem to point to the existence of a language at this stage of the human evolution.” (Carbonell & Mosquera 2006).

Based on the inner and outer ear anatomy of five *Heidelbergensis* individuals from Sima de Los Huesos, these hominins would have been able to perceive sound frequencies associated with modern human speech. Their estimated vocal tract proportions further suggest that these hominins would have been capable of producing the full range of sounds associated with modern human speech. The SH hominins’ human-like hyoid bones also indicate that they were capable of producing the subtle, timed and distinct sounds characteristic of human speech.: “The present study presents new data on the abilities of *Homo heidelbergensis* to produce and perceive the sounds emitted during modern human spoken language. The pattern of sound power transmission was studied through the outer and middle ears in five individuals from the Sima de los Huesos, four chimpanzees and four modern humans. The results were then used to calculate the occupied bandwidth of the outer and middle ears, an important variable related with communicative capacities. The results demonstrate that the Atapuerca SH hominins were similar to modern humans in this aspect, falling within the lower half of the range of variation, and clearly distinct from chimpanzees. Specifically, the Atapuerca SH hominins show a bandwidth that is slightly displaced and considerably extended to encompass the frequencies that contain relevant acoustic information in human speech, permitting the transmission of a larger amount of information with fewer errors. At the same time, the presence of a complete cervical segment of the spinal column associated with Cranium 5 from the Sima de los Huesos Middle Pleistocene site (Sierra de Atapuerca, Spain) makes it possible to estimate the vocal tract proportions in *H. heidelbergensis* for the first time. The results demonstrate that it is similar to the reconstructed vocal tract in the La Ferrassie 1 Neandertal individual, which has been suggested to have been capable of producing the full range of sounds emitted during modern human spoken language. These results in the Atapuerca (SH) hominins are consistent with other recent suggestions for an ancient origin for human speech capacity.”(Martinez et al. 2013).

“Perhaps important in this regard is the presence in the SH sample of two human-like hyoid bones, indicating the lack of laryngeal air sacs in *H. heidelbergensis* (Martínez et al., 2008). This absence of the air sacs is an important anatomical feature for creating subtle, timed, and distinct sounds, which are necessary for human speech (de Boer, 2012). The Atapuerca SH humans apparently already had this capacity.” (Martinez et al. 2013).

“Taking into account all the anatomical evidence available for the anatomy of the SVT and the external and middle ear in the Middle Pleistocene human fossils from the Sima de los Huesos, it is clear that they were capable of producing and efficiently perceiving a larger set of sounds than chimpanzees. The results show that both the proportions of the SVT and the occupied bandwidth of the external and middle ears, were slightly different from those of modern humans, indicating that the evolution of speech capacity may have been more gradual than previously believed.” (Martinez et al. 2013).

CULTURE

Author Note: no art, but stone tools and red ochre (Smithsonian 2016).

“Middle Pleistocene is extremely poor in symbolic traces...Other traces of Middle Pleistocene symbolism may be found at the so-called figurines of Berekhat-Ram (Israel) [18] and Tan-Tan (Morocco) [8].” (Carbonell & Mosquera 2006).

“Some authors have suggested advances in spatial cognition to nearly modern levels during the time of *Homo heidelbergensis*, even using the world Euclidean in describing their understanding of space. Bifaces (tools worked on both sides) generally become more beautiful during this period, at least to modern eyes. The earlier clunky hand axes are replaced by a wider variety of more carefully crafted and aesthetically beautiful tools that seem to go beyond what is necessary for butchering animals. This is another hint that something is changing in this lineage, perhaps involving a growing sense of aesthetics. Some have suggested that the conceptualization of two-dimensional symmetry used in the making of *Homo erectus*—associated hand axes gives way to three-dimensional conceptualization in the time of *H. heidelbergensis*.” (Gurche 2013).

The deliberate placing of bones at Sima de los Huesos, Atapuerca Spain ~400,000 ya suggests *Heidelbergensis* may have buried their dead.:

“On the contrary, human remains are mostly concentrated inside a quite discrete sedimentary level, which cannot be explained by any kind of catastrophic nor attritional event, according with the age's profile. The recent finding of an Acheulean handaxe at the Sima de los Huesos cave site casts light on the evolution of human behaviour during the Middle Pleistocene. It is a finely flaked quartzite handaxe, which is associated with the hominid assemblage. The particular nature of the deposit involving its taphonomy, palaeontology, and technology points to a symbolic meaning both of the tool and the human accumulation. This would support the hypothesis of human mortuary practices performed at the Sima around 400 kyr ago. This discovery allows us to extend human complex behaviour and symbolism of mortuary rituals 300 kyr earlier than broadly heretofore accepted.” (Carbonell & Mosquera 2006).

“The discovery at Sima de los Huesos of the quartzite handaxe in the midst of this human assemblage hence appears to be particularly significant. Obviously, it may eventually move to have fallen into the Sima shaft while being carried by someone close to the site. However, other

implications are worth consideration. Firstly, there is no lithic waste, or tool whatsoever in the Sima; this handaxe is the only such object accompanying a hominid assemblage which should be considered unusual, if not unique, in world-wide terms – one composed of about 3000 *H. heidelbergensis* skeletal parts. A use-wear analysis could not demonstrate conclusively as to whether this object was actually used, due to erosion of the piece's edges; however, it would seem quite clear that it was not made to be used in the Sima, since the latter was clearly not employed as an occupation site. Moreover, the tool was elaborated in a high-quality quartzite, a rock type rarely selected for use at the Gran Dolina and Galería situations, according to their known technological records. Moreover, the Sima instrument evinces a complex manufacturing process, having two phases of configuration that are bound to have been made by soft percussion. Handaxes represent the most complex and significant tools in Mode-2 or Acheulean technology. Thus, the possibility that the Sima handaxe was intentionally associated with the human skeletal assemblage, at some point of the hominids' deposition, must be considered. In such an event, the concept of complex symbolic behaviour by *H. heidelbergensis* populations at 400 kyr obviously emerges. This complex behaviour would be reflected in the fact of depositing a handaxe – the most widespread Acheulean tool –, into a context of intentional deposition of dead. This may have occurred 300 kyr before Neanderthals buried their dead, which places Sima de los Huesos at the first case of mortuary symbolism in human evolution.”(Carbonell & Mosquera 2006).

Author notes: Atapuerca Spain pit--suggests buried their dead

“One site in Atapuerca, northern Spain, dating to about 400,000 years ago, shows evidence of what may be human ritual. Scientists have found bones of roughly 30 *H. heidelbergensis* individuals deliberately thrown inside a pit. The pit has been named Sima de los Huesos ('Pit of Bones')." (Smithsonian 2016).

DENISOVANS SUMMARY

—possible previous hominids up north: Denisova (41k years ago, Siberia?-genetically distinct from-Neanderthals and Modern Humans but other results showed a common origin with Neanderthals and bred with humans)

“You mentioned Denisovans. Could they be *H. heidelbergensis* or its descendants? In 2010, DNA sequenced from a fossil finger bone in Siberia showed the existence of an unexpected additional human population in the late Pleistocene. This group was christened the 'Denisovans' after the site of Denisova Cave. We still don't know what the Denisovans looked like, or completely understand their position relative to other species, but genomic data suggest they are related to the Neanderthals (Figure 1A,B). However, evidence of interbreeding with recent *H. sapiens* in Southeast Asia shows that the Denisovans were once widespread in the region. As there are potential *H. heidelbergensis* fossils from Asia, it is possible they could represent the ancestors of the Denisovans.” (Buck & Stringer 2014).

“Using DNA extracted from a finger bone found in Denisova Cave in southern Siberia, we have sequenced the genome of an archaic hominin to about 1.9-fold coverage. This individual is from

a group that shares a common origin with Neanderthals. This population was not involved in the putative gene flow from Neanderthals into Eurasians; however, the data suggest that it contributed 4–6% of its genetic material to the genomes of present-day Melanesians. We designate this hominin population ‘Denisovans’ and suggest that it may have been widespread in Asia during the Late Pleistocene epoch. A tooth found in Denisova Cave carries a mitochondrial genome highly similar to that of the finger bone. This tooth shares no derived morphological features with Neanderthals or modern humans, further indicating that Denisovans have an evolutionary history distinct from Neanderthals and modern humans.” (Reich et al. 2010).

“Nevertheless, the picture that emerges from analysis of the nuclear genome is one where the Denisova population is a sister group to Neanderthals.” (Reich et al. 2010).

“While Neanderthals are known from an abundant fossil record in Europe and western and central Asia, Denisovan remains are currently only known from the Altai Mountains in southern Siberia^{3,4}. However, Denisovan ancestry is detected in present-day human populations from Oceania, mainland Asia and in Native Americans⁵, suggesting that they were once more widespread. High-quality genome sequences recovered from one Neanderthal and one Denisovan show that they were more closely related to each other than to modern humans and that they diverged from a common ancestral population between 381,000 and 473,000 years ago⁷ if a mutation rate of 0.5×10^{-9} per site per year is used.” (Meyer et al. 2016).

“A possible answer about the time of emergence of this last common ancestor comes from the complete mtDNA extracted from the phalanx of the Denisova cave in the Altai mountains, dated to 48-30 ka, which demonstrates the existence of humans that were different from both *Homo neanderthalensis* and *Homo sapiens*, but shared with them a common ancestor between 1.3 Ma and 779 ka (Krause et al., 2010; Meyer et al., 2012, 2014).” (Profico et al. 2016).

“After they diverged from one another, Denisovans and Neanderthals had largely separate population histories as shown by a number of observations. First, patterns of allele sharing indicate that Denisovan ancestors did not contribute genes at a detectable level to present-day people all over Eurasia whereas Neanderthals did⁸. Thus, Neanderthals at some point interacted with ancestors of present-day Eurasians independently of Denisovans. Second, the genetic diversity of Neanderthals across their geographical range in the last thirty or forty thousand years of their history was extremely low, indicating that they experienced one or more strong genetic bottlenecks independently of the Denisovans. Third, our results indicate that Denisovans but not Neanderthals contributed genes to ancestors of present-day Melanesians. Fourth, the dental morphology shows no evidence of any derived features seen in Neanderthals. In fact, dental remains from the Sima de los Huesos of Atapuerca, for which ages between 350,000 and 600,000 years have been proposed^{39, 40}, already carry Neanderthal-like morphological features that are not seen in the Denisova molar... The Denisova individual belongs to a hominin group that shares a common ancestor with Neanderthals but has a distinct population history... In our view, these results show that on the Eurasian mainland there existed at least two forms of archaic hominins in the Upper

Pleistocene: a western Eurasian form with morphological features that are commonly used to define them as Neanderthals, and an eastern form to which the Denisova individuals belong...the emerging picture of Upper Pleistocene hominin evolution is one in which gene flow among different hominin groups was common.” (Reich et al. 2010).

“The team’s latest mitochondrial sequences, meanwhile, again confirm the puzzling link between the Sima hominins and the Denisovans. Meyer suggests that the ancestors of the two groups carried mitochondrial DNA that is reflected in both — but which is not present in later Neanderthals. This elimination could have happened by chance, but Meyer now favours the hypothesis that an as yet unknown species from Africa migrated to Eurasia and bred with Neanderthals, replacing the mitochondrial DNA lineages. (Supporting this idea, stone-tool technologies spread from Africa to Eurasia around half a million years ago, and again 250,000 years ago).” (Callaway 2016).

NEANDERTHALS SUMMARY

The Neanderthals were only found in Eurasia between 300 and 30k years ago and most definitely did not evolve from Africa—but rather from a hominid, such as Heidelbergensis that moved into Europe. During this time, Europe was in the midst of the Ice Ages, going through periods of warmer and drier when the hominids would move further north, and then retreat once the glaciers returned. In Africa, hominids developed bodies equipped to deal with the heat—long and slender, with the ability to dissipate heat through sweating. However, the Neanderthals are clearly designed for the cold: short and stocky, to reduce the amount of tissue exposed to the cold. Although their brains were larger than our own (although less encephalized), they were not able to talk with the same level of sophistication as humans and they continued to use tools from the Mousterian, otherwise known as Middle Stone Age, tradition—well shaped, but larger, more blunt tools than were used by the humans that later displaced them; furthermore, it seems that over the course of their existence, their tool-use never evolved but stayed the same, suggesting that they were not as blessed with the skills of innovation as humans; indeed they did not create art. Nor, as anatomical studies, suggest were they able to talk, at least not with the sophistication of our own species. They lived, it seems, predominantly in caves and their lives were rough and tumble, suggested by their larger, stronger bodies and the amount of trauma they evidently endured during their lives: their bones are generally marked by trauma, fractures.

As for their diets, they were strongly carnivorous—even, at times, like many hominids, practicing cannibalism, although some convincing evidence—in the form of starch on their teeth—has suggested strongly that they also consumed carbohydrates likely in the form of grains. But archaeological remains and chemical tests conducted on their remains suggest they were strongly, almost exclusively, carnivorous, usually concentrating on large mammals—even the megafauna like the woolly mammoth—for most of their food.

And they used fire. It was recently revealed that the Neanderthals did, indeed, interbreed with humans and many of thus hold many of their genes.

They likely hunted with spears, wooden shafts with stone points, in packs driving these large mammals into places where they could be easily killed. As we shall investigate later, modern

humans moved into Europe later and displaced the Neanderthals, who then became extinct, right about the time of the advent of what is called the Upper Paleolithic Revolution when Homo Sapien began to exhibit more sophisticated behaviors. And one of the great questions of Anthropology—which might have some bearing on diet—is why this happened. Why did humans survive and prosper and the Neanderthal become extinct?

Neanderthal mating behavior and group size based upon genetic analysis—patrilocal mating, small groups with little genetic diversity:

“The remains of 12 Neanderthal individuals have been found at the El Sidrón site (Asturias, Spain), consisting of six adults, three adolescents, two juveniles, and one infant. Archaeological, paleontological, and geological evidence indicates that these individuals represent all or part of a contemporaneous social group of Neandertals, who died at around the same time and later were buried together as a result of a collapse of an underground karst. We sequenced phylogenetically informative positions of mtDNA hypervariable regions 1 and 2 from each of the remains. Our results show that the 12 individuals stem from three different maternal lineages, accounting for seven, four, and one individual(s), respectively. Using a Y-chromosome assay to confirm the morphological determination of sex for each individual, we found that, although the three adult males carried the same mtDNA lineage, each of the three adult females carried different mtDNA lineages. These findings provide evidence to indicate that Neanderthal groups not only were small and characterized by low genetic diversity but also were likely to have practiced patrilocal mating behavior...Patrilocality is present in about 70% of modern societies (18) and is expected to result in greater diversity of mtDNA lineages among females in social groups than among males—as we found in this study.” (Lalueza-Fox et al. 2011).

HOMO SAPIEN

Emergence from Erectus

As we consider our evolution into Sapien, let us first re-consider, for the sake of staying oriented, the point from which we last originated—Homo Erectus, a fellow slightly smaller than ourselves, with similar proportions and likely similar anatomy, except that his brain was not as large as our own, so he was not capable of our level of planning, communication or other cultural or artistic endeavors. However, in terms of his diets, he most certainly made some advancements, namely hunting and cooking, which allowed him tremendous efficiencies in the procuring, digestion and synthesis of nutrients and which afforded him the bulk of his nutrients that he likely needed in a fairly efficient form: animal protein and fats provided him are more or less complete and require a minimum of synthesis in the body. And likely, given the needs for glucose for his larger brain and nervous system, and that his predecessors were carb-eaters, we can assume that he procured his carbs from tubers, fruits, grains and sedges—all good, quality sources. On top of this, he likely processed and cooked these foods to further predigest them and increase the efficiencies of his food. To compensate for his smaller colon and less fiber in the diet, we have also contemplated the possibility that he may have fermented fruits or honey to attain the volatile fatty acids in some sort of precursor to wine, mead or beer.

In many ways, it sounds like his diet is our own. So the question emerges: did some kind of dietary improvement play some part in our evolution from Homo Erectus into Sapien. Though

little, if any, empirical evidence actually supports my assumptions at this point, I believe that, just using basic theoretical and imaginative constructions (as in mentally reconstructing the lifestyles of early Sapiens), we can possibly create an answer to this question. I believe, in short, that when converting from Erectus to Sapien, we developed enough intelligence, gradually through selection, to coordinate in the hunting or scavenging and slaying of large, fatty mammals that, within the span of maybe a few days of hunting and processing, afforded vast quantities of meat and, more importantly, fat for energy—which, when preserved through smoking, drying and fermentation, could provide enormous efficiencies: people worked less hard for their food...etc. I also theorized that advances in cooking—ie the slow boiling of food—provide enormous benefits in the digestion and nutrition of food.

However, as we shall see, as Sapien spread across the globe, he was able to use his superior intelligence, created through millions of years of climatic variation in Africa, to adjust all sorts of environments—from deserts, to seashore, to grasslands, to Arctic tundra. However, I do not believe that all these Sapiens were capable in these various environments of acquiring the nutrients and efficiencies to optimize their well-being and potential for culture and other “advancements” in humanity. My contention, instead, is that as Sapiens settled into environments that best supported them nutritionally—and in other ways—they were able to best optimize their potential for culture.

Our evolutionary line, anatomy and brain supports that continued to seek carbs—possible that made adaptation to fat and did not need anymore—in other words, likely that homo sapiens were looking for carbs—our physiology supports this....

As mentioned, Erectus spread from Africa into neighboring continents but, at some point about 500k years ago, he started to become extinct everywhere, possibly due to competing with other, more evolved hominids—but nobody really knows for sure. But one explanation, called the multi-regional theory, which held some credence for years, proposed that Erectus emerged into Sapien, not just in Africa, but across Eurasia; in other words, Erectus did not emerge into Sapien just in Africa and then spread outward from there: rather, he evolved separately into Sapien across Africa and Eurasia—thus accounting for the difference in world’s races. This theory, which seems somewhat counter-intuitive to me, was upheld by the fact that the skeletal construction of Erectus resembled the structure of the Sapiens who came later. However, this theory was just recently debunked through some, elaborate genetic testings and skull studies and displaced by its competing theory: “The out of Africa theory” that proposes that mankind evolved in Africa, likely from Erectus, and then migrated across the world, developing various, racial characteristics as they moved adapted to various environments.

OUT OF AFRICA THEORY

“The out of Africa” theory suggests that Homo Sapien did not evolve outside of Africa—but inside of Africa into just one form. Likely in Africa, Erectus evolved into Heidelbergensis and while some ventured forth into Eurasia and later became Neanderthals, some remained in Africa and likely over the course of several, hundred thousand years evolved into Homo Sapien

about 200k years ago. Unfortunately, when and where we evolved is not precisely known although, as we shall see below, studies in genetics are leaning scientists towards some ideas and even conclusions. But understanding, with greater specifics of our immediate origins—that is, the climate, the diet and society—could be one of the greatest and most helpful accomplishments of scientists because it could reveal so much about our original selves. It could ultimately reveal, too, the diet to which our bodies are most evolved to consume.

Regardless, since the archaeological evidence for our origins are so obscure, scientists now are turning to various genetic studies and tests to further understand our origins. As the author Nicholas Wade claims in his book, *Before the Dawn*, our genes are like document under continuous revision—what that means is that, while our genes are constantly changing, they do not necessarily lose their past information; and as such, geneticist can essentially travel back into time, read the genes and in some cases, at least with some amount of accuracy, suggests something interesting about our evolution.

Based on this research, we have estimated that about 600k years ago, the brains of our line of hominids increased in size to ninety-percent of our current volume—and then to its full capacity about 200k years ago when Africa was in the midst of what is called an Interglacial, a period, in between Ice Ages when the climate of the earth is similar to conditions of today—which means in Africa warmer and lush. On the female side, the Mitochondrial DNA remains unchanged—that is, in the act of procreation, the mitochondria of the sperm is destroyed, leaving only the mother's—which means that the mitochondria of the mother is passed down to both her son and daughter, unchanged. All humans alive today have the same mitochondrial DNA—although many different peoples have various branches of this DNA—including one branch thought to have left Africa many thousands of years ago. Studies have suggested that the birthplace of this Eve was Ethiopia, probably sometime around 200k years ago. And, indeed the earliest known fossils, which have been labelled as *Homo Sapien*, are Omo 1 and 2 which were found in Ethiopia near the Omo River.

Shortly after 200k years ago, The earth reentered into an Ice Age—The Marine Isotope Stage 6—to be technical that lasted until about 123k years ago. During this time, the deserts currently in Africa expanded in size, rendering much of the continent uninhabitable. At some point, though, it is believed that conditions were so bad in Africa, with much of the continent becoming one, large desert due to a series of droughts 135k to 90k years ago, that it is believed that the human population was at risk for extinction. At that point, genetic testing suggests that we then split into two, separate populations, one in East and the other in South Africa—that then remained separated for as much as 100k years before reuniting again about the time that humans started migrating from Africa. (National Geographic Society 2008).

However, perhaps in contradiction to this presentation of events, another study suggests that around 70k years ago, conditions were so harsh in Africa that only 2.5k Sapiens remained alive anywhere in Africa—and it is from this group of isolated homo sapiens, that all humans currently on earth supposedly evolved. One individual in this group—whom some call Adam—is thought to be the universal father of us all. To understand how this happened, consider that the Y chromosome—which only men possess—is passed down from father to son unchanged. And all men alive today have this same Y chromosome—which was inherited from one single source of or one single father of us all: Adam. Within this group of 2.5 k, there were probably lots of

men with different Y chromosomes—but over time, some of those chromosomes went extinct as some men died before rearing children or only reared females or never mated, except for this one man who, along with his scions, proved quite popular with the ladies until all the other chromosome went extinct and only his remained—and then his children and their grandchildren spread throughout the world. And although the Y chromosome is the same of all men, it nonetheless does contain mutations that account for the races of men. (mutation m168 some men in Africa and all men outside of Africa, have this, 50kyears ago)

NOTE: Nicholas Wade Before The Dawn

At some point, some researchers believe that homo sapien split into two, separate groups and evolved separately: one group evolving in East African, then the other groups into South Africa, and remained separated from each other for many decades before at last reuniting with each other at some point in the future.

Fortunately, and curiously enough, we do have some curious fossils from both of these regions: Homo Herto Idalatu from Ethiopia and the Klasies from South Africa. Fortunately, along with the skulls were discovered other artifacts and clues that suggest much about their actual diet and lifestyle.

These sapiens were anatomically like modern humans but behaved like Neanderthals, with the same level of craft in their tools. Were attracted to colors and pigments, built fire at will, and buried their dead and acquired large mammals as food. They did not travel that far, did not utilize bone ivory or shell, buried without grave goods, no ritual or ceremony, no structures, could not fish, no art or decoration. Middle Stone Age or Mousterian.

The physical frame and skull of the ancestral population was heavier compared to modern Sapiens, suggesting more accustomed to violence and warfare. Did not settle.

Homo Sapiens Sociality—

Sociality and DNA from “Before the Dawn: Recovering the Lost History of Our Ancestors” by Nicholas Wade

Yanomamo — a tribal people from the remote forest on the border of Brazil & Venezuela. settled villages, farm plantains, also armadillos and giant grubs—work 3 hours per day to harvest food, rest of the time sort hallucinogenic drugs and their shaman journeys and communicate with spirits.

Constant warfare: 30% of death of males due to violence. 57%, over age 40, lost two or more relatives to violence.

(Wade, Nicholas 2006 p. 140).

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