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The time between 2.5 million years ago and 1.5 million years ago represents a unique period in the history of human evolution. At this time several hominid species coexisted. There is a general consensus that at least two, and possibly more, hominid species lived in Africa at this time. Post–cranially, these species are similar to modern humans, but the cranial morphology of these species vary considerably. The many discoveries of stone tools together with fossil animal remains in archaeological settings have sparked debate over the behaviour of these hominids, and particularly how human–like their behaviour was. Some of the central questions surrounding this debate are: Did these early hominids control fire? Did they build structures? Which hominid species made stone tools? What where these tools used for? Did these early hominids hunt?

BACKGROUND: EARLY HOMINID SITES

Site Types

Generally speaking, there are three basic types of early hominid sites. The first type of site contains only tools. The second contains only animal fossils including hominids. The third contains both tools and animal fossils (hominid fossils may or may not be present).

Southern African Sites

All the southern African sites are caves that contain a jumble of stones, fossils, and in some cases artifacts. These remains are usually cemented together in a calcareous matrix which often requires the use of explosives and heavy equipment to extract fossils and artifacts (Klein 1989). According to Brain (1981) most of the fossil material, including the early hominids, accumulated as a result of carnivores or natural post–death accumulation. Most of the caves at the time of formation were open to the outside from their roofs and therefore were not easily accessible; these caves were not used as shelters by early hominids (Klein 1989; Brain 1981).

These south African caves are notoriously difficult to date due to their complex geology. It is not uncommon for older formations to lie above younger formations. Formations in a cave can intrude on other formations as a result of erosion, so that physical proximity may not necessarily imply chronological proximity of fossils or artifacts (Brain 1981). Furthermore, most of the established absolute dating techniques can not be used in these caves (Brain 1981). The ages of the contents of these caves are estimated through faunal correlation (Klein 1989).

A typical southern African site: Swartkrans

The geology of Swartkrans is one of the best understood of the south African sites, mainly as a result of the long term studies of C.K. Brain (Klein 1989). Brain (1981) recognizes five members in the Swartkrans cave. These members (or depositional layers) are numbered 1 to 5 from bottom to top, though member 2 also occurs below member 1 in some areas. Of particular interest here are members 1 and 2. Using fossil cross–dating, member 1 has been estimated to be between 1 and 2 million years old (Brain 1981) and was likely formed between 1.8 and 1.5 million years ago (Klein 1989). Member 2 is more difficult to date due to intrusion from member 3. Member 2 may span the period between 1 million and 750,000–500,000 years ago (Klein 1989).

Fossils of robust australopithecines are most common in member 1 but are also found in members 2 and 3. Early Homo[1] remains have been found in member 1. Fragmentary remains of *Homo erectus* have also been found in members 2 and 3.

Only one artifact from Swartkrans can be definitively shown to have come from member 1 (Brain 1981). This artifact was described as "heavy–duty scraper" made from a quartzite flake. The tool was 84 mm long and 88 mm wide. The artifact "showed a certain amount of general abrasion as if it had been transported in the stream bed some distance before it entered the cave" (Brain 1981:227). No association can be drawn between this tool and the numerous robust australopithecines recovered from the site.

Brain (1981) draws several conclusions based on the extensive faunal analysis of member 1. Based on the parts of animals that have been preserved Brain claims that carnivore activity is responsible for the bone accumulation. In the case of australopithecines, only 11 post–cranial bones are associated with 218 cranial bones. In the case of baboons, only 31 post–cranial bones are associated with 372 cranial pieces; other species suggest similar results. Moreover, this case for carnivore damage is supported by clear carnivore tooth marks. Definite carnivore damage was observed on three australopithecines as well as on bovid and other species. Carnivore damage is strongly suspected on 14 other australopithecines and on at least one of the early Homo specimens.

Brain was unable to perform detailed studies on all the non–primate fossils found in member 1 at Swartkrans. But of the fossils that were studied in detail, none of them showed any evidence of hominid damage; no cut marks were found.

Eastern African Sites

All the east African sites are open air sites. At most of these sites the geology is not overly complex which allows for fairly easy relative dating. However, in some areas such as Olduvai, extensive faulting has complicated correlation between sites. East African sites can be dated using radiometric

[1]Early Homo refers to a hominid ancestral to *Homo erectus* which may or may not be classified as *Homo habilis, Homo rudolfensis*, or a gracile australopithecine.

means through stratigraphic relation to volcanic tuffs and other extrusives. Many of these sites have been cross–checked using faunal remains, palaeomagnetism, and fission track dating using uranium 238 (Nelson and Jurmain 1991; Klein 1989). Unlike the south African sites, east African sites can be dated with a degree of confidence.

An example of an Eastern African site: Olduvai Gorge

Olduvai Gorge is a canyon in the Serengeti Plain of northern Tanzania. The canyon is about 15 kilometers long and up to 100 meters deep in some places. The exposed deposits are believed to have formed between 2.1 million years ago and 15,000 years ago (Klein 1989). Hominid remains have been found in the deposits that date from 1.85 million years ago to about 50,000 years ago (Nelson and Jurmain 1991; Klein 1989). These formations have been divided into 7 units. Of interest are the oldest units, known as Bed I and Bed II. The deposits in Bed I are believed to have accumulated between 1.86 million years ago and 1.71 million years ago (Hay 1981). Bed II is believed to have been deposited between 1.7 million years ago and 1.2 million years ago (Klein 1989). Bed II has been subdivided into upper and lower at about 1.5 million years.

Fossils of *Australopithecus boisei* have been found in Bed I, Lower Bed II, and upper Bed II. Fossils that have been classified as *Homo habilis* have been found in Bed I and Lower Bed II. Fossils of *Homo erectus* have also been found in upper Bed II. Two different industrial tool complexes occur in Bed I and Bed II (Klein 1989). Oldowan stone tools occur in Bed I and in lower Bed II. In upper Bed II, Acheulean tools and Developed Oldowan occur. Developed Oldowan is a term used by some researcher, such as Isaac (1984) and M. Leakey (1971), to describe a more advanced Oldowan industrial complex or an early Acheulean industrial complex.

Beds I and II at Olduvai have produced over 70 archaeological sites. Two specific sites in Bed I are particularly well known; they are as the FLK Zinjanthropus site and the DK site. The DK site in Bed I is a unique find in early hominid archaeology. At this site there is a circular shaped accumulation of rocks that are associated with numerous Oldowan artifacts and fragmentary animal bones (Klein 1989). The accumulation consists primarily of lava blocks, 10 to 25 cm across, which were clustered in a circle 4 to 5 meters in diameter. A partial skull of a hominid, classified as *Homo habilis*, was also found at the same level near the feature (Klein 1989; M. Leakey 1971).

The FLK Zinj site at Olduvai Gorge was first excavated by Mary Leakey in 1959. This site is famous because at the time of discovery it was the oldest site that produced both tools and early hominids. This site yielded over 2,500 Oldowan stone artifacts, the famous Zinjanthropus skull (later reclassified as *A. boisei*), and the first *Homo habilis* remains. Due to the fragmentary nature of *H. habilis* remains there is still some controversy about their classification.

At the FLK Zing site numerous non–hominid fossil remains were found. Approximately 60,000 mammalian bone fragments have been found in a wide range of taxa (Bunn and Kroll 1986). Of this assemblage, 3,500 bone specimens are identifiable to a specific skeletal position in the various large mammalian taxa. According to Bunn and Kroll (1986), bovid are predominant in the assemblage. These bovid ranged in size from an estimated 250 to 750 pounds and that both grazing and browsing forms are present. Most of the identifiable bone was preserved well enough so that bones show both carnivore activity and tool cut marks. The cause of this accumulation of bones and artifacts is heavily debated. However, it is generally agreed that this accumulation of bones is not a hydraulic jumble.

EVIDENCE FOR HUMAN-LIKE BEHAVIOUR

Oldowan Tool Forms

The oldest industrial complex is known as the Oldowan. These tool types have been found in both eastern and southern African sites. These Artifacts have been described as "crude" and "amorphous" (Klein 1989). However, these tools can be divided into four basic types: (1) manuports, pieces of rock that have been carried to a site but were not modified, (2) hammer stones, tools used to flake other tools, (3) flakes, including waste flakes and flake tools, (4) core forms, these include cores that were used as tools and cores that were used as a source of flakes.

Oldowan tools can be generally classified according to size, shape, and retouch. A scraper is a flake that has been retouched on one edge; a small scraper is light duty; a larger scraper is heavy duty. A core tool that is flaked on one end is a chopper. Other major tool classes include discoid, polyhedron, sub–spheroid, spheroid, and proto–bifaces. Bifaces do not occur in the Oldowan.

Experimental replication of these tools suggest that a great deal of the variation is a direct result of the initial blank (Klein 1989). Another characteristic of the Oldowan is uniformity through time and space which again is likely the result of availability of raw materials.

Experimental studies have shown that core tools choppers and flake tools are fairly efficient for butchering meat. Core tools, such as choppers were probably used for heavy–duty or prolonged butcher because they are easier to hold and remain sharper longer than flakes. Blunter core tools were likely used to fracture animal bones in order to get at the marrow. Although it is not widely accepted, Isaac (1984) suggest that spheroids or polyhedrons could have been "lethal projectiles".

Who Made The Stone Tools?

There is little doubt that an early Homo species produced at least some of the tools. The simplest and best evidence for this is the continuity through time in stratified sites such as Olduvai and others. These sites show Oldowan tools progressing towards the Acheulean industrial complex. However, the oldest stone tools come from the Hadar region of Ethiopia and are dated to 2.5 million years ago (Rapp 1981). Other tools found at Omo date to 2.4 million years ago (Klein 1989). There are no known fossils that have been clearly documented as early Homo that date that date to this period. Therefore there may be as much as a 400,000 year gap that exists between the first tools and the first tool makers. There are two common explanations for this discrepancy.

The first theory is that early Homo did in fact make these stone tools that predate 2 million years because the genus *Homo* already existed by 2.5 million years ago (R. Leakey 1992). It is possible that these Homo finds are out there

waiting to be discovered. However, it is difficult to convincingly base a theory on what may possibly be found.

The second theory simply states that early Homo's immediate ancestor produced the tools. However, who was early Homo's immediate ancestor? There is very little agreement among researchers as to who is the immediate ancestor to early Homo. The position of *Australopithecus africanus* in hominid phylogenies is highly contested. It is not clear if *Australopithecus africanus* is a direct ancestor to the Homo line and possibly a tool maker. It is also possible that *A. africanus* is not an ancestor to early Homo but still produced and used tools, although there is no direct archaeological evidence to support this hypothesis.

The main problem with determining who made the tools before 2 million years ago has to do with the taxonomic classification of hominids. The definition of species for a living population is different than the definition of species for a fossil (extinct) population (see Tattersall 1992). Classification for fossils is arbitrarily based on skeletal characteristics. The main problem with this method of classification is that natural variation within an extinct species is difficult to account for. This is further complicated by marked sexual dimorphism of the species in question. Another problem is the lack of skeletal remains. Although australopithecines are represented by several hundred individuals, there have been relatively few early Homo remains recovered and most of the ones that have recovered are fragmentary in nature.

Various researchers have placed the remains found in southern and eastern Africa in as many as three different genera (*Australopithecus, Paranthropus, Homo*) and seven different species, two gracile australopithecines, three robust australopithecines (or paranthropus) and two early Homo species (Klein 1989; Nelson and Jurmain 1991). With this lack of consensus on classification, it is virtually impossible to explicitly state that a species and only that species produced tools.

After 2 million years there is little doubt that these tools were produced only by early Homo since there were no other hominids present except for the robust australopithecines. There is some clear evidence that these robust species did not produce these stone tools. First, experimental production and use has shown that these tools are most useful in butchering meat. This meat butchering theory is supported be micro–ware studies and cut marks on fossilized bone (though this may just be a preservation bias). Characteristic of robust australopithecines is the massive dentition which was an adaptation to a vegetable diet (see duBrul 1977). It has been argued that these robust australopithecines had no real use for these stone tools. Furthermore, whenever stone tools are found with robust australopithecine remains there is also early Homo or gracile australopithecines remains present as well (Klein 1989).

Did Early Hominids Control Fire?

There is no unambiguous evidence which shows that early hominids had control over fire. Some of the most definitive evidence for the use of fire would be charcoal concentrations, but due to the age of the sites, this type of organic remains does not occur. Therefore, attention has been focused on sediments that show evidence of burning or heat fracture. Several reddish patches have been found at Koobi Fora sit FxJj 20E and fragments of burnt clay have been associated with Oldowan artifacts at Chesowanja (Klein 1989). However, in both cases, vegetation smouldering after a natural brush fire could have caused the features.

The oldest widely accepted site in which there is evidence for the controlled use of fire is Zhoukoudian cave in China. This cave is a Homo erectus site and these hearth features are 500,000 to 600,000 years old (Klein 1989). Therefore, there is little doubt that the early African hominids did not have control of fire.

Did Early Hominids Build Structures?

The only real evidence that early hominids might have built structures comes from the circular concentration of lava blocks at the DK site in Bed I at Olduvai Gorge. The site was excavated by the Leakeys and was described by M. Leakey (1971). M. Leakey argued that these blocks were the foundation that supported branches that functioned as a wind break.

As it might be expected there is some debate as to whether the DK feature really is the foundations of an early hominid structure. It has been suggested by Potts (1984) that a tree may have created the feature when its roots penetrated and fractured the lava layer that lies underneath; Klein (1989) states that modern trees have been known to do this. However, the most convincing evidence that this is not a structure is that the feature is an isolated incident. The next oldest definite evidence of hominid built structures is a *Homo erectus* site at Terra Amata, France dated to 300,000 years ago. This would suggest that the feature at the DK site is 1.5 million years older than the next oldest known structure. Furthermore, what would these early hominids need shelter from? Based on floral and faunal remains, the DK site was located on the marshy shore of an ancient lake where animals that are accustomed to a warm and tropical environment thrived (Hay 1981). This suggests that the area was as warm or warmer than the present. Therefore, until further sites showing similar features as the DK site (if they exist) are found, it must be assumed that this is just a coincidental association and not the foundation of a structure.

HUNTERS VS. SCAVENGERS: THE COMPETING THEORIES

The debate over what caused the accumulation of bones and artifacts at the FLK Zinj at Olduvai Gorge reflects the central question of early hominid archaeology. Are these bone accumulations a result of hominid hunting? Hominid scavenging? Carnivore activity? Or all three? Furthermore, what do these bone accumulation reveal about hominid behaviour?

The "Man The Hunter" theory

Many anthropologists agree that exploiting meat effected the physical and social evolution of early hominids (Blumenschine and Cavallo 1992; Bunn and Kroll 1986; Isaac 1984; Isaac 1978). Originally it was thought that it was "Man the Hunter" that stimulated the evolution of early hominids. This theory was originally introduced by Charles Darwin in 1871 and was made popular in the 1960's by Lee and Devore (Blumenschine and Cavallo 1992). The theory states that early

hominids encroached on the savanna by moving away from their vegetarian diet and increasing the amount of hunted meat in their diet. Hunting required foresight and dexterity, and therefore selected for larger brains and nimbler hands. These trait would result in an increased capacity for technology, which would in turn result in increased gains that would further stimulate evolution. This theory essentially states that hunting was the motivator of a self–sustaining cycle of physical and social evolution.

Isaac's Home Base Theory

In the 1970's Isaac's theory (1978) gained popularity. Isaac claimed that it was the sharing of the meat that was as important or more important than the actual hunting in stimulating evolution. Isaac tried to demonstrate that early hominids had home bases. Isaac argued that these home bases implied a sexual division of labour; males ranged in search of game or scavengeable meat; females gathered vegetable foods nearer to the home base. The home base was where all the food was brought and shared.

Binford's Scavenger Theory

In the 1980's a there was a back lash against "Man the Hunter" theories . Blumenschine and Cavallo (1992) summed up the sentiments of many researchers, such as Fedigan (1986), when they wrote "the theory of Man the Hunter is based more on sexual and other prejudices than on the fossil record and the ecology of finding food". Other theories arose to explain early hominid behaviour. Binford (1981) argued that neither hunting nor food sharing had evolved by the time of early Homo. Hominids had processed only the leftovers of carnivores by breaking open bones and skulls in order to get at the marrow and the brain. Binford argued that scavenging could not have provided the surplus needed to sustain food sharing.

Bunn and Kroll's Hunter Theory

Bunn and Kroll (1986) re–examined the large amounts of fossil bone that were found by M. Leakey at the FLK Zinj site at Olduvai Gorge and proposed the hominid hunter theory again. They argued the frequency of cut marks and the skeletal location of cut marks strongly supported the theory that early hominids were using stone tools to systematically butcher meaty carcasses of small and large animals that the hominids had hunted. Bunn and Kroll suggest that hominids were hunting or aggressively scavenging large animals. Aggressively scavenging means that the hominids were driving away the carnivore that initially killed the prey. They argued that the hominids of 2 million years ago cooperated in food sharing to a degree that is unknown in modern non human primates. They also claimed that the FLK Zinj site was formed principally (but not exclusively) by hominids. As for Isaac's home base theory, Bunn and Kroll state that it can not be determined if these concentrations of bones are "highly transitory" or "more intensively occupied" areas until further excavations are done at different sites.

Bunn and Kroll provide some good insights into hominid behaviour through the correlation of cut marks and the extent of butchering. However, there are some problems with their statistical manipulation of data. An example of this manipulation is when they determine the percentage of identifiable bones that show cut marks. Depending on their sample size, (which they seems change constantly in order to suit their end) 5%, 6.0%, and 6.3% are all given as the frequency of cut marks on identifiable bone specimens. Furthermore, they claim that 6.3% is enough to justify their claim that hominids were principally responsible for the accumulation even though over 11% of the identifiable bone fragments have carnivore gnaw marks (Binford, 1986); that is twice as many carnivore marks than hominid marks.

Blumenschine and Cavallo's Scavenger Theory

Blumenschine and Cavallo (1992) have proposed still another theory that stresses the importance of meat in the diet of early hominids. These researchers spent 20 months studying how predators and scavengers obtained meat in Tanzania's Serengeti National Park in Africa. The researchers state that the tried to discover: (1) if scavenging was inferior to hunting, (2) how postmortem events altered carcasses (3) how these finds relate to paleontological and archaeological evidence for the behaviour of hominids. Blumenschine and Cavallo concluded that hominids were scavengers that were able to fill a specific niche in a riparian woodland environment. They argued that these hominids were not just scavenging minimal leftovers and bones as Binford suggest. Rather, these hominids were able to scavenge entire animals that still had a great deal of meat on them. In fact, the researchers claim that there was a surplus of meat and Isaac's model of cooperative foraging, processing, and food sharing could apply.

The main criticism that scavenger models have run up against in the past is that hominids would have had trouble in locating the kills of wider ranging predators and any kill sites they might have chanced upon would have likely been thoroughly exploited by hyenas. A riparian woodlands would have been an ideal scavenging location for semi–arboreal bipeds. The single most important feature of this woodland environment is that it would hide sources of meat from other scavengers; the trees would hide carcasses from vultures, the premier scavenger. Two critical question arise: (1) Where did the carcasses come from? (2) If the kills were at least partially hidden how would the hominids find them? The large animal carcasses could be a result of lion kills, saber tooth cat kills and the natural deaths of animals. The smaller kills could be a result of smaller cats such as leopards. As for the second question, in the woodland environment there are other markers that indicate kill sites that draw less attention than circling vultures. However, could these early hominids recognize the same markers as the researchers (i.e.. modern humans)?

CONCLUSION

How human-like was early hominid behaviour? Unfortunately there can be no answer to this question based on the archaeological evidence that has been collected.

Taphonomy has shown that the bone accumulations at the FLK Zing site were caused by both carnivore and hominid activity. According to the evidence, the logical conclusion is that the majority of the bones were accumulated as a result of carnivore activity; 11% of the bones show carnivore marks whereas only about 6% of the bones show hominid modification. Regarding the hominid modified bones the question remains: Where these hominids hunters or scavengers?

According to Lewin (1989), one of the main problems with the study of the origins of *Homo sapiens* is the tendency to separate hominids from nature. Some modern researcher still tend to cling to the pre–Darwinian idea that humans have a special place in nature and the post–Darwinian idea that *Homo sapiens* was somehow a predestined species that was inevitable in its emergence. These views and some modern sexism have tended to shape researchers' theories about hunting and scavenging. It is often useful to go outside of the field of study and take another perspective on the problem at hand. In, *Serengeti Dynamics of an Ecosystem*, Houston writes:

> ... it was commonly believed that mammalian carnivores could be divided into predators which killed their own prey, such as lions, leopards, and cheetahs; and scavengers, such as hyenas and jackals, which relied of finding dead animals. We know that this distinction is completely unjustified ... All mammalian carnivores are primarily predators, and most of them will scavenge food whenever they have the opportunity. The distinction between predatory and scavenging animals is, therefore, not a very useful one, and none of the mammalian carnivores feeds entirely, or even substantially, by scavenging (1979:263).

Houston goes on to say that the hyena, *the* African scavenger, gets no more than 33% of its food from scavenging. Other "scavengers" such as jackals and wild dogs will hunt small animals and insects and only scavenge about 3% of their diet. If in fact, some early hominid evolved to exploit meat in a savanna (or near a savanna) setting as some researchers have suggested (Harris et al 1987; Blumenschine and Cavallo 1992) then why is there such a debate of hunting versus scavenging?

There are even more problems with the descriptions of early hominid behaviour in regards to sharing, division of labour, and the use of home bases. There is no direct archaeological or paleontological evidence that would suggest that these hominids were doing anything more than exploiting some meat. Although various amounts of meat or bone (for marrow) may have been carried to these sites by hominids, there is no archaeological evidence that suggests this meat was shared or that there was a sexual division of labour. Most of the evidence used by Isaac and others to support the home base theory is based on analogies to modern apes and modern hunter–gatherers. It is good to remind oneself that the early hominids were neither. Such analogies have the capacity to mislead, considering the lack of archeological evidence. Unfortunately there is not enough real data at present to support or justify such detailed theories.

REFERENCES

Binford, L. R. 1981 *Bones Ancient Men And Modern Myths*. New York: Academic Press.

__ 1986 Comment to Systematic butchering by Plio/Pleistocene Hominids at Olduvai Gorge, Tanzania. *Current Anthropology*, 27:431–452.

Blumenschine, R. J. and J. A. Cavallo. 1992 Scavenging and Human evolution. *Scientific American*, Oct. 1992:90–96.

Brain, C.K. 1981 *The Hunters Or The Hunted? An Introduction To African Cave Taphonomy*. Chicago: The University of Chicago Press.

Bunn, H. T. and E. M. Kroll 1986 Systematic butchering by Plio/Pleistocene Hominids at Olduvai Gorge, Tanzania. *Current Anthropology*, 27:431–452.

duBrul, E. L. 1977 Early Hominid Feeding mechanisms. *American Journal of Physical Anthropology*, 47:305–320.

Fedigan, L. M. 1986 The changing role of women in models of Human evolution. *Annual Review In Anthropology*, 15:25–66.

Hay, R. L. 1981 "Lithofacies and environments of Bed I, Olduvai Gorge, Tanzania". In: *Hominid Sites: Their Geologic Setting*, G. Rapp and C. Vondra (eds.), pp. 25–56.

Houston, D. C. 1979 "The adaption of scavengers." In *Serengeti: Dynamics of an Ecosystem*. A. R. E. Sinclair and M. Norton–Griffiths, eds. pp. 263–286. Chicago: University of Chicago Press.

Isaac, G. 1984 "The archaeology of Human origins: Studies of the lower Pleistocene in East Africa". In: *Advances in World Archaeology Volume 3*, F. Wendorf and A. E. Close (eds.), pp. 1–89.

___ 1978 "The food sharing behaviour of protohuman Hominids". *Scientific American* 238:90–108.

Klein, R. G. 1989 *The Human Career: Human Biological and Cultural Origins*. Chicago: The University of Chicago Press.

Leakey, M. D. 1971 *Olduvai Gorge: Excavations In Beds I and II, 1960–1963*. Cambridge: Cambridge University Press.

Leakey, R and R. Lewin 1992 *Origins Reconsidered: In Search of What Makes Us Human*. New York: Doubleday.

Lewin, R. 1989 *Human Evolution: An Illustrated Introduction*. Cambridge: Blackwell Scientific Publications.

Nelson, H. and R. Jurmain 1991 *Introduction to Physical Anthropology*. St. Paul: West Publishing.

Potts, R. 1984 Home bases and early Hominids. *American Scientist*, 72:338–347

Rapp, G. and C.F. Vondra 1981 *Hominid Sites: Their Geologic Setting*. Boulder: Westview Press.

Tattersall, I. 1992 Species concepts and species identification in Human evolution. *Journal of Human Evolution*. 22:341–349.