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NUMBER 1

THE OLDOWAN:

Case Studies Into the Earliest Stone Age

Edited by Nicholas Toth and Kathy Schick

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CHAPTER 4

THE ACQUISITION AND USE OF LARGE MAMMAL CARCASSES BY OLDOWAN HOMININS IN EASTERN AND SOUTHERN AFRICA:

A SELECTED REVIEW AND ASSESSMENT

BY TRAVIS RAYNE PICKERING AND MANUEL DOMÍNGUEZ-RODRIGO

ABSTRACT

Damage to fossil bone surfaces, in the form of cutmarks and percussion marks, establishes causal links between early hominin stone tool technology and spatially associated large mammal remains from archaeological sites located throughout eastern and southern Africa and dated *c.* 2.5–1.0 million years old. The presence of abundant tooth marks in faunal assemblages from most of these sites also implicates carnivores as significant actors in the formation of the bone accumulations. We review arguments based on this taphonomic evidence from selected, well-excavated sites and conclude that although Oldowan hominins likely engaged in a full range of carcass-acquiring behaviors, depending on immediate circumstances, they were not relegated solely to the role of passive scavengers, as some influential models of early hominin behavior imply.

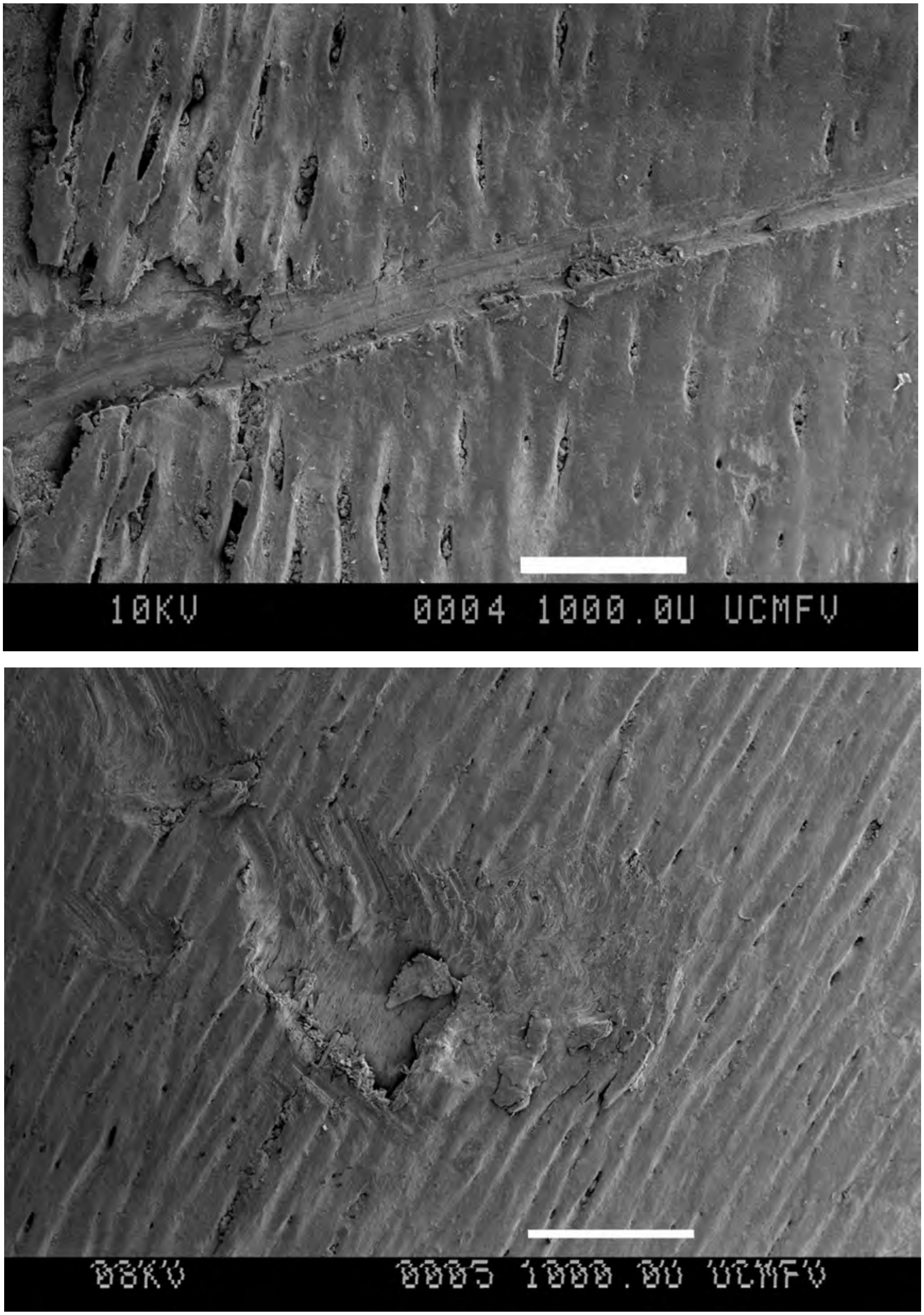
INTRODUCTION

The 1990s proved to be a productive and exciting decade for paleoanthropology. In addition to the announcement of several new early hominin species from various African sites (i.e., *Ardipithecus ramidus*, *Australopithecus anamensis*, *A. bahrelghazali*, *A. garhi*), work at Gona, in Ethiopia's Awash River Valley, yielded the world's oldest known stone tools, dated radioisotopically between 2.6–2.5 million years old (Ma) (Semaw *et al.*, 1997). Further, cutmarked and hammerstone damaged animal bones were recovered from Gona-aged deposits in the nearby Middle Awash paleoanthropological study area (at two localities in the Hata Member of the Bouri Formation) (de Heinzelin *et al.*, 1999)–providing the earliest-occurring, indisputable causal links between hominin stone tool technology and the exploitation of large mammal carcasses[1] (Figure 1).

Interestingly, early *Homo* is not represented in the fossil record of the Awash River Valley during this time period. Instead, a species of *Australopithecus*, *A. garhi*, is present (Asfaw *et al.*, 1999). It is not possible to assert definitively that *A. garhi* was responsible for the Gona stone tools and evidence of their use in the Middle Awash as carcass reducing implements, but circumstantial evidence (i.e., the absence of early *Homo*) makes a fairly compelling case for *A. garhi* as the author of the earliest known stone tool assemblages.

These earliest assemblages are classified by most experts as belonging to the Oldowan Industrial Complex (e.g., Isaac, 1984; Leakey, 1966, 1971; Semaw, 2000; Semaw *et al.*, 1997; Schick & Toth, 1993; contra, Kibunjia, 1994; Piperno, 1989; Roche, 1989, 1996), and various studies in the past 20 years have demonstrated causal links between Oldowan tools and large mammal bones–similar to that evidenced in the Awash River Valley–throughout fossil localities in eastern and southern Africa. Here we review and evaluate a selected sample of these studies with the goal of assessing early hominin carcass foraging capabilities. We restrict our discussion to well-studied faunal assemblages, most of which are associated spatially with Oldowan and Developed Oldowan stone tool assemblages and are in good to excellent archaeological contexts. This means that assemblages such as those from Senga (Democratic Republic of Congo) are not included because of problems with re-deposition (Boaz *et al.*, 1992; de Heinzelin, 1994). Finally, there are yet to be convincing inferences of hominin influence on prehis-

Figure 1



1. *Scanning Electron Microscope micrographs showing representative examples of two major classes of bone surface damage imparted by hominins–stone tool cutmarks (top) and hammerstone percussion damage (bottom). Note the internal microstriations within the main groove of the cutmark and the patches of striations emanating from the percussion pit (see Potts & Shipman, 1981; Blumenschine & Selvaggio, 1988). Identification of these microscopic features associated with incidences of bone surface damage, an understanding of the anatomical placement and patterning of such damage, and secure knowledge of the geomorphological context of the faunal assemblage in which the damage occurs are classes of evidence used by faunal analysts to infer hominin behavior in archaeofaunas.*

toric faunal assemblages *in the absence of stone tool marks*, even though various researchers are currently using primate models to establish criteria for identifying the involvement of pre-stone-tool-using hominins in bone assemblage formation (e.g., Pickering & Wallis, 1997; Plummer & Stanford, 2000; Tappen & Wrangham, 2000; Domínguez-Rodrigo, 1999a). Thus, we do not discuss this topic further, even though we are of the opinion–based on the observations that modern humans and many of our living primate relatives (e.g., chimpanzees, baboons) are avid meat-eaters (reviewed in Stanford & Bunn, 2001)–that hominins likely engaged in significant meat eating before the advent of stone tool technology.

FLK 22 (*ZINJANTHROPUS*): BED I, OLDUVAI GORGE, TANZANIA

The formational history of the Earlier Stone Age faunal assemblage from FLK 22 (*Zinjanthropus*) (more commonly referred to as FLK *Zinj*) has been the subject of more heated debate than the formation of any other archaeofauna of comparable age. We believe that there are several factors that contribute to this intense focus on the *c.* 1.75 Ma FLK *Zinj* fauna, including its meticulous excavation by Mary Leakey, its large size (~60,000 macro- and micromammalian specimens combined), its exquisite preservation of bone surfaces and its spatial association with fossil hominin remains and Oldowan stone tools–rendering the site *the* classic example of a so-called "home base" or Type C site (e.g., Isaac, 1978, 1984).

However, the interpretation of FLK *Zinj* as a hominin home base is not universally accepted. Lewis Binford (e.g., 1981, 1985, 1986, 1988) was the first archaeologist to question this interpretation of the site, arguing that it was instead a locale on the ancient landscape where early hominins scavenged for marginal scraps of flesh and marrow from ungulate carcasses killed and consumed primarily by carnivores. Binford's (1981) conclusions about the relatively minor involvement of hominins in the formation of the FLK *Zinj* fauna had a major impact on the course of actualistically-driven, zooarchaeological studies in Africa for the next 20 years[2].

It is important to note, however, that Binford was not the only early researcher to challenge previous assertions about the modern human behavioral capabilities of Plio-Pleistocene hominins. Based on his painstaking taphonomic analyses of faunal assemblages recovered from Swartkrans Cave (South Africa), C.K. Brain argued as early as 1970 that rather than being competent, bone-accumulating hunters (as traditionally proposed; e.g., Etkin, 1954; Washburn, 1959; Washburn & Howell, 1960; Washburn & Lancaster, 1968), many early hominins were actually the victims of predation. Although Brain's conclusions dealt specifically with the South African australopithecines, a group of species that *presumably* lacked stone tool technology–his general notion of early hominins as "the hunted" rather than "the hunters" must still be viewed as a major impetus (along with Binford's arguments about the FLK *Zinj* fauna) in the re-evaluation of early hominin foraging capabilities.

This re-evaluation eventually reached its zenith during the mid-1980s through mid–1990s, and was spearheaded by zooarchaeologist Rob Blumenschine. Returning to the FLK *Zinj* fauna, Blumenschine (1995) proposed a complex series of events resulting in its formation. Hominins first entered this sequence as scavengers, when they transported the marrow-bearing portions of ungulate carcasses–already largely defleshed by felid predators–away from acquisition sites to FLK *Zinj*, where these bones were then broken by the hominins for marrow. Subsequently, tertiary level scavengers (i.e., hyenas) impacted the assemblage by removing bone portions, which contained grease left unexploited by the hominins.

This model of bone assemblage formation at FLK *Zinj* was based on Blumenschine's study of bone surface damage in the ungulate limb bone subassemblage. First, midshaft sections of long bones at FLK *Zinj* preserve carnivore tooth marks in frequencies comparable to tooth mark frequencies on midshafts in experimentally-created bone assemblages in which carnivores had primary access to ungulate limb bones (Blumenschine, 1988; Capaldo, 1995, 1997; Selvaggio, 1994a). Second, limb bone fragments from FLK *Zinj* also preserve numerous hammerstone percussion marks. This suggests that the primary carnivore consumers did not regularly breech the bones for marrow, and that this resource was thus available to the hammerstone-wielding hominins. Finally, the abundant tooth marks on epiphyseal and metaphyseal ("near-epiphyseal", in the terminology employed by Blumenschine and his co-workers) specimens at FLK *Zinj*, suggested that these bone portions were ignored by hominins, but subsequently exploited by hyenas–carnivores that possess the masticatory and digestive apparatuses capable of rendering grease from the trabaculae of long bone ends.

In many aspects, this three-stage model of assemblage formation at FLK *Zinj* is powerful, but its major weakness is that it does not fully appreciate the abundant cutmark evidence preserved in the assemblage, first reported by Henry Bunn (1981, 1982; Bunn & Kroll, 1986) and Rick Potts and Pat Shipman (1981). While Potts & Shipman's (1981) interpretation of the FLK *Zinj* cutmark evidence (they argue that the cutmarks resulted not from hominins cutting meat from carcasses, but from the removal of tendons and skin) is not incompatible with the notion of early hominins as marginal scavengers, Bunn's (1981, 1982; Bunn & Kroll, 1986) interpretation is decidedly contrary to this view of early hominin behavior. Bunn argues that the abundance and placement of the FLK *Zinj* cutmarks suggest "an efficient [hominin] strategy of carcass skinning, joint dismemberment, and meat removal and for a significant amount of meat-eating by [hominins] nearly two million years ago" (Bunn & Kroll, 1986: 432)–behaviors that are consistent with primary or, at least, very early access to fully-fleshed carcasses.

Some researchers, however, remained unconvinced that the cutmark evidence at FLK *Zinj* is relevant to inferences about the quantity of muscle tissue removed from carcasses by early hominins. Binford (1986) retorted that the cutmark patterns at FLK *Zinj* are consistent with removal of desiccated meat from bone, while Blumenschine (1986a, 1988, 1995) countered that these patterns could have resulted from the removal of marginal meat scraps left after felids consumed the bulk of muscle masses; both responses imply that hominins were marginal (at least secondary or tertiary level) scavengers.

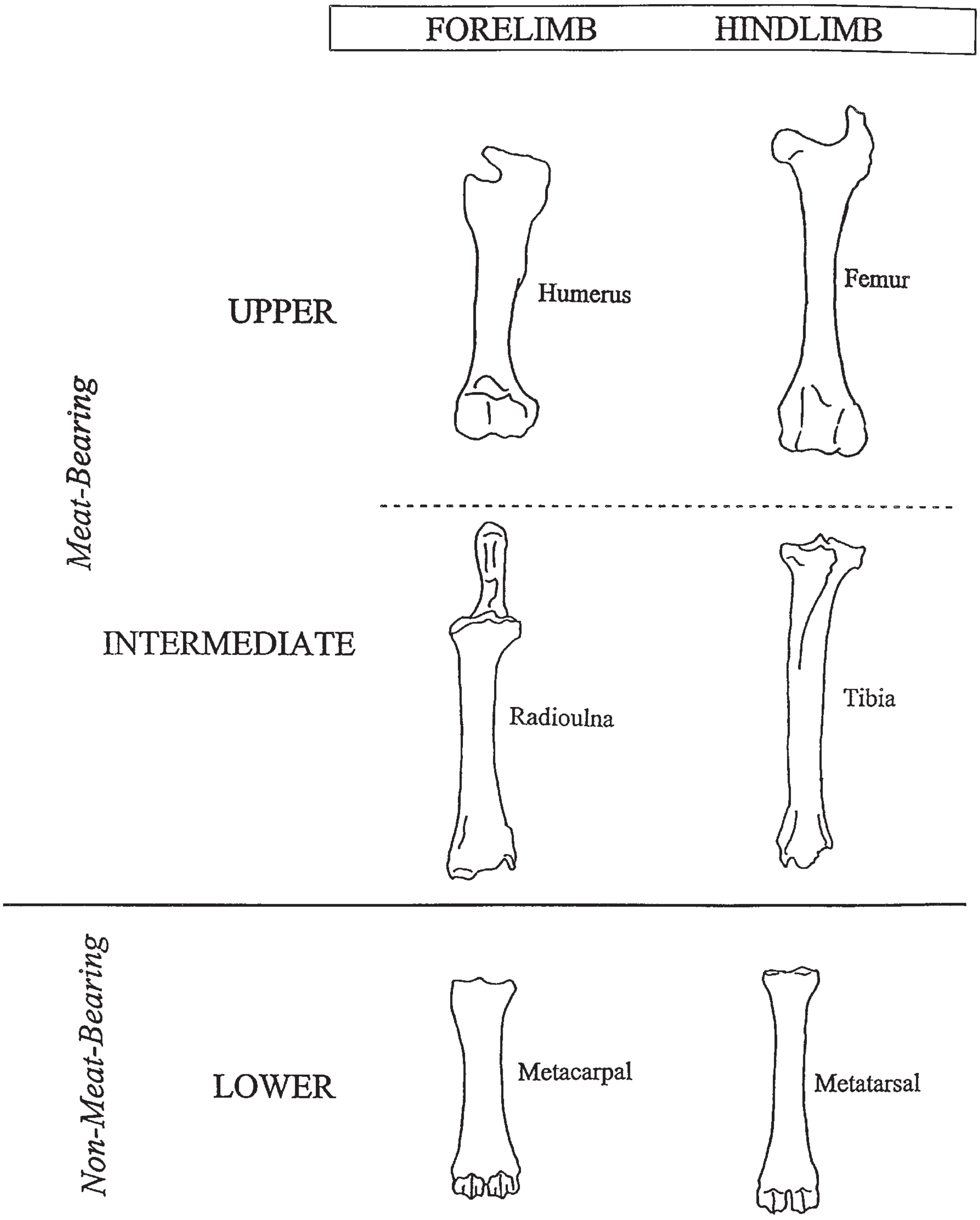
The general ambiguity surrounding the usefulness of cutmark data for helping to resolve the question of assemblage formation at FLK *Zinj* prompted one of us (MD-R) to conduct a series of experimental studies, in which the interface of carcass flesh availability and cutmark patterns was examined. A major finding of this research program calls into question the notion that felid carcass-consumers would regularly provide hominin scavengers with edible scraps of adhering tissue. Only negligible amounts of scavengeable flesh scraps were documented on 28 medium-sized (i.e., 150-350 kg) ungulate carcasses after ravaging by lions in the Maasai Mara National Reserve (Kenya) (Domínguez-Rodrigo, 1999b) (Figure 2). More specifically, upper limb bones (i.e., the humerus and femur) and intermediate limb bones (i.e., the radioulna and tibia) displayed a paucity of adhering flesh scraps after lion ravaging (Figure 3). Even more importantly, midshaft sections of upper limbs displayed a *complete* lack of flesh scraps and, similarly, flesh scraps on the midshaft portions of intermediate limb bones were poorly represented (Figure 4). These results suggest that cutmarks on upper and intermediate limb bone midshafts most likely indicate early access to fully fleshed carcass parts by hominins[3]; hominins would have no reason to put a cutting edge to a long bone midshaft previously defleshed in its entirety by a felid consumer[4].

Bunn (1981, 1982, 2001) conducted the most com-

Figure 2

2. *Lion and remnants of a lion-ravaged wildebeest carcass in the Maasai Mara National Reserve (Kenya). Note that the skeleton has been defleshed completely by lions, leaving marrow and brains as the only soft tissue resources available to potential secondary and tertiary level scavengers.*

Figure 3



3. *Limb bones of the bovid fore- and hindlimb (redrawn after Hillson, 1996). It is not always possible to identify an archaeological bone fragment to a specific element. In most cases, however, an experienced analyst can confidently categorize a diaphyseal fragment of bovid limb bone as deriving from an upper limb element (i.e., the humerus or femur), an intermediate limb element (i.e., the radioulna or tibia) or a lower limb element (i.e., the metacarpal or metatarsal), based on an assessment of the fragment's cortical thickness, apparent or projected cross-sectional shape and other features such as nutrient foraminae (see Domínguez-Rodrigo, 1999a). This generalized categorization is useful because of the differential distribution of flesh scraps across these element categories in felid-ravaged carcasses, and because that differential distribution influences subsequent cutmark patterns inflicted by hominin scavengers (see text for discussion).*

Figure 4

4. *Close-up of the remnants of a wildebeest carcass ravaged by lions in the Masaai Mara National Park (Kenya). Note that the femur–an upper limb bone in the classification scheme employed in this chapter–and especially its midshaft, has been completely defleshed by lions. The lack of edible flesh remaining on this bone portion after lion ravaging would discourage a potential hominin scavenger from using a stone tool to cut in this region of the femur; thus, cutmarks observed on upper limb bone midshaft fragments usually indicate early access (i.e., before ravaging by carnivores) to carcasses by hominins.*

prehensive study of the FLK *Zinj* cutmarks, and concluded:

> "Cut marks are concentrated on the meaty limbs [i.e., upper and intermediate limb bones] of both smaller and larger animal carcasses. Sixty-two percent of all cut-marked bone specimens from smaller animals and 39.2% of all cut-marked specimens from larger animals are from the meaty limb bones. A large majority of the cut marks on meaty limb bones occur on mid-shaft specimens rather than on or immediately adjacent to epiphyses. At least 61.3% of the cut marks on meaty limbs of smaller animals and at least 68.9% of the cut marks on meaty limbs of larger animals occur on shaft specimens, and these values are generous underestimates" (Bunn & Kroll, 1986: 436-437).

Oliver's (1994) reanalysis of the FLK *Zinj* fauna corroborates the findings of Bunn and Kroll–there are more cutmarked upper and intermediate limb bones than cutmarked lower limb bones (i.e., metapodials). And both studies support the notion that Bed I hominins at Olduvai Gorge gained access to ungulate carcasses possessing large amounts of edible flesh, contradicting the three-stage model of assemblage formation, favored by Blumenschine and colleagues.

However, Blumenschine's (1995) finding that tooth mark frequencies in the FLK *Zinj* midshaft subassemblage are comparable to those observed in experimental studies in which carnivores had primary access to ungulate limb bones, still demands explanation. First, in response to the midshaft tooth mark evidence at FLK *Zinj*, zooarchaeologists need to recognize the fact that *animals other than large carnivores* can and do impart tooth marks on bones. Using modern chimpanzees as models for early hominins, Pickering & Wallis (1997) demonstrated that large-bodied hominoids are capable of producing tooth marks identical to those created by carnivores, in terms of the types of damage produced, in the morphology of damage marks and in overall degree and veracity of damage (see also, Brain, 1976; Maguire *et al.*, 1980; Plummer & Stanford, 2000; Tappen & Wrangham, 2000). Similarly, even baboons (in both captive and wild-ranging situations) leave tooth marks on bones comparable in frequency and distribution to those made by carnivores on human-produced bone assemblages (Domínguez-Rodrigo, 1999a). Thus, it is possible that some, if not many, of the tooth marks on FLK *Zinj* fossils were imparted by non-carnivores–including possibly hominins.

Assuming, though, that all the FLK *Zinj* tooth marks were inflicted by carnivores, it is important to note that the percentage of tooth marks on the midshaft subassemblage is similar not only to experimental situations in which carnivores were the primary defleshers and demarrowers of bones (Blumenschine, 1995). Domínguez-Rodrigo (1999a) has also shown experimentally that a similar percentage of tooth marked midshafts results from cases in which hominins are the primary carcass defleshers, but leave some marrow-bearing bones unbroken, available secondarily to scavenging carnivores. Based on analysis of long bone completeness at FLK *Zinj*, there is some reason to believe that this might be a realistic scenario of hominin behavior at the site. There is significant number of complete bones (9–10% of the total minimum number of elements) in the FLK *Zinj* faunal assemblage (Potts, 1988). This observation means that quite a few marrow-bearing bones were left unbroken at the site.

Further, this observation can lead to at least two conclusions. First, if hominins (who *all participants* in the debate–e.g., Binford, 1981; Blumenschine, 1988, 1995; Bunn & Kroll, 1986; Domínguez-Rodrigo, 1999a–agree had some role in the formation of the FLK *Zinj* fauna) were relegated, as passive scavengers, solely to marrow exploitation, one would *not* expect high numbers of unbroken limb bones at the site (Domínguez-Rodrigo, 2002). In other words, why would limb bones already defleshed by felid predators be transported by hominins to the site and then left unbroken? Second, Capaldo (1995) has demonstrated that hyenas destroy nearly all grease- and marrow-bearing elements available in small accumulations of bone. Further, most researchers (e.g., Bunn & Kroll, 1986; Blumenschine, 1988; Blumenschine & Marean, 1993; Marean *et al.*, 1992; Domínguez-Rodrigo, 1999a) agree that hyenas ravaged the FLK *Zinj* fauna *after* hominin involvement in the assemblage. Thus, the presence of whole marrow-bearing bones in the fossil sample could suggest a glut of these elements available after hominin use (Capaldo, 1995), but not exploited completely by hyena scavengers, because of their overabundance[5]. Together, these conclusions argue for early (abundant cutmarks on flesh bearing elements) and frequent (abandonment of limb bones without full exploitation of their marrow reserves) access to fully fleshed carcasses by Bed I hominins–a decidedly different idea of early hominin foraging capabilities than that proposed by advocates of marginal scavenging models.

BEYOND FLK *ZINJ* IN EAST AFRICA

While many other Plio-Pleistocene archaeological sites preserve large stone tool and faunal assemblages, few display the exquisite bone surface preservation observed at FLK *Zinj*. This is true for many of the important Koobi Fora (Kenya) sites excavated in the 1970s (Bunn, 1982, 1997). The best of these relatively poorly preserved Koobi Fora faunal assemblages is the 2,000+ piece sample from FxJj 50 (Okote Member, Koobi Fora Formation, dated *c.* 1.6 Ma). This fauna consists of the remains of at least 22 individual mammals and was formed on the floodplain of a stream channel, where hominins may have had access to the river cobbles that form the basis of the large stone tool assemblage found in association with the bones (Bunn, *et al.*, 1980).

As with FLK *Zinj*, FxJj 50 conforms to the expectations of a hominin “home base” or Type-C site, because there is a spatial association of abundant stone tools and fauna at the site–in addition to demonstrated causal links between these classes evidence, in the form of cutmarks and percussion marks on many bone surfaces (Bunn, 1981, 1982, 1997; Bunn *et al.*, 1980). Recently, a more detailed examination was made of a sample of these bone surface modifications, and it was concluded that most cutmarks in the FxJj 50 assemblage occur on the midshafts of upper and intermediate limb bone specimens (Domínguez-Rodrigo, 2002). This pattern is similar to that observed in the FLK *Zinj* fauna, and again, suggests early access by hominins to ungulate carcasses. In addition, tooth mark patterns at FxJj 50 argue against passive scavenging by hominins, with fewer midshafts preserving tooth marks than in experiments in which carcasses were ravaged solely by carnivores. Further, the epiphyseal and metaphyseal samples from FxJj 50 preserve tooth mark frequencies nearly identical to those observed in experimental settings in which hyenas ravaged carcasses *after* their use by hominins (e.g., Blumenschine, 1988, 1995; Capaldo, 1995).

Beyond these observations, Koobi Fora also preserves an interesting dichotomy in the material composition of penecontemporaneous archaeological sites (all occurring in deposits bracketed by the KBS Tuff [1.88 Ma] and the Okote Tuff [1.6 Ma]) between regions within the study area. Henry Bunn (1994) has documented a new kind of archaeological occurrence in the ephemeral lake margin contexts of the Koobi Fora Ridge and Ileret region (located in the western portion of the study area, along the shore of modern Lake Turkana). This new kind of occurrence is defined by cutmarked bone specimens *in the absence of associated stone tools*, and thus, is unlike sites in the fluvial contexts of the Karari Ridge (located in the northeastern portion of the study area), where these two classes of evidence (cutmarked bones and stone tools) co-occur within the same sites (e.g., FxJj 50).

Bunn interprets this disparity with reference to the paleogeography of the Turkana Basin *c.* 1.6 Ma. Unlike today, the prehistoric basin was dominated not by a large, permanent lake, but rather by the perennial ancestral Omo River, which flowed north to south through the region (Brown & Feibel, 1986; 1988; Feibel, 1988). The Karari Ridge area is nearby the proposed confluence of the axial drainage system of this ancient river. Thus, hominins carrying out activities in Karari Ridge *c.* 1.6 Ma had ready access to stone cobbles, carried in hydraulically from the eastern margins of the basin. One can therefore infer that there was little pressure for curation of artifacts at the Karari Ridge, and that this may explain the abundance of discarded tools at archaeological sites throughout the area. In contrast, the nearest source of stone tool raw materials available to early hominins in the ephemeral lake margin of the Koobi Fora Ridge was 15 km away, in gravel channels to the east and northeast. Bunn (1994) has thus suggested that hominins (sensibly) did not discard stone tools while foraging at the Koobi Fora Ridge, and that this probably explains the lack of artifacts in this area *c.* 1.6 Ma. The abundance of cutmarked bones from the Koobi Fora Ridge, however, does attest to the fact that hominins did possess and use stone tools in the region.

There is also a striking difference in the taxonomic composition of the fauna from the Koobi Fora and Karari Ridges. Most of the bones from the Koobi Fora Ridge are hippopotamus, while most of those from sites in the Karari are bovid. Bunn (1994: 261) has suggested that the near-lakeshore paleohabitat of the Koobi Fora Ridge may simply have supported more hippopotamuses than the Karari Ridge paleohabitat, and that hominins were thus "utiliz[ing] carcasses in proportion to their availability in the different areas." Alternatively, archaeological occurrences at the Koobi Fora Ridge "may document some single-event locations of the consumption of meat and/or marrow that did not involve significant transport of carcass parts. In contrast, the pattern at the Karari Ridge, based as it is on home base/central place sites, may document a later stage in the process of carcass utilization in which [hominins] transported more bovid bones and fewer hippopotamus bones to the known sites" (Bunn, 1994: 262).

A disparate pattern of hammerstone damage in the two sub-regions may support Bunn's latter suggestion. Nearly all limb bones from sites at the Karari Ridge were broken by hominins, while only just over half of the hippopotamus limb bones from the Koobi Fora Ridge sites have been breeched by hammerstone percussion. Bunn posits that the enormous amounts of skeletal muscle available on hippopotamus limbs might have offset the need for hominins to break open these bones for marrow. In addition, it is likely that the paucity of stone raw material at the Koobi Fora Ridge resulted in a short supply of suitable hammerstones available for hominin use in that region (N. Toth, personal communication). Finally, we believe that it is also possible that a "meat-stripping and marrow-abandonment" strategy could have been a response to the relatively open, exposed situations (i.e., potential carnivore pressure) in which hominins found themselves, if the Koobi Fora Ridge sites do, indeed, represent happened-upon carcasses[6]. In contrast, assuming the Karari Ridge sites represent hominin central place locales, it makes sense that there would be additional time in these *relatively* secure areas for more thorough exploitation of the transported parts of smaller (e.g., bovid) carcasses.

Finally, some of the best evidence of large mammal carcass exploitation by Oldowan hominins in East Africa, other than that from FLK *Zinj* and Koobi Fora, comes from the site of BK (*c.* 1.2 Ma), Bed II, Olduvai Gorge (Tanzania) (Monahan, 1996) and the ST site complex (*c.* 1.5 Ma) at Peninj (Tanzania) (Domínguez-Rodrigo *et al.*, 2002). Analyses of bone surface damage (see discussion above about tooth marks and cutmarks) in these assemblages indicate that hominins had primary access to fleshed (not ravaged) carcasses, and that carnivores subsequently scavenged the remnants of these carcasses. Even though published studies of the BK and ST site complex faunas are fairly recent (and, thus, have not yet received the same level of scrutiny as publications about FLK *Zinj*), they are already important simply because they expand the application of actualistic research on faunal assemblage formation beyond better known sites such as FLK *Zinj* and FxJj 50.

FARTHER AFIELD: HOMININS IN THE STERKFONTEIN VALLEY (SOUTH AFRICA)

The Sterkfontein Valley is home to a multitude of paleontological sites, which preserve the abundant remains of large terrestrial mammals, including hominins. Only three of these sites, however, also preserve Oldowan stone tool assemblages, Kromdraai A (Kuman *et al.*, 1997), Swartkrans (Members 1–3) (Clark, 1993) and Sterkfontein Member 5 (Oldowan Infill) (Kuman, 1994a, 1994b, 1998; Kuman & Clarke, 2000)[7]. It is not yet possible to date these breccia infills absolutely, although faunal indicators suggest the following broad age estimates: Kromdraai A, *c.* 2.0–1.0 Ma; Swartkrans Members 1–3, *c.* 1.8–1.0 Ma; Sterkfontein Member 5 (Oldowan Infill), *c.* 2.0–1.7 Ma (Brain, 1993a; Cooke, 1994; Kuman, 1994a, 1994b; McKee *et al.*, 1995; Vrba, 1981).

Researchers have established causal links (i.e., the observation of stone tool cutmarks) between the abundant faunas and stone tools in only two of the South

African Oldowan assemblages, Swartkrans Member 3 and Sterkfontein Member 5 (Oldowan Infill) (Brain, 1993b; Pickering, 1999)[8]. Interestingly, the only taxonomically identifiable hominin species recovered from both of these assemblages is *Australopithecus (Paranthropus) robustus* (e.g., Grine, 1989, 1993; Kuman & Clarke, 2000; Pickering, 1999). Further, studies of fossil hominin hand bones from Swartkrans suggest that individuals from whom these bones derived possessed all the requisite morphology to produce Oldowan stone tools (e.g., Susman, 1988a, 1988b, 1989).

This finding has led some researchers to conclude that *A. (P.) robustus* was the stone tool maker and user at Swartkrans. It is important to note, however, that early *Homo* was contemporaneous with *A. (P.) robustus* in the Sterkfontein Valley and at nearby sites, such as Drimolen, throughout the Plio-Pleistocene (e.g., Clarke, 1977a, 1977b; Clarke *et al.*, 1970; Grine, 1989, 1993; Keyser *et al.*, 2000). With this knowledge in mind, there are taphonomic reasons to question the assumption that an abundance of (taxonomically diagnostic) *A. (P.) robustus* craniodental material necessarily means that all the (taxonomically un-diagnostic) hominin postcranial material is also attributable to *A. (P.) robustus* (e.g., Trinkaus & Long, 1990; Pickering, 2001).

Regardless of the taxonomic identity of the stone tool maker/user at Swartkrans, the Member 3 cutmark evidence preserved there is dramatic because, although Members 1 and 2 at the site also preserve stone tools, no faunal remains in these earlier members have been found to display tool damage (Brain, 1981, 1993b). While the tool-modified bone sample from Member 3 is small (14 cutmarked pieces and two chopmarked pieces), a majority of the damaged bones (N=13) are long bone midshaft specimens.

Unfortunately, we are not able to assess the relative timing of hominin access to carcasses using this information in combination with models developed by one of us (Domínguez-Rodrigo, 1999a, 1999b; see discussion above). This is because the types (i.e., upper, intermediate or lower) of cutmarked long bone fragments in Member 3 have not yet been specified. However, efficient carcass foraging by Swartkrans hominins can be inferred by examination of another class of evidence preserved in the Member 3 assemblage.

Two hundred seventy burned bone pieces have been recovered from this deposit (Brain, 1993c; Brain & Sillen, 1988; Sillen & Hoering, 1993). Chemical and histological studies of these pieces suggest that they were heated in fires that reached temperatures of modern, human-tended *Celtis* wood fires. Further, these burned bone specimens were recovered from a six-meter-deep profile, throughout a laterally restricted area, which was a gully during Member 3 times. Referring specifically to excavation grid square W3/S3, Brain (1993c: 240) states:

> "[B]urnt bones occur in 23 excavation spits, each 10 cm deep, indicating that the bones were heated in frequently recurring fires during the deposition period of this stratigraphic unit, which may have spanned several thousand years. The spatial distribution of the burnt bones suggests strongly that the fires occurred within the confines of the [gully], which was beneath a dolomite roof and had an inclined entrance towards the southeast."

In addition, the horizontal distribution of the burned bones *within* the gully might be viewed as supporting Brain's interpretation of these specimens (as evidence of hominin control of fire) as correct. Had the gully been wood-choked and naturally ignited in prehistory one might expect that bone across *every* excavation grid square would be burned for any particular horizon. This is not the case; twelve of the 30 gully excavation grid squares preserve no burned bone. Finally, several of the burned bone specimens are also cutmarked, further bolstering the image of technologically competent hominins, consuming the meat of large mammals, around tended fires during Member 3 times at Swartkrans (Brain, 1993b).

SUMMARY AND CONCLUSION

This brief but critical review of arguments about large mammal carcass acquisition and use by Oldowan hominins in eastern and southern Africa (*c.* 2.5–1.0 Ma), highlights the exciting actualistic research conducted by various zooarchaeologists over the past 20 years. These innovative researchers have taken taphonomic studies beyond the level of mere "cautionary tales", and have provided colleagues not only with hypotheses about early hominin foraging capabilities, but also with the methods and techniques to test these hypotheses. It is our view that the most important of these methods are utilized during naturalistic and experimental studies with modern carnivores and humans, and are predicated on the precise recording of intraskeletal and intra-elemental placement of taxonomically indicative bone surface modifications (i.e., carnivore toothmarks versus hominin tool damage)[9].

Rob Blumenschine and several of his colleagues took the early lead in much of this type of work, which resulted in models used to explain the anatomical distribution and frequency of carnivore tooth marks and hominin-induced percussion damage in the FLK *Zinj* archaeofauna. This important body of work, however, did not deal as specifically with another, major class of bone surface modification preserved in FLK *Zinj* faunal assemblage–stone tool cutmarks, damage that often indicates butchering activities by hominins.

Analyses of bone surface damage in the FLK *Zinj* and other important Oldowan faunal assemblages from East and South Africa (e.g., FxJj 50, Koobi Fora; BK, Olduvai; ST site complex, Peninj; and possibly Swartkrans Member 3) demonstrate that hominin-inflicted cutmarks occur predominately on the midshaft sections of upper and intermediate limb bone specimens at these prehistoric sites (e.g., Brain, 1993b; Bunn, 1981, 1982, 1997, 2001; Bunn & Kroll, 1986; Domínguez-Rodrigo *et al.*, 2002; Oliver, 1994; Monahan, 1996). It has been demonstrated, under naturalistic conditions, that large carnivores (such as modern lions) with primary access to dead ungulates seldom abandon such carcasses with substantial portions of meat still adhering to upper and intermediate limb bone midshafts (e.g., Domínguez-Rodrigo, 1999b). Thus, an abundance of cutmarked upper and intermediate limb bone midshaft specimens at FLK *Zinj* and other Oldowan archaeological sites, seems to indicate that hominins often gained early access to fully fleshed ungulate carcasses during the Early Stone Age in eastern and southern Africa. Such early access to carcasses by hominins implies active hunting and/or power scavenging, a term coined by Bunn (1996: 322) for "the aggressive, confrontational driving away of primary predators or primary scavengers at kills" (see also, Bunn, 2001; Bunn & Ezzo, 1993).

This does not mean that we accept the notion that Oldowan hominins never acquired substantial carcass resources from passive scavenging opportunities. Countless researchers have emphasized the inherent behavioral flexibility of various mammalian taxa, in general, and of large-brained primates (early hominins included among this group), more specifically.

This said, however, does not diminish the importance of the conclusion that early hominins possessed the capability to acquire large mammal carcasses soon after these animals died. It thus follows that Oldowan hominins also possessed fairly sophisticated cognitive capabilities, because early access to such carcasses by these relatively diminutive, clawless and dull-toothed creatures would have required the skilled use of tools as weaponry and/or group coordination during hunting and power scavenging episodes.

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ENDNOTES

1. In 1999, we recovered several cutmarked bone specimens (associated spatially with stone tools) as surface finds throughout the Gona study area, from archaeological localities at the same stratigraphic interval as the 2.5–2.6 Ma sites, based on preliminary outcrop tracing in the field. To date, however, no cutmarked or hammerstone percussed bone specimens have been recovered *in situ* from Pliocene deposits in the Gona study area. Archaeological sites slightly younger (all dated radioisotopically *c.* 2.3 Ma) than those from Gona occur in the Omo (Ethiopia), Hadar (Ethiopia) and West Turkana (Kenya) study areas. Of these, only the Hadar site, A.L. 666, has produced a bone specimen possibly modified by hominins (a bovid scapula with a suspected cutmark) (Kimbel *et al.*, 1996), even though other early stone tool sites such GaJh 5 (Lokalalei, West Turkana) and FtJj 1 and FtJj 5 (Omo) did preserve associated fauna (e.g., Kibunjia, 1994; Merrick, 1976; Merrick & Merrick, 1976; Howell *et al.*, 1987).

2. We note here that the debate about the formation of the FLK *Zinj* archaeofauna, sparked by Binford, was based on two separate classes of evidence—ungulate skeletal part profiles and bone surface modifications. Perceptively, all participants in this long-running discussion have made reference to *both* of these classes of evidence. To place too much weight on the interpretation of skeletal part profiles, at the expense of an emphasis on bone surface damage, severely restricts any conclusion about the formation of a fossil assemblage (see, e.g., White, 1992). We make this assertion for several reason, including, most importantly: (1) the growing realization, based on ethnoarchaeological studies, that there is no (reliable) static model of a "human pattern" of carcass and carcass part transport (e.g., Bartram, 1993; Domínguez-Rodrigo & Marti Lezana, 1996; contra, White, 1952; Perkins & Daly, 1968); and (2) the well-established fact that skeletal part ratios in faunal assemblages of disparate origins can resemble one another simply because many different taphonomic processes often remove the same less dense bones and bone portions from an assemblage, regardless of accumulating agent(s) (summarized in Lyman, 1984, 1994; Bartram & Marean, 1999). Thus, our discussion here, although often referring to specifics of skeletal part representation at Oldowan sites, maintains a focus on interpretations based primarily on patterns of bone surface damage.

3. This finding is contrary to what we view as the "traditional expectation" of hunting (a proxy term for early access to carcasses by hominins) being inferred based on a concentration of cutmarks on limb epiphyses—which is usually thought to indicate disjointing of limb units (e.g., Shipman, 1986).

4. The same will hold true for partially, but largely, defleshed limb bone midshafts. Bunn (2001: 206-207) articulates the idea well:

   > "It is, of course, possible to start with a largely defleshed bone and then experimentally slice away at the visible muscle attachment areas, as Selvaggio (1994b) has shown…I would suggest, however, that butchers with any interest in preserving the sharpness of their knife blades are not going to repeatedly hack into the visible bone surfaces when the adhering meat can be shaved free without hitting the bone directly enough to produce cutmarks…Cutmarks are mistakes; they are accidental miscalculations of the precise location of the bone surface when muscle masses obscured it. As soon as a butcher can see the bone surface, few if any cutmarks will be inflicted thereafter in that area."

5. We realize that animals could have died naturally in places where hominins had previously or would eventually accumulate archaeofaunas, and that this phenomenon (rather than abandonment by hominins after flesh-stripping) could account for unbroken marrow bones at FLK *Zinj*. One way to provide support for the natural-death-source-of-whole-bones alternative is with the discovery of whole bones offsite in Bed I deposits at Olduvai. Such discoveries would broaden the environmental context of FLK *Zinj* and render whole bone representation at the site more coincident than it now seems. As the situation now stands (i.e., the absence of offsite discoveries of whole limb bone specimens), accepting this alternative will lead the skeptic to ask if animals were only dying at localities where hominins were accumulating carcass remains?

6. We do note, however, that predator risk was likely to have been minimal in prehistoric alluvial environments, based on analogy with modern lakeshore situations in East Africa—which support a low degree of carnivore overlap in use of space (e.g., Blumenschine, 1986b; Domínguez-Rodrigo, 2001). It is also important to acknowledge Monahan's (1998) reminder that hominins would have predicated their carcass and carcass part transport decisions based on a complex interplay of other variables *in addition to potential predation pressure*—including the number of hominin carcass-carriers and carcass size.

7. C.K. Brain (1958) recovered several stone tools—two of which are definitive (a chert flake and quartzite pebble) and a few others of which are more ambiguous—in the Kromdraai B deposit. We

also note that it is difficult to categorize definitively the stone tool assemblages from Kromdraai A and Swartkrans Member 3, which could be classified as Acheulean, rather than as Developed Oldowan (Kuman *et al.*, 1997; Clark, 1993).

8. Disappointingly, the 28,274-piece macromammalian faunal assemblage from the Sterkfontein Member 5 Oldowan Infill preserves only one definitively cutmarked bone specimen, a bovid scapula fragment (Pickering, 1999). An additional specimen, a bovid rib fragment, displays probable (but not definite) cutmarks. The re-deposited context of the Oldowan Infill stone tool assemblage, the inferred geomorphological setting of the cave during that time period (Kuman, 1994a, 1994b; Kuman & Clarke, 2000) and other taphonomic indicators (Pickering, 1999) all suggest hominins did not dwell in the cave during the deposition of the recovered materials; this may account for the paucity of cutmarked bone specimens in the Oldowan Infill assemblage when compared to the relative abundance of cutmarked specimens in Swartkrans Member 3 (see discussion in text), an assemblage inferred to have been created by hominin occupants of that cave, during Member 3 times (Brain, 1993b).

9. Many of the researchers mentioned in this paper are pioneers in this approach to questions in Early Stone Age archaeology, and it is encouraging to know that others are further refining recording processes and techniques (e.g., Abe *et al.*, 2000).

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