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Abstract
In lieu of an abstract, below is the first paragraph of the paper.

Savrda and Lewis Gastaldo define taphonomy as the paleontological subdiscipline which is concerned with the process responsible for any organism becoming part of the fossil record, and how these processes influence information in the fossil record (Gastaldo 1996, 1). Lee Lyman goes on to state that even more so it is the science dealing with the laws of burial or embedding (Lyman I). In this paper taphonomy will be discussed along with its use in cave settings mainly during the Pleistocene era. Mary C. Steiner makes it known that hominids evolved as members of animal communities, not in an ecological vacuum (Stiner 1993, 61). Because of this there are many factors which can influence the appearance of bone remains from the time the animal has died until the time the remains are discovered. Taphonomy is needed to distinguish what exactly happened to the bones. The effects of animal scavenging and early hominid hunting and scavenging are huge factors in creating marks on bones which leave us with a record of what exactly was or was not occurring since the death of the animal/hominid. Another issue that is highly debated is whether or not early humans were hunters or scavengers. This too can be examined through the analysis of remains found at cave sites. John Shea writes, "During the last decade both the antiquity and the pale ecological significance of hunting by hominids have been challenged by taphonomic studies" (Shea 441 ).
Cave Taphonomy
By Amberly Rounds

Savrda and Lewis Gastaldo define taphonomy as the paleontological subdiscipline which is concerned with the process responsible for any organism becoming part of the fossil record, and how these processes influence information in the fossil record (Gastaldo 1996, 1). Lee Lyman goes on to state that even more so it is the science dealing with the laws of burial or embedding (Lyman 1). In this paper taphonomy will be discussed along with its use in cave settings mainly during the Pleistocene era. Mary C. Steiner makes it known that hominids evolved as members of animal communities, not in an ecological vacuum (Stiner 1993, 61). Because of this there are many factors which can influence the appearance of bone remains from the time the animal has died until the time the remains are discovered. Taphonomy is needed to distinguish what exactly happened to the bones. The effects of animal scavenging and early hominid hunting and scavenging are huge factors in creating marks on bones which leave us with a record of what exactly was or was not occurring since the death of the animal/hominid. Another issue that is highly debated is whether or not early humans were hunters or scavengers. This too can be examined through the analysis of remains found at cave sites. John Shea writes, “During the last decade both the antiquity and the pale ecological significance of hunting by hominids have been challenged by taphonomic studies” (Shea 441).

Taphonomy is looked at in three main stages. The first stage is Necrology. This is the death or loss of a part from a particular individual. The second stage is called biostratigraphy, and this is all of the interactions involved with the remains since necrology. The third and final stage is referred to as diagensis. This stage included all the processes that are responsible for the lithification of sediment, and mainly deals with the chemical interactions that occur. Steiner believes that although taphonomy prepares the way, taphonomy alone cannot provide the full interpretive structure needed to understand hominid adaptations (Stiner 63).

When looking at sites that are within a cave setting there are certain factors which must be looked at in order to understand the processes that have changed the bone remains found within that cave. The type of rocks or minerals that the cave is composed of must first be determined. Caves that are made up of dolomite or limestone for example, cause deposits on the bones to occur and many times cause the bones to break open or dissolve due to chemical reactions from the rocks they are found in. Lewis and Savrda go on to explain that those parts of an organism that are already mineralized, have a higher probability of preservation that any of the soft, fleshy tissues either around or within the skeleton (Gastaldo 1). Many caves are also in very close proximity to, or in water. This helps in the preservation of the bones, but can also mean that the bones were washed in from another area and were not initially placed here. The size of the cave is also very important. If the cave is very narrow or small, then it is not likely that early hominids occupied it, but could mean that smaller animals have/had brought in the bone remains from other locations. The stratigraphic layers of the cave also possess great importance when studying artifacts in cave sites. These layers must be determined and the rocks within these layers must be dated in order to date the objects found within each layer.

The next criterion that must be determined when analyzing a cave site is what or who has inhabited the cave in the past and the present. One main group of animals that occupy caves is rodents. The two main rodents that will be discussed are small rodents (mice), and porcupines. The second groups of animals that have been found to occupy certain cave sites are large carnivores such as hyenas, bears, and leopards. In particular the role of leopards will be discussed in association with bone remains found in early hominid cave sites. Finally the last group of inhabitants is early humans, or hominids. Each of these individuals leaves certain traces of their actions in the past. Taphonomy is used to sort out these traces left, and determine what or who was responsible for them. Porcupines and leopards in particular can leave remains that appear to be manipulated by early humans at first glance and before taphonomic practices were developed which help to distinguish between these particular markings.

Porcupines in particular are well known for leaving marks on bones that may be initially determined as human made. The African porcupine, hystrix africaeaustralis, is found in southern Africa. This particular type of porcupine has long, heavy quills, a stocky body and short legs. The porcupine usually forages alone, but when in a den (cave) they can be found in small family groups. C.K. Brain, a highly respected and attributed paleoanthropologist, has done a great deal of studies on these rodents, and has found many facts which help identify their presence in many cave sites. One aspect of the porcupine which is very important when looking at the marks they leave on bones and why is the fact that their teeth grow continually. C.K. Brain explains that because of this they must gnaw on hard objects in order to prevent overgrowth of the front incisors (Brain 109). There is no nutritional value that is produced from the gnawing practice. There are
certain bones the porcupines choose to gnaw on and particular marks that are left on these bones. Brain explains how in particular, porcupines are more attracted to dry, non-fleshy bones (Brain 109). These bones are harder and provide the porcupine with a better substance to gnaw and wear their teeth down on. Because there is no nutritional value associated with the gnawing of these bones, porcupines are not prone to chew on the greasy parts of the bones. It has also been found that porcupines are more prone to chewing on bones that are larger in length and size. This is because it is easier for the porcupine to grasp these bones and gnaw than it would be on smaller bones such as vertebrae. Although these rodents tend to chew on the dry, larger bones they have been found to collect a great number and variety of bones and other objects which they never gnaw on. The marks made on bones by porcupines are highly characteristic and easily distinguishable from those made by early humans or carnivores.

(African Porcupine)

The second animal that creates marks on bones found in cave sites that may be mistaken for bones manipulated by hominids is the leopard. The leopard, Panthera pardus, is found in southern and central Africa and southern Asia. These carnivores are suited with a rosette patterned coat and can often be confused with the Jaguar. The leopard weighs between thirty and ninety kilograms, with an average lifespan of twelve to seventeen years. Leopards can also be black in color and then are more often referred to as black panthers. This coat color mutation is the result of the Black Panther living in wet areas, and is advantageous when hunting in these areas. The leopard is a carnivore and a nocturnal hunter. It is in competition with other carnivores such as lions and tigers. Because of this competition leopards often take their prey to a tree to consume rather than eating the prey at the open area kill site. This allows the leopard to have more time for processing the animal they have killed. Leopards can be associated with cave sites. They sometimes do use the caves/den as a home but are more often used as a “hiding place”, just as the trees, to consume their kills.

One important detail that links leopard prey remains with cave sites from the past is the fact that during the time of early humans many of the cave sites were is close proximity to forested areas and rivers/streams. Because of this many bones that were left over from the leopard’s meals in the trees may have washed into the caves by way of the river or stream. Because of this many of the bones that had been manipulated by leopards are found in cave sites along with bones that have been processed by early humans. Fortunately there are distinguishable differences in the marks left by early humans and those created by leopards. This allows scientists today to separate which bones are associated with hominids and which were processed by leopards.

There are three cave sites in particular that show evidence of leopard, porcupine, and early hominids being present and creating marks on remains found at those sites. Zhoukoudian is one cave site, more commonly known as the “home” of the Beijing, Peking, Man. Sterkfontein and Swartkrans are two cave sites that are located in Africa. Each of these sites is essential to understanding the importance that Taphonomy has when analyzing cave sites that possess bone remains that could have been influenced by many different physical aspects.

Anthropologist and Archaeologist Lewis Binford describes Zhoukoudian as being located 50km southwest of Beijing, China (Binford 416). This site was first discovered in the pre-WWII era and dates back from 18,000-11,000 BC. This site has a very tragic twist that occurred during WWII. When WWII entered China, the remains were attempted to be moved to the east coast of china for safe keeping by the American army. During this transport the remains were lost and have still yet to be found. Those remains were those of Sinanthropus pekinensis who lived during the middle Pleistocene era. It has been proposed that Sinanthropus pekinensis used this cave
site as a home. Binford writes, "The idea that Zhukoudian was the "cave home of Beijing man" has been basic to the interpretation of its contents since the very early days of its investigation" (Binford 413). It was first thought that there was evidence proving that the hominoids living in this cave were cannibals. Taphonomy evidence has since proved these early assumptions to be false.

From the remains that were found at this site pre-WWII, it was first thought that there were signs found which proved *Homo-erectus* to have been cannibals. Binford states that the first piece of evidence which was mistaken for evidence of cannibalism was postcranial bone fragments which were said to be split longitudinally (Binford 414). This was thought that only humans had the capability to make this break at that particular period of time. Because of advances in Paleoanthropology, especially Taphonomy, it has been proved that this type of breakage was caused by weathering rather than human contact. A couple of bones found were also identified as being burned. This was disproved and it was found that these particular bones were rather "heavily stained by minerals" (Binford 414). A third piece of evidence that was mistaken as cannibalism was the breakage of mandibles which was thought to have been done by man. This was once again disproved by further research more recently. Binford states, "It is a natural result of structural weakness in mandibles that have been subjected to even minor physical pressures or movement after defleshing. Along with the breakage of hominid mandibles, there was also a large number of hominid skulls recovered that did not have the facial area and base. This was also seen as a sign of cannibalism on the part of *Homo-erectus*. Binford has since stated that "The eating away of facial portions of the skull is a characteristic marker of carnivore activity", and because the skulls were found in gravel deposits and not in their primary context, they could have been transported by streams, "rolled and tumbled" (Binford 414) causing the breakage of these areas also. Finally, there was found many skulls that had abrasions and grooves on them which were thought to have been produced by hominids while processing the remains to be eaten. Once again the advancements in science and taphonomy have made it possible to recognize these abrasions and grooves as being "a common consequence of animal gnawing on skulls" (Binford 415).

Binford goes on to state that one other skull "registers strong evidence for at least one hominid's having been gnawed on by feeding animals". Therefore, due to the advancement of the field of taphonomy many initial beliefs about the activities at Zhukoudian have been attributed to either rodent and carnivore gnawing or natural weathering processes which are more easily recognizable today.

The second site that deals with this subject is located in Africa, north of Krugersdorf, and has been named Sterkfontein. Phillip Tobias has found that this site dates back to 3.3-3.5mya (Tobias 318). This is considered to be one of the world's most productive and important paleoanthropological sites. This site was first excavated by Broom in 1936. Sterkfontein is also where the first remains of *Australopithecus africanaus* were found, and is the home of the famous "Mrs. Ples". Mrs. Ples was found by Broom on April 18th, 1947 and is derived from *Plesianthropus*. This in-tact skull is said to be the most "perfect pre-human skull ever found" at the time (Worsnip par2). More recently there has been found hominid remains. One foot was found imbedded in the Breccia in Sterkfontein, and has since then been nicknamed "Little Foot". There was also found five hundred skull, jaws, teeth, and skeletal fossils of these early hominids. This cave in particular is made of dolomite and limestone. Sterkfontein also possess groundwater. The combination of these two elements leads to a tendency of sinkholes and caves. This makes it more difficult for the stratigraphic layers to be determined, and therefore the artifacts within those layers are also very hard to date accurately. There was taphonomic evidence showing the existence of carnivore activity as well as porcupine gnawing.

There was evidence of porcupine activity found at this site, but as stated by Brain "recognition of such damage has been seriously complicated for Member 4 fossils by postdepositional events". As far as the evidence for porcupine gnawing, there is very little. C.K. Brain states, "Gnaw marks were observed on one specimen only - a juvenile Parapapio mandible" (Brain 210). When it comes to carnivore activity there is much more evidence apparent at Sterkfontein. The following passage has been taken from the book written by C.K. Brain, *The Hunters or the Hunted?: an Introduction to African Cave Taphonomy."

Two *Australopithecus* specimens, a juvenile mandible and a palate, show ragged-edge damage that could have resulted from carnivore chewing. In both cases the bone is in poor condition, and such a diagnosis is tentative. Two Parapapio mandibles show evidence of carnivore damage—one, STS 351, bears two punctures of the inner side of the corpus caused-unquestionably, I think- by carnivore
teeth. An antelope mandible and two distal humeri show traces of carnivore chewing, and two classic cranial pieces have been damaged in a way characteristic of food remains left by large cats.

This goes to show that the damage done by weathering and postdepositional movement of bones can severely effect the determination of what has happened to bone remains. This also shows us *Australopithecus* carnivore and present, which does influence the appearance of bone remains and can be mistaken for human alteration through tool use. Because of the developments in the field of taphonomy, these alterations on bones can be more easily distinguished and analyzed in a more precise manner.

The third cave site to which taphonomy is vital in understanding the processes which acted on the artifacts found is Swartkrans. Swartkrans is located about 1.5km northwest of the Sterkfontein caves in Africa. This site was first discovered by Broom and Robinson in 1948. Unfortunately the publicity that erupted from this site caused it to be mined for the rock from 1949-1951. Unfortunately shortly before the mining was completed Broom died, so Brain took over the excavation starting in 1951. This site is where the “ape-man” remains have been found. More scientifically these remains can be attributed to *Australopithecus robustus*.

**(*Australopithecus robustus*)**

These remains have been dated to 1.7mya. Since the start of the excavation of this site more than two hundred hominid specimens were found, most of which were attributed to *Paranthropus* (*Australopithecus*) Robustus. There have also been numerous amounts of animal remains, stone tools, and bone tools that have been recovered. There were also specific damages to the bones that were observed.

According to Brain, there was evidence of both porcupine/small rodent gnawing and carnivore-inflicted damage. In *The Hunters or the Hunted*? Brain described the details of the damage found:

The typical gnaw marks of porcupines were observed on twelve pieces, and 163 specimens bore marks caused by the incisors of small rodents. No fewer than 291 bones, out of a total of 5,884, showed clear evidence of carnivore damage, and another 123 bore less positive traces. Carnivore damage was observed on 17 vertebrae, 6scapulae, 9 pelvis pieces, 55 humeri, 15 radii, 46 femurs, 19 tibiae, 3 calcanei, and 39 metapodials form bovid class IIa.

Once again the field of taphonomy was able to step in and interpret what had happened to these bone remains. It has been found that leopards and porcupines were both influences on these bones just as at Swartkrans’ sister site, Sterkfontein. Not only does taphonomy help us in understanding the processes that have acted on the remains since their detachment or death of the individuals, but it also helps us to further understand the lifestyle of the individuals which were living in the area millions of years ago.

Many have called these early hominids hunters or killers, but because of the evidence that has been found at these cave sites that idea has been refuted quite often. When these sites were first examined the lack of taphonomic evidence led researchers to believe that the early hominids were hunters and in the case of the Peking man, cannibals. Now however we are able to see that many of the marks left on bones that were thought to have been made by early humans can actually be attributed to animal activity and/or weathering processes. It was stated by Pat Shipman, a member of the department of Anthropology at Penn State University, that “One of the main aims of taphonomic studies has been to establish whether hominids were instrumental in creating and modifying the assemblage in question or whether its features can better be explained by the action of natural agencies: carnivores, wind, water, trampling animals, sedimentary abrasion, and the like.” (Shipman I). This was proved in the examples mentioned above dealing with cannibalism at Zhoukoudian. This was also a factor at the two caves in Africa, Sterkfontein and Swartkrans.

Finally the question of hominids being fierce hunters can be addressed through bones found at these three well known and studied sites. John Shea writes, “Much of the recent research in hominid strategies for meat procurement has focused on the interpretation of bones recovered from archaeological sites” (Shea 441). Brain writes about “who or what could most likely have been responsible” for the animal remains and the markings on them that were found at Swartkrans. He goes on to say, “I have little hesitation in suggesting that the springbok were killed by carnivores and consumed within the catchments of the Swartkrans cave entrance” (Brain 245). This goes to show that although these animal remains were found in the same stratigraphic layers as hominid remains, it does not necessarily mean that the hominids were responsible for the bone accumulations.
and alterations. Brain does go on to say that although hominids were not responsible for these particular accumulations, “evidence is clear that human hunters were also involved in the building up of the bone assemblage” (Brain 245). From this evidence it is very likely that this cave was inhabited not only by the hominids, but also by carnivores such as leopards and hyenas. This also shows us that although humans may have been doing some hunting at this time, they were also most likely scavengers of meat that had been killed by larger carnivores. In fact, John Shea states, “recent models of hominid subsistence have stressed the importance of scavenging in the meat procurement strategies of Early, Middle, and Late Pleistocene hominids (Shea 441). There are others who argue that there is evidence that these hominids were, however, using stone tools to hunt and kill the animals and then process them all by themselves. But as anthropologist Henry T. Bunn writes, “Archaeological reconstructions that employ multiple lines of evidence are preferable to single-cause explanations” (Bunn 438). Because there are pieces of evidence that point both ways in explaining the subsistence patterns of these early hominids, only further research and advancements in the archaeological finds can help to finalize what exactly our early ancestors were doing.

In conclusion, taphonomy has become an essential part of conducting paleoanthropological studies when dealing with bone assemblages. Marking on bones that were once attributed to work done by early hominids have now been proved to be the result of other processes. It is often found that marking that may seem to be made by human alterations are in fact caused by weathering agents or natural processes, carnivore activity, or rodent (porcupine) gnawing. Because of the discovery that most marking on bones are not human alterations, it has also been suggested that hominids were nothing more than scavengers and were not involved in tool-aided hunting and killing of large mammals. This idea has also been highly debated and is still just that today. Finally, taphonomy has come a long way since it was first introduced by Binford in the 1960’s, and will continue to be the agent which deciphers the many clues that are found on bone assemblages throughout time. Taphonomy is the key to understanding archaeological records found in the past, and those yet to be discovered.

Works Cited


