Chapter 2 – Definitions and the Theoretical Framework

This chapter will provide the definitions and theoretical framework to be used in this project. The term "taphonomy" will be defined and attention will be given to the definition of "bone density". This project will be concerned largely with the ways in which certain bones are removed from the archaeological record as a result of destructive taphonomic forces. It is therefore appropriate to define the protocol by which a bone is described as being "absent" from an assemblage. Finally, a theoretical framework of archaeological interpretation will be presented, around which this project will be structured.

2.1: "*Taphonomy*" Defined

"Taphonomy" is a term deriving from the Greek words "taphos" (burial) and "nomos" (laws), and was coined by I.A. Efremov (1940 p85). Efremov defined the term as being the study of the "transition in all its details of animal remains from the biosphere to the lithosphere" or geological record. Although it was originally a paleontological term, it has been readily adopted by zooarchaeologists as a means to identify, explain and interpret patterns of bone frequencies in the archaeological record. It has also been used to assess histories of bone deposition and site formation processes.

Within his definition, Efremov implied that all processes affecting an assemblage prior to its incorporation into a stable sub-soil should be termed "taphonomic". This could include both diagenesis (the largely chemical transformation of bone in the ground) and a range of anthropogenic processes such as selective killing, cooking and disposal practices. In addition, it is possible to argue that there are other biasing "filters" which are controllable by the archaeologist. These might include selective retrieval, analysis and publication (Medlock 1975 p225).

A more exclusive definition is that used by Millard (1998 p95), who describes taphonomy as being distinct from both anthropogenic processes and diagenesis. Millard's main taphonomic processes include digestion, trampling, burning and weathering.

The term taphonomy as used by this project will mirror the definition supplied by Efremov. For the purposes of this project, taphonomic processes will include all transformations of bone (particularly those that lead to the analytic destruction of bone – see below) that occur between the death of an animal and the archaeological excavation of its remains. Within this term, it will still be possible to differentiate between anthropogenic (or c-transforms (Schiffer and Rathje 1973 pp174 - 178)), diagenetic and "natural" processes. "Natural" processes can be defined as being separate from anthropogenic and diagenetic processes and relate to Schiffer's n-transforms (Schiffer and Rathje 1973 170 - 174). It is clear that there is some overlap between taphonomic and anthropogenic processes. For example, trampling could be argued to be an anthropogenic process if the trampling agents are human. Similarly, weathering could be seen as a diagenetic process, since it largely involves the chemical alteration of bone. Table 2.1 shows the main taphonomic processes to be discussed by this project and the categories into which they might most sensibly be placed. The overlap between the categories defined in table 2.1 is such that they might be argued to be arbitrary. It is for this reason that individual processes will not be categorised in this way by this project. Instead, all taphonomic processes will be considered together.

"Natural"	Anthropogenic	Diagenetic
Weathering	Butchery	Collagen Loss
Gnawing	Heating	Mineral Loss
Trampling		Histological Destruction

Table 2.1: Showing the main taphonomic processes explored in this project and the categories into which they might been placed. Although overlap between the categories means that some of the categorisations are arguable, this will not affect the validity of the terms being used.

2.2: The Concept of Analytic Absence

One of the interpretative tools available to the archaeologist is the analysis of the numbers of different bones, or parts of bones, which have been excavated from archaeological sites. The data used in this type of analysis are commonly referred to as "element frequencies". In order to create element frequencies, it is first necessary to identify the elements in the assemblage under analysis. Almost all assemblages will contain bones that both can be identified to the required level (be it taxa, genus or element) and those that cannot. Since it is theoretically possible to identify any bone fragment, given sufficient time, resources and a suitably skilled faunal specialist, it is

incorrect to refer to bones as being *unidentifiable.* Instead, fragments that do not enable identification to a particular level using a specific protocol are said to be *indeterminate* (Gobalet 2001 p379).

Indeterminate bones are of little use in creating element frequencies. Lyman and O'Brien (1987 p496) make the observation that the determinate bone fragments tend to be larger and less fragmentary than the indeterminate fragments. They refer to the phenomenon of bone fragments being too small to be identified as *analytic absence*. Thus, even if a bone has not been destroyed physically, it can be fragmented to an extent that, for the purposes of the creation of element frequencies, it is effectively absent.

The probability that a bone will be analytically absent from an assemblage is intimately linked to three factors:

1) The likelihood that the bones will be subjected to destructive forces.
2) The nature of the destructive forces acting on the bones in question.
3) The ability of the bones to withstand these destructive forces.

These three factors are not uniform for all bones (or parts of bones). This variation results in certain bones being more or less likely to be analytically removed from an assemblage, which, in turn, leads to biases in the archaeological record. Unless these biases can be identified and accounted for, it is possible that recorded bone data will be misinterpreted. This project will endeavour to produce bone density data that can be used to overcome this bias.

2.3: Establishing a Theoretical Framework for Taphonomic Analysis

The ultimate goal of archaeological research is to increase our understanding of the activities of past societies. This goal is usually pursued through the analysis of the material left behind by these people. Archaeologists primarily work under the presumption that since the material under analysis originated from human activities, it somehow reflects those activities. It will soon be noted that this presumption is not entirely correct. In addition to cultural factors, other processes are partially responsible for the formation of the archaeological record.

An early study that was reliant on the notion that the archaeological record is a direct reflection of past human activities was that of Dart (1957 & 1962 – for an

exhaustive bibliography of Dart's remarkable series of papers on this subject, see Brain 1981). In this pioneering work on the remains of the Makapansgat Australopithecines, Dart noted the repeated absence of specific animal bones from the archaeological record. This, he proposed, was the result of the Makapansgat Australopithecines habitually selecting certain animal bones for food. Certain bones were suggested as being absent because they were used as a raw material for the manufacture of a suite of tools. These tools were supposed to characterise this culture, which Dart termed the "osteodontokeratic culture".

It is clear that in this study, Dart has attempted to establish a direct link between the element frequencies in an assemblage and the activities of the people responsible for the deposition of the material. The value of such clear cut causal linkages between human behaviour and the archaeological record has since been questioned (Brain 1989, Marean *et al* 1992 p102). Instead, it is generally supposed today that the nature of archaeologically excavated material is the result of some combination of cultural and non-cultural processes. Although Dart's interpretations are now generally seen as being flawed, his work was instrumental in that it indirectly demonstrated the relative importance of taphonomic processes in the formation of the archaeological record.

The formation of the archaeological record is a subject that was extensively explored by Schiffer (Schiffer, M. (1976) *Behavioural Archaeology*. New York: Academic Press. – cited and reproduced in Schiffer 1995). Schiffer (and many others subsequently) noted that the archaeological record does not truly represent fossilised cultural systems. He points out that a number of "correlates" and "transforms" prevent archaeologists from inferring past cultural systems directly from archaeological data.

"Correlates" represent the relationship between material culture and the cultural system that produced it. They bridge the gap between static material objects and the constantly changing cultural systems from which they are derived. Correlates can be used to "infer the manufacturing operations that produced an artefact or the use(s) to which it was put" (Schiffer 1995 p36).

"Transforms" have the effect of altering the data available to the archaeologist. By doing so, it becomes more and more difficult to infer cultural systems from archaeological material. According to Schiffer, transforms can be split into two types. The cultural, or c-transforms are usually the first to act on a material culture. These transforms are best described as cultural processes that determine what material is deposited into the archaeological record. They include processes such as butchery,

discard, burial and abandonment. Schiffer (1995 p37) notes that they are the most difficult transforms to model or predict. This is largely because they are partly controlled by human behaviour, which is extremely difficult to model (Wilson 2000 p103). Superficially, c-transforms and correlates are the same, since they relate to cultural behaviour. However, a difference exists in that correlates do not determine what material is deposited in the archaeological record, whereas c-transforms do.

The other type of transform defined by Schiffer (1995 p38) is "non-cultural" or n-transforms. These processes define what material survives to be recovered by the archaeologist. They include fluvial action, gnawing and diagenesis. N-transforms are the best understood processes, and much has been done in the last 25 years to understand them and to model their effects.

Schiffer proposes that a prime objective of archaeologists is to establish laws by which c- and n-transforms can be understood. These laws would enable archaeologists to recreate the original cultural material from the altered archaeological material and so inferring cultural systems accurately would become possible (provided that the necessary correlations were understood). It is important to note that, should such laws be established, they would be neither spatially nor temporally constant. This is because, although the processes that govern n-transforms can potentially be modelled (Hodder 1982 pp47 - 56) there are aspects of c-transforms (including the ways in which they interact with n-transforms) that vary unpredictably through space and time (Wilson 2000 p103).

In the field of zooarchaeology, the need to understand the site formation processes described by (above) has led to a considerable quantity of taphonomic research (eg Behrensmeyer 1978, Binford and Bertram 1977, Brain 1967, Fiorillo 1989, Knight 1985, Myers *et al* 1980, Shipman 1988, Stallibrass 1984). This research has been both experimental and observational (including ethnoarchaeological) in its nature and has contributed to our understanding of taphonomic processes in two ways. Firstly, it has provided a basis by which the factors affecting a bone assemblage can be directly assessed. For example, the work of David (1990) provided a series of physical signatures on burned bones that could be used to assess the temperature and duration of the burning event. In this way, examination of bone material can provide information relating to its treatment and the nature of the taphonomic processes that have affected it. This might be seen as taphonomic research providing "positive" information relating to an assemblage.

Secondly, some taphonomic research has focussed on what might be termed "negative" information. This type of study is typically more concerned with identifying and accounting for biases in faunal assemblages that are the result of the differential effects of destructive taphonomic processes. Such research attempts to overcome the fact that destructive taphonomic processes destroy (or at least, render analytically absent) certain elements (or parts of elements) more readily than others. If it can be modelled, differential destruction of this type will result in distinctive element frequencies in an assemblage. Consequently, where such frequencies are observed, they can be attributed to taphonomic, rather than cultural processes. It is the understanding of bone destruction and the resulting bias in bone frequencies that will be the major concern of this project. This will be achieved through experimental methods (rather than observational study).

The taphonomic processes in which archaeologists are primarily interested all occurred in the past. As a result the processes themselves cannot be observed. Instead, only the results of these processes (modified or biased archaeological assemblages) can be observed directly. Consequently archaeologists are obliged to rely on analogy between observable modern processes and invisible archaeological processes. This is achieved by comparing the results of modern and archaeological processes. When these two sets of results can be shown to be the same, it is often concluded that the modern (observable) and archaeological (unobservable) processes are also the same. In addition to the analysis of taphonomic processes, analogy is also frequently employed in the identification of artefact types, building forms, social structures etc. Modern observation of these variables for use in analogy with archaeological data is achieved through both experimentation and ethnography. This use of analogy forms the basis of the vast majority of taphonomic and archaeological research (Gifford-Gonzalez 1991).

An example of analogy in taphonomic research is apparent in the observation of the behaviour of living hyenas, paying particular attention to their bone altering potential. Where the bone assemblage formed by the modern animals can be shown to be similar to that recovered archaeologically, it can be concluded that hyenas were instrumental in the production of both.

Analogical comparisons of this type rely on the assumption that the archaeological processes of primary interest operate in the same way and produce the same results as their analogical modern processes. This *uniformitarianism* enables analogies to be drawn between modern and archaeological processes with reference to

their observable results. Uniformitarianism has been variously defined by different authors (see Lyman 1994 pp46 - 49), although the basic premise of non-variation through time and space remains the same. The role of analogy and uniformitarianism in archaeological interpretation is described in figure 2.1.

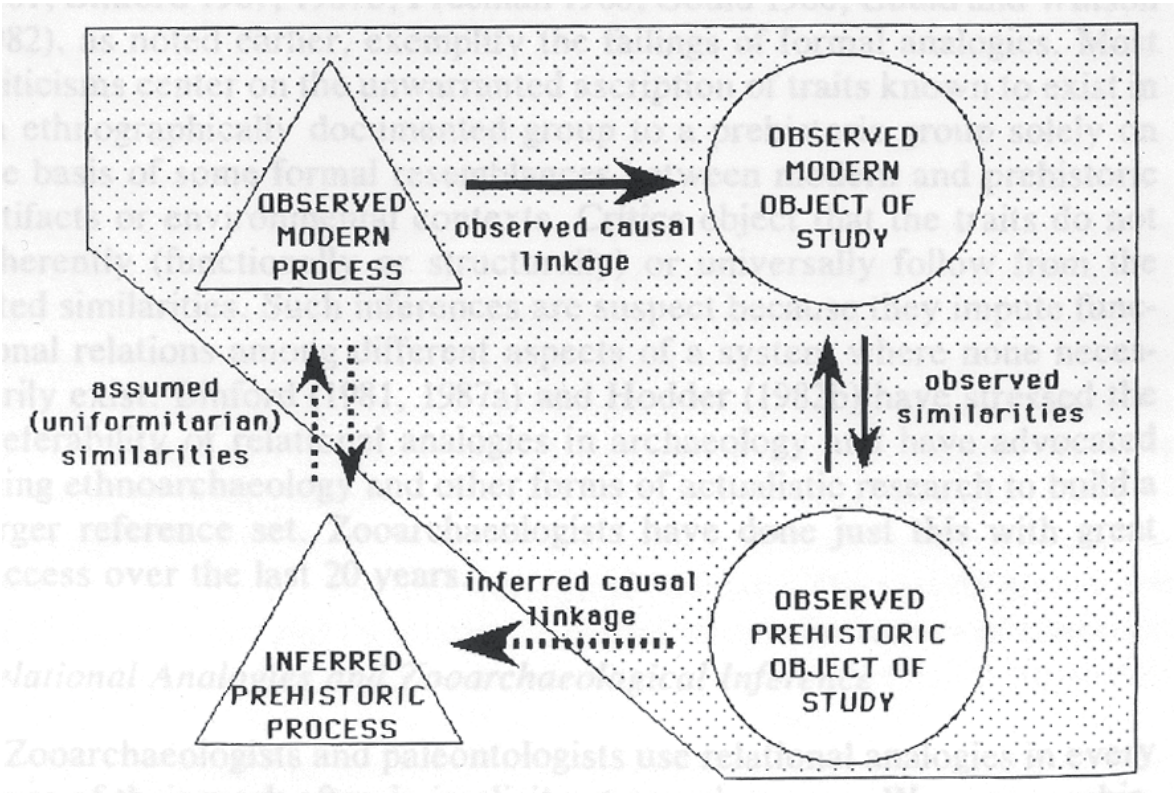

Figure 2.1: Diagrammatic representation of the nature of analogical reasoning in archaeology. The shaded area represents the realm of contemporary observations. From Gifford-Gonzalez (1991p222 Fig 1)

The importance of uniformitarianism can be seen in the hyena experiment described above. The conclusion that hyenas were responsible for both the modern and the archaeological assemblage can only be supported *assuming* that the behaviour and natural history of hyenas (their bone altering potential) have not altered through time or space.

It has been noted (Binford 1981 p27, Simpson 1970 pp62 - 63) that the assumptions on which uniformitarianism are based cannot be tested and are therefore potentially false. Furthermore, when modern observations do not exactly match observations of archaeological material, it is necessary to rely on ad hoc arguments in order to explain this discrepancy. This is said to weaken the assumptions associated with uniformitarianism (Scott, 1963 p513). However, Lyman (1994 p51) points out that

a more suitable or reliable analytical method has not been proposed and so uniformitarian methods remain the best (and only) option available. Furthermore, the need for “ad hoc” arguments is largely a product of an incomplete knowledge of modern processes, rather than an inherent weakness of the uniformitarian method itself. This emphasises the need for a greater understanding of modern processes, so that future analogy based archaeological and taphonomic research will be more reliable. The increase of the current level of understanding of these processes, and in particular of the variability of bone density among animals of the same species, will be an aim of this project.

Even if, through a process of analogical analysis, the processes that acted on archaeological material in the past can be understood fully, the powers of explanation are not necessarily guaranteed. Knowledge of the taphonomic history of an assemblage does not imply that all aspects of past human culture can be determined. This relates to the difference between the c- & n-transforms and the correlates defined by Schiffer (1995 - see above). This project aims to aid the understanding of c- and n-transforms (particularly those relevant to Çatalhöyük). It does not intend to elucidate the nature of correlates. In other words, even though our understanding of the processes that can act on the archaeological material will be improved, it will not be possible to draw conclusions as to the implications of these processes (or their products) in the behavioural system being researched (Gifford-Gonzalez 1991 pp18 - 21).

The first part of this project draws upon previous archaeological research in order to distil laws that will enable this to be achieved. Naturally, this task is a considerable one and so the laws used here will be broad and necessarily flawed. It will become apparent that in order to apply these laws, experimentally produced data will be required. This will be produced as necessary. The final part of this project applies the laws to an archaeological assemblage in order to assess their suitability and to demonstrate any scope for their refinement.

This chapter has defined the concepts of taphonomy, density and analytic absence. It has also presented a broad theoretical framework by which bone density data can be used to identify bias in element profiles.