2 METHODOLOGY

The main areas to be investigated were identified in chapter 1. The initial investigation of butchery would inform the secondary analysis of the distribution of bone parts, which itself would take two forms: a basic two dimensional analysis of pit content and then three dimensional analysis to investigate smaller more discrete groups of assemblages within the pits. This thesis is divided into three main sections of investigation: butchery, two-dimensional spatial distribution of animal bone and three-dimensional spatial distribution of animal bone. These were carried out consecutively as the methodologies for the separate analyses were in part based on results from the previous sections. The thesis was thought to flow better in this way, and the argument to be presented more concisely. Each of chapters 3, 4 and 5 are structured as hypothesis, methodology, results, discussion and conclusion, with a final chapter, chapter 6, combining all three strands of the analysis.

Throughout the thesis technical terms for parts of particular bones have been avoided, unless their presence was necessary to clarify the prose. In such cases the terms are included in the glossary. The omission of specific terminology was intended to avoid confusion, for example where authors use different terms for the same area of bone, and most importantly to make the work more accessible to the non-specialist.

Certain words have been used throughout, for example ‘proximal’ and ‘distal’ (referring to the top and bottom parts of the bone); where they were thought to be unavoidable. Complex vocabulary to indicate certain parts of specific bones (such as the olecranon fossa, described by the OED as the depression in the humerus into which the olecranon (the proximal part of the ulna) fits when the arm is extended) has generally been avoided where a more simple expression can suffice. Where the use of technical terms has been necessary for clarity (for example, calling the articular surface on the pelvis the acetabulum), a description has been provided in the glossary.

The main emphasis of the work is the interpretation, not description, of butchery marks. Thus those readers interested in the exact positions of the cuts can refer to the diagrams, or to the original archive (held by Annie Grant). The focus of the text is on the purpose of the marks, not a description of their location.

2.1 SAMPLE AREA

The sample chosen for investigation was a strip across the site, grid north-south. This was thought ideal as it covered all of the 'functional areas' (storage, housing and ritual) defined by Cunliffe (figure 2.1), and provided a continuous area that could provide a direct comparison. It was hoped that any distinction between the peripheries and centre of the site could also be investigated. The sample area covers about half of the excavated area, a quarter of the site; the area was excavated in the first series of excavations, from 1969 to 1978.

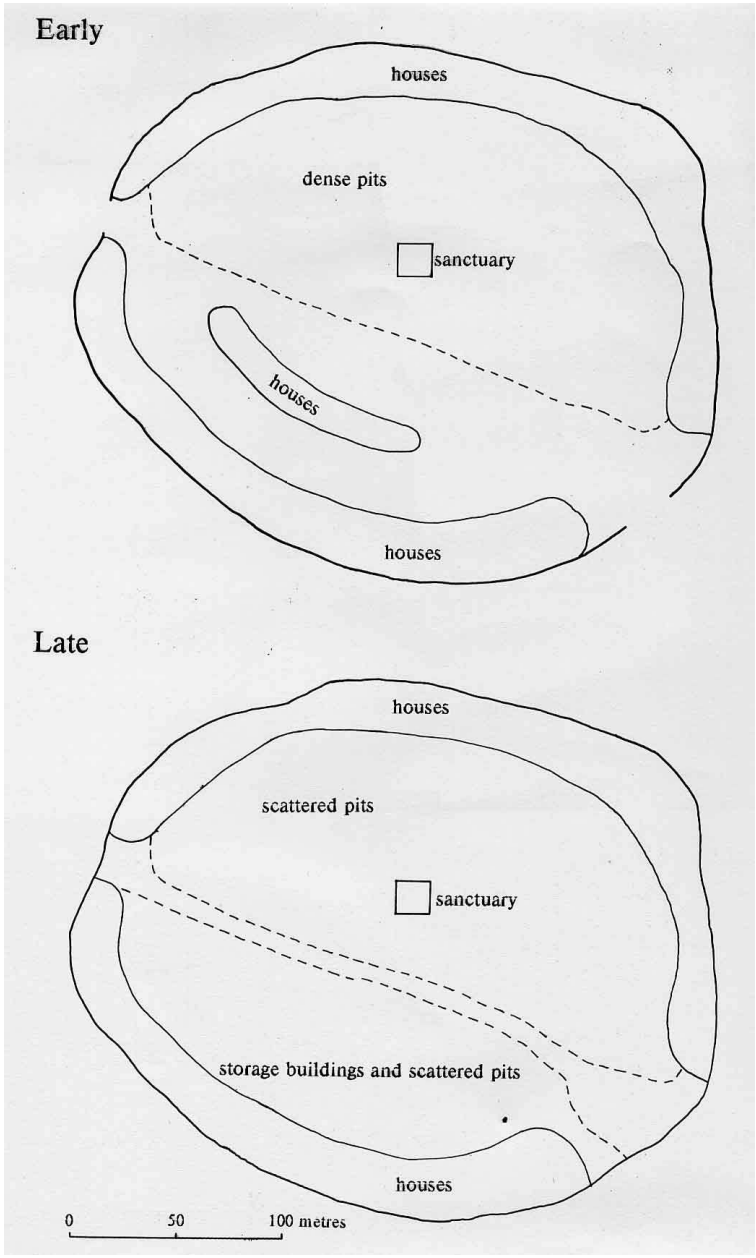

Figure 2.1: Functional areas in the early and later phases at Danebury. After: Cunliffe 1995: 41.

2.2 DATING THE BONE MATERIAL

Ceramic phase (cp)	Corresponding Dates	Phase
Cp3	470-360 BC	Early
Cp4-5	360-310 BC	Early
Cp6	310-270 BC	Middle
Cp7	270-50 BC	Late
Cp8-9	50 BC-50 AD	Latest

Table 2.1: The dating at Danebury, as defined by Cunliffe 1995: 18.

The deposits were dated to 'ceramic phases' (cp) by association with pottery, for which a sequence was developed (Cunliffe 1995: 18). The dating of ceramic phases 3-9 is shown in table 2.1, which also indicates the broad grouping into early, middle and late phases (defined by Cunliffe 1995: 23-25).

Since each bone in the database available to me was dated to ceramic phase it was decided to investigate the animal bone evidence by individual ceramic phase, where this could be determined. The phases could then be compared separately, in order to identify any changes that might be missed if data was lumped into larger groups. Thus phases 4, 5 and 6 could be investigated separately. This method provides the potential for testing whether animal bone shows differences in composition or character which was not found using other analyses. The phases could then be amalgamated if no differences were shown, an easier process than attempting to split phases that had initially been combined. Some phases had to be amalgamated, such as 1-3 and 7-8, since the vast majority of bones from these phases could not be more precisely dated. There were no bones dated to cp9.

2.3 THE EXISTING DATA SET

2.3.1 Feature selection

The bone from Danebury was recorded in two databases, that from pits and that from layers. The layers consisted of all features except pits, i.e. rampart build up, quarry hollow fills, occupation layers, etc. The diversity of feature type, and the presence of structured or special deposits in pits, led to the decision to investigate the two types of feature separately. Differences had also been noted between ditch and pit deposits by other authors (Maltby 1985: 99; Grant 1991a: 449) and suggested to be a result of preservational, depositional or cultural (butchery) factors. The differences between the types of deposit at Danebury could be integrated into this existing body of knowledge.

2.3.2 Bone selection

The large quantity of animal bone data from Danebury meant that it was impractical to manipulate all species information at once. The pig was chosen, at just over 10% of the identified sample (a total of 10,963 fragments), to test the methodologies and hypotheses and refine them before any other species (with larger samples) were also investigated. Cattle were chosen to complement the investigation of pig butchery since they were of a larger size (figure 2.2) and it was thought butchery technique could be influenced by size as well as species.

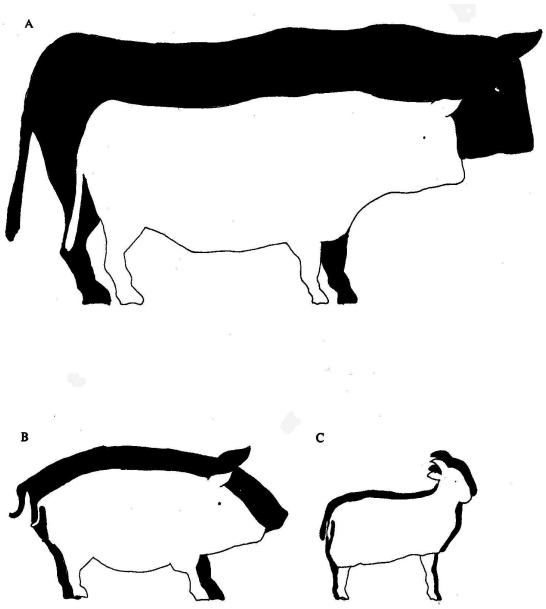

Figure 2.2: Relative average sizes of adult animals at Danebury (white; foreground) compared to modern domestic species (black; background). Animal outlines after Green (1992). A=Cattle, B=Pig, C=Sheep.

Cattle were better represented than pigs and comprised 21,025 fragments. Sheep were the best represented species, at 62,359 identified fragments; time did not allow for investigation of this species.

2.3.3 Grant's bone records

The animal bone records were available on a spreadsheet, and each identified fragment included information on species, bone type, epiphyseal fusion and bone fragmentation, as recorded by Annie Grant. Table 2.2 gives an example of some entries in the database.

ID no	Species	No	Bone	R/L	Prox	F/U	Sh1	Sh2	Sh3	Sh4	Sh5	Dist	F/U	Artic	Butch	GP	GSh	Gd	Burnt	Erod	Disease	Ftr	Ftr No	Layer	Phase
69020	OX	3	VERT		0		0	4	0	0	0	0		0	0				0	0	0	P	23	1	7
69021	OX	1	CALC	L	4		0	0	4	0	0	0		0	0				0	0	0	P	23	1	7
69022	OX	1	UMOL		0		1	0	0	0	0	0		0	0				0	0	0	P	23	1	7
69023	OX	1	SKULL		0		3	0	0	0	0	0		0	0				0	0	0	P	23	1	7
69024	OX	1	TIB		0		0	0	0	0	4	4	F	0	0				0	0	0	P	23	1	7
69025	OX	2	UPM		0		1	0	0	0	0	0		0	0				0	0	0	P	23	1	7
69031	OX	1	UMOL		0		1	0	0	0	0	0		0	0				0	0	0	P	23	2	7
69032	OX	1	LMOL		0		1	0	0	0	0	0		0	0				0	0	0	P	23	2	7
69033	OX	1	THOR		0	F	4	4	0	0	0	0	F	0	0				0	0	0	P	23	2	7
69034	OX	1	LUMB		0	F	4	4	0	0	0	0	F	0	0				0	0	0	P	23	2	7

Table 2.2: An example of the database entries for cattle bone, available for use in this study.

Most records were given numerical values, with the exception of the species, bone element, left or right side, fusion status and feature type, which were abbreviated. In the above examples, cattle were called OX, the tibia coded TIB, left called L, fused coded F and pits coded P. A diagram is provided in the appendices to indicate which bone element is located where in the skeleton. The fields from Prox to Dist indicate the completeness of the bone: the bone is normally divided into seven recorded parts, so the epiphyses are recorded separately and the shaft divided into five parts. A value of 1 indicates complete, 2 over 50% and 3 under 50%. 4 indicates some bone is present but not how much. Some bones showed

different recording patterns, for example the pelvis was split into ilium, isheum and acetabulum, while the phalanges and teeth, for example, were recorded only in two fields.

The sample area includes the pits excavated, and therefore analysed, earliest. These earlier records can be less comprehensive than the later ones: Grant recorded 9.6% of the bone from the first series of excavations (1969-1978) with a '4' to indicate presence of an uncertain quantity of bone, instead of '1', '2' or '3' to indicate completeness. This forms approximately 10% of the bone from the sample area, or 5% of the whole excavated area. This more limited recording still indicates the presence or absence of each part of the bone, so aspects such as fragmentation can still be considered. Also, in the same first tenth of the records, ribs were not assigned to species, making the investigation of numbers of butchered ribs difficult. It should therefore be remembered that ribs may have been butchered more frequently than the records suggest. Both of these biasing aspects apply equally to all species and relative comparisons between them and between phases should not be affected.

Butchery marks were recorded in a separate field as codes: a '1' meant the mark had been sketched, '2' that it was a cut mark and '3' a chop mark. The drawings of marks were filed on cards, while the marks just recorded as a 2 or 3 indicated the same cut type as the majority of the drawn marks. Chapter 3 gives examples and a full description of the sketched marks.

The author recorded a complete pit of over 1000 bones, which had been omitted from the original recording, using these methods. This aided familiarity with the recording methods, and gave an understanding of the overall condition of bone from each layer of the pit.

2.3.4 Knight's reanalysis of butchery mark incidence

For any study to be credible a good understanding of the nature and limitations of the original data is necessary. While the identification and recording of the bone and butchery marks recovered from the sample area were undertaken by Annie Grant, the detailed study of the butchery was undertaken from these records by the present author. The original records described the presence and nature of the butchery marks, and usually included individual sketches of the marks recognised. Dr Grant thought it was possible that some butchery marks may have been missed, as butchery was only one of many parameters recorded from the considerable sample of bone fragments (over 240,000).

To test the extent of differences between the two researchers, four pits from different phases were selected for investigation. All of these were recorded as containing butchered pig bone, and had been both excavated and analysed at a similar time in 1974, and were from similar areas (in the centre just south of the road). The author looked at the assemblages for these pits and bone element and frequency of butchery marks was recorded. This was then compared to the recorded bone from the original database. The database was not consulted first in case this influenced the analysis.

No additional butchery marks on pig bones were identified by the present writer from pits 576 and 599. In pit 593 one additional butchery mark was found on a pig ilium. In pit 596 a mark on a pig astragalus had been initially overlooked in the first analysis (see table 2.3). Since similar marks on the astragalus and pelves were noted originally in other pits, it does not seem likely from this analysis that the recording of butchery on pig bones was biased towards or against particular bones, although some marks may have been overlooked.

	PIT	PHASE	BUTCHERY MARKS IDENTIFIED BY GRANT	ADDITIONAL BUTCHERY MARKS IDENTIFIED BY KNIGHT	NUMBER OF PIG, CATTLE OR SHEEP BONE IN EACH PIT
PIG	576	6	Astragalus		9
	593	1-3	Vertebra Pelvis	Pelvis (ilium)	4
	596	7	Radius	Astragalus	7
	599	4	Ulna		5
CATTLE	576	6	Tarsal	Vertebra	10
	593	1-3		Ulna Thoracic vertebra	2
	596	7		Carpal	3
	599	4	Lumbar vertebra	Rib (3)	10
SHEEP	576	6	Astragalus Humerus	Ulna	59
	593	1-3			16
	596	7	Carpal Scapula	Femur Metatarsal	36
	599	4	Tibia	Femur (2) Tibia Scapula (2) Pelvis (2) Ribs (6)	102

Table 2.3: Incidence of butchery marks recorded on pig, cattle and sheep bone by Grant and Knight (Pits 576, 593, 596 & 599).

On cattle bone, of seven butchery marks recognised by the author, only two were in the original records. In pit 599, marks on three ribs were missed, although this probably relates to not recording ribs to species in the early identifications. In this pit, one mark on a lumber vertebra was noted, which I missed. These larger bones may not have needed such careful inspection to identify species, so the butchery was probably less comprehensively recorded.

Additional sheep bone butchery marks were noted from three of the four pits analysed. In pit 596 the current writer overlooked a mark on a scapula.

Although only a limited reanalysis was undertaken, several key points are suggested:
a). a significant number of butchery marks was not recorded in the original database;
b). more butchery marks from sheep and cattle were missed than those from pigs;
c). there does not seem to be a bone-element based bias in the original recording;
d). there are almost certainly more butchery marks on ribs of all species than have been noted.

However, the reanalysis was undertaken on pits investigated before the recording system had been finalised. Ribs, for example, were not assigned to species; and the bone fragmentation was not recorded in full detail. It is likely that a smaller proportion of butchery marks was missed from pits examined later when ribs were assigned a species and bone fragmentation was recorded in full.

2.4 BONE CONDITION AND TAPHONOMY

Inevitably, a range of taphonomic factors will have influenced the nature of the bone sample analysed for this study. These are outlined below.

2.4.1 Bone Recovery

Sieving was not routine during the excavation of Danebury, so bias in the form of lack of young or small bones may have been introduced. This is reflected in the low incidence of smaller bones such as the tarsals and carpals (see Grant 1984a: 496-7). This can be compensated for when looking at the presence or absence of different bones by species, as large and small species are not directly compared.

The majority of pits were fully excavated and this is useful for analysis of which activities led to different deposits (see chapter 5). The incidence of erosion was low (see below) and the bone was in chalk subsoil and generally of excellent condition.

2.4.2 Bone Condition

Canine activity is not well represented at Danebury. The incidence of gnawing on bone from the pit sample analysed in this study is only 0.2% for proximal parts, 0.08% for shaft fragments and 0.3% on distal parts. This is very low and suggests that the bones were deposited soon after use, and covered quickly. Even in occupation deposits the incidence of

erosion and gnawing was low, for example, bone from layers in circular structure 20 showed no evidence of gnawing and only 2% erosion from 490 bone fragments. In layers overall the incidence of gnawing was 2.7% for cattle and between 2.6% and 3.5% for pigs, far more than in pits, but nevertheless in very good condition.

Dogs were almost certainly present in the hillfort as their bones were recovered, and it is possible that some bones were entirely digested by or removed from the hillfort by dogs. If so, this need not have influenced the butchery mark incidence, as all bone parts were recovered in the expected proportions if one assumes no parts were taken off site (Grant 1984a: 544).

The low rate of erosion at 1% of the bone in the pits (166 of 15,647 bone fragments) and 2.2% from deposits comprising occupation levels of circular structure 20, suggests that bone was not routinely left around for periods before being tidied away into ditches or pits. Instead it appears that at Danebury bones were deposited and covered up in a short space of time (and see Grant 1984a: 196).

This indicates that butchery marks were not likely to be obscured or lost by surface erosion or gnawing.

2.4.3 Fragmentation of Bone

The incidence of complete bone can be a useful indicator of bone condition, butchery techniques and disposal methods. The proportion of complete long bones was calculated from the original database by Annie Grant and is shown in table 2.4. ‘Complete’ bones are those where at least part of the proximal and distal parts of the same bone were present, and are calculated as a proportion of the total number of bones with either the proximal or the distal (or both) parts present for each species.

A number of trends is apparent from table 2.4. It appears that in pits the bone is generally more complete than in layers. This could be a consequence of differential survival with bone in the layers subject to more trampling after deposition. The bones with the highest percentages of complete examples are often the densest, for example the metapodials (Brain 1981), while the less sturdy bones such as the femur show a relatively low incidence of completeness.

Apparent differences can be seen between species: in most cases, there is a higher incidence of complete pig bones than cattle and sheep. This does not seem to be related to species size, as in the pit deposits the proportions of complete bone from cattle and sheep are very similar. The difference in incidence of complete bone between species does not seem to be a result of preservational differences either. Pig bone is softer than that of the other species and would be expected to show a lower incidence of complete bone, especially since the incidence of young animals is high at Danebury. Cooking differences could provide the reason for the difference: if pig meat was roasted on the bone less often than cattle and sheep, then it would be less brittle and so more likely to remain whole. Otherwise, butchery could be the cause, if for some reason pigs were less often chopped up, but instead cooked in whole joints or carcasses.

Bone	**PITS**				**LAYERS**			
Sheep	**Early**	**Middle**	**Late 7**	**Late 8**	**Early**	**Middle**	**Late 7**	**Late 8**
Humerus	14.1	12.5	13.5	22.6	13.2	5.6	4.7	9.1
Radius	18.7	18.0	18.5	20.0	11.5	11.0	10.3	15.2
Metacarpal	25.4	29.1	26.9	9.4	11.4	17.7	17.6	8.6
Femur	8.4	9.7	9.1	6.5	4.0	3.7	7.1	4.7
Tibia	8.7	8.1	7.2	1.3	1.1	1.7	2.7	0.8
Metatarsal	29.0	23.5	23.5	5.3	10.0	13.3	9.0	5.6
Metapodial	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0
Total	**15.4**	**14.7**	**14.5**	**9.7**	**8.1**	**7.2**	**7.5**	**6.7**
Sample size	2060	2302	7754	279	406	1078	3677	403
Cattle	**Early**	**Middle**	**Late 7**	**Late 8**	**Early**	**Middle**	**Late 7**	**Late 8**
Humerus	12.5	13.2	9.2	7.7	7.7	0.0	1.6	8.0
Radius	16.7	16.2	15.8	4.8	21.1	9.8	5.5	0.0
Metacarpal	32.9	33.9	29.5	0.0	38.5	13.3	12.5	0.0
Femur	12.0	17.3	7.8	7.1	12.5	5.3	1.4	0.0
Tibia	14.0	19.7	10.1	6.3	9.1	6.5	1.5	0.0
Metatarsal	28.3	35.3	24.7	40.0	28.6	24.2	13.1	11.1
Metapodial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**16.2**	**20.0**	**13.5**	**9.9**	**17.0**	**7.9**	**4.7**	**2.8**
Sample size	579	490	1731	81	123	278	827	108
Pig	**Early**	**Middle**	**Late 7**	**Late 8**	**Early**	**Middle**	**Late 7**	**Late 8**
Humerus	23.2	27.6	13.2	0.0	0.0	6.7	3.6	0.0
Radius	30.4	47.7	22.7	20.0	0.0	10.0	9.9	33.3
Metacarpal	89.5	85.9	64.9	0.0	33.3	66.7	48.8	60.0
Femur	25.4	27.6	12.3	0.0	0.0	8.0	4.0	0.0
Tibia	19.8	30.2	13.2	0.0	12.5	0.0	3.3	0.0
Metatarsal	70.3	84.9	58.6		50.0	44.4	34.1	50.0
Metapodial	24.5	31.0	43.6	25.0	0.0	12.5	13.3	100.0
Total	**34.4**	**44.6**	**26.1**	**6.7**	**9.0**	**17.4**	**10.7**	**18.4**
Sample size	410	495	705	30	67	178	553	49

Table 2.4: Percentage of complete long bones by phase and feature type: data from Grant, pers. comm.

Another overall trend is the general decrease in numbers of complete bone over time. The only exceptions are the sheep and pig bone in layers: the former remains relatively constant, while for the latter, there is a clear pattern of more complete bone over time. The smaller sample in this section may be the cause of the disparity, or the layers might have been

receiving a different type of deposit. The decrease in numbers of complete bone over time could be due to a more intensive method of butchery, for the production of smaller joints of meat. Grant's analysis (1984a: 504) shows that there were no significant differences in the proportions of mature animals kept in different phases, which might have influenced the age at death for sheep or pigs, although cattle do appear to have been kept for longer (1984a: 512). There is no evidence to suggest more gnawing or erosion in the later phases so it is suggested that bone was intentionally divided up in the later Iron Age.

There is no evidence from Danebury that bone was routinely split for marrow: the author investigated 5 pits (576, 593, 596, 599 and 2426) covering the early, middle and late phases for evidence of ancient chopping through or breaking up of bone, which had been overlooked in the original recording. This could be indicated only by a small mark at the edge of the break since the bone can be nicked then force applied to break it (O'Connor 2000). In the five pits, none of this type of mark was noted, so it is suggested that the incidence of deliberate breaking of the bone was low, at least in these five pits, and probably also in the remainder of the site. Although analysis of fracture patterns to indicate bone breakage when 'green' (Outram 2001; Vehik 1977) was not undertaken due to time restrictions, the completeness of the bones and lack of evidence for splitting them with tools suggests that marrow extraction was not routinely practised.

The proportions of complete bone at Danebury suggest that different animals were butchered in different ways, and more intensively over time, although overall the incidence of complete bone is not exceptionally high, and lower than that recorded at, for example, the Roman site at Portchester (Grant 1975: 391).

2.4.4 Bone Working

There is evidence of bone working from Danebury, and the removal of certain bones for working may have influenced the proportion of bone elements recovered and their spatial distributions. Parts of the skeleton can be used for particular artefacts, for example cattle scapulae blades can be used for buttons, and sheep metapodials for gouges.

At Danebury a variety of items made of bone and antler was recovered, including combs, needles, toggles, gouges, awls and miscellaneous items. The species or bone element used could not be determined for many of these. However some worked bones show distinctive

parts and also working debris can indicate which bones were used. Table 2.5 shows which bones were worked in the early investigations, from which my sample area is derived.

Species/ Bone	Tibia	Metapodial	Femur	Ulna	Ribs	Canine	Fibula
Sheep	30	30	1				
Ox		7	2	1	8		
Horse		5					
Pig						1	1

Table 2.5: Frequency of different bone elements identified as used in bone working at Danebury excavations 1969-1978.

Only 1.3% of the total number of Iron Age bone recovered from Danebury were worked. This is a fairly insignificant proportion and perhaps indicates a low percentage of the bone being used for working. However, bone objects could have been taken, traded or deposited off-site. If this were the case, certain elements would be under-represented, which is not so (Grant 1984a: 544). Further analysis of bone working with relation to spatial distribution is considered in chapter 4.

Proportions of worked bones at the other two sites investigated were lower: at Nettlebank Copse four pieces of worked bone were found (0.02% of the assemblage). At Suddern Farm, 0.2% of bone from the Iron Age was worked. Bone working thus may not play a large part in biasing the proportions and spatial distributions of bone elements.

2.4.5 Possible Effects of Cooking on Bone Survival at Danebury

Small scale investigations into the different tensile properties of cooked and raw bone have shown that roasted bone is more fragile than raw or boiled bone (Pearce & Luff 1994: 54). However, the excellent state of preservation and lack of evidence for charring (1.5% of cattle and pig bone) suggests that bone was not roasted at Danebury. Coy suggested that an ‘ivoried’ appearance to bones indicates that they have been roasted (Coy 1975). The contents of one pit was re-examined to look for evidence of such bone, but no examples were found amongst the 614 identified bones, and so it is not suggested that meat on the bone at Danebury was commonly roasted. It is possible that roasted bones were rare as they were more easily destroyed, but this is improbable when the condition of the bone is considered.

2.5 CONCLUSIONS

The sample area consists of a complete section across the site, but was mainly excavated in the initial years, so the computerised database does not always show the completeness of bones. However it was thought better to have a continuous sample than a staggered one, and the large number of bones should minimise bias. Small sample size in the middle phases necessitated their amalgamation, but they were short phases and merging them forms more comparable time spans (and sample sizes) to the early and later period.

Damaging taphonomic effects seem to be limited to erosion on bones from the upper layers in pits, and occupation layers. The functional explanations proposed by Wilson for spatial patterns to bone appear to be too simplistic to apply to Danebury (see part 1.3.3). Bias may have been introduced by a lack of sieving, and this should be remembered in interpretation.