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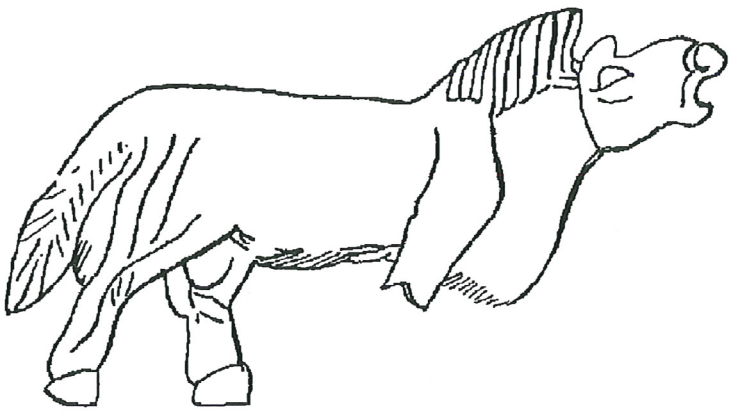

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BRONZE AGE BONE AND ANTLER MANUFACTURING AT ARSLANTEPE (ANATOLIA)

Alice M. Choyke[1]

Abstract

This article is an analysis of over 600 Early to Late Bronze Age bone and antler tools from Central Anatolia. Changes in raw material selection, manufacturing techniques and possible function are reviewed in a diachronic sequence.

Résumé

Cet article présente l'analyse de 600 objets en os et en bois de cervidé provenant de l'Age du Bronze ancien à l'Age du Bronze récent d'Anatolie centrale. Les changements diachroniques dans la matière première, les techniques de fabrication et les diverses fonctions de ces objets sont examinés.

Key Words: Turkey, Bronze Age, Bone Tools, Archaeological Context

Mots Clés: Turquie, Age du Bronze, Industrie osseuse, Contexte archéologique

Introduction

The study of worked animal remains is a truly multidisciplinary area in archaeology in which zoological, culture-historical, technological and sometimes ethnographic information must be critically combined in order to make inferences possible regarding prehistoric ways of life.

The archaeozoological aspect of bone working is that most bone tools derive from a large and renewable source of raw material: refuse bone, selectively representing the wild and domestic fauna available to prehistoric craftspeople. The manufacturing process, however, can vary in the degree to which a particular tool was planned and modified. Better planned, more elaborate Class I tools were often made from what had been perceived as higher quality (i. e. harder, sharper, or more resilient) materials. The best example at Arslantepe of perfect Class I tools would be the seal stamps made from some kind of tusk (i.e. elephant or hippopotamus - in any case a rare raw material) from the earliest Middle Chalcolithic levels. On the other hand, poorly identifiable, less standardized and superficially worked Class II bone may be associated with a lesser degree of attention paid to both the production of the tool and its ultimate function. Such tools, made from "expediently" chosen long bones, take the form of awls at this site.

The diachronic manifestation of these trends has been studied in an assemblage of 622 worked animal remains from the important Bronze Age settlement of Arslantepe in East Central Anatolia. Arslantepe is located in a kind of cultural ecotone between the Caucases and Mesopotamia, with the cultural levels sometimes displaying influence by one or the other, but always maintaining cultural continuities. There is a long settlement history at Arslantepe from the early Middle Chalcolithic (ca. 3600 BC) to the Neo-Hittite levels of the Late Bronze and early Iron Ages (Table 1).

Bone working traditions tend to belong to the intimate household sphere and as a result are conservative. It was expected that the nature of the worked bone and antler found would be most affected by the following related factors:

1) changes in the availability of raw materials,
2) cultural orientation - manufacturing traditions,
3) specific location in complex settlements.

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Table 1. Chronological sequence at Arslantepe

Period	Date	Settlement type	Characteristic finds
Middle Chalcolithic	Local Ubaid 3600 BC	Village – little known	Ivory seals, perforated shells, awls
Late Chalcolithic	Local late Chalcolithic 3400 - 3200 BC	Monumental buildings and village	Spindle whorls, hourglass-shaped pins
Early Bronze Age IA	Late Uruk 3200 - 3100 BC	Royal tomb, palace, temple	T and rounded T-shaped pins, spatulae,
Early Bronze Age IB	Uruk-Trans Caucasian 3100 - 2900 BC	Destruction levels and huts and pits	Incised handles, straight pins
Early Bronze Age II	Local 2750 - 2500 BC	Pits and big square houses	*Most radical change in tools:* Manufacture with flint only, more s/g metapodium awls, incised pins, less antler used
Early Bronze Age III	Local 2500 – 2350 BC	Square houses and city walls with towers in phase 2, *one level round houses*	Antler workshop and cache of bezoar goat and antler projectile points and elongated antler points
Middle Bronze Age	2000 BC	Small surface excavated	Astragalus 'gaming' pieces
Late Bronze Age – Hittite levels	1650 BC	Houses, disturbed levels	More astragalus 'gaming' pieces

Material and method

The find material discussed in this study has been brought to light during the course of excavations carried out by the research team of the Università di Roma «La Sapienza» for almost 30 years. Research at the important tell settlement of Arslantepe near Malatya was first directed by Prof. S. Puglisi, then by the late Prof. Alba Palmieri and recently by Prof. Marcella Frangipane.

The stratified, largely Bronze Age settlement of Arslantepe is located on the eastern edge of the central Anatolian plateau by the upper reaches of the Euphrates River, on the right bank which can be seen to the west from the top of the tell. In a broader, regional context it is of interest that this location is approximately equidistant from the Black Sea and the Mediterranean (Fig. 1). Burney (1993) has described it as a "gateway" settlement.

Today, the tell is surrounded by eroded barren hills with green valleys where apricot trees are grown. During the Chalcolithic and Bronze Age the surrounding hills were certainly covered with forest steppe and open forests with oak related to positive amounts of precipitation (Erinc 1980: 80). The high proportion of cattle bone in the faunal assemblage suggests that there were good grazing fields on the valley floors (Bökönyi 1983).

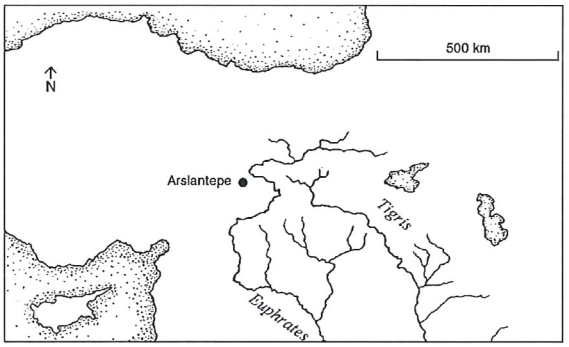

Fig. 1. The location of Arslantepe in Central Anatolia in relation to the Black Sea (north) and the Mediterranean Sea (southwest)

Absolute dates for the occupation under discussion here range from the Middle Chalcolithic Ubaid culture component in the 4th millennium to the historic period. However, the modified animal bones, antler and tusk from eight archaeologically defined units from the Chalcolithic to Middle Bronze Age levels were used for the purposes of this study. This paper concentrates on the late local Chalcolithic to the Early Bronze Age III levels where, for the moment, the bulk of the find material comes from. The chronological distribution of these finds is listed in Table 2.

Depending on the different aspects of bone manufacturing studied, sub-samples

Table 2. Worked animal remains from Arslantepe

Period	Abbreviation in this study	Number of tools
Middle Chalcolithic	-	*1(9)*
Late Chalcolithic	L. Chalc.	134
Early Bronze Age IA	EBIA	82
Early Bronze Age IB	EBIB	100
Early Bronze Age II	EBII	81
Early Bronze Age III	EBIII	134
Middle Bronze Age	MBA	33
Late Bronze Age	LBA	9
Miscellaneous	-	48
Total		**622**

derived from this assemblage may contain varying numbers of specimens. It is in general true, however, that the interval between the Late Chalcolithic to EBIII (marked by shading in Table 2) is best represented by these finds. At the time of the initial analysis virtually no finds were available from the Ubaid levels at this site. Since then, after another field season, 9 more worked specimens, including 3 very special seal stamps made from ivory, were recovered from the Ubaid village. These will be touched upon briefly because this small material appears strikingly different from later types both in terms of raw material selection and manufacturing techniques. It is also important to note that the two *coeval* samples from EBI represent both "urban" (A) and "village-pastoral" (B) sectors of the same settlement respectively.

Following the standard osteological description (animal taxon/skeletal part, tentative typological classification etc.), the marks of manufacturing, use and eventual reworking/sharpening were both studied. The bone tool typology developed by Jörg Schibler (1981) was followed throughout this study as consistently as possible. Recent work on the classification of bone tools along the manufacturing continuum expressing increasing complexity (Choyke 1997) was taken as a basis in trying to identify diachronic changes in bone and antler manufacturing technology.

Hypothesis and test implications

The underlying assumption throughout this work has been that, while the raw material supply for bone manufacturing (represented by refuse material) was rich and easily available during the settlement's history, changes may have taken place during the Chalcolithic and Bronze Age in manufacturing techniques themselves, the work expended on bone tool making and the possible functions these artifacts might be associated with.

Among the factors influencing raw material supplies for mundane bone manufacturing, one should reckon with culturally idiosyncratic human activity such as animal husbandry as well as the intensity of primary butchering for meat distribution and secondary chopping of carcass cuts for the purposes of pot-sizing. Other substances, especially antler, may be procured differently, either by hunting or, as was probably the case at Arslantepe, gathering. In complex economies secondary distribution (multi-stage procurement and trading) may even be hypothesized (Choyke 1995) in the case of especially precious materials such as ivory (elephant or hippopotamus; Caubet and Poplin 1987) and drilled ornaments made from Mediterranean seashells (Frangipane, personal communication), all found in the earliest Ubaid settlement levels. Drilled seashell reflecting long distance trade were also found in the EBIII levels.

The assumption that the joint effect of these factors may actually cause diachronic shifts in the composition of worked animal bone assemblages was tested by looking at the composition of the assemblage from a variety of aspects.

These included:
1) diachronic changes in raw material use by animal size categories,
2) chronological distribution of bone and antler tools by specific type,
3) distribution of tools by manufacturing techniques,
4) proportion of curated to non-curated tools,
5) distribution by major functional tool categories,
6) diachronic distribution of Class I and Class II ("ad hoc") tools,
7) chronological distribution of major point types.

While probably none of these features reflect unambiguous changes in and of themselves, considered together they contribute to a general picture in which bone tools can be interpreted beyond simple osteological identification or formal typological interpretations. Where major changes occur in several categories, a stronger case can be made for actual shifts in the ethnicity of the population. Concurrently where only typological or stylistic changes may be found within the modified osseous materials, an argument for some kind of cultural continuity seems reasonable.

Results

One of the fundamental characteristics of bone/antler as a raw material is size, which sets limitations on the dimensions of the tool to be produced. The basic effect influencing available raw material size is the animal species, both large and small, whose bones are actually available for manufacturing and later go through natural fragmentation processes related to trampling and redeposition. These latter, usually being intensive at densely inhabited urban settlements, tend to have an adverse effect on identifiability. This has also been observed in the refuse bone material of two samples from Arslantepe (Bartosiewicz 1998), although even small splinters can usually be identified as originating from "large" or "small" animals.

Similarly to preliminary analyses carried out at the site of Arslantepe (Bökönyi 1988, Bökönyi 1993a, Bartosiewicz 1998), the worked assemblage is overwhelmingly dominated by the remains of domesticates. Among these the remarkable importance of sheep and goats may be observed in each meat value category, followed by cattle (remains of pig bone, usually insignificant as a raw material, only occur sporadically in Bronze Age assemblages of worked bone; Choyke 1984a). The Ubaid levels (not included formally in this analysis), in contrast, seem to contain strikingly more worked material made from tusk of various kinds and Class II points made from wild animal long bones.

Worked ruminant bones identified on the species (cattle – *Bos taurus* L. 1758) or subfamily (sheep and/or goat - *Caprinae* Gill 1872) level and by the large/small size category only, are listed in Table 3.

Table 3. Gross raw material categories of ruminant bone tools by animal size.

Period	Cattle	Large	Caprine	Small	Total
Late Chalcolithic	33	25	33	17	108
EBIA	7	15	30	13	65
EBIB	7	7	37	11	62
EBII	3	9	52	4	68
EBIII	3	12	40	16	71
MBA	3	5	3	4	15
LBA			7	1	8
Total	**56**	**73**	**202**	**66**	**397**

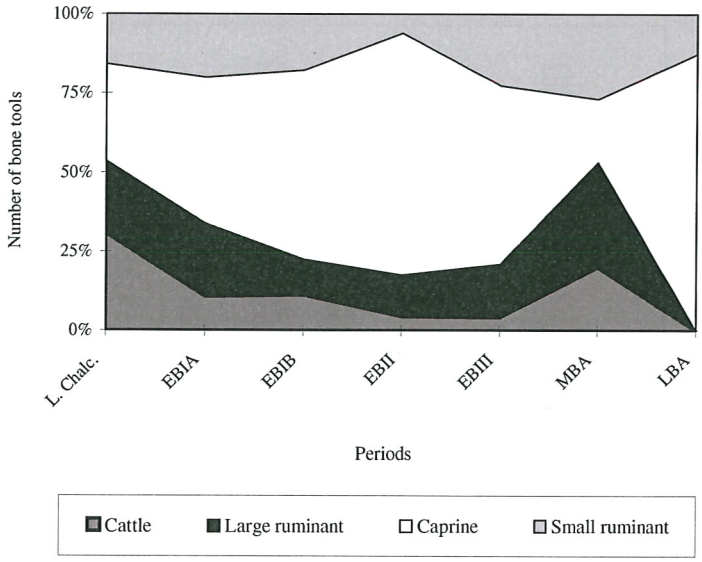

Fig. 2. Diachronic changes in the raw material by animal size categories.

Since by the Late Chalcolithic and Bronze Age, animal husbandry had achieved fundamental importance, especially in the provisioning of large sites with high population densities, most "large" ruminant bones also originate from cattle, while "small" ruminant remains most likely come from caprines, i. e. sheep/goat. Owing to this taxonomic overlap between the two pairs of categories (cattle/large and caprine/small) the diachronic trend in using ruminant bone as raw material could be best illustrated in percentage terms. Figure 2 shows a gradual decline in using large (cattle) bones in tool making relative to the Late Chalcolithic period. With the exception of EBIA, only about 1/4 of all worked ruminant bones represents this category during the EB (Bones from large ruminants were used more commonly in the "urban" palace area of the EBIA settlement than the rest of the EB site). In light of the raw data listed in Table 3, it is clear that an apparent MBA increase and the exclusive presence of small ruminant bones in the LBA are probably the product of random bias caused by small assemblage size.

An important distinction between worked bone, pig tusk and antler must be made, owing to their different origins, procurement and patterns of fragmentation. While some pieces of probably shed, and thereafter gathered, or even stockpiled (Choyke 1987) red deer antler are present in the assemblage, the occurrence of red deer bones may be considered sporadic. As is shown by the assemblage of refuse bones, hunting must have played a negligible role in the procurement of meat (Bökönyi 1993a), even if one assumes that large artiodactyl bone splinters in the non-identifiable category sometimes originate from wild animal species. In Figure 3, the percentage of worked antler fragments is shown against the absolute number of all worked animal remains (bone+ boar tusk+antler pooled) listed in Table 1. Of the major (and therefore statistically more reliable) sub-assemblages, antler tools exceed 25% of all worked animal remains in the EBIB "village" settlement and the EBIII period (The increase in demand for heavy duty antler tools seems to parallel the expansion of land cultivation at least during the Bronze Age of the Carpathian Basin; Choyke 1998: 174). On the other hand, the relative absence of antler working is especially conspicuous during the "rural" local Late Chalcolithic period. This may indirectly support the theory that the use of this substance in craft activities is somewhat independent from hunting. Percentages in the MBA and LBA sub-assemblages cannot be reliably appraised as a consequence of small sample size.

As far as the composition of bone tools by the wild/domestic dichotomy is concerned, exact proportions are difficult to appraise owing to the presence of worked remains from non-identifiable small and large ruminants. On the basis of identifiable elements and average percentage of almost 20% worked wild animal bones is obtained for the entire assemblage, with individual percentages varying

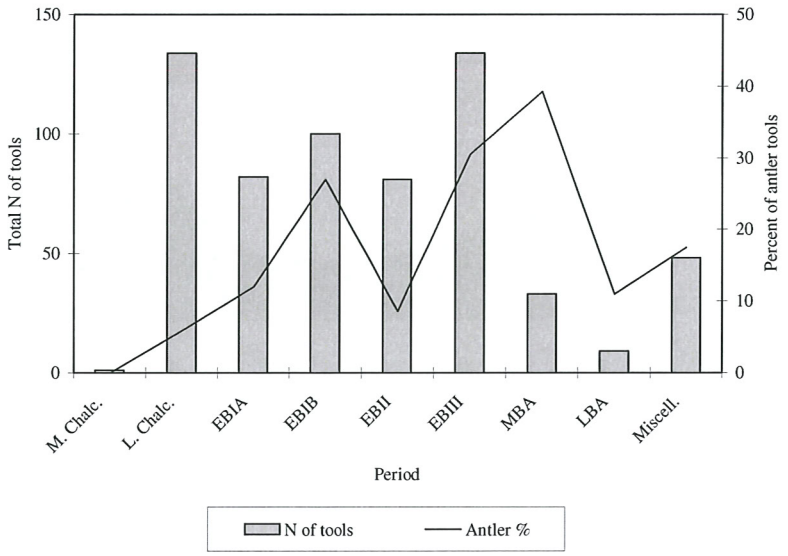

Fig. 3. The chronological distribution of bone and antler tools.

capriciously throughout the chronological sequence (Table 4).

Although difficult to demonstrate, the appearance of refuse bone from red deer metapodia used in pin making in the EBIA and B levels suggest that these bones may have been a preferred raw material for this common type of artifact. However, the finished pins are too modified to permit identification of either the species or skeletal part, with all diagnostic morphological features having been carved away. It may be that differences in cell structure between cattle and red deer bone do exist but I am aware of no study which would provide this kind of data.

Typically for animal bone assemblages from the Chalcolithic-Bronze Age transition, the percentage of wild animals in the refuse bone assemblage was just a little above 10% in the Chalcolithic, and fell below that value during the Bronze Age (Bökönyi 1988: 582, 591). Partly as a result of no distinction having been made between bone and antler fragments, the remains of red deer always dominate the wild animal portion of the refuse bone assemblage (Bökönyi 1993a: 343, Table 1). It may be hypothesized therefore, that the non-specified bone remains from wild animals would consistently yield values less than 10% among the food refuse, which is in sharp contrast with the 18.9% observed in the worked bone assemblage. Even if the contribution of domesticates to this latter is maximized by taking all non-identifiable ruminant remains as originating from this group (Table 4, supplementary line), the resulting 13.4% shows a clear preference for wild animal bones in manufacturing. This is largely explained by the gracile shape and mechanical properties of deer metapodia, superior to those of either cattle or caprines (as described for the aforementioned decorative pin manufacturing). Conse-

Table 4. The use of bones from wild and domestic animals

Period	Wild	Domestic	Wild %
Late Chalcolithic	16	68	19,0
EBIA	6	37	13.9
EBIB	11	44	20.0
EBII	5	55	8.3
EBIII	20	44	31.3
MBA	3	8	27.3
LBA	1	7	12.5
Total	**62**	**263**	**18.9**
+small and large ruminant	62	402	13.4

quently, deer is often overrepresented in worked bone assemblages, in comparison with its contribution to the bulk of refuse bone (e. g. Bartosiewicz and Choyke 1997). Three shifts in the proportion of antler to the total of worked bones in the worked assemblage should be emphasized. The first occurs in the EBIB period following the palace phase to which a "royal" burial may also be assigned. Antler tine debitage is common in the village-type features which lie outside, above, and among the ruins of the burned palace/temple complex. The EBII sample originates from a village-like settlement with big square houses and Transcaucasian handmade pottery. Here the amount of antler used drops sharply to below 10%. This period is one where a change in population may actually be postulated (Frangipane personal communication) and perhaps the new population living in this part of the site was not accustomed to using this particular raw material. By the next period, the EBIII, however, antler again becomes important rising to over 30%. These are the levels that contain the greatest number of heavy duty antlers incorporating the antler burr and lower beam in workshop settings together with grinding stones and figurines.

In addition to raw materials, manufacturing techniques also deserve attention. Figure 4 shows that while bone tools produced simply by cuts or even using a combination of cutting and snapping are rare, scraping seems to be an important single method of shaping bone implements during the early periods (almost 50% of all cases). The other important method seems to be the combination of cutting, snapping and scraping, that largely corresponds to the so-called "groove and splinter" technique (Clark and Thompson 1953: 148), which has been one of the most patterned ways of processing the metapodia of small and large ruminants alike in many periods and places, resulting in some highly planned tool types within the manufacturing continuum (Choyke 1997: 67). Not only was the raw material of these tools anatomically uniform and carefully selected. The multi-stage and complex manufacturing process is also very characteristic (Camps-Fabrer and d'Anna 1977: 312-313). Along with the increasing contribution of caprine bones, this technique of preparing small points (Schibler's Types 1/1 and 1/2) became very common, especially during the EBII and EBIII periods which, as noted above, stand out from the preceding Chalcolithic and Bronze Age assemblages. The EBII period also stands out in manufacturing terms because it was in this time alone that small points were manufactured by cutting out the complete outline of the rough form, ignoring the natural fracturing properties of caprine metapodia. This phenomenon directed attention to the typological classification of the most important tool types.

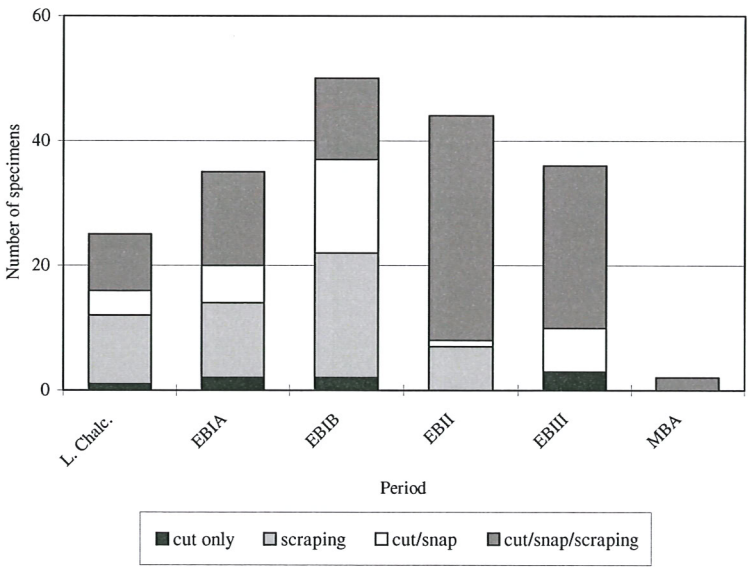

Fig. 4. The distribution of tools by manufacturing techniques

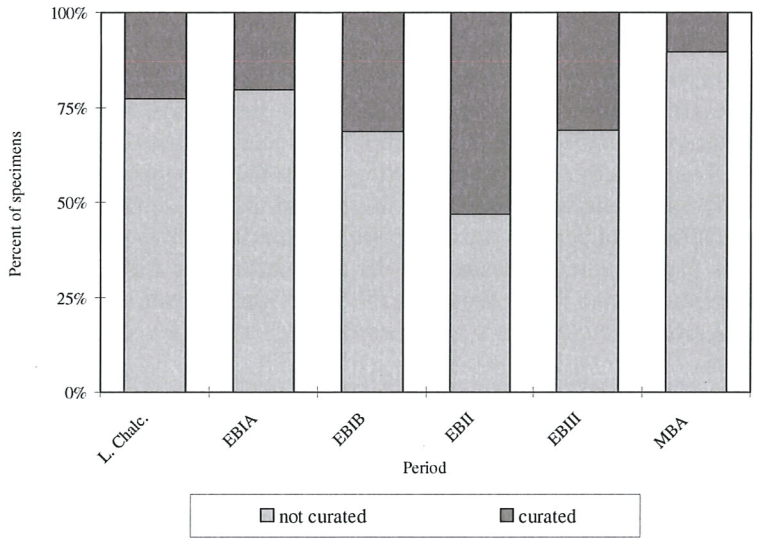

Fig. 5. The proportion of curated to non-curated tools.

Curation is a special aspect of bone tool preparation, a form of secondary manufacturing. Broken or worn specimens may be re-worked, sharpened etc. depending on the cultural or individual value attached to the tool itself. Curation is a typical way of "recycling" small ruminant metapodium points and as such seems to parallel their increase, especially during the EBII period (50%) which again stands out from the other sub-samples. In most cases, however, about 3/4 of the worked animal remains were not repaired or curated in any visible way (Fig. 5).

Tool typologies are, in part, developed as an effort to systematically understand the function of prehistoric artifacts. When the Arslantepe assemblage is sub-divided by gross functional categories, a

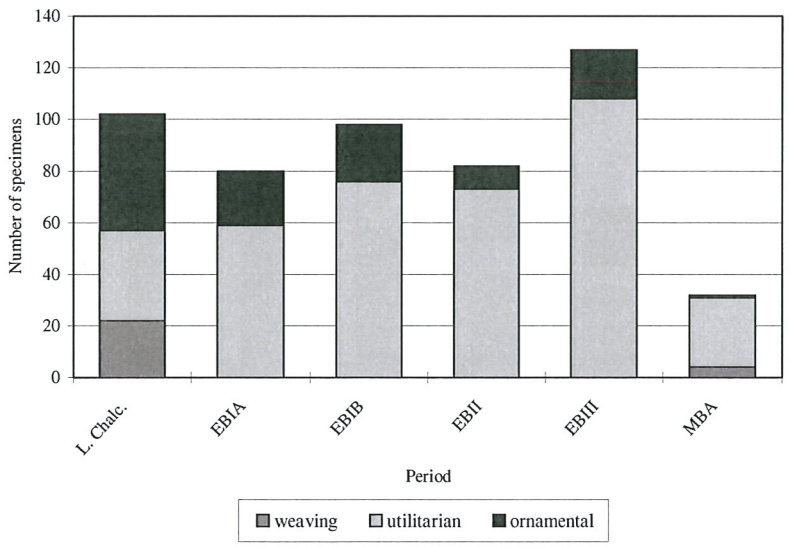

Fig. 6. Distribution by major functional tool categories.

diachronic decline in ornamental bone, ivory and antler artifacts may be observed (Fig. 6). The majority of tools could only be classified in the general "utilitarian" category that includes many, possibly multi-purpose, points and beveled ended "chisels" or "scrapers" used in leather working, ceramic manufacturing and (animal as well as plant) fiber processing. Tool function must be strongly related to location within complex settlements and in fact it is possible that tools classed as ornamental may actually have had utilitarian uses such as ornamented distaffs for spinning or as parts of composite tools and objects (i.e. the tiny decorated nail-like pins from the EBIII sub-sample). Finely worked spatulate tools, classified here as ornamental as they seem more in the luxury category, are typical of the worked bone assemblage from the palace area of the late Uruk EBIA sub-sample.

On the basis of both iconographic and artifactual evidence from coeval sites in the Near East, it must be hypothesized that the great numbers of sheep, evidently contributing to meat provisioning, were also exploited for at least one secondary product, wool (Bökönyi 1994). Tools identified with great probability as weaving implements were recognized only in the Late Chalcolithic (spindle whorls made from the *caput femoris* of large ruminants, red deer and cattle) and MBA sub-assemblages, although many of the "utilitarian" tools and possibly some of the decorated implements may have served related purposes as well.

When tools in the Arslantepe assemblage are classified between the two extreme points of the manufacturing continuum, most of them fall within the carefully planned, Class I category. The contribution of opportunistically used "secondary or improvised " (Clason 1991; "expedient" *cf.* Johnson 1977; "*ad hoc*" *cf.* Schibler 1981), that is Class II tools (Choyke 1994b) is rather small, usually below 20% (Table 5, Fig. 7).

Table 5. Changes in the number of tools between two intervals of the manufacturing continuum

Period	Class I	Class II	Total
Late Chalcolithic	105	29	134
EBIA	72	10	82
EBIB	88	12	100
EBII	76	5	81
EBIII	121	13	134
MBA	30	3	33
Total	**492**	**72**	**564**

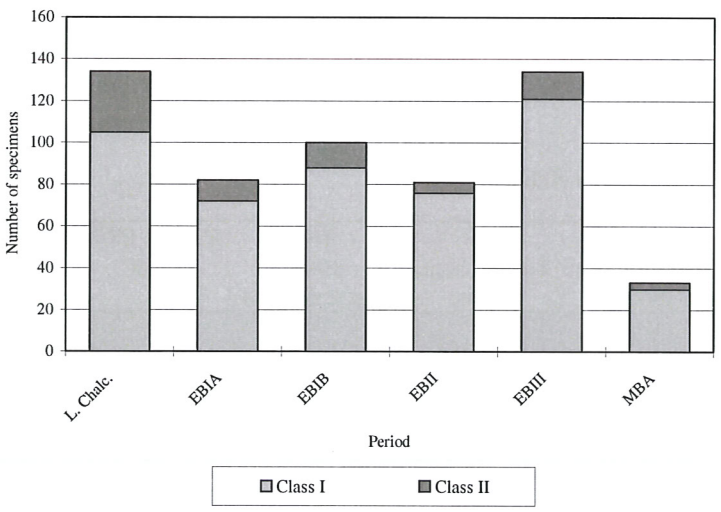

Fig. 7. The diachronic distribution of Class I and Class II ("ad hoc") tools.

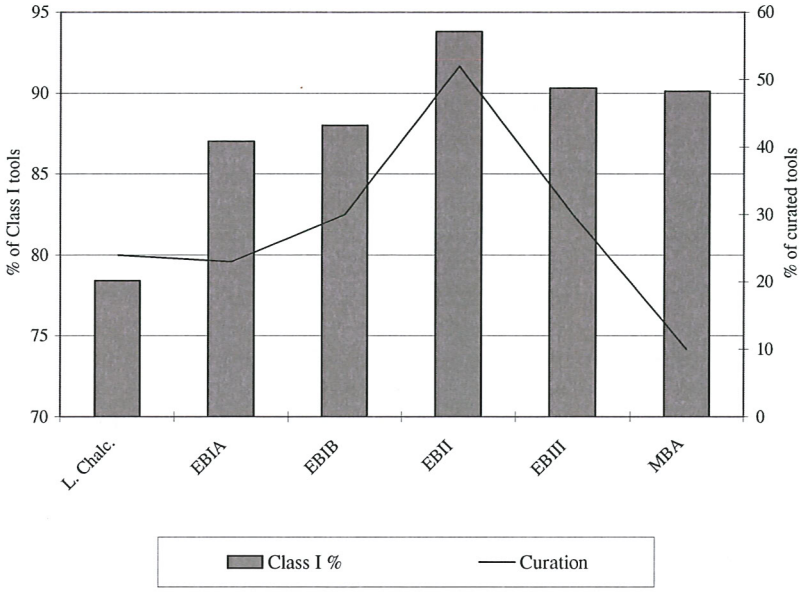

Fig. 8. Trends in the ratios of Class I tools and curation

The overwhelming dominance of more sophisticated planned bone tools is characteristic in all periods. This shows the importance of bone manufacturing tradition during the Late Chalcolithic and Early Bronze Age periods at Arslantepe, before the ubiquitous mundane use of metal (especially iron) implements started. Only one carved handle from the EBIB sub-sample shows signs of having had the criss-cross design been incised with a metal tool. Otherwise flaked stone tools and abrasive stones were the manufacturing materials of choice for working osseous materials.

The previously analyzed curation behavior, not used in defining Class I tools, logically occurs more frequently on these high quality artifacts. Naturally, the proportion of such repaired bone and antler remains is far less (10-50%) than that of Class I tools (78-94%; not all of the latter needed curation or were worth repairing). On an assemblage level, however, the percentages of Class I and curated bone tools clearly parallel each other (Fig. 8). This reconfirms the hypothesis that a greater "value" was associated to the more carefully prepared tools made from a selected raw materials.

Finally, the best represented group of worked bones, that of point types, was looked at in some detail through time (Fig. 9). The absolute numbers of some 200 specimens (1/3 of the entire assemblage) were classified into Schibler's (1981) most frequently occurring types (Table 6).

Table 6. The diachronic distribution of major point types

Type **Period**	**1/1-1/2** Small ruminant metapodium	**1/3** Tubular bone point	**1/4** Small w/articular end	**1/7 and 1/10** Small	**1/8 and 1/9** Large/medium w/o articular end	**Total**
Late Chalcolithic	10	6	5	11	7	39
EBIA	3	5	4	5	8	25
EBIB	9	5	4	8	5	31
EBII	28	1	10	6	3	48
EBIII	14	6	9	12	3	44
MBA	2	2	3			7
Total	**66**	**25**	**35**	**42**	**26**	**194**

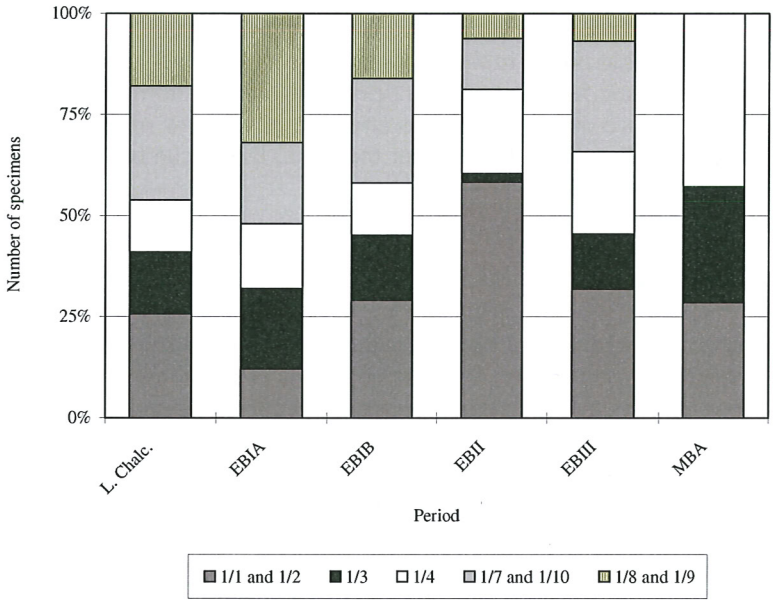

Fig. 9. The chronological distribution of major tool types (Type codes after Schibler, 1982)

The gradually increasing contribution of small ruminant metapodium points, usually produced using the "groove and splinter" technique, culminates in the EBII period where it has been pointed out that the manufacturing technique also changes radically. Such commonly occurring points are usually made utilizing either the distal (Type 1/1) or the proximal (1/2) articular end of the split bones retained as "handles". These tool types are particularly characteristic of the EBII period. Type 1/3 tubular bone points are also often made from metapodia without splitting, but distal caprine tibia fragments are another commonly used raw material for this type whose contribution is rather constant, except again for the EBII period which continues to stand out in this typological aspect as well.

The combined group of Type 1/7 and 1/10 small points contains many worked splinters obtained as by-products of the "groove and splinter" technique. These artifacts may be parts of composite tools, such as rakes or combs, but might also have been used as simple projectile points. Their relative contribution tends also to be rather constant.

Type 1/4 is characteristically made from bones other than caprine metapodia at Arslantepe (e. g. ulna fragments), although their final size and shape is largely similar to those of Type 1/1 and 1/2 points which suggests they may have shared comparable functions as well. Elaborate classifications based on anatomical difference may more reflect modern day classification efforts than coeval technical concerns in this case (Bartosiewicz and Choyke 1994).

Finally, the contribution of medium size and large points, usually made from bones of cattle and red deer, tends to decrease through time, while the greatest number of these tools is known from the "urban", EBIA deposits. The gradual decrease in the proportion of these tools may, to some extent, be related to the parallel diachronic decline in both hunting and cattle exploitation (at least for beef).

There are two other special tool types which deserve mention here because they seem to be characteristic of the sub-sample they appear in. The first are the worked caprine and cattle astragali in the MBA levels which are conventionally associated with gaming activities. The second is a cache of points and arrowheads found in the level of round houses in the EBIII period at the site. These latter objects are made from both antler and, most amazingly and impractically, horn core. Sándor Bökönyi, then working at Arslantepe on the refuse bone, identified the horn core as coming from bezoar goat but the possibility still remains that these strange objects could also have been made from aurochs horn cores. A suggestion that these tools could have been made from elephant rib, also an extremely

porous material, could be rejected after I had the opportunity to examine elephant ribs under magnification. The 17 objects in the cache included shaped raw material, half-finished, finished shouldered double points and elongated projectile points with tiny holes along the lower part of the tang. There were a total of 91 other double points in this sub-sample from the level as a whole, showing this type to be particularly characteristic for this settlement period. However, horn core objects would not only have been difficult to produce due to the porous structure of this raw material but also too brittle to actually use as projectile points. For the moment therefore, this cache has been interpreted as being somehow related to hunting magic.

Discussion and conclusions

A special feature of worked animal remains is that most of them are derived from a rich, renewable source of raw material, food refuse. The assemblage of bones, tooth and antler implements from Arslantepe, therefore, reflects the underlying tendencies found in animal keeping/meat consumption, in that caprine herding gained in importance at the expense of cattle husbandry during the studied time interval. At the time of the local Late Chalcolithic, a broader range of species (in general representing the Anatolian-Mesopotamian domestication model: Bökönyi 1993: 4) was observed, while the use of caprine bones became increasingly important.

Within this general trend, individual dimensions (raw material selection, manufacturing technique, curation and use) of worked animal remains revealed some details. While the phenomena under discussion here are sometimes interrelated, they shed light on the role of modified animal remains within the context of prehistoric economy and culture as well as provide guidelines for the tentative identification of tool function:

1) Diachronic changes in raw material by animal size categories show a decline in the use of large ruminant (cattle) bones. Three quarters of the worked ruminant bone originate from sheep-size animals. This falls in line with the trend seen in refuse bone assemblages that the importance of sheep and goat greatly increased at Arslantepe during the BA (Bartosiewicz 1998: 229).

2) The chronological distribution of antler tools does not show clear diachronic patterning at the beginning of the sequence. It may be reconfirmed, however, that the use of this material varies independently of the dwindling importance of subsistence hunting. The presence of worked antler at rural sections of the settlements may also be related to tool function. There is a sharp drop in the use of antler in the EBII followed by an equally sharp rise in its use in the next EBIII period related to the increased occurrence of heavy duty burr and beam tools as well as double points made from antler.

3) The distribution of tools by manufacturing techniques shows that scraping is an important single method of shaping bone implements during the early periods. The increasingly characteristic method, however, seems to be the combination of cutting, snapping and scraping together with abrasion, largely corresponding to the so-called "groove and splinter" technique performed on commonly occurring sheep and goat metapodia. Again the EBII period stands out in terms of manufacturing techniques with many points made by actually deeply incising the full outline of points, snapping them out and smoothing the rough edges, a very impractical and time consuming method which takes absolutely no advantage of the natural fracturing properties of caprine metapodia. Not surprisingly this technique vanished by the subsequent period.

4) The proportion of curated to non-curated tools is around 1 to 3 in most sub-assemblages. Bone tools were most intensively re-worked during the EBII period (50%).

5) The distribution by major functional tool categories shows a relative decline in the occurrence of ornamental pieces. Within the category of utilitarian tools, however, functional distinctions are difficult to make. Many tools may even have had multiple uses.

6) The diachronic distribution of Class I and Class II tools, shows the overwhelming dominance of carefully planned artifacts, also related to the high frequency of the aforementioned multi-stage manufacturing procedure. Curation, a form of secondary manufacturing independent of the designation of individual tools along the manufacturing continuum, is indicative of the reparation, that is, the recycling of Class I artifacts representing a relatively high degree of technical sophistication in bone use.

7) The chronological distribution of commonly occurring point types mirrors the decline in the consumption of beef and venison, as well as an upswing in caprine exploitation during the history of this site. Class I type, caprine metapodium points produced with the "groove and splinter" technique make up over 50% of the EBII sub-assemblage.

The characters of the sub-samples of worked bone, antler and tusk within the chronological sequence at Arslantepe are, thus, affected by various constellations of all of the above factors. Breaks in continuity occur in the Ubaid period and in the EBII period. Otherwise, differences between periods are related to general availability, horizontal location in the settlement and natural stylistic development. In the future it will be important to synchronize the analysis of the worked bone, pig tusk and antler with the detailed analysis of the refuse bone and look at the way other artifact classes may co-occur with particular tool and ornament types. Understanding why these tools appear as they do will hopefully help fill gaps in those parts of the puzzle related to craft activities such as textile, basketry and leather production and ornamentation. Abrupt changes in techniques and types in this most conservative of household manufacturing traditions may also provide clues to ethnic shifts in the population of this site located between the Trans-Caucasian and Mesopotamian cultural spheres.

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