ARCHAEOZOOLOGY OF THE NEAR EAST III

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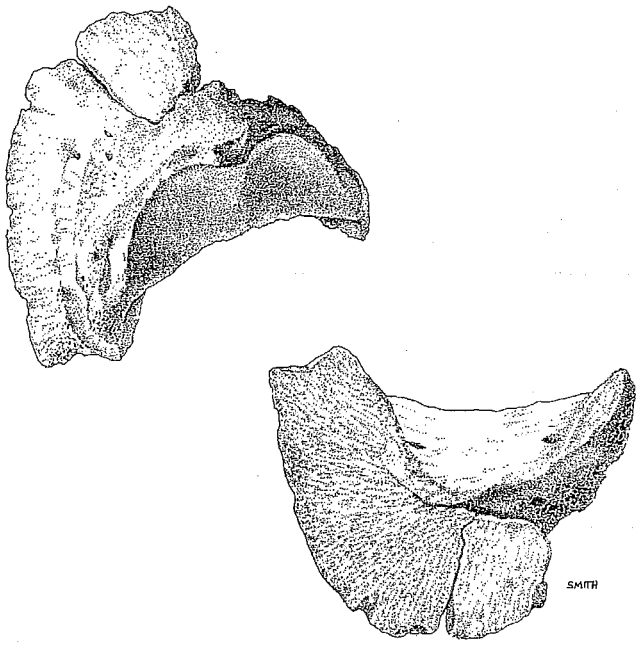
H. Buitenhuis, L. Bartosiewicz and A.M. Choyke



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Cover illustration: Dorsal and palmar aspects of a
Bronze Age horse phalanx from Arslantepe, Turkey,
identified by Sándor Bökönyi.
Courtesy by the artist, Patricia Smith (Reduction: 64%).

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Preface

This publication is the result of the third international symposium on archaeozoology of southwestern Asia and adjacent areas, held in Budapest, Hungary from 2 - 5 September 1996. The editors would like to thank all colleagues of the Working Group who helped with the translation of abstracts. Financial support for the publication was given by the Acker Stratingh Stichting, Groningen, The Netherlands.

Participants of the 3rd ASWA Conference, Budapest 1996
(Photo: Péter Komjáthy, Aquincum Museum)

Standing, left to right: B. De Cupere (Belgium), G. Bar Oz (Israel), H. Buitenhuis (The Netherlands), R. Rabinovich (Israel), L. Leblanc (New Zealand), N. Benecke (Germany), H. Hongo (Japan), N. Russell (USA), J. Speth (USA), A. Patel (India), E. Stephan (Germany), C. Cavallo (The Netherlands), W. Van Neer (Belgium), A.T. Clason (The Netherlands), T. Dayan (Israel), L. Van Es (The Netherlands), C. Becker (Germany), R. Meadow (USA), M. Mashkour (France), F. Poplin (France), E. Vila (France), Mrs. Poplin (France), L. Bartosiewicz (Hungary), E. Pellé (France), P. Ducos (France).
In front, left to right: E. Tchernov (Israel), L. Martin (Great Britain), A. Choyke (Hungary), I. Zohar (Israel).
Participants not shown in picture: D. Carruthers (Great Britain), D. MacHugh (Ireland), S. Whitcher (Great Britain).

Contents

INTERIM REPORT ON THE BRONZE AGE ANIMAL BONES FROM ARSLANTEPE (MALATYA, ANATOLIA)

László Bartosiewicz[1]

Resumé

Durant la campagne de 1996 à Arslantepe, près de Malatya en Turquie, plus de quatre mille ossements ont été identifiés, provenant de trois niveaux de l'Age du Bronze. Ces données confirment les observations déjà faites par le défunt S. Bökönyi sur la majorité écrasante des animaux domestiques, en particulier des moutons, parmi les restes de faune. En plus d'un simple rapport d'étude d'un site, les effets de la fragmentation sur la fiabilité de l'identification taxonomique ont été aussi, pour la première fois, analysés.

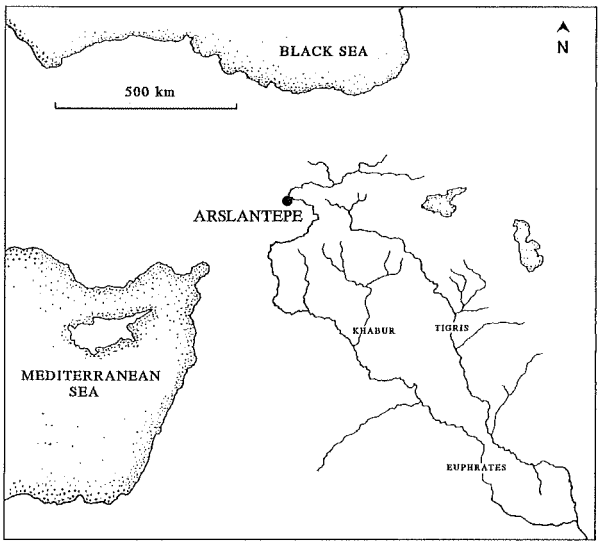

Figure 1. The geographical location of Arslantepe in relation to major rivers and seas.

Introduction

The identification of animal bones from the predominantly Bronze Age tell settlement of Arslantepe near Malatya in Anatolia (Fig. 1) was begun by Sándor Bökönyi in 1979. Over several seasons, he meticulously recorded some 50,000 bone fragments and published a fraction of these data in two preliminary reports on the material identified up until 1984 (Bökönyi, 1983, 1993). Following his untimely early death in 1994, however, the majority of these data lay unexplored and with the advancement of field work at the site even more animal remains will become available for study.

This paper is an overview of the more than 4000 additional bones identified by the author himself during the 1996 field season, in light of the entire material currently at hand. Considering the unusually large size of the bone assemblage as well as the immense complexity of both the horizontal and vertical stratigraphies of the site, the first step in organizing this work was starting the transformation of Sándor Bökönyi's hand-written notes into an electronic data base (Bartosiewicz, 1996). Over the long run, this will create better possibilities for multi-faceted evaluation using both archaeological and zoological criteria and will help in the integration of data gathered by two different analysts at the same site.

Current excavations at the site are directed by Prof. Dr. Marcella Frangipane of the Dipartimento di Scienze Storiche Archeologiche e Antropologiche dell' Antichitá, Universita di Roma "La Sapienza". Her support as well as help by her field team is gratefully acknowledged here.

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Material and Methods

The majority of the material under discusion here originates from the Early Bronze Age IA Period (3350-3000 BC, Period VI A) or late Uruk times. It includes bone remains from a small storage facility (A340) and a larger room (A450) identified as a temple and a niche adjacent to the latter (A812). Samples from the sections of the main corridor in the proximity of these were studied, while the faunal material from a number of smaller features in the same area was pooled to represent the same period (EBA IA i.e.VI A).

The remaining part of the bones studied in 1996 were found in a level attributed to the Early Bronze (EBA IB) where a series of small houses occur, built by Transcaucasian people who moved into the area after the collapse of the centralized late Uruk authority (Periods VI B1: 3000-2900 BC and VI B2: 2900-2700 BC). This relatively small body of data originates from spatially dispersed features and was only pooled for the purposes of a gross chronological comparison.

Assemblages of comparable sizes from these two gross chronological periods were identified and published by the late Sándor Bökönyi (1983, esp. Tables 3-4). The preliminary analysis of my own data not only provides complementary information (especially on rarely occurring wild animals), but also offers an opportunity to attempt a methodological study of how the continuity of faunal work at Arslantepe could best be maintained.

The evaluation of animal bones under discussion here was carried out in three major steps. First, general faunal lists (broken down, to some extent, by major features) were presented in Table 1. Calculating the minimum numbers of individuals (MNI) is frequently used in attempts to reconstruct animal keeping. In fact, Bökönyi himself devised an improved method aimed at increasing the accuracy of such estimations (Bökönyi, 1970). In this interim report, however, it seems best to concentrate on the numbers of identifiable bone specimens (NISP) as indicators of meat consumption in a large, heavily fragmented assemblage. On the whole, the better part of meat and bone tend to originate from the most commonly available animals. This logical relationship is clearly expressed by the high positive correlation between NISP and MNI values when assemblages of *sufficiently large size* are available for study (Bartosiewicz, 1990).

In Table 1, all values were given as numbers of identifiable bone specimens. In the case of the economically most important domestic artiodactyls (cattle, sheep/goat, and pig), skeletal parts were classified into the conventionally used meat value categories published by Uerpmann (1973). Possible heterogeneity in this regard was appraised in the large EBA IA material in terms of percentages, since these features equally represented public areas (temple and corridor) and storage facilities (rooms). Due to the smaller number of bones, such detailed comparison between meat values could not be carried out in the smaller EBA IB assemblages that originated from more sporadically located features in the "small house level".

The conventional faunal analysis was complemented by a bone fragmentation study. Data on fragment sizes were for the first time recorded at Arslantepe. Since weighing bones requires equipment and may be biased by differential fossilization, the greatest linear dimension (*not osteological measurement*!) of each individual fragment was recorded in terms of 25 mm size intervals ("length units") in order to detect patterning in the surviving sizes of bones.

Both diachronic and between-author variability were evaluated in light of fragment sizes. Bone lengths of the economically most characteristic domesticates (sheep/goat and cattle) as well as previously not discussed non-identifiable bones were compared between the two Early Bronze Age (IA and IB) periods as well as in terms of possible systematic differences between previous identifications by Sándor Bökönyi and the material published in this paper. For purely heuristic purposes, minimum numbers of individuals were estimated on the basis of 78 prehistoric sites (Bartosiewicz, 1990) in relation to this fragmentation study.

In this paper, bone measurements were limited to fragment sizes. The osteometric evaluation of animal remains would have been beyond the scope of an interim report.

NISP	A450	A812	A340+ corridor	General pooled	General west	Total
Cattle A	67	7	15	111	39	239
Cattle B	73	17	16	142	23	271
Cattle C	83	15	11	124	26	259
Sheep A	14	1	2	17	11	45
Sheep B	15	1	1	20	12	49
Sheep C	35	11	6	57	15	124
Goat A	4			5	2	11
Goat B	5			3	2	10
Goat C	14	4	1	13	5	37
Caprinae A	177	24	50	275	71	597
Caprinae B	223	36	43	312	80	694
Caprinae C	104	18	19	160	27	328
Pig A	4		1	1	2	8
Pig B	20		3	4		27
Pig C	8			4	2	14
Dog	27		1	10	5	43
Aurochs	111	1	4	31	10	157
Red deer	4	2	2	7	1	16
Wild pig				4	2	6
Wild sheep	2	3	2		7	14
Ibex				3	1	4
Brown hare	10	10	1	29		50
Brown bear	1			1		2
Lion	2					2
Pelican		1				1
White-tailed eagle				1		1
Carp				4		4
Riverine mussel				2		2
Domestic %	87	89	95	94	94	91
Wild %	13	11	5	6	6	9
NISP total						3016
Unidentifiable or presumably intrusive						
Large ungulate	209	24	25	186	38	482
Small ungulate	144	36	27	166	17	390
Chiroptera	3					3
Rodentia				2		2
Anseridae				1		1
Passeriformes				2		2
Aves sp.	8	1		5		14
Anura sp.	4			1		5
Total						899

Table 1. Early Bronze Age IA animal remains.

NISP	VIB1	VIB2	Total
Cattle A	45	17	62
Cattle B	46	21	67
Cattle C	44	16	60
Sheep A	9	2	11
Sheep B	22	7	29
Sheep C	49	13	62
Goat A	2	2	4
Goat B	4	1	5
Goat C	11	4	15
Caprinae A	149	47	196
Caprinae B	191	49	240
Caprinae C	80	15	95
Pig A	4	2	6
Pig B	5	1	6
Pig C			
Dog	78	1	1
Aurochs	18	5	23
Red deer	7	1	8
Wild pig	6	2	8
Wild sheep	11		11
Gazella sp.	13	9	22
Brown hare	6	3	9
Riverine mussel	1		1
Domestic %	92	91	91
Wild %	8	9	9
NISP total			939
Unidentifiable			
Large ungulate	65	32	97
Small ungulate	38	20	58
Aves sp.		1	155
Total			310

Table 2. Early Bronze Age IB animal remains.

Faunal information

The vernacular names and NISP values of animals identified in the two Early Bronze Age components of the site, as well as the numbers of bones from not precisely identifiable and intrusive (secondary deposition) animals are presented in Tables 1 and 2.

The large EBA IA assemblage (NISP= 3016), from an urban context at the tell settlement was identifiable to a great extent, in spite of the usual combination of trampling, cleaning and clearing activities on the floor levels of this elite habitation/ceremonial area which resulted in heavy bone fragmentation. The number of non-identifiable bones hardly exceeds ten percent of the NISP and even a few characteristic species occur which are usually not exploited by humans but originate from secondary "taphonomic gain". These remains of commensal animals include bones from an unidentified small bat (*Chiroptera*), long bone fragments of a relatively large, souslik size animal (*Rodentia*) and those of a sparrow size bird (*Passeriformes*). Some unidentified bones from other birds and frogs/toads (*Anura*) most probably fall within the same category.

By far the most important domesticates were small ruminants, sheep (*Ovis aries* L. 1758) and goat (*Capra hircus* L. 1758). As is very well known, however, distinction between the bones of these two closely related species is usually extremely difficult, thus they are most frequently referred to as sheep/goat (subfamily: Caprinae Gill 1852) in this study. Data listed in Table 1 also show that approximately three times more bones could be consistently assigned to sheep than to goat. Values of binomial standard error (Hammond and McCullagh, 1974) calculated for each of the periods available in Bökönyi's 1983 publication confirmed the dominance of goat bones during the Late Chalcolithic (Bartosiewicz, 1996).

Logically, most bones of sheep/goat identifiable to species fall within Uerpmann's "C" meat value category, since precisely identifiable skeletal parts usually either originate from the head or from the dry limbs (*autopodia*) which contain but little meat. It is at this point, that the low degree of fragmentation enhances the morphological identifiability of these latter bones. Although in the first ever faunal study from Arslantepe fragment sizes were not stated in explicit terms, the high degree of fragmentation was verbally characterized by the observation that of the almost 10,000 identifiable animal remains only 20 complete long bones were found and 17 of those were metapodia (Bökönyi, 1983: 581). These relatively compact bones are not only more resistant to natural taphonomic agents but due to their low meat and marrow content they are also less likely to have been exposed to extensive secondary butchering. Furthermore, metapodia are used most often in the prehistoric manufacture of various bone tools at this site, providing a further reason why they must have been saved during carcass processing (Choyke, personal communication).

Another domestic animal of some importance in meat provisioning was cattle (*Bos taurus* L. 1758). As will be discussed later, however, in spite of its large live weight, the consumption of beef must have been significantly less characteristic than that of mutton.

When proportions between animal remains are compared by meat value categories within the Bronze Age IA period, a remarkable similarity occurs between the features and general areas (Fig. 2). Naturally, percentual comparisons between sub-assemblages of radically differing sizes are always difficult in formal statistical terms. However, remains of the main domestic animals display, more-or-less, the same proportions. In other words, there are no differences apparent in Figure 2 that could be attributed to variations in sample size.

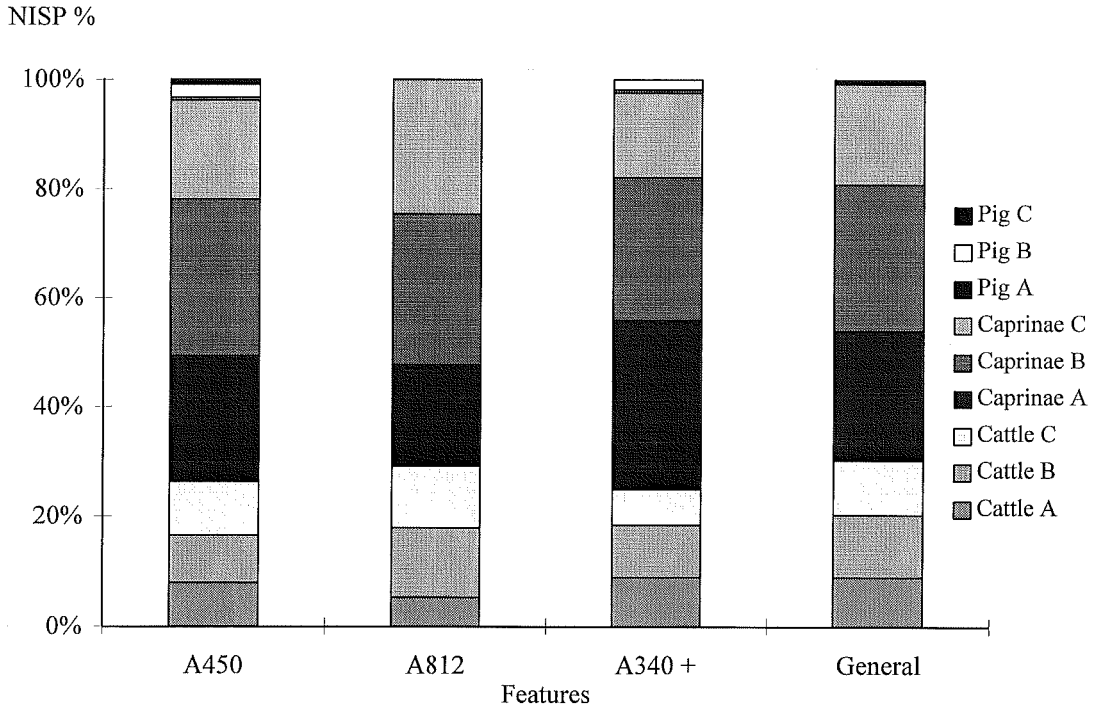

Figure 2. Bone distributions by meat values in the Early Bronze Age IA Period.

As always, the "devil is in the details", that is, the almost negligibly small portion of wild animal remains. As one might expect at an urban site, only around ten percent of the bones originate unambiguously from game. This observation also falls perfectly in line with observations made at the same site by Bökönyi (1983: 582). Fortunately, large samples not only offer a more detailed picture but are more likely to contain rare finds on a purely stochastic basis as well. As a consequence of the exponential relationship between assemblage size and taxonomic richness (Grayson, 1984; Bartosiewicz, 1990-1991), the greatest numbers of rare wild animal bones such as the remains of brown bear (*Ursus arctos* L. 1758), lion (*Panthera leo* L. 1758), pelican (*Pelecanus onocrotalus* L. 1758), eagle (*Haliaetus cf. albicilla* L. 1758) and the like occur in the large "temple" assemblage of room A450 and the general pooled sample from the same period which is of comparable size. This means that although one may reasonably hypothesize that bear and lion teeth as well as metapodium fragments in particular were attached to high status items such as pelts and skins, used in the socio-culturally important temple area, their discovery is also a natural product of large sample size. Bear bones especially, also appear in the less distinct "general" area as reminders of Bökönyi's (1983: 590) opinion that even their meat may have been consumed.

Eastern-Central Anatolia is one of the typical zoogeographical areas where the natural distributions of four wild artiodactyls of strategic importance overlap. All of them figured as the ancestors of the most important domesticates. They include aurochs (*Bos primigenius* Boj. 1827), wild pig (*Sus scrofa* L. 1758), wild sheep (*Ovis orientalis* Gmelin 1774) and wild "Bezoar" goat (*Capra aegagrus*

Erxl. 1777). Although the domestication of these animals is not supported by the osteological evidence of transitional forms at this site (Bökönyi, 1969: 223; Bökönyi and Bartosiewicz, 1987), size overlaps between small wild and large domestic individuals *of the same species* may lead to misidentifications, especially in the case of early maturing, distal extremity segments whose epiphyses are ossified in younger animals thereby ending longitudinal growth (Bartosiewicz, 1984a: 137), while the robusticity (i. e. transversal dimensions) of bones in such individuals may further increase with the advancement of age related live weight thereby approaching the proportions of the wild ancestor. While the intricacies of wild/domestic distinctions complicate only the identifications of *Suidae* and *Bovinae* in the Carpathian Basin where no wild sheep or goat lived during the Holocene, this problem further plagues the otherwise problematic distinction between various species of *Caprinae* in the area under discussion here. Fortunately, with the notable exception of the enigmatic horse, most early domesticates tend to be smaller than their wild ancestors, a fact that is of some help in metric distinctions. Indeed, those largest bones could be safely assigned to aurochs, wild pig, wild sheep and wild goat respectively both by Bökönyi (1983, 1993) and myself in this study.

In chronological as well as ecological terms, it is noteworthy that no bones of (more closely non-identifiable) gazelles (*Gazella* sp.) occur in the Early Bronze Age IA assemblage.[2] On the other hand, these previously very rare ruminants (Chalcolithic and Early Bronze Age IA in Bökönyi, 1983: 589) are relatively well represented among the wild animal remains in the small VIB1-2 assemblages in which bones of brown hare (*Lepus europaeus* Pall. 1778) also occur consistently.

Of the other wild animals, red deer (*Cervus elaphus* L. 1758) is worth briefly discussing here as well. Sporadically occurring antler fragments (1 in the EBA IA and 11 in the EBA B1-2 periods) were not included in the calculations due to the special way they were probably procured in the Bronze Age (gathering of shed antler vs. hunting) and fragmentation characteristics (Choyke, 1987). The actual number of red deer bones, indicative of the consumption of venison, is very small indeed while just about half of the worked animal remains derive from red deer antler (A. M. Choyke, personal communication). This selectivity is a reflection of the value of antler as a raw material.

Differential deposition

Aside from the aforementioned description of Late Chalcolithic and Early Bronze Age bones from Arslantepe as typical settlement material from which "whole skeletons, larger skeletal parts, whole skulls or larger skull fragments are missing and even whole long bones rarely occur", Bökönyi (1983: 581) did not carry out a quantitative assessment of fragmentation. Moreover, neither did he publish the numbers of non-identifiable bone fragments in his 1983 report, which have become an indispensable parameter in archaeozoology during the last decade.

Fragment sizes recorded during 1996 in the aforementioned 25 mm size intervals as well as previously ignored information on non-identifiable remains were used in outlining diachronic patterns of bone fragmentation at this site. The results are summarized in Table 3.

Most notably, the mean length of bone fragments from the earlier, "urban" period is consistently below 3 length units (75 mm), while in the later material it is above this threshold. This diachronic difference apparent between EBA IA and EBA IB fragment sizes (Table 3, summary row), although not significant in *sensu stricto* statistical terms ($P \leq 0.05$), raises the question, at which point in the settlement's history were the animal bones deposited, especially in the temple area. In light of the unquestionable continuity of animal exploitation strategies (Tables 1 and 2; Fig. 3), this size difference is unlikely to have been massively biased by the only slightly different taxonomic composition of the EBA IA and EBA IB materials.

[2] Tentative identifications of these fragments fall in line with Bökönyi's (1993: 349) observation that they most probably originate from goitred gazelle (*Gazella subgutturosa* L. 1758).

	A450	A812	A340 + corr.	General pooled	General west	VIB1	VIB2	Total	Standard deviation
Cattle, n	223	39	42	377	88	135	54	958	
mean value	3.4	3.8	3.7	3.4	3.7	4.0	3.5	**3.547**	**0.220**
Caprinae, n	523	95	122	862	225	515	140	2482	
mean value	2.7	2.5	2.7	2.7	2.5	3.0	2.6	**2.731**	**0.153**
Large ungulate, n	209	24	25	186	38	65	32	579	
mean value	2.6	2.6	2.6	2.9	3.3	3.0	3.0	**2.809**	**0.210**
Small ungulate, n	144	36	27	166	17	38	20	458	
mean value	2.2	2.1	2.1	2.3	3.1	2.0	2.3	**2.241**	**0.193**
Total, n	1099	194	216	1951	368	753	999	4477	
mean value	**2.758**	**2.699**	**2.808**	**2.848**	**2.897**	**3.129**	**3.054**	**2.833**	
SD	**0.362**	**0.575**	**0.479**	**0.340**	**0.519**	**0.462**	**0.465**	**0.382**	

Table 3. Univariate statistics for fragment sizes by animal groups and periods (1 length unit = 25mm; SD=standard deviation).

Even if many of the EBA IA bones were found in an apparently primary position on the floor level, it is unlikely that an important and presumably prestigious public building would have been thickly littered with decaying animal remains during the heyday of its use. Nevertheless, these heavily fragmented bones associated with finds dated to ca 3350-3000 BC, are certainly earlier than the time of Transcaucasian "pastoral influx" (3000 to 2900 BC and 2900 to 2700 BC respectively). Perhaps the presence of bones and their fragmentation may be related to the abandonment of areas and clearing activities in the still used parts of the complex. On the other hand, food refuse deposited by the Transcaucasian population was often buried in pits, thereby resulting in somewhat better preservation.

Taxonomic identifiability and fragmentation

When the percentual proportions of the main domestic animals are compared (Fig. 3) not only by main chronological units (EBA IA "urban" and EBA IB1-2 "village-pastoral") but also by authors (S. B. = S. Bökönyi and L. B. = L. Bartosiewicz), a contradictory pattern emerges. In contrast to any sensible research hypothesis, diachronic differences seem to be far smaller than variability between authors. As a matter of fact, the composition of food remains deriving from domesticates are apparently very stable through time, while percentual contributions by "identifiable" remains of domestic cattle and sheep especially, seem to be higher in this study than in Bökönyi's 1983 preliminary report. Although this difference is not statistically significant at the $P \leq 0.05$ level of probability, the notable empirical trend may be due to the subjective element inherent in the ambiguous identification of smaller fragments. While these differences are not dramatic enough to challenge the general conclusions concerning the fauna of Bronze Age Arslantepe, they inspired this short inquiry into the effect of fragmentation on taxonomic identifiability at the site.

Undoubtedly, relatively large domestic cattle is present in both samples. Bökönyi (1983: 585) even described long and heavy, primigenius type horn cores from the Late Chalcolithic of Arslantepe. The domestic nature of such animals may be more difficult to recognize in other robust but highly fragmented skeletal elements. Similarly, at least a dozen non-identifiable but heavy splinters from Caprinae were described during the 1996 field season. Their precise identification beyond the subfamily level could not even have been attempted.

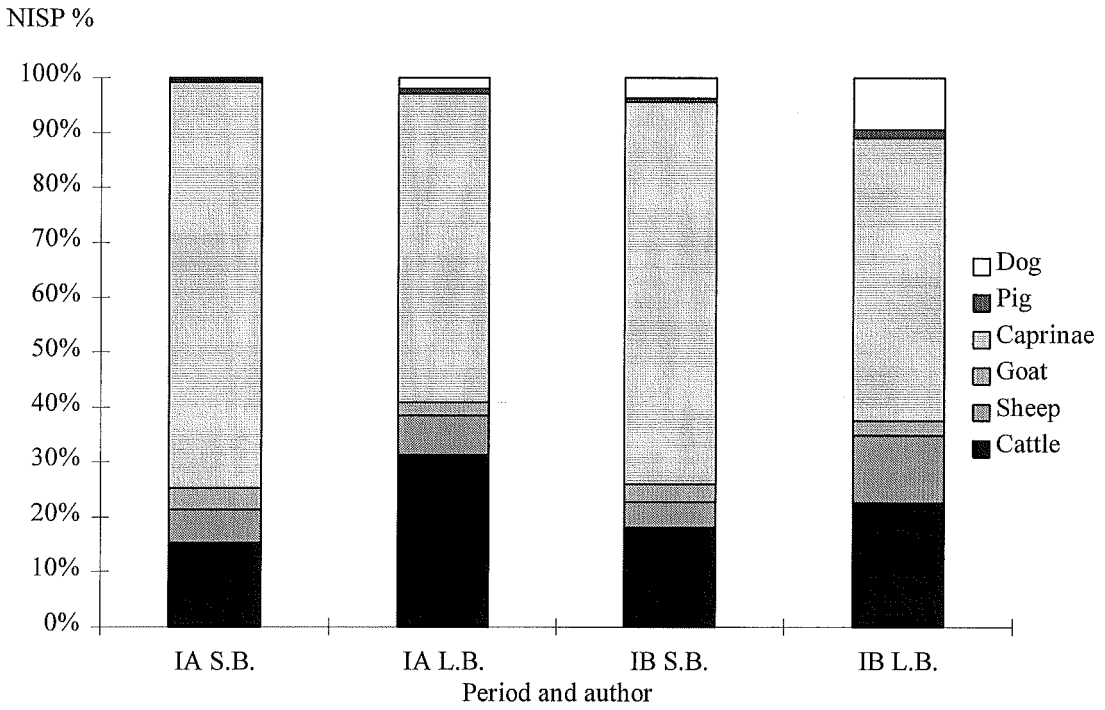

Figure 3. Comparison between Early Bronze Age domestic faunas.

In light of the faunal composition of the entire material from Arslantepe, one may hypothesize with confidence that most of the "large" and "small", non-identifiable bone fragments originate from cattle and sheep/goat respectively. Therefore the fragmentation study is aimed at outlining patterning within the context of large versus small domestic ruminants. Naturally, among the non-identifiable fragments, the presence of aurochs, red deer and wild pig remains cannot be ruled out in the first group. Similarly, sporadic bone splinters from domestic pig, wild Caprinae, gazelle and even dog must have, to a negligible extent, contributed to the non-identifiable set of bones from "small ungulates".

The proportion between the total number of cattle and "large ungulate" bones was 958:579, while the same ratio was 2482:458 in the case of Caprinae and "small ungulates". This in itself shows a significantly greater intensity of fragmentation for large bones (from larger animals), which actually is a well known phenomenon. The overall tendency of heavy fragmentation is also shown in the statistical parameters calculated for the four taxonomic groups. Considering that slaughtering a cow may yield 8-10 times as much meat as killing a sheep (Matolcsi, 1982: 68), mean fragment lengths are remarkably homogeneous. While identifiable cattle bones, on average are 3.5 units (ca 87 mm) long, non-identifiable long bone splinters originating from „large ungulates" are practically as small as bone fragments from Caprinae (2.809 vs. 2.731 units, i.e. 70 and 68 mm respectively). Although, logically, non-identifiable small ungulate remains should be the shortest (2.241 units = 56 mm), the differences are so small that in spite of the relatively narrow ranges of standard deviations, statistically significant differences ($P \leq 0.05$) were found only between this value, and the mean length of identifiable cattle bones at the other extreme of the size scale. This precisely corresponds to the trend observed in smaller, heavily fragmented Iron Age materials from Slovenia (Bartosiewicz, 1991).

Taphonomic reasons for this phenomenon may be manifold. Aside from the natural, mechanical properties of bone (Binford and Bertram, 1977) which make larger bones more fragile, human fracturing, especially marrow extraction and "pot-sizing" (Oliver, 1993: 203), further exacerbate fragmentation. Therefore, it is easy to find bone splinters from cattle (?) and Caprinae (?) which are not significantly different from each other in terms of length but are fragmented beyond precise taxonomic identifiability. It is this size range which was not discussed in Bökönyi's 1983 preliminary

report but which may „swamp" between-author differences shown in Figure 3. In the case of these osteometrically non-characteristic splinters, no objective criteria are known for the precise distinction between wild and domestic forms. Therefore, due to differences in experience, impressions and other completely subjective considerations, systematic differences between authors conspire to produce an inevitable bias during identification work.

Rather than the manifestation of this phenomenon, its interpretative implications should also be briefly reviewed. Although the simplistic interpretations of MNI values can be a source of sometimes wild conclusions, this parameter shows a parallel phenomenon, that is, the higher degree of fragmentation in the case of cattle compared to smaller domesticates. In strictly nominal terms, the proportion of MNI estimates to NISP values in Table 4 is consistently higher in Caprinae (usually some 2/3 of the NISP count in large sub-samples) than in the case of cattle where the number of „individuals" is usually 1/10 of the number of cattle bone fragments.[3] It cannot be emphasized enough that these figures reflect consumption activities and do not tell us anything about cattle and sheep/goat „stocks" in an absolute sense. Furthermore, they confirm that the contribution of beef to the diet would be greatly overestimated using NISP values due to the intensive fragmentation of bones from large animals.

An important subjective element in MNI calculations, aggregation, is shown in the last four columns of Table 4. MNI estimates based on the total samples are always lower than the sum of MNI values calculated for individual sub-samples, since it is not possible to tell how often bones from the same individual were identified from different features, thereby introducing redundant information (in addition to innumerable forms of other bias) into MNI calculations.

	A450	A812	A330 +corr.	Gen. pooled	Gen. west	VI BI	VI B2	A1 sum	A1 total	B1-2 sum	B1-2 total
Cattle NISP	223	39	42	377	88	135	54	769	769	189	189
Estimated MNI	22	7	8	31	12	16	9	**80**	**49**	**25**	**20**
Caprinae NISP	591	95	122	862	227	517	140	1897	1897	657	657
Estimated MNI	357	65	82	507	145	315	93	**1156**	**1056**	**408**	**393**
Pig NISP	32		4	9	4	9	3	49	49	12	12
Estimated MNI	12		3	5	4	7	4	**24**	**16**	**11**	**6**
Dog NISP	27		1	10	5	78	1	43	43	79	79
Estimated MNI	5		1	3	2	7	1	**11**	**6**	**8**	**8**

Table 4. NISP and MNI estimates in the studied assemblages.

Discussion

As far as the species composition of domestic animal remains is concerned, at the site of Arslantepe, the importance of sheep and goat greatly increased throughout the Early Bronze Age. It must be emphasized that most animal bones brought to light from settlement features should be considered remains of meals, thereby representing chiefly meat consumption rather than animal keeping.

It may be hypothesized that a settlement such as the EBA IA levels of Early Bronze Age Arslantepe with its monumental buildings was the focus of some form of a central meat provisioning system based on sheep keeping in the settlement's surroundings. In this case, within the settlement one should reckon with "pieces of meat" rather than individual animals. An indirect indication of this development may be the decline of pork consumption in comparison with the less elaborate and smaller Late Chalcolithic rural settlement at Arslantepe (Bökönyi, 1983: Table 1). Before the Bronze Age, pig keeping may have been more easily practiced on a household level within the boundaries of human habitation. According to a hypothesis by Diener and Robkin (1978) the religious prohibition of

[3] The number of pig bones was not sufficiently great for similar estimations. In addition to being represented by even fewer bones dog, a non-meat purpose animal, is often present in the form of articulated skeletal parts which would further obscure any overall patterning.

pork consumption in many areas of the Middle East may originate from the efforts of urban owners of large sheep flocks who achieved a monopoly in the meat market by banning pig keeping on the level of family farms. While this interpretation is still to be substantiated at the site under discussion here, it certainly falls in line with both ethnographic and archaeological examples of a dichotomy between sheep/goat and pig keeping in many areas (Bartosiewicz 1984b; Bartosiewicz and Choyke 1985).

Within the otherwise overwhelmingly dominant Caprinae subfamily, bones of sheep and goat are often difficult to tell apart. In heavily fragmented materials, the distinction further decreases along with the number of identifiable bone specimens. Nevertheless, the exceptional dominance of goat bones in the material from the Late Chalcolithic rural settlement (Bökönyi 1983: 591) may be indeed related to the complementary role of this animal in milk production at that earlier time. In addition to early pig keeping, it may be regarded as yet another sign of subsistence-like household production (Dahl and Hjort, 1976) that was supressed by large scale sheep keeping during the Early Bronze Age.

The meat exploitation of game played a lesser role at Arslantepe. As a rule of thumb, an at least 25 % contribution of wild animal bone is thought to be indicative of a major contribution by hunting to the procurement of meat (Matolcsi, 1982). Animal keeping is adaptable to a wider variety of environments than the habitat preference of wild animals. However, typically for many human settlements, Arslantepe is located in an ecotone between at least three major types of environments, whose fauna is well- represented, especially in the larger faunal assemblages. A decrease in the percentual contribution of aurochs bones and the presence of wild pig may be indicative of a dense forest cover which also favored the presence of brown bear, especially during the earlier periods. Remains of wild sheep and wild goat also consistently occur, showing that the keeping of their domestic forms would have been equally feasible in the broader area surrounding the settlement.

Because of their greater direct dependence on habitat types, wild animals may be considered more reliable environmental indicators than domesticates. Remains of Greek land turtle were found in greatest numbers in the Late Chalcolithic settlement (Bökönyi, 1983: 582). Their contribution, however, radically decreases in the Early Bronze Age assemblages. Meanwhile, greater numbers of brown hare bones were deposited which may also reflect human impact on the environment. Deforestation around the large Bronze Age settlement may have created an ideal habitat for hare. Bones of (possibly goitred) gazelle occur only sporadically in both of the relatively large assemblages studied by Bökönyi (1983, 1993). Once, however, the urban character of the settlement had decreased (EBA IB1-2), gazelle remains seem to become more common, in spite of the relatively smaller sample sizes. In contrast with the continuity in the exploitation of domesticates, these latter two grassland species may be indicative of a partial abandonment of intensive agricultural activity in the open area around the settlement allowing steppic faunal elements to move in. The smaller Transcaucasian human population of the VIB1-2 periods could be probably provisioned by smaller cultivated areas, and an upsurge of the wild game species benefiting from an expanded habitat apparently also contributed to the meat diet. Given the number of rare zoological finds from Arslantepe (bones of panther, lion and elephant; Bökönyi, 1985; 1993) there is hope that additional data will become available on *Equids* as well.

Fragmentation studies have shown an indirect but quantitative relationship between preservation and taxonomic identifiability, which may be of critical importance when comparisons are made between faunal lists compiled by different authors. From the viewpoint of practical interpretation, the occurrence of similarly small bone splinters from cattle and sheep deserves special attention, since cattle may yield an entire order of magnitude more meat than sheep. Therefore faunal parameters discussed in this study should be regarded more as primary evidence of meat consumption than direct indicators of stock rearing. Avoiding the overestimation of the role played by beef in the diet is especially important from this point of view.

Archaeozoology in later periods has, at least indirectly, addressed gastronomic questions for over two decades (e. g. Coy, 1972; Bartosiewicz, 1985: 116; Vörös, 1986; Schibler and Furger, 1988; Van Wijngaarden-Bakker, 1990; Takács, 1990-1991; Oliver, 1993). It is important to keep in mind, how-

ever, that intentional fragmentation by humans is only part of this picture. Preservation is always dependent on the modes of deposition and the entire process of fossil diagenesis as well.

Conclusions

By the early Bronze Age (3350-3000 BC), animal exploitation at Arslantepe was firmly dominated by the presence of domestic sheep. Diachronic changes between the EBA IA and EBA IB periods occur mostly in the small wild animal bone component and the degree of fragmentation, both of which reflect a decrease in the settlements' urban character.

Differences in the composition of synchronous Early Bronze Age materials previously published by Sándor Bökönyi and established in this study reflect an insignificant subjective bias in the *en masse* identification of animal bones. Considering the source of this author-dependent difference can be of help in ensuring the continuity of faunal analysis at this site.

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