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The Archaeozoology of Bronze Age Offerings from Burial Cave 900 in Naḥal Refa'im, Jerusalem

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Introduction

Examination of the archaeozoological record of the Levant shows that from the Middle Paleolithic on, whole animals or selected body parts served as burial offerings (e.g., Vandermeersch 1970; Davis and Valla 1978; Legge and Zeder 1988; Lev-Tov and Maher 2001; Weissbrod and Bar-Oz 2004; Vila 2005; Goring-Morris and Horwitz 2007; Horwitz, Rosen and Bouquentin 2011; Maher et al. 2011). Perhaps the most widespread and consistent examples of animal offerings in the region are to be found in tombs dating to the Intermediate and Middle Bronze Ages. Inside these tombs, animal offerings, predominantly remains of ovicaprines, are found either within ceramic vessels or comingled with human remains and those of material culture—ceramics, furniture, ornaments, weapons and sometimes botanical remains that also served as grave offerings (e.g., Grosvenor-Ellis and Westley 1965; Zettler et al. 1996; Horwitz 2001; 2007; 2010; Vila 2004a; 2004b; Cartwright 2005; Vila and Chahoud 2006; Al-Maqadissi et al. 2006; Genz et al. 2010; Marinova et al. 2012; Chahoud 2014–2015). It is apparent that the faunal remains represent animals that were slaughtered as part of Bronze Age mortuary rituals. However, their symbolic significance—whether they represent food offerings for the next world, either for the deceased or the gods, tribute for the gods, or remains of the funeral feast consumed by the mourners—is still unresolved (e.g., Horwitz 2001; 2014; Pollock 2003; Vila 2004a; 2004b; Polcaro 2010). Only through the examination of additional assemblages may it be possible to elucidate this issue. Consequently, the animal remains recovered during the salvage excavations in 2002 from a rich tomb in Naḥal Refa'im, Jerusalem (see Weksler-Bdolah, this volume; Gershuny, this volume), offer a noteworthy addition to the corpus of Bronze Age tomb fauna described to date.

Materials and Methods

The faunal remains were recovered from an oval-shaped tomb hewn into the bedrock on the northern bank of Naḥal Refa'im. The majority of the tomb contents date to the Middle Bronze Age IIB, while scanty remains are attributed to an earlier, Intermediate Bronze Age burial phase (L912; see Weksler-Bdolah, this volume).[1] Two phases of use during MB IIB were discerned: the lowermost level comprised finds from Loci 908, 909 and 910, while finds dating to the uppermost layer were recovered from Loci 900, 901 and 902.

The animal offerings inside the cave were interspersed among human skeletal remains (see Nagar, this volume), ceramics, weapons and ornaments. All animal remains were hand collected during excavation, and limited sieving of deposits was carried out. Identified bones were summed to provide total bones identified (NISP counts), and the minimum number of individual animals represented (MNI estimates) was calculated for each locus separately, by species. MNI counts were based on the most frequently represented part of a bone (the shaft, proximal or distal epiphyses), with the side of the bone element (left or right) and its biological age (fused or unfused ends)

taken into consideration. It is possible that the MNI estimates for sheep and goats inflate the numbers of animals in a locus, as these bones may belong to the same animals whose remains could not be identified to species and were placed in the combined sheep/goat category.

To distinguish cranial and post-cranial remains of sheep from goats, the modern osteological collection held in the National Natural History Collections of the Hebrew University of Jerusalem was consulted, as well as morphometric criteria outlined in Boessneck, Müller and Teichert (1964), Prummel and Frisch (1986), Payne (1969; 1985) and Halstead, Collins and Isaakidou (2002). Given the difficulties in accomplishing this distinction for all remains, those which could not be separated were placed in a combined sheep/goat category. Ageing of sheep and goat was based on three sources: dental eruption, long-bone fusion (Silver 1969) and dental attrition (Payne 1973). Since few complete mandibles were recovered, dental attrition was scored for isolated molars as well as teeth in jaws (Tooth-Wear Scores 1–9) and the sum of their attrition converted into estimated ages (Payne Stages A–I), as outlined in Payne (1973:293). Height at withers (shoulder height) was calculated using the coefficients proposed by Teichert (1975) for sheep and Schramm (1967) for goats.

An index for skeletal-element survivorship was calculated for the MB IIB layers using the following equation:

$$\frac{\text{\% survivorship} = \text{N in whole skeleton} \times \text{MNI per layer} \times 100}{\text{NISP per layer}}$$

This provided a quantifiable survivorship value for each element. The closer the % survivorship value is to 100%, the nearer its representation in the assemblage falls to that expected for the specific MNI estimation. As the frequency of an element decreases, this reflects its decreasing survivorship in the sample relative to the specific MNI. As such, a survivorship value of 20% is low, as it means that 80% of the expected elements were not present in the assemblage.

For examination of patterns of butchery and consumption, skeletal elements were re-grouped into body-part categories that reflect their utility in terms of meaty or non-meaty bones (cranial, forelimb, hindlimb, trunk and feet).

Bone measurements were taken with a digital caliper (accurate to 0.01 mm) and, unless otherwise stated, followed standards given in von den Driesch (1976). Modifications to the bones, including weathering, burning and butchery marks, were recorded for each bone following visual observation using a hand-held magnifying glass (× 10). Butchery damage and its associated activity was classified following Binford (1981).

THE FINDS

The bones were generally well-preserved, but extremely friable. Most had suffered damage from the excavation, as evidenced by numerous breaks (>60% of bones), especially on the bone ends. The bones are light yellow in color, with root etching visible on the outer surface of most (c. 70%). A few bones showed more extensive surface weathering (fissuring, exfoliation).

The faunal assemblage from the tomb comprised 993 remains that could be identified to skeletal element and taxon. Of these, 984 bones were recovered from MB IIB loci and nine bones, from a single Intermediate Bronze Age locus (L912; Table 1). In both periods, the identified faunal remains were exclusively those of domestic sheep (*Ovis aries*) and goat (*Capra hircus*).

Intermediate Bronze Age

Locus 912. Close to the cave entrance, an oval pit (1.8 × 1.1 m) had been dug into the cave floor and sealed with soil and stones. Inside the pit were nine similar store jars, isolated human bones representing an adolescent individual, and nine animal bones (Tables 1, 2).

Table 1. Sheep, Goat and Sheep/Goat Representation by Locus and Period
(NISP counts per species and relative frequencies of sheep to goat per locus)

Locus	Period	Sheep NISP	Goat NISP	Sheep/Goat NISP	Total Ovicaprines NISP	% Sheep to Goat
912	IBA	3	0	6	9	100.0
910	MB IIB	61	0	27	88	100.0
908–909	MB IIB	97	45	319	461	69.9
900–902	MB IIB	94	19	315	428	83.1
900–902 vessels	MB IIB	5	0	2	7	100.0
Total		*260*	*64*	*669*	*993*	

Table 2. MNI Estimates by Locus for Sheep, Goat and Sheep/Goat and for Humans
(after Nagar, this volume; both side and age taken into account when calculating MNI)

Locus	Period	Sheep MNI	Goat MNI	Sheep/Goat MNI	Humans MNI
912	IBA	1		1	1
910	MB IIB	3		2	5
908–909	MB IIB	5	2	4	7
900–902	MB IIB	6	2	7	7
900 jug	MB IIB	1			
900 bowl	MB IIB	1		1	
Total		*17*	*4*	*15*	*20*

Table 3. Skeletal-Element Breakdown (NISP Counts)
by Species and Side for the Intermediate Bronze Age Pit 912

Skeletal Element	NISP in Complete Skeleton	Sheep NISP		Sheep/Goat NISP		Total NISP
		R	L	R	L	
Maxilla teeth	12				1	1
Mandible	2		1			1
Rib proximal	26				3	3
Pelvis acetabulum	2				1	1
Pelvis ilium	2			1		1
Tibia distal	2	1				1
Astragalus	2		1			1
Total	*48*	*1*	*2*	*1*	*5*	*9*

The faunal remains probably belong to the same animal (Table 2), identified as a young sheep aged 1–2 years (based on individual tooth-wear scores of '6' for M2, and '1' for M1; Payne Stage D). Skeletal elements represented are not derived from the same side of the skeleton, indicating that they were not in anatomical articulation when interred in the pit (Table 3). No modifications were observed on any of the bones.

Middle Bronze Age II

Faunal, human and other archaeological remains were concentrated in the center of the cave on top of an oval stone surface. Surrounding the stone surface were ceramic vessels, ornaments and human remains of c. 12 individuals together with animal bones. Along the cave margin more ceramic vessels, as well as remains of seven interred humans, were found comingled with animal bones.

Two MB IIB depositional layers were identified, with slightly more bones recovered from the lowermost level in L908–L909 and L910 (NISP = 549) than from the uppermost layer in L900–L902 (NISP = 435; Table 1).

Lowermost Level (L908–L909, L910)

A total of 461 animal remains were recovered from L908–L909 (Table 4) and 88 bones from L910 (Table 5).

In L908–L909, numerous small vessels and two daggers were recovered, as well as articulated human remains of at least seven individuals (Table 2; see Nagar, this volume). The MNI counts for ovicaprines was 11 (Table 2), slightly higher than the estimated number of human interments in this part of the cave.

In L910, the MNI estimate of interred humans is five (Table 2), which shows some concordance with the MNI count for animals for this locus, which is three sheep with a possible addition of two animals if the unidentified sheep/goat remains are included.

In the lowermost MB IIB layer, all skeletal elements are represented (see Tables 4, 5). When they are grouped by body part (Fig. 1) it is evident that hindlimb elements are the most frequent and that the number of foot bones is slightly augmented relative to the uppermost MB IIB level, where foot bones are poorly represented (L900–L902). However, when the % survivorship of the elements is calculated, taking into account the MNI estimates, it is evident that cranial and trunk elements are also markedly underrepresented here (Fig. 2).

Ageing based on bone fusion resembles the trend reported for the uppermost MB IIB level (Table 6; Fig. 3), with c. 20% of the animals culled by 2 years of age, followed by a drop to 50% by 3 years and a further drop to just over 30% by 3.5 years, indicating that only some 30% of animals represented in the assemblage had survived into adulthood. Tooth-wear data (Table 7) supports this trend, with the majority of animals aged 3 years or less: two animals aged c. 6–12 months of age (estimated Payne

Table 4. Skeletal-Element Breakdown (NISP Counts) by Species and Side for MB IIB L908–L909

Skeletal Element[i]	Sheep NISP (N = 97)			Goat NISP (N = 45)			Sheep/Goat NISP (N = 319)			Total NISP
	R	L	?	R	L	?	R	L	?	
Maxilla teeth								6	26	32
Mandible								1		1
Mandible teeth	11	2							24	37
Tooth fragments									8	8
Atlas			1			1				2
Vertebrae cervical									7	7
Vertebrae thoracic									18	18
Vertebrae lumbar									11	11
Vertebrae caudal									3	3

[i] prox. = proximal; dist. = distal; undet. = undetermined side

Table 4. (cont.)

Skeletal Element[i]	Sheep NISP (N = 97)			Goat NISP (N = 45)			Sheep/Goat NISP (N = 319)			Total NISP
	R	L	?	R	L	?	R	L	?	
Vertebrae undet.									6	6
Sacrum									2	2
Rib prox.							11	8		19
Rib shaft									33	33
Scapula glenoid	2	2			1		2	5		12
Humerus prox.							1	1	5	7
Humerus dist.	4	4								8
Radius prox.	3						3		1	7
Radius shaft	2						5	4		11
Radius dist.	4	2					3	2		11
Ulna prox.				1			5	4		10
Metacarpal whole		2		1	2					5
Metacarpal prox.	1	1					4			6
Metacarpal dist.		1	3		1	2		2	3	12
Pelvis acetabulum							7	7		14
Pubis							2	5		7
Pelvis ilium							3	2		5
Pelvis ischium							1	1		2
Femur whole							2	3		5
Femur prox.							1	1	5	7
Femur shaft								1	2	3
Femur dist.							4	3	5	12
Tibia prox.		1					2	4		7
Tibia shaft									2	2
Tibia dist.		3		2			2	1		8
Patella							2	2		4
Calcaneum	5	5			1		4	3		18
Astragalus	2	2		2	1		1	5		13
Navicullo-cuboid							2	1		3
Sesamoids									2	2
Tarsals									4	4
Metatarsal whole	1	1			1					3
Metatarsal dist.			6		2					8
Metatarsal shaft		2						1		3
Metatarsal prox.	2						2	4		8
1st phalanx			15			20			6	41
2nd phalanx			7			7				14
3rd phalanx										
Total	*37*	*28*	*32*	*6*	*9*	*30*	*69*	*77*	*173*	*461*

Table 5. Skeletal-Element Breakdown (NISP Counts) by Species and Side for MB IIB L910

Skeletal Element[i]	Sheep NISP (N = 61)		Sheep/Goat NISP (N = 27)			Total NISP
	R	L	R	L	No side	
Maxilla teeth			3			3
Mandible	3	2	1			6
Mandible teeth	3	3				6
Axis	1					1
Vertebrae cervical					2	2
Vertebrae thoracic					1	1
Vertebrae lumbar					1	1
Rib prox.					7	7
Rib shaft					2	2
Scapula glenoid				1		1
Humerus whole	1					1
Humerus prox.						0
Humerus dist.	1	2				3
Radius prox.		1		2		3
Radius dist.						0
Ulna prox.	1	2				3
Metacarpal whole	1					1
Metacarpal prox.	1					1
Metacarpal dist.	2	2				4
Pelvis ischium				1		1
Pelvis ilium	2		1			3
Femur whole	1					1
Tibia whole	2		1			3
Tibia prox.	2					2
Tibia shaft			2			2
Tibia dist.	1	1				2
Calcaneum	1		1			2
Astragalus	3	2				5
Navicullo-cuboid			1			1
Metatarsal prox.	1					1
1st phalanx	13					13
2nd phalanx	2					2
3rd phalanx	4					4
Total	*46*	*15*	*10*	*4*	*13*	*88*

[i] prox. = proximal; dist. = distal

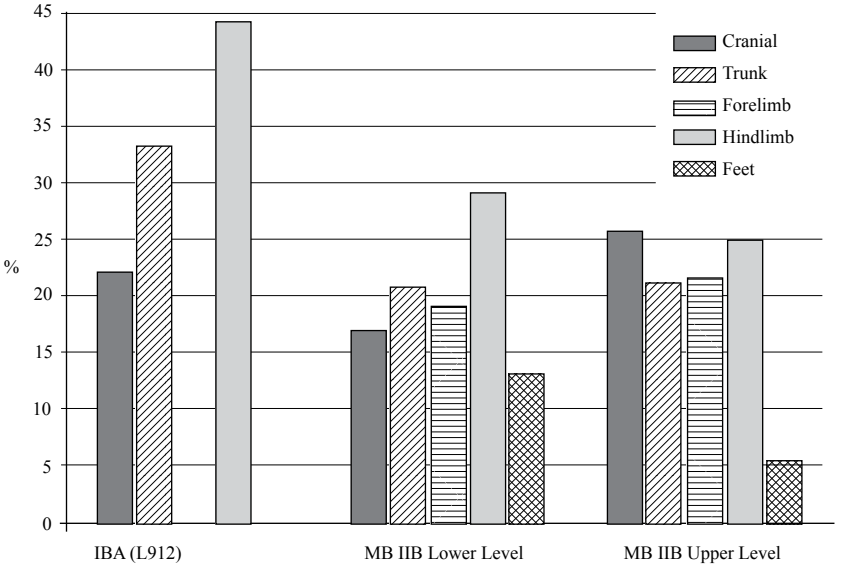

Fig. 1. Skeletal-element breakdown by body parts for the IBA and MB IIB samples.

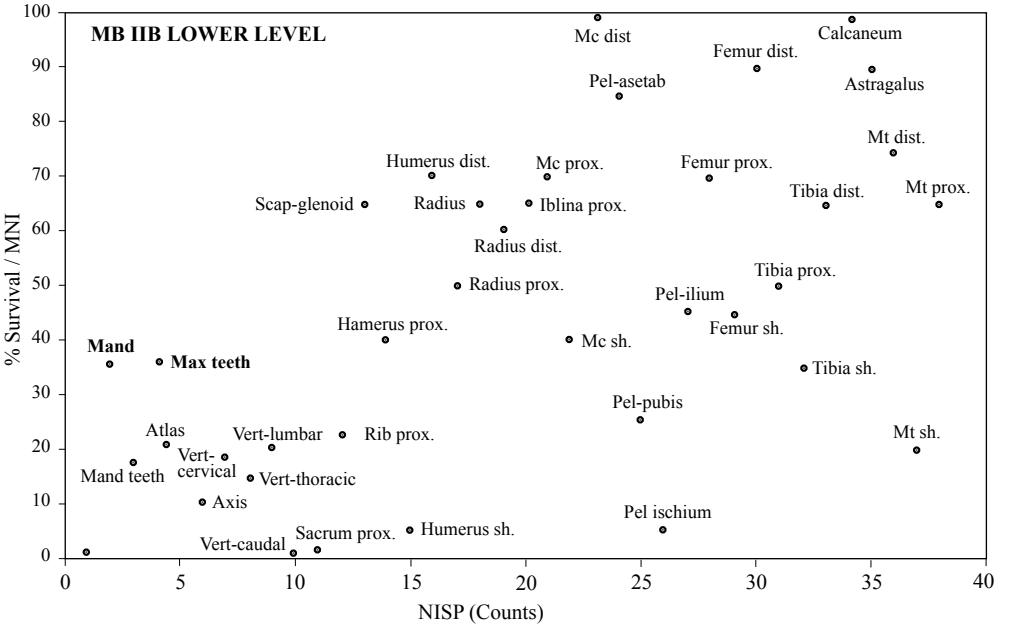

Fig. 2. NISP counts of skeletal elements against % Survival for the lower MB IIB level (L908, L909, L910) % Survival is calculated as: MNI × N in skeleton NISP count of each element.

Table 6. Bone Fusion (ages based on Silver 1969)

Date/Loci / Skeletal Element	IBA		MB IIB, Lower Level						MB IIB, Upper Level		
	L912 NISP		L910 NISP			L908–L909 NISP			L900–902 NISP		
	F	UF	F	UF	%F	F	UF	%F	F	UF	%F
0 to 12 Months											
Scapula glenoid						6			7		
Humerus dist.			3			8			16		
Radius prox.			1	1		9			10		
1st phalanx prox.			10	3		30	5		9	3	
2nd phalanx prox.			2						3		
NISP Total 0 to 12 Months			16	4	80.0	53	5	91.3	45	3	93.7
12 to 24 Months											
Tibia dist.	1		3	1		2	1		3	2	
Metacarpal prox.			2			15			1		
Metacarpal dist.			3	1			6		3	2	
Metatarsal dist.						8	5		3	1	
Metatarsal prox.			1			10			7		
NISP Total 12 to 24 Months	1		9	2	81.8	35	12	74.4	17	5	77.2
24 to 36 Months											
Ulna prox.			2	1		3	3		5	1	
Femur prox.				1		2	4		1	7	
Calcaneum			1	1		7	8		5	2	
NISP Total 24 to 36 Months			3	3	50.0	12	15	44.4	11	10	52.3
36 to 42 Months											
Humerus prox.				1			5			6	
Radius dist.						3	6		2	4	
Femur dist.				1		1	9			4	
Tibia prox.			3	1		5	4		8	5	
NISP Total 36 to 42 Months			3	3	50.0	9	24	27.2	10	19	34.4
NISP Total	*1*		*31*	*12*		*109*	*56*		*83*	*37*	

F = fused; UF = unfused

Stage C), two young adults aged c. 1–2 years (estimated Payne Stage D), and two jaws belonging to animals aged c. 2–3 years of age (estimated Payne Stage E). A further two jaws belong to slightly older animals aged 3–6 years of age (estimated Payne Stage F–G), but no animals over 6 years of age were represented.

In the lower MB IIB level, the majority of bones (N = 22) exhibiting butchery damage derive from L908 and L909, compared to only two bones from L910 (Table 8). In both assemblages, most marks are associated with primary butchery (dismemberment), such as cut marks on the medial aspect of two atlas

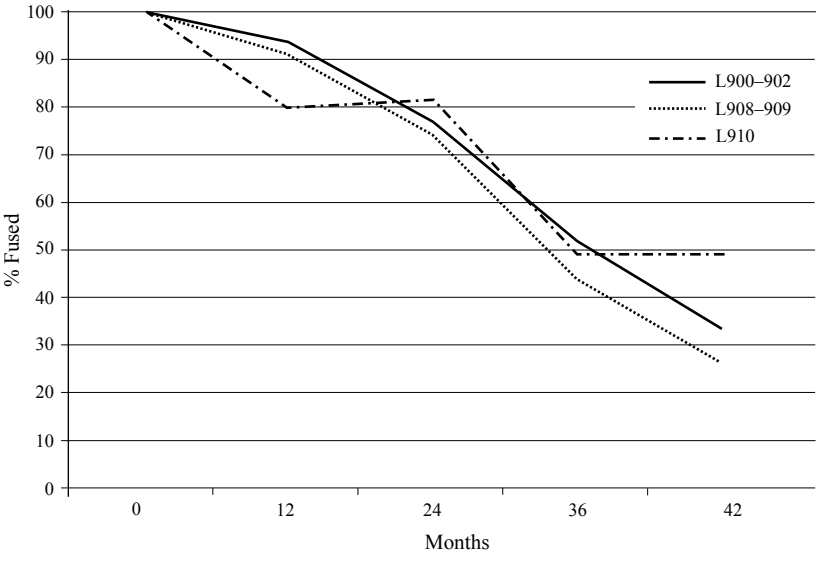

Fig. 3. Mortality pattern based on bone-fusion data.

Table 7. Individual Tooth-Wear Scores for Sheep/Goat Molars for MB IIB (includes both isolated molars and those in jaws; after Payne 1973:293)**; Numbers for Each Tooth = Quantity of Teeth with a Specific Attrition Score (1–9)**

Molar Teeth / Locus	Individual Tooth-Wear Scores	Left-Side Molars			Estimated Payne Stage (Age in Years)	Right-Side Molars			Estimated Payne Stage (Age in Years)
		M1	M2	M3		M1	M2	M3	
908–909, 910	1	4		1	C (0.5–1)		1	1	C (0.5–1)
	2							1	
	3			1	D (1–2)				
	4							1	D (1–2)
	5							1	E (2–3)
	6								
	7		1		E (2–3)				
	8	1	1		F–G (3–6)	2	1		F–G (3–6)
	9								
900–902	1		5	1	C (0.5–1)		1	1	C (0.5–1)
	2			1	D (1–2)	8			C (0.5–1)
	3	1		1	D (1–2)	1		1	D (1–2)
	4	1		1	D (1–2)		1		D (1–2)
	5			1	E (2–3)			1	E (2–3)
	6								
	7							1	E (2–3)
	8	4	1		F–G (3–6)	1	2	1	F–G (3–6)

Table 8. Butchery Marks by Locus, Species, Skeletal Element and Number
(associated activity: dismemberment = primary butchery; filleting = secondary butchery, following Binford 1981)

Locus	Species	Skeletal Element	Side	Butchery Location	Associated Activity
900–902	Sheep/goat	Rib proximal		1 chop mark behind anterior of rib, 2 cuts on inner surface beneath rib head	Dismemberment
900–902	Sheep/goat	Thoracic vertebral spine		1 angled cut on spine	Dismemberment
900-902	Sheep	Radius whole	Right	1 cut under proximal lip	Filleting
900–902	Goat	Radius whole	Right	1 cut under proximal lip	Filleting
900–902	Sheep	Radius proximal	Left	Multiple cuts under proximal lip	Filleting
908–909	Sheep	Atlas vertebra		2 small cuts on medial side	Dismemberment-cranium removal
908–909	Goat	Atlas vertebra		1 cut on medial aspect, 1 deep chop mark on central aspect	Dismemberment-cranium removal
908–909	Goat	Metacarpal shaft (uf dist)	Left	1 cut on proximal end, anterior aspect	Skinning
908–909	Goat	Metacarpal whole	Right	3 cuts on proximal end—anterior aspect of bone, 2 together and one alone	Skinning
908–909	Goat	Metacarpal whole	Left	1 cut on proximal end	Skinning
908–909	Sheep/goat	Humerus distal	Right	1 cut on medial side of trochlea and on basal aspect of epiphysis	Dismemberment
908–909	Sheep/goat	Pelvis-ilium	Right	2 short cuts on ventral aspect	Dismemberment
908–909	Sheep/goat	Pelvis-ilium	Right	2 short cuts on ventral aspect	Dismemberment
908–909	Sheep/goat	Navicullo-cuboid	Pair	Both are cut on process—3x and 2x respectively	Dismemberment
908–909	Goat	Astragalus	Right	1 cut at right angles to long axis of the bone across its anterior aspect, 1 cut on medial aspect of bone	Dismemberment
908–909	Sheep	Calcaneum	Left	3 longish, diagonal cuts on posterior aspect	Dismemberment
908–909	Goat	Calcaneum	Left	1 cut on posterior aspect	Dismemberment
908–909	Sheep/goat	Navicullo-cuboid	Left & right	Both are cut on proximal process—3x and 2x respectively	Dismemberment
908–909	Sheep/goat	Thoracic vertebra		1 long shallow cut on spine	Dismemberment
908–909	Sheep/goat	Thoracic vertebra		1 angled cut on side of spine	Dismemberment
908–909	Sheep/goat	Rib proximal		Shaft severed beneath proximal epiphysis; adjacent to the severed end is 1 sharp, short cut	Dismemberment
908–909	Sheep/goat	Rib proximal		3 short cuts at right angles to shaft below anterior end	Dismemberment
908–909	Sheep/goat	Proximal rib		Rib proximal epiphysis severed horizontal to the epiphysis	Dismemberment
908–909	Sheep/goat	Rib distal		Shaft severed at an angle	Dismemberment
908–909	Sheep	Radius proximal	Right	Multiple cuts under proximal lip	Filleting
908–909	Sheep	Radius proximal	Right	Multiple cuts under proximal lip	Filleting
908–909	Sheep	Radius proximal	Right	Multiple cuts under proximal lip	Filleting
910	Sheep/goat	Proximal rib		1 cut on proximal end towards head, 2 cut marks on shaft below anterior aspect	Dismemberment
910	Sheep/goat	Tibia proximal and shaft	Right	2 short cuts on mid-shaft, anterior aspect	Filleting

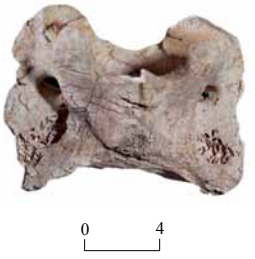

Fig. 4. Butchery marks associated with cranium removal on a sheep atlas vertebra.

Fig. 5. Skinning marks on a proximal metatarsal of a sheep.

Fig. 6. Butchery marks associated with carcass dismemberment on a sheep astragalus.

vertebrae produced by cranium removal (N = 2; Fig. 4), skinning on proximal metapodials (N = 3; Fig. 5) and modifications resulting from carcass dismemberment (N = 18; Fig. 6). A few marks represent secondary butchery involving filleting (N = 4). No burnt bones were found.

Two bones, a goat metacarpal and a sheep/goat tibia exhibit pathologies (Fig. 7). The metacarpal was distorted on the shaft toward the distal epiphysis due to a large exostosis (bony growth) that extends out from the medial edge of the shaft. The cause of this growth may have been trauma to the leg following a fall (Baker and Brothwell 1980), although the

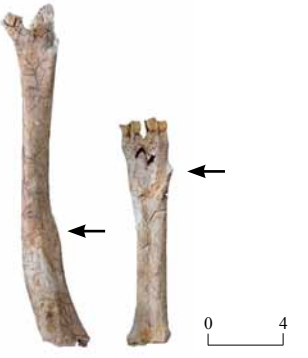

Fig. 7. Bone pathologies (shown by arrows): abscess on the distal shaft of a sheep/goat tibia (left); exostoses (bony growths) on the distal shaft of a goat metacarpal (right).

metacarpal had not been broken. The tibia lacked epiphyses and so could not be identified with certainty to species. Toward the distal end of this bone, the shaft is distorted and swollen, probably due to an abscess that was the result of a localized infection (Baker and Brothwell 1980). Although found in the same locus, the two bones do not necessarily derive from the same animal, as the aetiologies of the pathologies are probably unrelated.

Uppermost Level (L900–L902)

A total of 435 animal remains were recovered from this level (Table 9), of which 428 bones were scattered and comingled with human remains and ceramics (Table 9), while seven bones were found inside two intact vessels (Table 10).

Jug B9013 (Table 10; see Gershuny, this volume: Fig. 9:3).— This double-handled vessel was found lying horizontally in the deposit. The animal remains inside it were identified as a left jaw of a young adult sheep, c. 6–12 months old (Payne Stage C). A jaw of a rodent (the Palestine molerat, *Spalax ehrenbergi*), also found inside the jug, was deemed to be a recent intrusion.

Bowl B9015 (Table 10; see Gershuny, this volume: Fig. 4:2).— This bowl was found in

Table 9. Skeletal-Element Breakdown (NISP Counts) by Species and Side for MB IIB L900–L902: General Loci

Skeletal Element[i]	Sheep (N = 94)			Goat (N = 19)			Sheep/goat (N = 15)			Total
	R	L	?	R	L	?	R	L	?	
Horncore					1					1
Cranium							1	1		2
Maxilla teeth							15	4	13	32
Mandible	1	1			1		3	4		10
Mandible teeth	12	13		2			21	19		67
Axis									1	1
Vertebrae cervical processes									3	3
Vertebrae cervical									3	3
Thoracic spines									6	6
Vertebrae thoracic									4	4
Vertebrae lumbar processes									8	8
Vertebrae lumbar									12	12
Vertebrae undet.									1	1
Sacrum									1	1
Rib prox.							8	10	35	53
Rib shaft										
Sternum									1	1
Scapula blade frags.									9	9
Scapula glenoid	1	2			1		6	1	1	12
Humerus prox.							2	2		4
Humerus shaft								2	2	4
Humerus dist.	6	3					4	3		16
Radius prox.	6	5		2						13
Radius shaft	4	5								
Radius dist.	1							5	4	10
Ulna prox.	1			1			2	2		6
Metacarpal whole										
Metacarpal prox.				1			1	1	1	4
Metacarpal dist.						1			3	4
Pelvis acetabulum							5	2		7
Pubis							2	2		4
Pelvis ilium							1	6		7
Femur prox.							7	7	2	16
Femur whole										

[i] prox. = proximal; dist. = distal; undet. = side unknown

Table 9. (cont.)

Skeletal Element[i]	Sheep (N = 94)			Goat (N = 19)			Sheep/goat (N = 15)			Total
	R	L	?	R	L	?	R	L	?	
Femur shaft							2	1	1	4
Femur dist.										
Tibia prox.							7		4	11
Tibia whole					1					1
Tibia shaft									2	2
Tibia dist.							7		5	12
Calcaneum	3	2			1		2	4		12
Astragalus							2	7		9
Navicullo-cuboid	1	5		1	2			1	1	11
Metatarsal whole		1								1
Metatarsal dist.			2							2
Metatarsal shaft		1							1	2
Metatarsal prox.	4						1	1		6
1st phalanx			7			4			7	18
2nd phalanx			4							4
3rd phalanx			3							3
Total by side	*40*	*38*	*16*	*7*	*7*	*5*	*99*	*85*	*131*	*428*

Table 10. Skeletal-Element Breakdown (NISP Counts) by Species and Side for MB IIB L900–L902: Remains Inside Ceramic Vessels

Skeletal Element	Sheep		Sheep/goat	*Total*
	R	L	L	
Jug 9013				
Mandible		1		*1*
Bowl 9015				
Scapula glenoid	1			*1*
Humerus whole	1			*1*
Ulna proximal	1			*1*
Femur whole			1	*1*
Tibia distal			1	*1*
Calcaneum	1			*1*
Total	*4*	*1*	*2*	*7*

an upright position, containing six bones of a young sheep aged 1–2 years (according to bone-fusion stage). Based on the non-repetition of skeletal elements, their side and state of fusion, it seems most likely that the left and right limbs in this bowl belong to the same immature animal, and may have been articulated when placed in the bowl. The bones comprised an upper right forelimb (a scapula with fused distal end, a humerus with unfused proximal end, and an ulna with unfused proximal end), and a partial upper hindlimb (a left femur with unfused distal end, a tibia with unfused distal end and a calcaneum with unfused proximal end).

The majority of the remains (72.8% of bones in L900–L902) could not be identified to species and were placed in a combined sheep/goat category (see Table 1). Of the 118 bones that could be identified to species, the vast majority (83.8%) belonged to sheep. The MNI estimate for this locus, including finds inside vessels, was eight sheep, two goats and eight sheep/goat (see Table 2). When skeletal-element representation is examined for sheep and goats, taking into account non-repetition of bones by

side and part (see Table 9), it seems most likely that a total of ten animals are represented, with the sheep/goat body parts attributable to either the identified sheep or the goats. The MNI of interred people is estimated as seven (see Nagar, this volume), such that the estimated number of animals is minimally higher.

When the skeletal elements (see Table 9) are grouped by body part (see Fig. 1), it is evident that with the exception of foot bones, all categories are represented in relatively equal quantities. However, when the NISP counts for each bone are plotted against the survival % index, which takes into account the MNI estimate for this level (Fig. 8), it is clear that trunk and cranial elements are markedly under-represented and fore- and hindlimb elements are the most common, especially those of the upper hindlimbs. This pattern does not appear to be the result of diagenetic factors that favored the survival of more robust long bones over the more friable trunk and cranial bones, as teeth, which are present in the cranium and comprise the most robust element in the skeleton, are under-represented in the assemblage to the same degree as trunk and cranial elements (Fig. 8). This pattern demonstrates that there was intentional selection of meat-rich long-bone elements for use as grave offerings, with cranial, trunk and foot bones less favored or altogether excluded.

In L900–L902, based on the state of bone fusion, only a few sheep (<10%) were culled by 1 year of age (see Table 6; Fig. 3), and just under 20% by 2 years of age. However, by 3 years the cull increased, with half the sample having been culled by this age. Just over 30% of the sample survived into adulthood (>3.5 years). Unfortunately, no complete jaws were recovered, but based on scores of tooth-wear stages for mandibles with more than one molar present, plus isolated molars (see Table 7), it is evident that the overall pattern of dental attrition supports the trend for bone fusion. The majority of lower third molars (six M3s) are unerupted or show no wear (estimated Payne Stages C and D), while slight to medium wear (no posterior cusp wear, estimated Payne Stage E), indicative of young adults aged 2–3 years, is found on three M3s. Two jaws represent older animals aged c. 3–6 years (estimated Payne Stage F–G), but no animals over 6 years are represented.

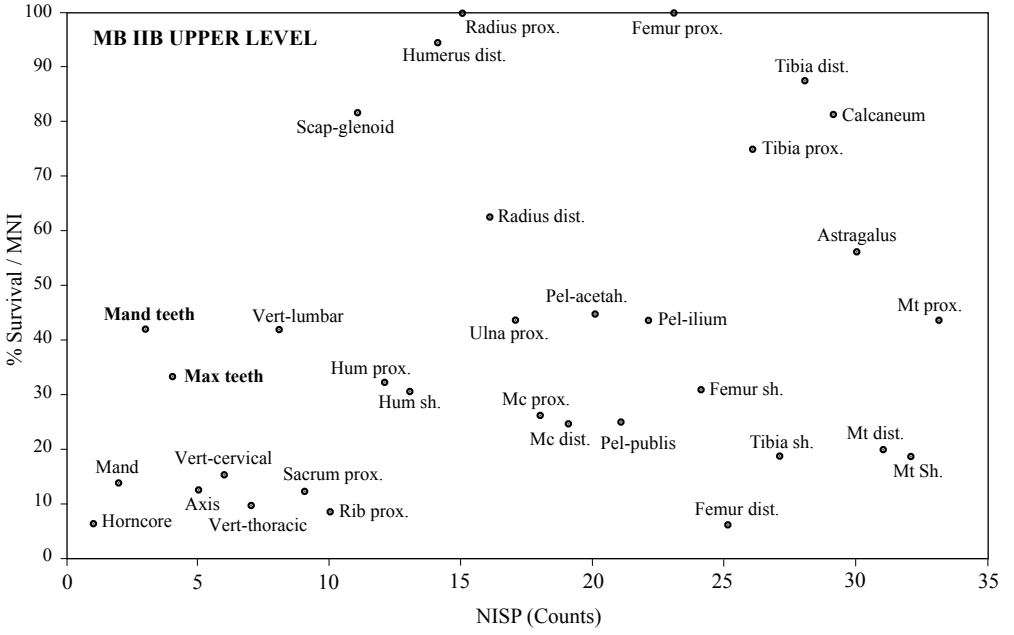

Fig. 8. NISP counts of skeletal elements for the upper MB IIB level (L900–902).

Table 11. Withers-Height Measurements (calculated using the coefficients proposed by Teichert [1975] for sheep, and Schramm [1967] for goats; bone length measurements taken from Appendix 1)

Skeletal Element	Sheep			Goat		
	Side	Bone Length (mm)	Withers Height (cm)	Side	Bone Length (mm)	Withers Height (cm)
Radius	R	150.3	60.4	-	-	-
Metacarpal	L	129.3	74.3	R	102.9	59.16
Metacarpal	L	124.4	60.8	-	-	-
Tibia	R	227.4	68.4	L	195.9	58.10
Calcaneum	R	54.3	61.9	L	52.3	59.60
Calcaneum	R	52.8	60.1	R	53.0	60.40
Calcaneum	L	56.3	64.1	L	53.9	61.40
Calcaneum	L	59.5	67.8	-	-	-
Calcaneum	R	58.9	67.1	-	-	-
Calcaneum	R	55.7	63.4	-	-	-
Calcaneum	R	57.6	65.6	-	-	-
Calcaneum	L	59.0	67.2	-	-	-
Calcaneum	L	57.6	65.6	-	-	-
Calcaneum	L	52.7	60.0	-	-	-
Metatarsal	L	139.1	63.2	R	91.7 (uf)	>48.96
Metatarsal	R	143.7	65.2	R	97.7 (uf)	>52.17
Metatarsal	L	138.9	63.1	-	-	-

Butchery marks were evident on five bones (see Table 8). Two bones display damage associated with primary carcass dismemberment, in this case of the trunk, while three bones exhibit butchery damage indicative of meat removal, or filleting.

Withers Height

Withers height (shoulder height) was calculated for both sheep and goats from the Cave 900 assemblage. For sheep, withers height ranged from 60 to 74.3 cm (Table 11). This compares well with data from MB II Tell Mardikh (Ebla, Syria), where withers-height estimates for sheep (based on astragali) were 61.0–74.3 cm (Minniti and Peyronel 2005). For modern Awassi sheep, withers-height ranges are given as 68–80 cm for rams and 58–67 cm for ewes (Epstein 1982). Using 68 cm—the lowest withers-height measurement for modern Awassi rams—as a standard for sexing the sheep, it may be understood that the Cave 900 assemblage was dominated by ewes, as most measured bones (15 out of a sample of 16) fall below this number. Alternately, this burial assemblage may represent a sheep breed that was considerably smaller than modern Awassi.

For goats, the withers-height range in Cave 900 is 58.1 to 61.4 cm. Modern Baladi goat rams in Sinai have an average withers height of 64.5 cm, while the larger Shammi goat rams have an average withers height of 75.8 cm (Helal 2009). The Cave 900 goats fall closer to the Baladi range, indicating the presence of a relatively small breed of goat or, as for the sheep, an assemblage comprised primarily of ewes.

DISCUSSION

The archaeozoological record indicates that the animal economy of most MB II sites in the Levant was based on domestic herd animals, sheep, goats, pigs and cattle, which served as the principal sources of meat, fat and skins. In addition, secondary products—milk, cheese and hair/wool—were obtained from sheep,

goats and cattle, the latter probably also exploited for traction and portage. Pigs, on the other hand, were kept for their meat, fat, sinews and skin. Ancillary sources of protein may have derived from other domestic taxa (equids and possibly dogs) that were kept and perhaps also consumed, together with a limited range of wild ungulates that were hunted (deer, gazelle), fish and wild birds (e.g., Hellwing and Gophna 1984; Wapnish and Hesse 1988; 1991; Horwitz and Milevski 2001; Horwitz et al. 2005; Minniti and Peyronel 2005; Sade 2006; Genz et al. 2010).

In contrast to the MB II settlements, including the adjacent site of Naḥal Refa'im (Horwitz 1998), only remains of domestic sheep (*Ovis aries*) and domestic goat (*Capra hircus*) were identified in the Cave 900 assemblage. The latter pattern is quite common in other contemporaneous burial caves (e.g., Horwitz 1997; 2014). MNI estimates (see Table 2) indicate that the Intermediate Bronze Age sample in Cave 900 was represented by a single sheep. For the MB IIB assemblages, when only the animals that can be identified as either sheep or goat are counted, the numbers are 16 sheep and 4 goats. If the undetermined sheep/goat remains are considered, a further 14 animals are added to the MB IIB assemblage. However, the lower MNI estimates, based only on identified numbers of sheep and goat, are probably more correct as shown by the detailed skeletal-element breakdowns that illustrate the non-repetition of skeletal elements in the different categories (see Tables 3–5, 9). Thus, remains of sheep were the most common (over 80%) of the ovicaprine remains identified to species in the MB IIB levels (NISP = 321) and represent the only species in the Intermediate Bronze Age assemblage (see Table 1). This fits with the patterning in most other Middle Bronze Age tomb assemblages from the Levant, with a predominance of sheep, suggesting preferential selection of this species for mortuary rituals (e.g., Horwitz 2001; 2007; 2010; 2014). While it is uncertain what factors determined which animals served as offerings in Middle Bronze Age tombs, common features of the mortuary faunal repertoire include a clear predominance of ovicaprines, irrespective of their precise Middle Bronze Age chronology, geography, or the ethnic identity of the communities (e.g., Grosvenor-Ellis and Westley 1965; Horwitz 1987; 1996; 1997; 2001; 2007; 2010; Zettler et al. 1996; Vila 2004a; 2004b; 2005). Evidently, the most readily available animal taxa, ovicaprines, were used in most mortuary rituals. Taxa other than ovicaprines (e.g., cattle, pig, deer, fish and even molluscs) are, however, documented in several Middle Bronze Age tombs in the Levant, from sites as geographically disparate as Sidon on the Lebanese coast and Efrat in the Hebron Hills (Horwitz 2001; Villa 2004a; 2004b; Villa and Chachoud 2006; Genz et al. 2010; Chahoud 2014–2015). Thus, it is evident that a broad range of animal offerings was considered acceptable in Middle Bronze Age mortuary rituals. However, it is noteworthy that even in burial sites located close to the sea (e.g., Sidon), sheep and goat remains predominate, rather than those of fish or molluscs, emphasizing the intentional selection of the former taxa. It is likely that both their availability and size (i.e., quantity of meat provided), played a role in determining their selection.

In two instances, animal bones were found inside ceramic vessels in Naḥal Refa'im Cave 900. However, none of the faunal remains were clearly articulated and most were comingled with those of humans, clearly attesting to their association with the interred. Indeed, the MNI count for identified sheep and goats (N = 21, excluding sheep/goat) tallies with the minimum number of people identified in the tomb as a whole (MNI = 20), and by locus (see Table 2). This accords well with the idea that each person was buried with remains derived from one animal.

No burnt bones were recorded in Cave 900, but butchery marks were documented on 29 bones (2.9%) of the total identified assemblage (Fig. 9). The majority of butchery damage identified in the tomb assemblage relates to primary

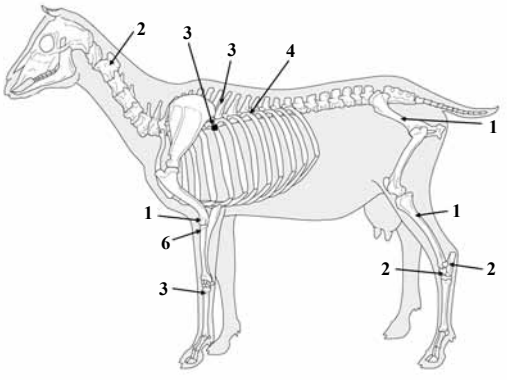

Fig. 9. Location of butchery marks on skeleton (numbers represent the quantity of bones with butchery damage).

butchery, involving skeletal dismemberment and disarticulation, including cranium removal. Fewer marks were associated with secondary butchery (filleting), which represents a further partitioning of the skeleton for cooking and consumption (see Table 8). Clearly, the carcass parts interred in the tomb derive from whole animals that were slaughtered.

When differences in skeletal-element representation are examined, taking into account variations in bone-mineral density (see Figs. 2, 9), meat-rich carcass parts (long bones) predominate in the Middle Bronze Age levels, while those poorer in meat, such as the cranium and foot bones—elements that are frequently discarded after primary butchery (Binford 1981; Hellwing and Gophna 1984; Reitz and Wing 2008)—were under-represented in the burial cave. Given the robusticity and greater potential survivorship of tooth enamel and phalanges, these body parts were clearly not preferentially selected as grave offerings. In contrast, the low frequencies of trunk elements (vertebrae and ribs) may reflect their poorer status of preservation relative to limb bones, rather than human selection.

Based on both bone fusion and dental attrition data, it is evident that young animals were preferred (see Fig. 3; Table 7), while selection of meat-rich skeletal elements is attested—long bones, especially of the upper hindlimbs (see Fig. 1). Carcass parts poor in meat, such as the cranium and foot bones that are frequently discarded after primary butchery (Binford 1981; Hellwing and Gophna 1984; Reitz and Wing 2008), were under-represented in the burial cave and clearly not preferentially selected as grave offerings. A possible preference for ewes, tentatively supported by withers-height measurements, finds additional support in other MB II tomb assemblages such as Jericho, Jebel Qa‘aqir and Yoqne‘am (Horwitz 2001; 2014).

Animal sacrifice appears to have been an integral part of Middle Bronze Age mortuary rites and was a widespread practice in the Levant. Confirmation of the regular occurrence of ritual sacrifice in this region during MB II may be found in the fragment of a cuneiform tablet from Tell Rumeida (Hebron) that concerns 67 sheep and 46 ‘he-goats’, which was interpreted by the epigraphers Anbar and Na’aman (1986–1987) as an account tablet listing sacrificial animals collected as taxes. Moreover, animal sacrifice (along with offerings of cereals and fruit) is attested in Middle Bronze Age temples, as at Tell al-Hayyat (Jordan), Tel Haror and Nahariya (e.g., Dothan 1981; Falconer and Magness-Gardiner 1989; Magness-Gardiner and Falconer 1994; Klenck 2002).

As discussed by researchers (e.g., Helwing 2003; Pollock 2003; Zuckerman 2007; Polcaro 2010), food and drink played an important symbolic and ideological role in past Near Eastern societies—not only what was eaten and drunk, but how it was prepared, served and in what context it was consumed. Funerary feasts involving the sharing and offering of meat from an animal from which portions had been interred with the deceased, or the interment of a complete animal that had been intentionally sacrificed as part of the mortuary ritual, no doubt served an important role in ensuring social cohesion, identification and continuity, by honoring the deceased, the gods and the participants. The Cave 900 assemblage provides additional evidence for the widespread nature of this custom in both the Intermediate Bronze Age and Middle Bronze Age IIB.

APPENDIX 1. BONE MEASUREMENTS[i]

	Period	Side	Measurements							
(a) Sheep										
Scapula			*GLP*	*BG*	*SLC*					
L900–L902	MB IIB	R	26.9	16.8	-					
L900–L902	MB IIB	L	30.8	19.5	17.8					
L900–L902	MB IIB	R	29.6	20.7	17.3					
L908–L909	MB IIB	L	-	-	17.9					
L908–L909	MB IIB	R	35.0	21.9	20					
Humerus			*Bd*	*BT*	*HT*					
L900–L902	MB IIB	R	26.7	24.7	12.9					
L900–L902	MB IIB	L	31.7	30.7	13.1					
L900–L902	MB IIB	R	30.3	28.9	14.2					
L908–L909	MB IIB	R	29.5	28.8	13.7					
L908–L909	MB IIB	R	30.0	29.6	14.1					
L908–L909	MB IIB	L	-	26.5	11.6					
L908–L909	MB IIB	L	31.5	30.5	15.8					
L908–L909	MB IIB	L	33.0	32.8	15.7					
L908–L909	MB IIB	L	31.7	30.8	14.8					
L910	MB IIB	L	31.0	28.9	13.9					
L910	MB IIB	L	32.8	31.4	15.6					
L910	MB IIB	R	32.8	-	-					
L910	MB IIB	R	31.4	28.7	13.8					
L910	MB IIB	L	32.0	31.0	14.1					
L910	MB IIB	L	29.3	28.9	13.8					
L910	MB IIB	L	28.8	28.2	14					
L910	MB IIB	R	26.8	26.2	12.5					
L910	MB IIB	R	26.9	26.4	12.5					
L910	MB IIB	R	32.7	29.4	14.1					
L910	MB IIB	R	31.7	30.8	-					
L910	MB IIB	R	-	31.5	15.4					
L910	MB IIB	R	31.0	29.1	13.5					
Radius			*GL*	*Bp*	*Dp*					
L900–L902	MB IIB	L	-	31.8	15.8					
L900–L902	MB IIB	L	-	30.4	15.3					
L900–L902	MB IIB	L	-	25.4	13.4					
L900–L902	MB IIB	L	-	32.7	15.6					
L900–L902	MB IIB	R	150.3	32.6	15.8					
L900–L902	MB IIB	R	-	25.6	13.6					

[i]All measurements are in mm and follow definitions given in von den Driesch (1976), with the following exceptions:
Davis (1985: Fig. 29): (1) HT = distal humerus trochlea height (Davis 1985 measurement); (2) HDW = metacarpal and metatarsal width of distal condyle (Davis 1985 measurement; (3) SC and LC = metacarpal and metatarsal small and large distal condyle diameter or height (Davis measurements 4 and 2 respectively).
This study: Dd = greatest depth taken at right angles to Bd; Dp = greatest depth taken at right angles to Bp; CAW = length of the distal portion of the calcaneum taken from the distal tip to the top of the articulation.
Boessneck, Müller and Teichert (1964): Condylar Index.

APPENDIX 1. (cont.)

	Period	Side	Measurements							
L900–L902	MB IIB	R	-	32.3	15.6					
L900–L902	MB IIB	R	-	33.5	19.2					
L908–L909	MB IIB	R	-	28.2	15.1					
L908–L909	MB IIB	R		32.0	16.3					
L908–L909	MB IIB	R	-	30.4	15.2					
L908–L909	MB IIB	R	-	32.2	17.1					
L908–L909	MB IIB	R	-	30.7	15.5					
L910	MB IIB	L	-	32.1	16.8					
Metacarpal			*GL*	*Bp*	*Dp*	*Bd*	*HDW*	*SC*	*LC*	*Condylar Index*
L908–L909 (pathological)	MB IIB	L	129.3	-	-	26.2	-	-	-	-
L908–L909	MB IIB	L	124.4	20.7	15.6	23.4	10.3	10.6	13.8	76.8
L908–L909	MB IIB					25.4	11.6	12.0	16.9	71.0
L908–L909	MB IIB					26.6	11.3	11.0	15.6	70.5
L908–L909	MB IIB						10.4	9.6	15.1	63.5
L908–L909	MB IIB	-	-	-	-	-	11.0	11.4	15.4	74.0
L908–L909	MB IIB	-	-	-	-	-	9.3	10.6	13.9	76.2
L910	MB IIB	-	-	-	-	-	12.0	11.8	18.0	65.0
L910	MB II	-	-	-	-	-	11.5	11.7	16.7	70.0
Tibia			*GL*	*SD*	*Bd*	*Dd*				
L900–L902	MB IIB	R	-	-	27.9	21.4				
L900–L902	MB IIB	R	-	-	23.6	19.1				
L900–L902	MB IIB	R	-	-	25.5	20.4				
L900–L902	MB IIB	R	-	-	24.1	19.4				
L908–L909	MB IIB	L	-	13.4	24.6	20.3				
L908–L909	MB IIB	L	-	-	24.3	19.5				
L908–L909	MB IIB	L	-	14.1	26.5	19.9				
L908–L909	MB IIB	L	-	-	28.0	22.6				
L910	MB IIB	R	227.4	15.2	25.8	21.0				
L910	MB IIB	R	-	-	25.2	20.8				
L910	MB IIB	L	-	-	26.2	21.2				
L912	IB	R	-		23.9	17.6				
Patella			*GL*	*GB*						
L908–L909	MB IIB	L	30.7	22.7						
L908–L909	MB IIB	L	26.8	18.5						
L908–L909	MB IIB	R	27.5	18.8						
L908–L909	MB IIB	R	-	19.4						
Navicullo–cuboid (Os centro tarsale)			*GB*	*Dd*						
L900–L902	MB IIB	L	25.4	20.6						

APPENDIX 1. (cont.)

	Period	Side	Measurements							
L908–L909	MB IIB	L	22.0	17.8						
L908–L909	MB IIB	R	22.4	18.0						
Astragalus			*GLl*	*Bd*	*Dl*					
L900–L902	MB IIB	L	27.5	18.8	15.5					
L900–L902 (juv)	MB IIB	R	26.0	16.7	14.8					
L900–L902	MB IIB	R	28.9	19.7	15.3					
L900–L902	MB IIB	R	29.5	17.4	16.3					
L900–L902	MB IIB	R	27.7	18.2	15.5					
L900–L902	MB IIB	R	-	18.4	-					
L908–L909	MB IIB	R	31.0	18.9	16.4					
L908–L909	MB IIB	R	27.0	17.9	14.7					
L908–L909	MB IIB	R	28.8	18.1	16.1					
L908–L909	MB IIB	R	29.5	18.8	15.9					
L908–L909	MB IIB	R	31.3	19.7	17.3					
L908–L909	MB IIB	L	31.3	19.8	17.3					
L908–L909	MB IIB	L	31.2	20.2	17.1					
L910	MB IIB	L	26.8	18.0	13.6					
L910	MB IIB	L	28.9	18.4	15.1					
L910	MB IIB	R	27.9	-	16.2					
L910	MB IIB	R	26.7	16.8	14.3					
L910	MB IIB	R	28.2	17.5	14.9					
L912 (juv)	IB	L	25.8	17.5	14.8					
Calcaneum			*GL*	*CAW*						
L900–L902	MB IIB	R	54.3	22.5						
L900–L902	MB IIB	R	52.8	22.3						
L900–L902	MB IIB	L	56.3	22.5						
L900–L902	MB IIB	L	59.5	23.3						
L908–L909	MB IIB	R	58.9	23.9						
L908–L909	MB IIB	R	55.7	22.5						
L908–L909	MB IIB	R	57.6	23.4						
L908–L909	MB IIB	L	59.0	24.0						
L908–L909	MB IIB	L	57.6	22.9						
L908–L909	MB IIB	L	52.7	21.4						
Metatarsal			*GL*	*Bp*	*Dp*	*Bd*	*HDW*	*SC*	*LC*	*Condylar Index*
L900–L902	MB IIB	L	139.1	21.7	20.7	24.0	11.1	10.5	15.9	66.0
L900–L902	MB IIB		-	-	-	24.3	11.4	10.8	16.6	65.0
L900–L902	MB IIB		-	-	-	-	11.0	10.6	15.6	67.9
L908–L909	MB IIB	R	143.7	20.2	20.0	23.7	11.2	11.3	16.0	70.6
L908–L909	MB IIB	L	138.9	19.8	20.3	24.2	11.2	11.1	16.6	66.8
L908–L909	MB IIB		-	-	-	24.1	11.0	9.7	14.2	68.3

APPENDIX 1. (cont.)

	Period	Side	Measurements							
L908–L909	MB IIB		-	-	-	24.4	10.8	11.2	15.5	72.2
L908–L909	MB IIB		-	-	-	25.5	11.6	11.1	15.9	69.8
L908–L909	MB IIB		-	-	-	24.8	11.6	11.5	16.5	69.6
L908–L909	MB IIB		-	-	-	24.0	10.4	9.8	15.1	64.9
1st Phalanx			*GLpe*	*Bd*						
L900–L902 (fusing)	MB IIB		34.2	10.7						
L900–L902 (fusing)	MB IIB		34.7	11.0						
L900–L902	MB IIB		36.4	11.8						
L900–L902	MB IIB		37.0	12.2						
L900	MB IIB		36.6	12.1						
L900	MB IIB		37.1	12.3						
L900–L902	MB IIB		36.2	10.8						
L908–L909	MB IIB		37.2	11.9						
L908–L909	MB IIB		37.8	10.9						
L908–L909	MB IIB		36.8	10.6						
L908–L909	MB IIB		36.7	10.9						
L908–L909	MB IIB		35.0	11.0						
L908–L909	MB IIB		36.6	11.4						
L908–L909	MB IIB		36.6	10.8						
L908–L909	MB IIB		32.4	10.4						
L908–L909	MB IIB		35.5	11.8						
L908–L909	MB IIB		33.1	10.3						
L908–L909	MB IIB		32.7	10.5						
L908–L909	MB IIB		36.9	10.8						
L908–L909	MB IIB		32.6	10.2						
L908–L909	MB IIB		34.6	10.5						
L908–L909	MB IIB		35.8	11.0						
L910	MB IIB		35.0	11.3						
L910	MB IIB		35.0	10.9						
L910	MB IIB		36.2	10.7						
L910	MB IIB		35.7	11.8						
L910	MB IIB		37.1	11.9						
L910	MB IIB		34.6	10.4						
L910	MB IIB		36.6	11.3						
L910	MB IIB		37.6	12.4						
2nd Phalanx			*GLpe*	*Bd*						
L900–L902	MB IIB		20.9	9.6						
L900–L902	MB IIB		22.3	9.7						
L900–L902	MB IIB		21.2	9.7						
L908–L909	MB IIB		23.0	11.0						

APPENDIX 1. (cont.)

	Period	Side	Measurements							
L908–L909	MB IIB		22.3	11.1						
L908–L909	MB IIB		24.9	10.5						
L908–L909	MB IIB		22.7	10.0						
L908–L909	MB IIB		23.5	11.1						
L908–L909	MB IIB		21.8	10.5						
L908–L909	MB IIB		23.5	11.1						
L910	MB IIB		21.1	11.1						
L910	MB IIB		20.9	10.8						
3rd Phalanx			*Lad*							
L900–L902	MB IIB		33.3							
L900–L902	MB IIB		29.8							
L900–L902	MB IIB		26.8							
L910	MB IIB		34.1							
L910	MB IIB		29.9							
L910	MB IIB		29.0							
L910	MB IIB		30.9							
(b) Goat										
Scapula			*GLP*	*BG*	*SLC*					
L900–L902	MB IIB	L	32.1	20.5	19.3					
L908–L909	MB IIB	L	–	20.5	19.8					
L908–L909	MB IIB	L	29.2	20.8	17.4					
Radius			*Bp*	*Dp*						
L900–L902	MB IIB	R	31.7	15.7						
L900–L902	MB IIB	R	32.1	16.0						
Metacarpal			*GL*	*Bd*	*HDW*	*SC*	*LC*	*Condylar Index*		
L900–L902	MB IIB		–	–	12.3	9.4	16.1	58.3		
L900–L902	MB IIB		–	–	12.5	10.3	16.5	62.4		
L908–L909	MB IIB		–	–	11.5	9.6	16.1	59.6		
L908–L909	MB IIB		–	–	11.2	9.1	15.8	57.5		
L908–L909	MB IIB	R	102.9	26.6	11.8	9.6	15.9	60.3		
Tibia			*GL*	*SD*	*Bd*	*Dd*				
L900–L902	MB IIB	L	195.9	13.1	26.6	19.2				
L900–L902	MB IIB	R	–	–	26.6	19.3				
L908–L909	MB IIB	R	–	13.1	26.1	20.1				
L908–L909	MB IIB	R	–	–	27.5	21.2				
Astragalus			*GLl*	*Bd*	*Dl*					
L900–L902	MB IIB	R	28.9	18.5	15.5					
L900–L902	MB IIB	L	26.6	17.8	14.5					
L900–L902	MB IIB	L	26.1	17.4	14.0					
L908–L909	MB IIB	R	29.3	19.0	15.5					
L908–L909	MB IIB	R	27.4	17.5	14.6					
L908–L909	MB IIB	L	27.6	17.3	15.5					

APPENDIX 1. (cont.)

	Period	Side	Measurements							
Calcaneum			*GL*	*CAW*						
L900–L902	MB IIB	L	52.3	20.8						
L900–L902	MB IIB	R	53.0	20.9						
L908–L909	MB IIB	L	53.9	20.6						
Metatarsal			*GL*	*SD*						
L908–L909 (unfused)	MB IIB	R	91.7	10.6						
L908–L909 (unfused)	MB IIB	R	97.7	12.0						
1st Phalanx			*GLpe*	*Bd*						
L900–L902	MB IIB		36.6	12.5						
L900–L902	MB IIB		36.8	12.6						
L900–L902	MB IIB		35.9	12.4						
L900–L902	MB IIB		35.6	12.6						
L908–L909	MB IIB		36.1	12.7						
L908–L909	MB IIB		35.7	12.9						
L908–L909	MB IIB		37.2	12.5						
L908–L909	MB IIB		38.1	12.8						
L908–L909	MB IIB		35.3	12.3						
L908–L909	MB IIB		33.3	11.4						
L908–L909	MB IIB		34.6	12.6						
L908–L909	MB IIB		36.5	12.8						
L908–L909	MB IIB		34.7	11.0						
L908–L909	MB IIB		36.4	12.8						
L908–L909	MB IIB		36.9	12.3						
L908–L909	MB IIB		34.1	11.3						
L908–L909	MB IIB		36.1	13.1						
L908–L909	MB IIB		33.4	10.5						
2nd Phalanx			*GLpe*	*Bd*						
L908–L909	MB IIB		23.1	9.0						
L908–L909	MB IIB		22.8	9.3						
L908–L909	MB IIB		23.4	9.6						
L908–L909	MB IIB		22.3	8.4						
L908–L909	MB IIB		23.1	9.8						
L908–L909	MB IIB		19.2	8.4						
L908–L909	MB IIB		19.3	8.2						

NOTE

[1] The terminology and chronology used in this article are: Intermediate Bronze Age = EB IV/MB I (2200–2000 BCE; *NEAEHL*), Middle Bronze Age = MB IIB (1750–1550 BCE; *NEAEHL*).

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