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The dogs from Kerma (Sudan) 2700 to 1500 BC

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Summary

Excavations in northern Sudan have shed significant new light on the particular functions of dogs in the Kerma culture, not only during their life-time, but also in death rituals. Dog skeletons were found in graves, dated from about 2700 to 1500 BC. They were presumably buried as pets, as companions of the deceased, or as shepherd dogs. From a morphological point of view, the Kerma dogs represent a population of remarkable uniformity in size with elongated skulls and relatively slender limb bones.

Keywords: Sudan, Kerma culture, Dogs, Burial rituals, Morphometric analyses.

Introduction

The site of Kerma is located in northern Sudan, a few kilometres south of the third Cataract on the right bank of the river Nile. During many years of research, a mission from Geneva University has carried out excavations in this large archaeological complex. The site was occupied at periods which extend from the Eneolithic to the Christian era. The architecture and other occupational structures provide an insight into the foundation phase of this town at about 2500 BC. Soon afterwards it became the capital of the Kush kingdom. Buildings of different kind were erected around a magnificent temple, constructed of raw bricks. Since centuries this exorbitant monument, named the "Deffufa", attracted and still attracts the attention of travellers. The American archaeologist G. Reisner (1923) believed this large building to represent the remains of an Egyptian fortress. However, the Geneva mission's research reached different conclusions. The latter are based on the particular character of the buildings that surround the palace. Constructions including a large meeting hut clearly indicate an African origin – the same holds true, of course, for the central monument (Bonnet 1996).

In addition to the excavations in the ancient town, the Geneva University Mission carried out diggings in the area of a large necropolis located some 3 km to the East. The horizontal stratigraphy of the necropolis is characterised by a progressive North to South positioning of burials, exhibiting a considerable number of exceptionally well-preserved tombs. Their complete analyses surely will enlarge our knowledge and understanding of the complex funeral rituals which were enacted at that time and practised by the people of the Kerma civilisation. The Kerma cultural sequence can be divided into three phases. The earliest one or Ancient Kerma is assigned to the time period of 2500-2050 BC, the Middle Kerma to 2050-1750 BC, and the Classical Kerma to 1700-1500 BC. At the end of the final period, the city was destroyed by warriors of Egyptian Pharaohs from the 18th dynasty.

Over several years, studies on the subsistence economy of the Kerma civilisation have been accomplished. People lived sedentarily, cultivated cereals (barley and probably wheat), and practised the breeding of cattle and small livestock. From the ancient town a large amount of bone refuse has been unearthed, indicating that domestic animals constituted more than 90 % of the meat resources, while hunting did play a minor role (Chaix 1993). Goats and sheep were well represented in the faunal spectrum. They make up more than 45 % of the livestock. The second most frequently encountered domestic species were cattle, coming up to 34 % of the total. They probably were the main source of protein. These cattle were extremely large (up to 1.5 m withers height). On average, they must have weighed about 500 kg (Chaix 1994). Donkeys were also included in the economy of the site. Their meat seemed to have been consumed, because the bones display butchering marks.

Within the boundaries of the town as well as in the necropolis, also dog remains were found in smaller numbers (table 1). Most probably, these animals were kept by the inhabitants as shepherd dogs or as pets and companions. Their presence in graves, or in other words their role in an after-life con-

cept is also documented, not only from Sudanese but also from Egyptian funeral records. This custom seems to emerge during the Neolithic, as can be deduced from finds at the sites of El Kadada in central Sudan and Kadruka in northern Sudan (Gautier 1986; Bonnet et al. 1989; Chaix forthcoming). Inside the tombs, dating from the end of Ancient to the Middle Kerma, a single dog or several individuals were found, laying next to completely preserved sheep and goat skeletons. Some of the dogs were even deposited at the feet of the deceased.

The dogs in the graves

Most obviously dogs had a particular function as companions of men and women, even beyond their death. This is for example illustrated by tomb 67 (fig. 1), where a male dog was deposited on his right side with the head to the East and buried near the feet of an adult woman. In another grave of an adult man, the dog was found rolled up in a ball at the foot of the bed - a most typical picture. Other inhumations, e.g. in tomb 238 (fig. 2), reveal dogs which apparently were acting as shepherd dogs: The animals were placed at the head of a small flock of caprines. These dogs were buried on their right sides too, though their bodies were not crouched, but deposited in a walking position.

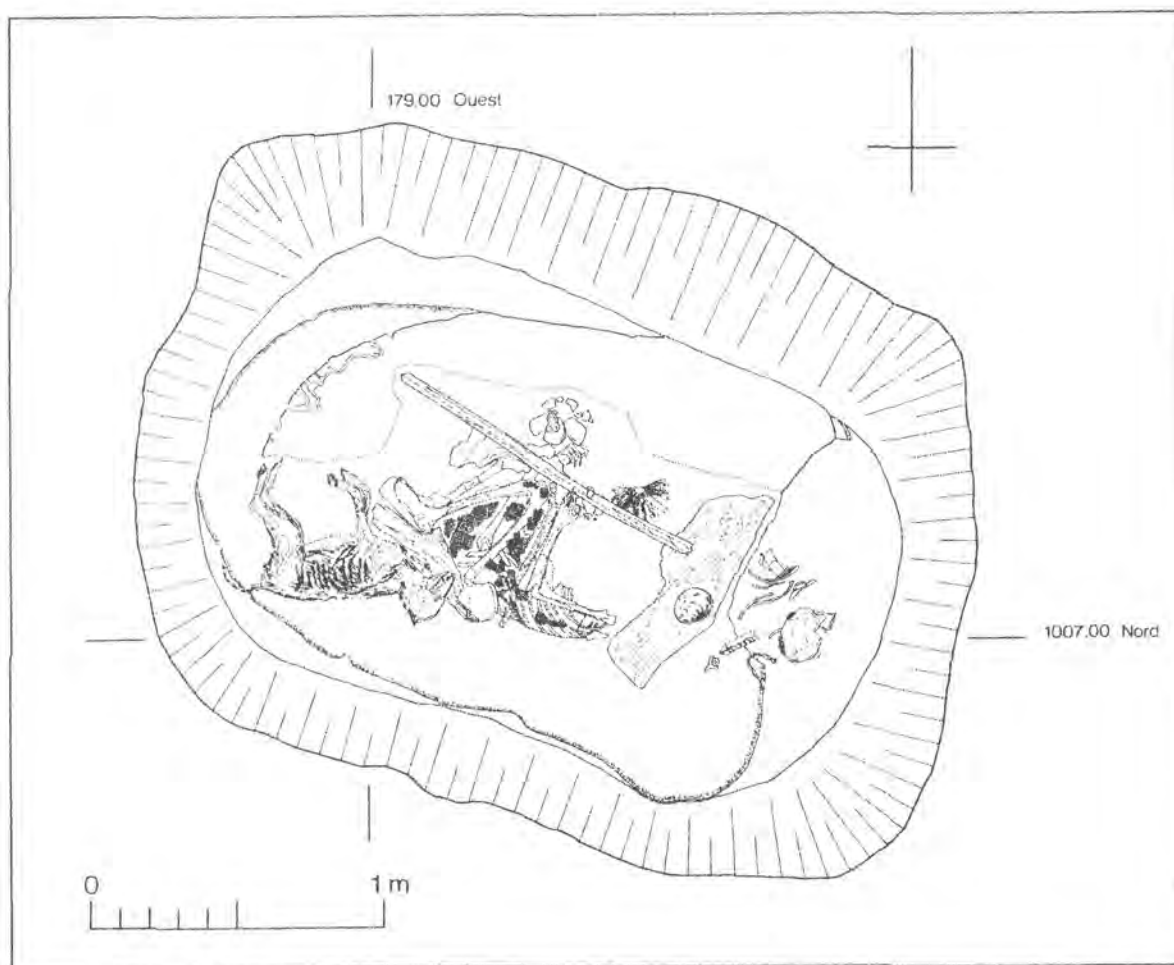


Fig. 1 Dog buried with an adult woman. Kerma, eastern cemetery, grave no. 67 (Drawing: B. Privati).

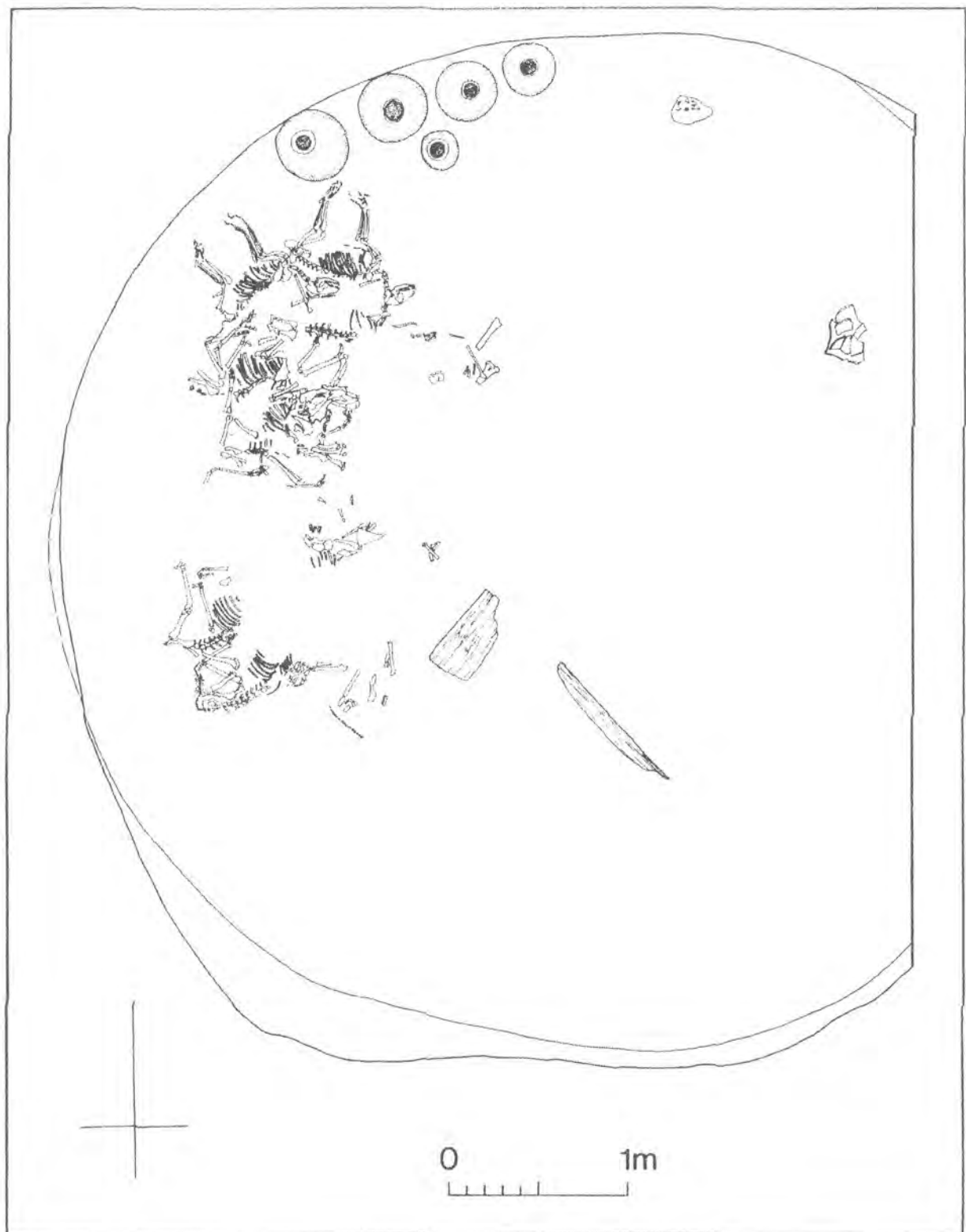


Fig. 2 Dogs deposited in front of an assemblage of caprines. Kerma, eastern cemetery, grave no. 238 (Drawing: M. Berti).

In most cases, dogs as well as caprines did not show any traces of slaughtering. However, two exceptions have to be mentioned. In tomb 67, the animal was strangled with a leather string, and in tomb 133, cutting marks due to decapitation were present on the first cervical vertebra of this particular skeleton. In some cases, the last meal of the dogs could be identified, thanks to the excellent conditions of preservation. These dogs evidently had eaten very young lambs *in toto*, the food remains being preserved in every state of digestion (Payne & Munson 1985). The examination of the digestive system of other dogs also revealed the consumption of a complete autopodium of a subadult sheep. The latter showed butchering marks which indicate a previous consumption or at least a carcassing by man. In addition, two still recognisable stomachs of dogs contained vertebrae of large Nilotic fish.

The remarkable good preservation in a number of graves led to the discovery of some pieces of dogs' fur. Most likely the dogs were solidly coloured, ranging from light brown to white. Such a shading is very characteristic, making up the dominant colouring of more than 95 % of present-day dogs in the Kerma region and all over northern Sudan. Cases which indicate that the dogs carried long tails with a typical right-oriented incurvation are extremely seldom, but evidenced too.

Up to now, 250 graves have been unearthed during the excavations which started in 1977. That is only a tiny section of an approximate total of 35 000. The graves already analysed and attributed to the Middle Kerma period have produced a total of 236 sheep, 14 goats, and 22 dogs. In most cases, the dogs were completely preserved, so we were able to analyse their morphological and osteometrical features in detail.

The determination of the animals' age at death was carried out using all the "classical" criteria (Habermehl 1975). This method includes both tooth eruption and dental wear as well as the fusion of epiphyseal sutures in long bones. Those criteria which are relevant for the wear of the incisors have been used with great caution, because the semi-desert environment around Kerma implies pronounced tooth wear. In spite of this restriction, the age of death for 22 dogs could be ascertained (table 1). Twenty-one dogs were of adult age, which varied between 2 and 10 years. Only one dog died at a younger age (between 8 and 9 months).

Determination of sex was carried out by assessing the presence or absence of the penis bone. It has to be stressed, that the absence of this characteristic element may not always be indicative for a particular sex, due to post-depositional disturbances or destructions of the graves. Because of this, the sex of eight individuals could not be established. Among the sheep which were also deposited in the graves, young males of less than two years largely predominate (Chaix & Grant 1987). This contrasts to the dog skeletons, which belong to both male and female specimens, although males seem to be somewhat more numerous.

The metrical and morphological analyses focus on skulls (table 2), mandibles (table 4), and the main long bones (humerus, radius, ulna, femur and tibia; tables 5-9). Measurements taken are those recommended by A. von den Driesch (1976), but only the most useful ones are given here. A few extra parameters were added, such as the orbital angle (Ducos 1971). In addition, measurements of skeletal elements of dogs from different prehistoric Egyptian sites (Lortet & Gaillard 1903; Ducos 1971; Boessneck 1975; 198; Chaix & Olive 1986; Churcher 1993) and from the osteological collection of Sudanese dogs, stored in the Natural History Museum at Geneva, were compared with the Kerma material. Ducos (1971) has pointed out that, although domestic dogs differ greatly concerning their morphology, typological differentiations made by earlier osteologists on Egyptian material are no longer valid. However, from the study of the iconography we know that the Ancient Egyptians already knew and kept several types of dogs. From 2500 BC onwards, breeds such as basset hounds, whippets, and mastiffs, as well as the so-called pariah dogs, did occur (Epstein 1971; Senglaub 1976). The latter were quite small, had a pointed muzzle, cocked ears, thin legs, and a curly tail. They are also known as "Egyptian stray dogs" (Lortet & Gaillard 1903).

By all appearances, the specimens identified from the Kerma assemblage apparently seem to belong to this particular type of dog. The crania were quite elongated, had a rectango-linear profile, and weakly marked muscle scars (plate 1-6). A comparison of the condylobasilar length with the bizygomatic diameter indicated that the Kerma individuals form a quite homogeneous group, characterised by elongated skulls, but with a total length which was evidently smaller than that of the Ancient Egyptian types. They resemble skulls of modern dogs in northern Sudan (fig. 3; table 2).

As for the dentition, the upper carnassial (P4) is decidedly larger compared to those of Ancient Egyptian and present-day Sudanese dogs. Another interesting feature concerns the occurrence of a distinct diastema between the teeth of the upper premolar row. This phenomenon might be caused by an elongation of the facial zone of the skull. A similar tendency has been noted for the mandibles (see table 4). By the way, no case of teeth crowding was registered. This irregular position of teeth is typical for short-muzzled breeds such as boxers, bulldogs and many others. Moreover, it is noteworthy to state that the basal lengths, calculated with Brinkmann's (1924) coefficient, approximate the actual lengths measured on the crania.

Previous authors have used the values of the orbital angle in correlation to the maximal length of the femur for a typological classification of Ancient Egyptian dogs. For the Kerma dogs, this method was also applied (after Ducos 1971), enhancing the following result (table 3, fig. 4): The correlation of both measurements was comparatively low, with a coefficient of 0.096 for Kerma and of 0.407 for Egypt. Consequently, any classification based on this seems to be arbitrary and less useful for the recognition of specific types of dogs.

The preservation of the postcranial skeleton was good enough to allow a detailed analysis of size and morphology. As was pointed out already, this study is limited to the analysis of the main long bones (humeri, radii and ulnae, femora and tibiae). Contrary to the skulls, which were evidently smaller at Kerma than in Ancient Egypt, the mean size of the long bones in the Kerma material surpasses those of Egyptian dogs by far. If we compare for example the humeri from both assemblages, it becomes obvious that the Kerma dogs had relatively long and strongly built fore-legs (fig. 5). This massiveness is expressed by the high values of the distal transverse diameter, whereas the median diameter of the diaphysis was much more similar to that of Egyptian dogs (fig 6). However, only few complete humeri could be considered in this study, the number of specimens measured being 13 (table 5). On the basis of humerus finds from other (pre)historic sites, however, clearly larger dogs are attested, e.g. from the Neolithic site of Merimde-Benisalâme (von den Driesch & Boessneck 1985) or from the pharaonic site of Tell el-Dab'a (Boessneck & von den Driesch 1992), so it can be concluded that the sample of humeri studied is not entirely representative for the canine population of Ancient Egypt. Interestingly, the dogs found in the necropolis and those issued from the modern Kerma sample were of more or less identical dimensions.

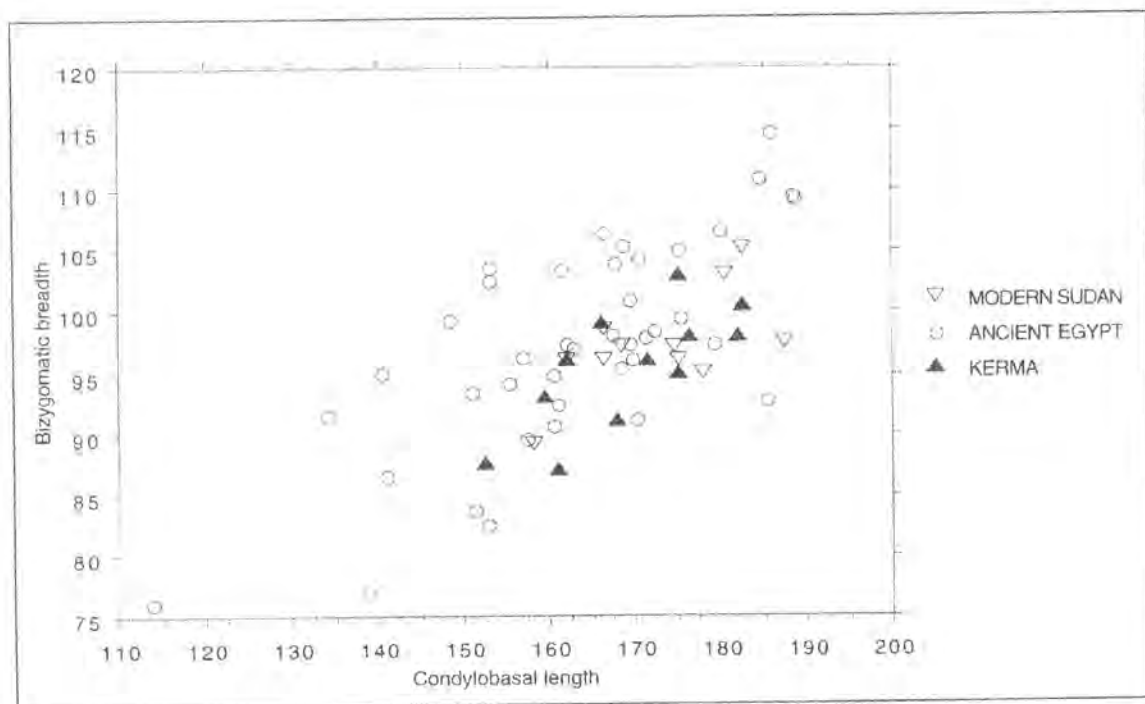


Fig. 3 Scattergram. Skull. Correlation between condylobasal length and zygomatic breadth.

The same phenomenon could be evidenced for the radius (tables 6, 7). Once again, the radii of Egyptian and Sudanese prehistoric dogs differ greatly in their mean lengths. The animals from the necropolis and from modern Kerma dogs are almost identical in this respect. Unfortunately, the ulnae of the Egyptian dogs could not be measured.

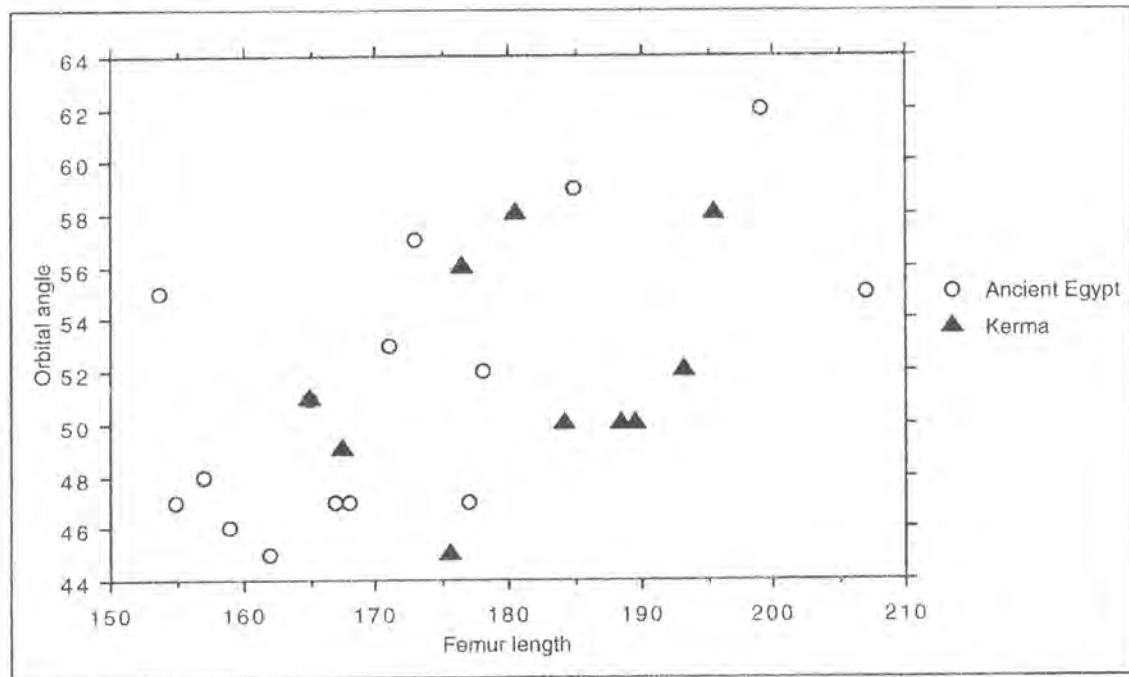


Fig. 4 Scattergram. Correlation between the length of the femur and the orbital angle.

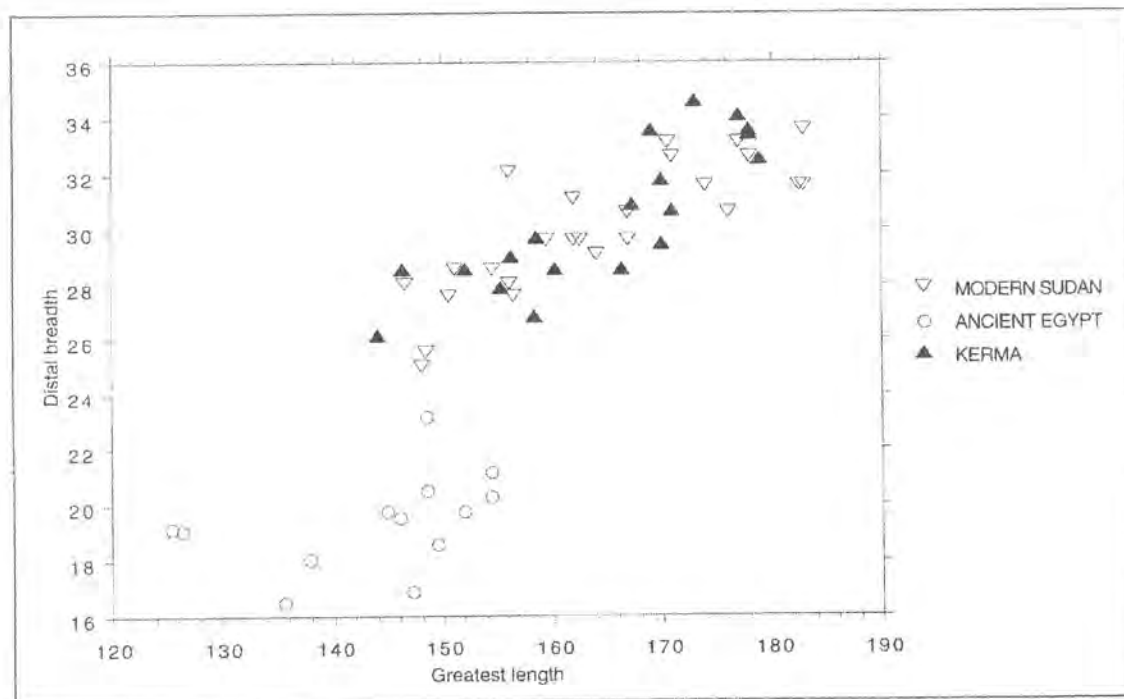


Fig. 5 Scattergram. Humerus. Correlation between the greatest length and the distal breadth.

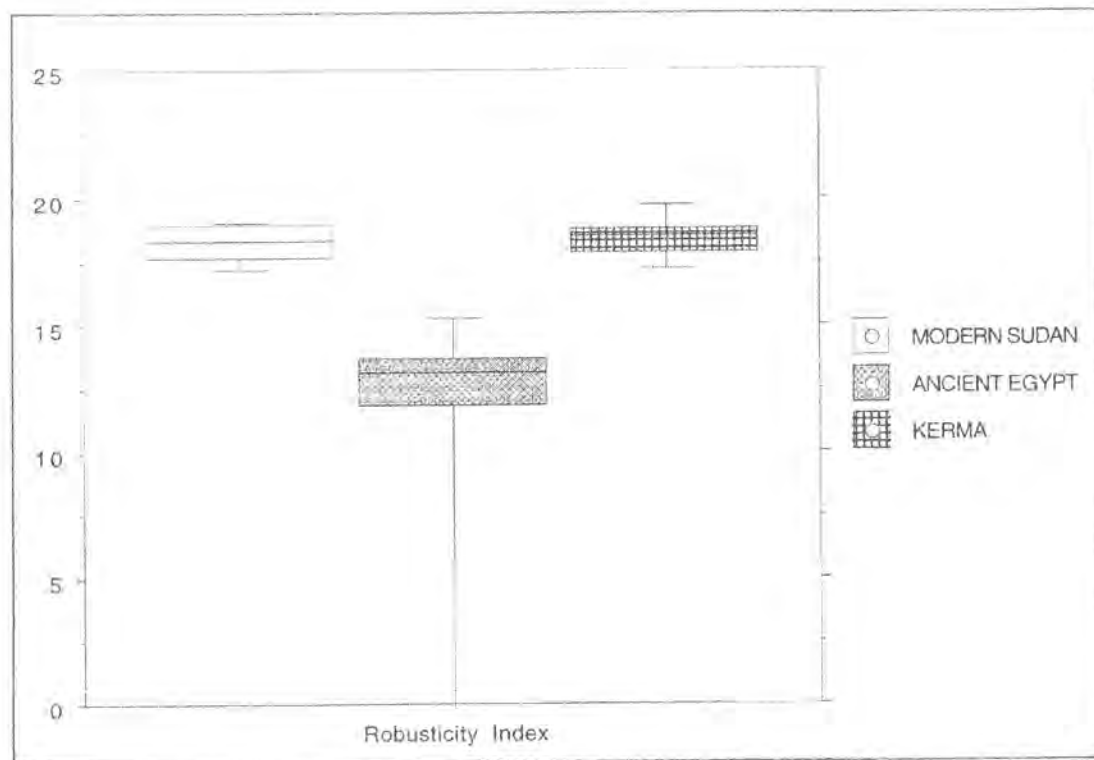


Fig. 6 Humerus. Index of robustness. Comparison between dogs from prehistoric Kerma (KCE), modern Sudan (ACT) and Ancient Egypt (EGY).

Similar results are obtained from the analysis of the bones of the hind-leg (tables 8, 9): Femora and tibiae of the Kerma dogs were on average considerably larger than those from Egyptian dogs. On the other hand, they resemble those of modern dogs living in the same area. Another aspect should be mentioned here, concerning the femur and the tibia. According to Ducos (1971), both elements do exhibit more or less the same length in modern breeds, whereas in wolves and jackals, comparatively longer femora and shorter tibiae are noted. Surprisingly, these differences in hind limb proportions between wild and domestic canids appear not to be so clear-cut in the Kerma material. Three out of seventeen hind-legs measured displayed femora which were longer than the corresponding tibiae. This was also the case for five out of thirteen examples from Ancient Egypt (fig. 7). On the other hand, a wolf and two Australian dingoes from our comparative collection displayed longer tibiae, compared to the femora.

Finally, the withers height of the Kerma dogs was calculated, using the methods both of Koudelka (1885) and Harcourt (1974). The average withers height of the Kerma dogs varied between 46.7 - 61.5 cm (after Harcourt) and 48.2 - 60.3 cm (after Koudelka), with mean values from 53.8 (humerus) to 56.1 cm (femur) respectively (table 10, fig. 8). The mean height at the withers of modern dogs from this area is very similar to the one calculated for the prehistoric specimens, except for a few minor discrepancies (fig. 8). On the other hand, the Ancient Egyptian dogs were on average smaller in size. Their shoulder heights varied between 40.3 - 61.2 cm (after Harcourt) and 42.2 - 59.9 cm (after Koudelka) with mean values between 47.5 (humerus) and 49.3 cm (radius) respectively. To sum up, the calculation of the withers height shows that dogs kept in prehistoric times near Kerma and those which still exist today in northern Sudan do resemble largely in size. They also fit the upper range of the variation of medium-sized modern breeds (Haltenorth 1958). The similarity in size between the prehistoric dogs of Kerma and the animals kept in Ancient Egypt, postulated above, has to be corrected: The prehistoric Egyptian dogs were on average smaller than their relatives living in the Sudan.

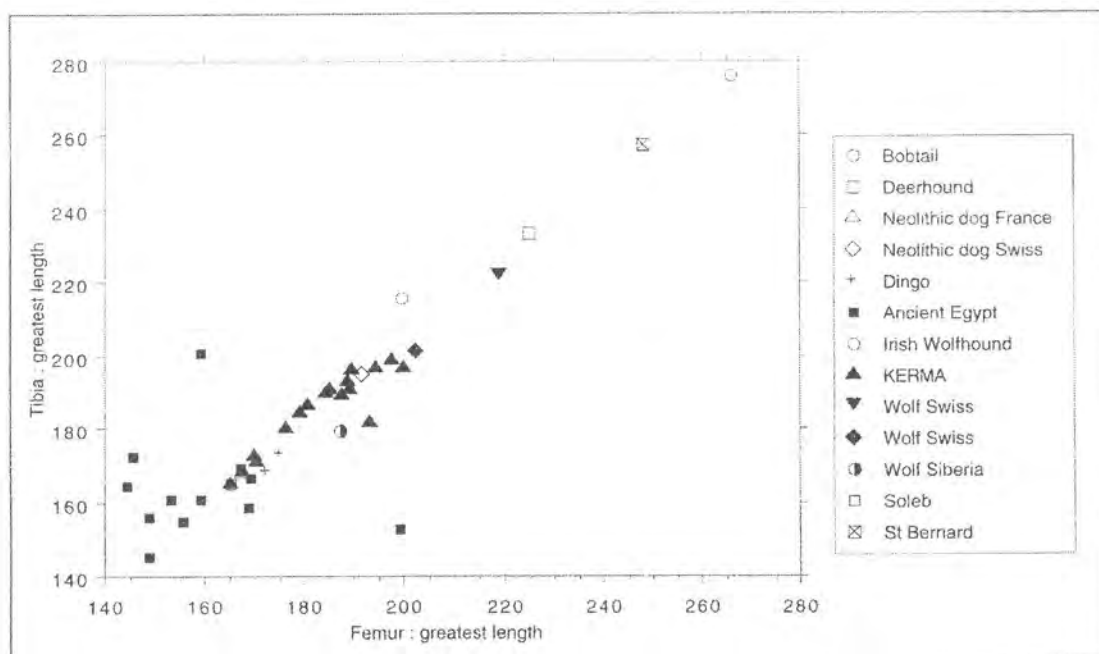


Fig. 7 Correlation between the length of the femur and the length of the tibia amongst wolves, African dogs and different breeds of modern dogs.

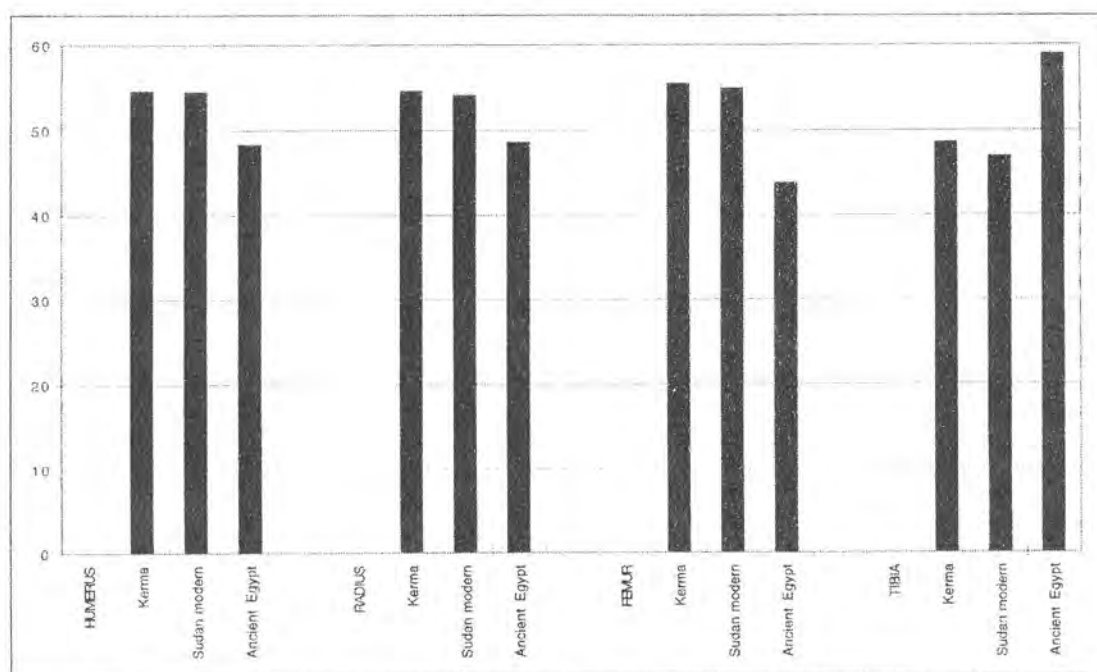


Fig. 8 Calculation of the height at the withers on the basis of four long bones (humerus, radius, femur, tibia). Size comparison between the dogs from Kerma, modern Sudanese "pariah"-dogs and dogs from Ancient Egypt.

Summary

The briefly characterised bone material from dogs, found in the necropolis of Kerma, exhibits some interesting features, which can be summarized as follows:

(1) The inhumation of dogs in the Kerma necropolis has not been practised systematically, but mainly during the final sequence of Ancient Kerma and particularly during the Middle Kerma period. Out of 250 graves excavated and examined so far, twenty-two provided dog skeletons (8.8 %). This frequency may be compared to the Neolithic cemetery (C) of El Kadada in central Sudan, where sixteen out of 221 graves contained dogs (7.2 %; Bonnet *et al.* 1989). In addition, it seems as if specific sectors of the necropolis were characterised by a higher density of graves containing dogs;

(2) The motivation for the inhumation of dogs assumably are (a) companionship to the deceased and (b) as a shepherd dog for a small flock of caprines, deposited to the west of the pit;

(3) The Kerma dogs are in a way outstanding because of their striking uniformity in morphology and body size. The main characteristics were elongated skulls, which were narrower than those of the Egyptian dogs, pointed muzzles and weakly developed muscle scars. The dentition of these dogs was characterised by noticeable diastemata, especially in the premolar row. The postcranial skeletons of these dogs were slender with elongated elements. However, from the robustness of some elements, particularly humeri, a certain dissimilarity to the more gracile dogs from Ancient Egypt becomes obvious. The calculation of the withers height classified them as medium to large sized dogs, comparable in size to a boxer or a dalmatian;

(4) The dog population at Kerma was very uniform and lacked highly modified animals such as the basset hounds and the mastiffs, well known during the Ancient and Middle Egyptian Kingdoms (Boessneck 1988). Moreover, a comparison with present-day dogs from northern Sudan revealed no significant differences in morphology or size.

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Table 1 List of the dogs from the Eastern Cemetery of Kerma.

No.	Year	Sex	Age	C14-Date
25 A	1981	?	adult > 4 ans	
67	1982	?	adult	3700 ± 60 BP
83	1983	♂	adult	
89/1	1984	♂	adult > 10 years	3295 ± 60 BP
121	1987	?	adult	
125	1987	♂	adult > 4 years	2975 ± 65 BP
133/4	1988	♂	adult > 2 years	3465 ± 50 BP
151/1	1989	♀	adult > 10 years	2825 ± 115 BP
199/1	1996	♂	adult > 2 years	
205/1	1996	?	adult	3720± 30 BP
205/2	1996	♂	adult	3720± 30 BP
212/1	1996	♀	adult	3053 ± 59 BP
212/2	1996	♂	adult	3053 ± 59 BP
221A	1996	♂	adult > 5 years	
221B	1996	♂	adult > 5 years	
223/1	1997	♀	adult	
233A	1997	?	adult	
233B	1997	?	adult	
238/1	1998	♂	adult	
238/2	1998	♂	adult	
249/1	1998	?	juvenile 8-9 months	
249/2	1998	?	adult	

Table 2 Skull: main statistical data.

	N	mean	min.	max.	st.-dev.
Condylbasal length					
Kerma	12	169.3	152.5	182.5	9.38
Northern Sudan modern	12	171.4	157.5	187.5	9.72
Ancien Egypt	46	163.6	113.9	188.8	15.69
Greatest neurocranium breadth					
Kerma	13	54.7	51.5	60.0	2.09
Northern Sudan modern	12	56.9	54.5	60.0	2.02
Ancien Egypt	47	54.3	47.8	65.7	3.36
Zygomatic breadth					
Kerma	12	95.3	87.0	103.0	4.94
Northern Sudan modern	11	97.2	89.0	105.0	4.15
Ancien Egypt	42	97.5	76.0	114.6	8.61
Carnassial length (cingulum)					
Kerma	19	18.1	15.9	21.0	1.23
Northern Sudan modern	12	17.6	15.5	19.3	1.16
Ancien Egypt	40	17.2	12.2	19.9	1.65

Table 3 List of the values of the orbital angle compared with the greatest length of the femur.

Site	No.	Sex	Orbital angle	Femur length
Kerma	67	?	49	167.4
Kerma	83	♂	56	176.4
Kerma	89/1	♂	45	175.6
Kerma	125/1	♂	58	180.5
Kerma	133/4	♂	58	195.6
Kerma	151/1	♀	51	165.0
Kerma	212/1	♀	50	189.5
Kerma	212/2	♂	52	193.2
Kerma	233/1	♀	50	188.5
Kerma	249/1	?	50	184.2
Soleb	T31	?	59	165
Ancient Egypt	Ro35	♂	57	173
Ancient Egypt	Ro36	♂	53	171
Ancient Egypt	Ro39	♀	52	178
Ancient Egypt	Ro51	♀	51	165
Ancient Egypt	Th64	♀	59	185
Ancient Egypt	Ro34	♂	48	157
Ancient Egypt	Ro38	♂	47	168
Ancient Egypt	Ro40	♂	46	159
Ancient Egypt	Ro41	♂	47	167
Ancient Egypt	Ro47	♂	47	177
Ancient Egypt	Ro53	♂	45	162
Ancient Egypt	Ro54	♂	47	155
Ancient Egypt	Ro48	♂	55	207
Ancient Egypt	Bal1	♂	62	199
Ancient Egypt	Bal6	?	55	153.7
Sudan modern	3602/35	♂	62	200

Table 4 Mandible: statistical data.

	N	mean	min.	max.	st.-dev.
Total length					
Kerma	18	132.2	117.0	144.5	8.22
Northern Sudan modern	11	136.0	122.0	146.5	6.89
Length pr. ang-infradent					
Kerma	19	132.9	117.0	148.5	8.57
Northern Sudan modern	11	133.7	119.0	146.5	7.43
Length inc. ang.- infradent					
Kerma	19	127.6	112.8	141.5	8.03
Northern Sudan modern	11	128.9	115.0	139.0	6.66
Length condyle-C post					
Kerma	18	116.0	102.5	127.0	8.07
Northern Sudan modern	11	118.1	104.8	129.5	6.85
Length of the cheektooth- row					
Kerma	19	70.6	63.0	76.5	4.07
Northern Sudan modern	11	72.5	67.0	77.0	2.85
Length of the carnassial (cingulum)					
Kerma	19	21.0	18.9	23.0	1.14
Northern Sudan modern	11	20.5	19.5	22.0	0.77
Breadth of the carnassial (cingulum)					
Kerma	19	8.2	7.5	9.9	0.50
Northern Sudan modern	11	8.1	7.7	8.5	0.26
Height of the ramus					
Kerma	18	53.7	46.0	59.5	3.45
Northern Sudan modern	10	53.5	50.0	59.0	2.52
Basal length (Brinkmann, 1924)					
Kerma	19	160.9	141.6	179.7	10.36
Northern Sudan modern	11	161.8	144.0	177.3	8.99

Table 5 Humerus: statistical data.

	N	mean	min.	max.	st.-dev.
Greatest length					
Kerma	19	164.7	144.0	178.9	10.77
Northern Sudan modern	27	164.4	146.5	183.0	11.24
Ancient Egypt	16	146.2	125.3	172.5	12.06
Greatest length from caput					
Kerma	19	159.4	141.4	173.0	10.21
Northern Sudan modern	27	159.6	143.0	178.0	10.43
Proximal breadth					
Kerma	19	26.3	21.9	30.4	2.14
Northern Sudan modern	26	26.3	22.5	30.5	2.47
Ancient Egypt	13	23.4	20.8	26.8	2.04
Proximal depth					
Kerma	19	37.1	31.1	41.4	2.81
Northern Sudan modern	27	37.3	28.5	42.5	3.31
Ancient Egypt	16	34.4	30.5	40.5	2.80
Smallest breadth of diaphysis					
Kerma	19	11.8	10.5	13.6	0.91
Northern Sudan modern	27	12.3	10.5	14.0	1.15
Ancient Egypt	13	10.3	8.8	11.8	0.88
Distal breadth					
Kerma	20	30.4	26.1	34.5	2.57
Northern Sudan modern	27	30.0	25.0	33.5	2.27
Ancient Egypt	13	19.4	16.5	23.2	1.76

Table 6 Radius: statistical data.

	N	mean	min.	max.	st.-dev.
Greatest length					
Kerma	18	167.9	151.0	180.3	9.88
Northern Sudan modern	18	166.2	144.5	197.0	13.60
Ancient Egypt	14	149.0	137.3	180.5	11.07
Proximal breadth					
Kerma	20	17.3	14.4	19.3	1.41
Northern Sudan modern	18	16.4	13.5	19.0	1.56
Middle shaft breadth					
Kerma	18	11.4	9.8	12.8	0.74
Northern Sudan modern	18	12.2	10.5	14.0	1.27
Distal breadth					
Kerma	21	21.9	17.4	24.5	1.96
Northern Sudan modern	18	21.8	17.5	25.5	0.57

Table 7 Ulna: statistical data.

	N	mean	min.	max.	st.-dev.
Greatest length					
Kerma	16	197.4	175.4	212.4	12.40
Northern Sudan modern	9	190.0	177.0	205.5	9.50
Depth across proc. anconaeus					
Kerma	21	23.4	19.7	26.0	2.01
Northern Sudan modern	12	23.3	20.5	26.5	2.03
Smallest depth of the olecranon					
Kerma	21	19.6	16.6	22.0	1.61
Northern Sudan modern	12	19.5	17.0	21.5	1.58

Table 8 Femur: statistical data.

	N	mean	min.	max.	st.-dev.
Greatest length					
Kerma	20	182.9	165.0	200.0	10.74
Northern Sudan modern	18	180.7	156.2	205.5	12.80
Ancient Egypt	16	160.3	144.5	199.0	13.43
Greatest proximal breadth					
Kerma	22	35.8	30.2	41.0	2.94
Northern Sudan modern	18	36.2	32.0	41.5	2.75
Ancient Egypt	16	32.7	28.8	40.7	2.92
Greatest depth of caput femoris					
Kerma	22	18.1	15.4	20.4	1.45
Northern Sudan modern	18	17.1	14.5	19.5	1.47
Ancient Egypt	15	15.3	12.7	19.6	1.70
Smallest breadth of diaphysis					
Kerma	21	12.5	11.0	14.0	0.92
Northern Sudan modern	18	12.5	10.5	15.0	1.11
Ancient Egypt	15	11.8	9.8	14.3	1.20
Greatest distal breadth					
Kerma	22	29.9	25.4	34.0	2.47
Northern Sudan modern	18	29.9	25.5	34.0	2.36
Ancient Egypt	16	28.3	23.3	37.6	3.59

Table 9 Tibia: statistical data.

	N	mean	min.	max.	st.-dev.
Greatest length					
Kerma	19	185.0	164.9	199.0	10.76
Northern Sudan modern	11	186.6	159.0	208.0	15.50
Ancient Egypt	13	164.1	145.4	201.1	13.49
Proximal breadth					
Kerma	20	32.1	27.5	35.5	2.50
Northern Sudan modern	11	32.0	26.0	36.5	3.60
Ancient Egypt	14	31.2	26.0	36.6	3.01
Smallest breadth of diaphysis					
Kerma	20	12.0	9.9	13.4	1.02
Northern Sudan modern	11	12.0	10.5	13.5	1.11
Ancient Egypt	14	11.1	9.1	12.5	0.98
Distal breadth					
Kerma	20	20.6	16.5	23.3	0.40
Northern Sudan modern	11	21.1	17.0	23.5	2.08
Ancient Egypt	2	21.7	20.4	23.0	1.83

Table 10 Estimation of the withers height (in cm) for each bone, according to Koudelka (1885) and Harcourt (1974).

<i>Humerus</i>	N	mean	min.	max.	st.-dev.
Kerma					
Koudelka	19	55.5	48.5	60.3	3.64
Harcourt	19	53.8	46.7	58.7	3.70
Sudan modern					
Koudelka	27	55.4	49.4	61.7	3.79
Harcourt	27	53.7	47.6	60.1	3.85
Ancient Egypt					
Koudelka	16	49.2	42.2	58.1	4.06
Harcourt	16	47.5	40.3	56.5	4.14

<i>Radius</i>	N	mean	min.	max.	st.-dev.
Kerma					
Koudelka	18	54.0	48.6	58.1	3.18
Harcourt	18	55.3	50.0	59.3	3.15
Sudan modern					
Koudelka	18	53.5	46.5	53.4	4.39
Harcourt	18	54.8	47.9	54.6	4.35
Ancient Egypt					
Koudelka	14	48.0	44.2	58.1	3.56
Harcourt	14	49.3	45.6	59.4	3.53

<i>Femur</i>	N	mean	min.	max.	st.-dev.
Kerma					
Koudelka	20	55.0	49.7	60.2	3.23
Harcourt	20	56.1	50.5	61.5	3.37
Sudan modern					
Koudelka	18	54.4	47.0	61.9	3.86
Harcourt	18	55.4	47.8	63.2	4.01
Ancient Egypt					
Koudelka	16	48.2	43.5	59.9	4.04
Harcourt	16	49.0	44.1	61.2	4.21

<i>Tibia</i>	N	mean	min.	max.	st.-dev.
Kerma					
Koudelka	19	54.0	48.2	58.1	3.13
Harcourt	19	54.9	49.1	59.0	3.13
Sudan modern					
Koudelka	11	54.5	46.4	60.7	4.56
Harcourt	11	55.4	47.4	61.7	4.54
Ancient Egypt					
Koudelka	13	47.9	42.5	58.7	3.93
Harcourt	13	48.8	43.4	59.7	3.95

Legends of plates 1 to 6:

Plate 1 Kerma. Skull and mandible of a ♂ dog (grave 83).

Plate 2 Kerma. Skull and mandible of a ♂ dog (grave 125/1).

Plate 3 Kerma. Skull and mandible of a ♀ dog (grave 151/1).

Plate 4 Kerma. Skull and mandible of a ♀ dog (grave 212/1).

Plate 5 Kerma. Skull and mandible of a ♂ dog (grave 212/2).

Plate 6 Kerma. Skull and mandible of a dog (grave 233/1, sex unknown).

All photographs were made by J.M. Zumstein

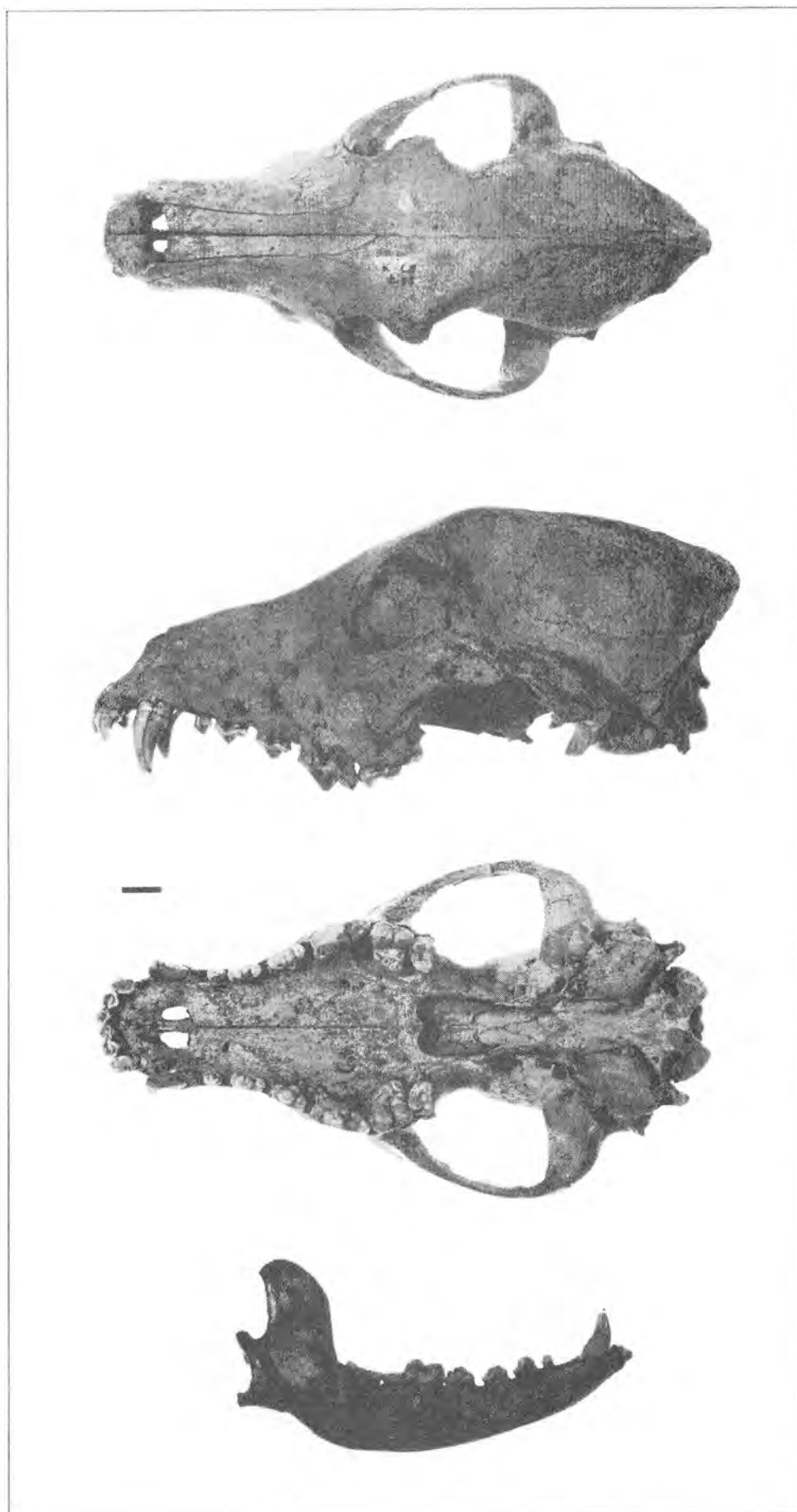


Plate 2



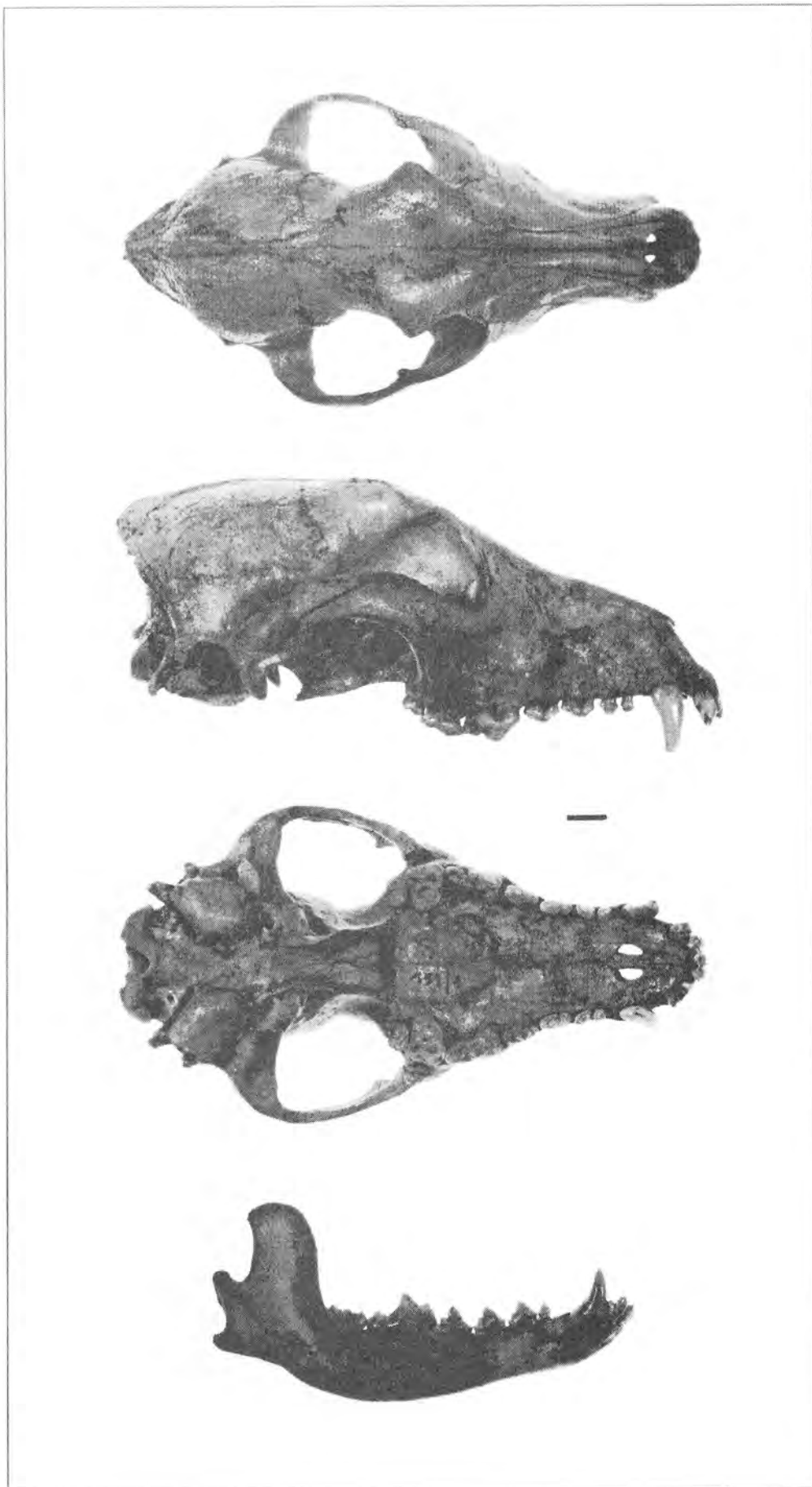
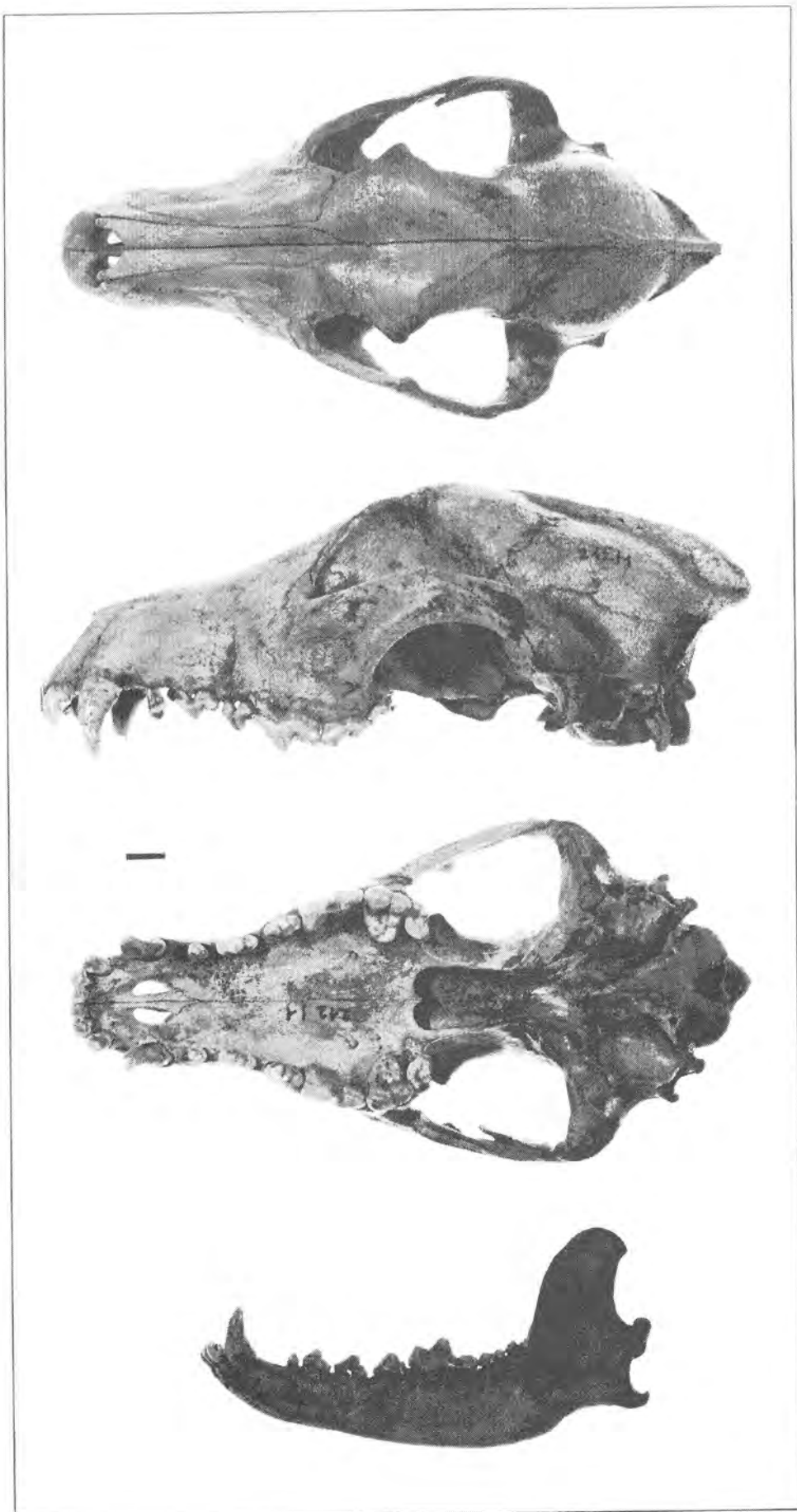


Plate 4



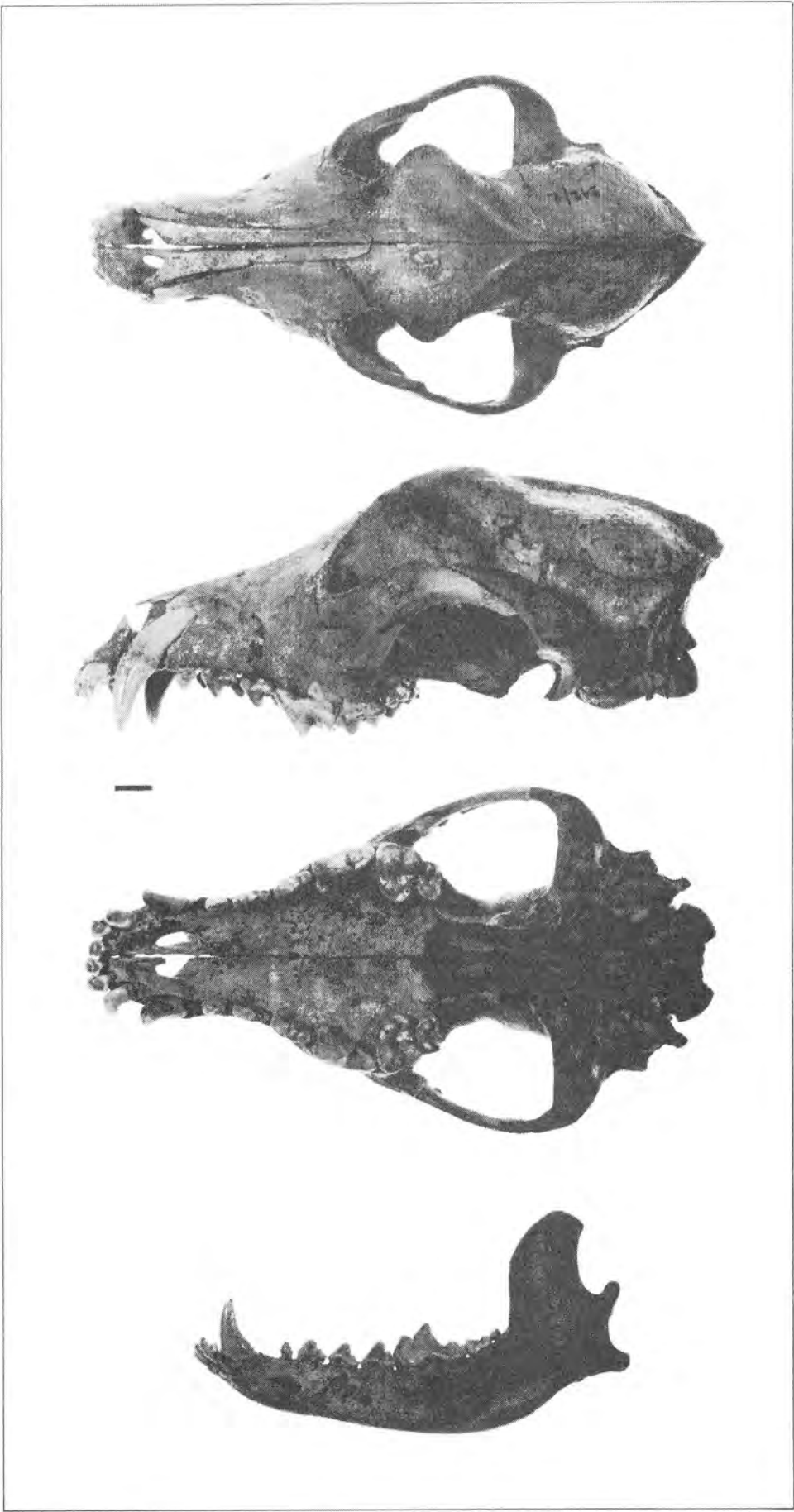


Plate 6

