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Middle Pleistocene *Carnivora* (*Mammalia*) from Kozi Grzbiet in the Świętokrzyskie Mts, Poland

[with 43 text-figs]

***Carnivora* (*Mammalia*) środkowego plejstocenu z Koziego Grzbietu w Górach Świętokrzyskich (Polska)**

Abstract. The study contains a description of Middle Pleistocene fauna of *Carnivora* from the locality of Kozi Grzbiet in the Świętokrzyskie Mts. 13 species have been recorded: *Ursus deningeri* REICHENAU, *Canis mosbachensis* SOERGEL, *Canis strandi* KORMOS, *Vulpes praeglacialis* (KORMOS), *Mustela palerminea* (PETENYI), *Mustela praenivalis* KORMOS, *Mustela strandi* KORMOS, *Males atavus* KORMOS, *Mustela* cf. *putorius* LINNAEUS, *Martes vetus* KRETZOI, *Lutra* sp., *Felis* sp., and *Crocuta* sp. Some of the mentioned species have been found in fossil material from Poland for the first time. The association points to the presence of a temperate climate forest environment with open areas.

I. INTRODUCTION

The locality of Kozi Grzbiet, discovered by A. WÓDKOWSKI in 1971, is situated ca. 20 km west of Kielce (50°5'N, 20°21'E). It consists of a part of a highly destroyed eroded cave in Devonian limestone, filled with sediment. The deposition of the sediment took place in the Middle Pleistocene — corresponding to glaciations and intermittent periods of warmer climate.

The second topmost layer in the profile consists of brown calcareous and sandy soils with relics of vertebrates and snails, and fragments of limestone and dripstones. The age of this level, obtained as a result of treating bone remains with the fluorine-chlorine-apatite method, was determined as 550 000—700 000 years (GŁAZEK et al. 1976). On the basis of lithological variation, the layer 2 was subdivided into three levels: 2a, 2b, 2c (Fig. 1). Collagen content in bone remains allowed to differentiate, within these levels, two periods of significantly warmer climate occurring in layers 2b and 2c, and three periods of colder climate visible in the bottom and the top parts of the layer 2c as well as in the layer 2a (GŁAZEK et al. 1976). The deposition of the entire layer 2 took place during a period of warmer climate corresponding to an interglaciation. According to GŁAZEK et al. (1976, 1977 a, b), the interglaciation period in question was that of Mindel I/Mindel II, corresponding to the period of Wilga/Mogilanka in the stratigraphy of Quaternary sediments in Poland; on the other hand, thermo-

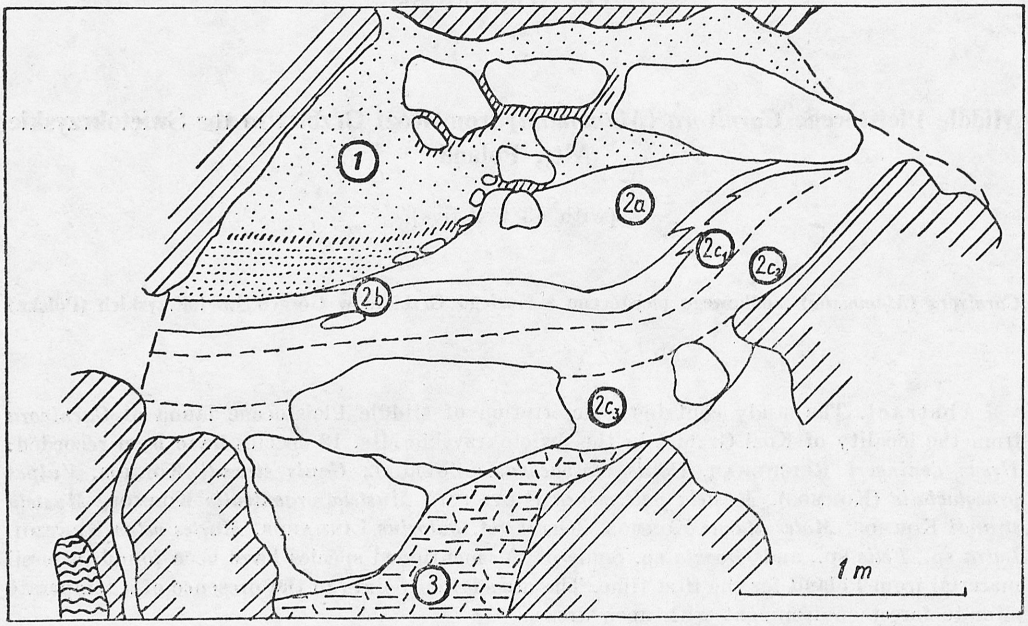

Fig. 1. Kozi Grzbiet profile. Symbols in circles represent separate layers and sublayers (according to GŁAZEK et al. 1976)

luminescence analysis (LINDNER 1984) date the sediment of the horizon 2 in the Kozi Grzbiet profile to an earlier period of warmer climate between the glaciations of Nida and San termed the Małopolska interglacial (LINDNER 1982) or the Kozi Grzbiet interglacial (MOJSKI 1985).

Results of research on the fauna of this locality have already been published in part. The faunistic list included snails (STWORZEWICZ 1982), amphibians and reptiles (MŁYNARSKI 1977; SZYNDLAR 1981; SANCHÍZ and SZYNDLAR 1984), birds (BOCHEŃSKI 1984), and small mammals (BLACK and KOWALSKI 1974; KOWALSKI 1975; RZEBIK-KOWALSKA 1976; KOWALSKI 1977, 1979; NADACHOWSKI 1985).

The present study describes bone relics of carnivores from the layer 2 of Kozi Grzbiet profile. The presented material belongs to the collection of the Institute of Systematic and Experimental Zoology, Polish Academy of Sciences, Cracow.

II. DESCRIPTION

Order *Carnivora* Bowdich, 1921
Family *Ursidae* Gray, 1821
Genus *Ursus* Linnaeus, 1758

Ursus deningeri Reichenau, 1906
(Figs. 2—4, Tables I—IV)

Material. Represented by at least 29 individuals (MF/1346/1—201). Layer 2a: P_4, M_3, Pd_4, radial bone, navicular+lunar bone, trapezoid bone, metacarpal II, 3 phalanges, 2 claws; layer 2b: $3I^2$, I^3, P^1, M^1, M^2, 4 fragments of M^2, 2 fragments of M^3, 2 I_1, I_2, P_4, $3M_1$, $2M_2$, $2M_3$, $3Pd_4$, 3 phalanges, 3 claws; layer 2c: $2I^1$, $4I^2$, $2I^3$, $2P_4$, a fragment of P_4, $7M_2$, $3M_3$, 2 fragments of M_3, $3Pd^4$, $9Pd_4$, 3C, 2 fragments of C, 4 skull fragments with occipital region, lumbar vertebra, caudal vertebra, 2 fragments of vertebrae, metacarpals II, III and IV, a fragment of metacarpal bone, 2 metatarsals III, patella, talus, 3 phalanges, 3 claws; layer 2b+c; I^3, P^4, M^1, M^2, P_4, M_2, a phalange; layer 2a+b+c: M_3; slope waste: $5I^2$, $3I^3$, $2P^4$, $2M^1$, M^2, a fragment of M^2, I_2, I_3, $2P_4$, M_2, M_1, Pd^4, a fragment of scapula, 2 fragments of navicular+lunar bone, pisiform bone, multangular bone, calcaneal bone, cuneiform bone, metacarpals II, III and IV, metatarsal II, 2 phalanges, a claw.

Description. The structure of incisors and canines similar to that in *Ursus arctos* Linnaeus, 1758. Dimensions of these teeth (Table I) approach the lower variability boundary for these dimensions in *Ursus deningeri* from other lo-

Table I

Ursus deningeri from Kozi Grzbiet. Teeth measurements

Teeth	N	Length		Width	
		O.R.	M	O.R.	M
C	7	17.2—27.1	21.3	13.0—19.9	16.2
I^{1-2}	12	7.5—10.5	8.9	8.5—11.9	10.4
I^3	5	11.0—14.0	12.4	11.0—14.5	13.1
P^4	5	18.6—19.5	18.8	12.6—14.5	13.2
M^1	10	22.9—27.5	25.7	16.0—19.9	18.8
M^2	7	39.5—42.0	40.0	20.2—22.2	20.6
I_3	10	6.6—8.4	7.5	9.2—10.7	10.1
P_4	6	13.3—15.5	14.4	8.2—9.8	8.8
M_1	1	25.3		12.0	
M_2	20	26.6—31.4	28.8	15.7—19.6	17.2
M_3	7	20.0—26.5	24.0	17.1—19.8	18.2

calities. The crown of P^4 is triangular, its paraconus is the highest. The smaller metaconus has a small thickening in its posterior part. An additional tubercle adjoins to the lingual wall of the crown between the two tubercles, separated from them by a long groove. A well-developed cingulum occurs around the tooth. The crown of M^1 is rectangular or trapezoidal in shape. The paraconus is single and taller than the metaconus; between them, a small prominence occurs. Small thickenings are present in front of the first tubercle and behind the second one. Their size was identical in 40 % of analysed teeth; the second thickening was bigger in the remaining 60 %. Protoconus and metaconulus are bigger than the tubercle between them. Paraconus is the highest tubercle of M^2; it is followed by the metaconus, which sometimes has and additional tubercle. Protoconus usually developed in the shape of a crest, followed by the higher metaconulus with an adjacent smooth hypoconus, gently descending towards the talon. The rounded talon is divided into a number of blunt tubercles and slightly bent on its outside edge. The central area of the chewing surface is hardly complicated, and the majority of its tubercles are ordered along the direction from the metaconus to the metaconulus. The cingulum ends at the metaconulus. P_4 is rectangular (sometimes its shape might be oval). The tongueward edge of the tooth is usually straight. The protoconid is the tallest tubercle. Its anterior edge is notched, and its posterior edge has a well-developed edge, in 30 % of specimens. The paraconid is well-developed in 60 % of all cases, while the deuteroconid is absent in 50 % of teeth. The talonid either constitutes an elongation of the paraconid or is clearly separated from it; sometimes, tubercles are present on the talonid. The protoconid is the tallest tubercle of M_1. The metaconid consists of two prominences, while the paraconid and the hypoconid are single. A small additional hypoconulid is situated behind the latter one. The entoconid is made up by two tubercles; the posterior one is slightly taller; a small prominence occurs on the anterior one. Tooth surface between the two tubercles is smooth. The crown of M_2 is short, with a wide interior area; it is slightly concave on both sides. The triple metaconid is its tallest tubercle; it might occasionally be single. The protoconid, situated in front of it, is usually blunt. The hypoconid is flanked on its inner side by an additional hypoconulid separated from the main tubercle by a groove. The hypoconid might sometimes have the form of an integral crest. The entoconid is made of two tubercles of different size (the posterior one being larger). An additional prominence of varying size and development is situated between the entoconid and the metaconid. The crown of M_3 is slightly convex on its labial side, convex on the tongue-ward one, and widened anteriorly, thus assuming a kidneyshape. The hypoconid is relatively big; it might attain the size of the protoconid in some cases. The length of deciduous teeth Pd^4_4 oscillates between 12.2 mm to 13.2 mm; their width is between 5.1 to 6.4 mm. Mean values of these dimensions (12.7 mm and 5.8 mm respectively) are within the variability range of these in *Ursus deningeri*. Bones of extremities found belong to adult individuals. The morphology of these bones is similar to that in *Ursus arctos*. Their dimensions (Table II) suggest the re-

Table II

Ursus deningeri from Kozi Grzbiet. Bone measurements

Bones	N	Length		Proximal epiphysis width		Distal epiphysis width		Minimum diaphysis width	
		O.R.	M	O.R.	M	O.R.	M	O.R.	M
Metacarpal I	1	55.0		19.0		15.0		8.6	
Metacarpal II	3	65.2—75.5	69.6	15.7—16.6	16.1	17.6—21.8	19.4	10.0—14.8	12.0
Metacarpal IV	3	81.0—79.2	80.1	19.7—21.5	20.6	21.2—23.0	22.1	13.2—14.6	13.9
Metatarsal III	3	60.2—65.3	61.5	19.2—21.3	20.0	20.5—23.9	22.3	12.1—13.7	12.9
Phalanges	12	47.4—40.4	43.1	21.2—23.1	22.0	15.6—16.9	16.1	12.7—13.5	13.1
Radial bone	1	264.0		41.5		44.0		28.0	

Table III

Percentage of particular tooth length in the overall teeth row length in the jaw of *Ursus deningeri* from Kozi Grzbiet and other European localities

Teeth / Locality		P^4	M^1	M^2	E
Kozi Grzbiet	M	17.7	25.7	41.5	84.9
	%	20.8	30.2	49.0	100.0
Kovesvarad	M	16.0	26.2	40.0	82.2
(Janossy 1963)	%	19.4	31.8	48.8	100.0
Ehringsdorf	M	19.0	26.6	43.8	89.4
(Rode 1935)	%	21.2	29.7	49.1	100.0
Mauer	M	17.9	26.3	41.8	86.0
(Schütt 1963)	%	21.0	30.6	48.4	100.0
Taubach	M	17.7	24.6	40.0	82.3
(Rode 1935)	%	21.9	29.9	48.2	100.0
Einhornhöhle	M	18.8	26.7	42.8	88.0
(Schütt 1968)	%	21.4	30.3	48.3	100.0
Urdhöhle	M	17.9	25.3	39.8	83.0
(Feustel et al. 1971)	%	21.6	30.4	48.0	100.0
Żernava	M	19.4	27.3	42.0	88.7
(Musil 1969)	%	22.0	30.7	47.3	100.0
Hundsheim	M	18.1	25.5	39.1	82.7
(Zapfe 1948)	%	21.9	30.9	47.2	100.0
Mosbach	M	18.3	26.1	40.7	85.1
(Schütt 1968)	%	21.4	31.7	46.9	100.0

latively small size of the Kozi Grzbiet Cave bear, within variability boundaries observed for the species *Ursus deningeri*.

Population characteristics. Teeth structure analysis yields that there occur, at the same time, features characteristic for both the cave and the brown bears, often visible in the same tooth. Bears of the *Ursus deningeri* group are characterized by a great variability, both in morphology and in dimensions. Climatic changes were of great importance in this case; their rate particularly accelerated in the transition periods between cold and temperate climate. This was undoubtedly connected with changes in feeding habits conditioned by ecological factors,

Table IV

Percentage of particular tooth lengths in the overall teeth row length in the mandible of *Ursus deningeri* from Kozi Grzbiet and other European localities

Tooth / Locality		P_4	M_1	M_2	M_3	E
Kozi Grzbiet	M	14.4	25.3	28.8	24.0	92.5
	%	15.5	27.1	31.1	26.0	100.0
Kovesvarad (JANOSSY 1963)	M	15.1	27.7	29.8	23.0	95.6
	%	15.8	29.0	31.0	24.2	100.0
Ehringsdorf (RODE 1935)	M	15.8	28.7	28.2	25.0	97.7
	%	16.1	29.3	28.9	25.7	100.0
Mauer (SCHÜTT 1968)	M	14.9	25.1	26.7	23.5	90.2
	%	16.3	27.8	29.6	26.3	100.0
Taubach (RODE 1935)	M	14.0	25.7	27.2	23.1	90.0
	%	15.5	28.6	30.2	25.6	100.0
Einhornhöhle (SCHÜTT 1968)	M	14.2	28.9	28.8	25.1	97.0
	%	14.5	29.9	29.7	25.9	100.0
Urdhöhle (FEUSTEL et al. 1971)	M	15.5	27.0	27.1	23.9	92.5
	%	15.6	29.2	29.3	25.9	100.0
Mosbach (SCHÜTT 1968)	M	14.8	27.0	27.1	24.0	92.5
	%	16.0	29.1	29.1	25.8	100.0

leading to the shift creophagism to phytophagism. This fact might also find its confirmation in the analysis of teeth percentage in the dental rows of the jaw and the mandible. The Kozi Grzbiet bear exhibits a significant elongation of M^2 and a shortening of M^1 and P^4 (Fig. 2). Similar proportions occur in *Ursus deningeri* from Ehringsdorf, Mauer, and Taubach (Table III). On the other hand, the percentage of M^1 length in the dental row is the highest in the bears from Mosbach and Hundsheim, both of which have been dated back to later periods. This allows to suggest the predominance of vegetal food in the former group, especially in the bear from Kozi Grzbiet, pointed out by the relatively wide crown of M^2 (Fig. 3); this also permits to presume the tendency towards the increase of importance of meat in the diet of the latter group of bears. The percentage length of particular teeth in the P_4—M_3 dental rows is also differentiated

(Table IV). A relatively short M_1 and long M_2 and M_3 have been observed in bears from Kozi Grzbiet (Fig. 4). The ratio of mean lengths M_2/M_3 is 83%. This value is low in comparison with that in the herbivorous cave bear (90%), and significantly higher than those in the totally carnivorous form *Thalarctos maritimus* PHIPPS, 1774 (71%), and the Early Pleistocene *Ursus etruscus* CUVIER, 1823

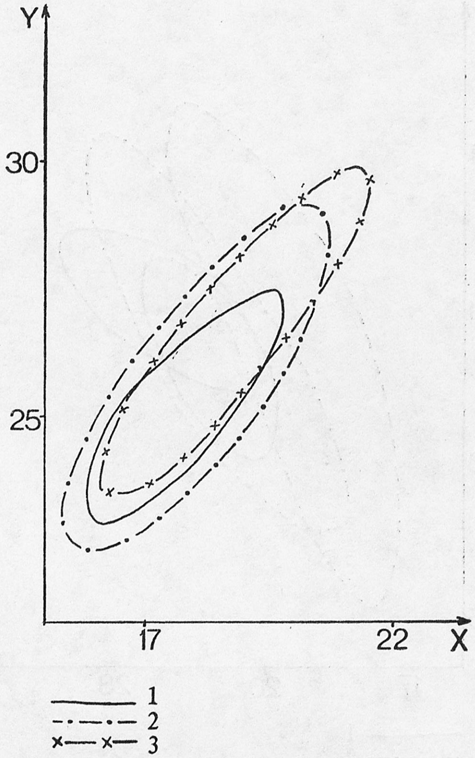

Fig. 2. Length (y) — width (x) ratio for M^1 in *Ursus deningeri*. 1 — Kozi Grzbiet, 2 — Kövesvarad, 3 — Ehringsdorf

(78%). The morphology of dentition in *Ursus etruscus* (RYZIEWICZ 1969) points to the predominance of vertical movement in functioning mechanism of the maxillar system (ŻUK 1985), which suggests the small participation of vegetal food in the diet of that bear. It might be ventured that this ratio might serve as the exponent of type of food. The value of this ratio for the European *Ursus deningeri* is similar to that for *Ursus spelaeus* ROSENMULLER, 1794, and points to the omnivorousness of representatives of this species.

Discussion. The described bones and teeth of the Kozi Grzbiet bear are different in size from those of the Early Pleistocene *Ursus etruscus*, the more recent *Ursus spelaeus* and *Ursus arctos*. The morphology and dimensions of particular elements are contained within the variability range characteristic for *Ursus deningeri* from other European localities (Figs. 2—4). *Ursus deningeri* mainly occurred in East and Central Europe in the Early and Middle Pleistocene (HELLER 1958, 1975; JANOSSY 1986; KAHLKE 1961, 1975; KRETZOI

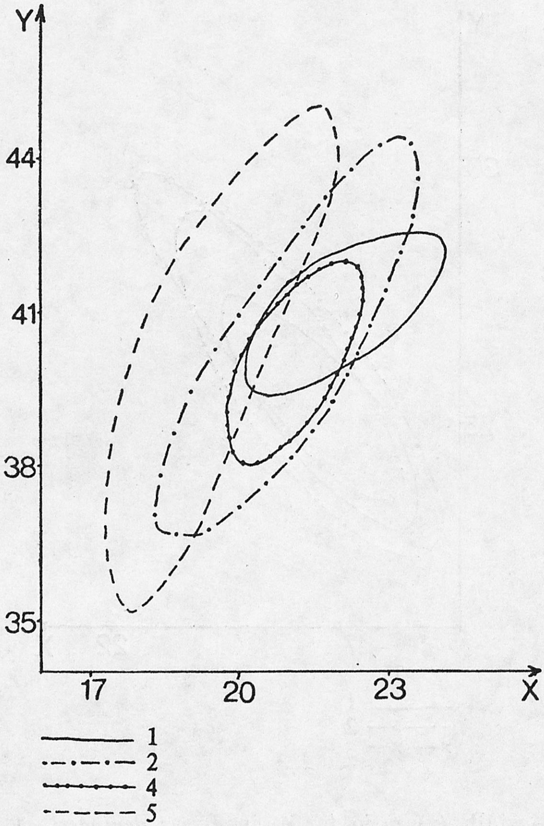

Fig. 3. Length (y) — width (x) ratio for M^2 in *Ursus deningeri*. 1 — Kozi Grzbiet, 2 — Kövesvarad, 4 — Mauer, 5 — Taubach

1938; KURTÉN 1968; MUSIL 1972, 1974; SCHMIDT 1970; SICKENBERG 1969; THENIUS 1965). The northernmost locality for this species is that of Bacton, Wales (STVART 1982), the southernmost one is that of Split (MALEZ 1961), and it has just been found farthest East and West in Tiraspol (NIKIFOROWA 1968; SOTNIKOVA, 1978) and in Lezetziki, Iberian Peninsula (ALTUNA 1972), respectively. The only recorded presence of this species from Poland has been that of cave sediments at Kozi Grzbiet, where it probably wintered.

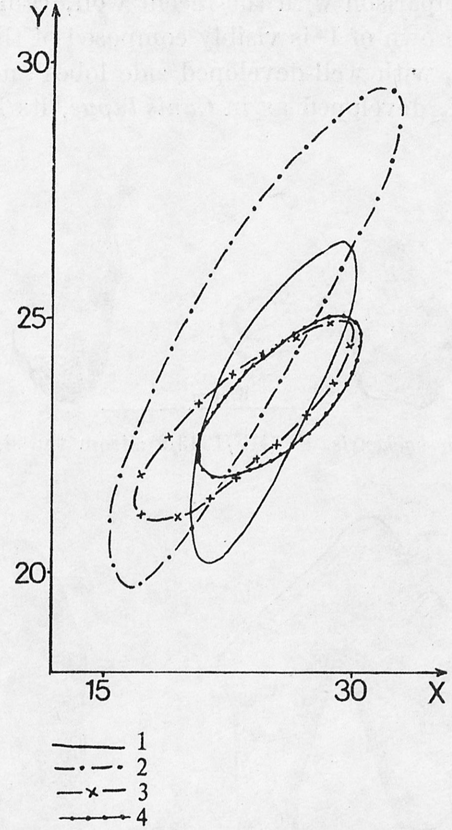

Fig. 4. Length (y) — width (x) ratio for M_3 in *Ursus deningeri*. 1 — Kozi Grzbiet, 2 — Kövesvarad, 3 — Ehringsdorf, 4 — Mauer

Family *Canidae* GRAY, 1821
Genus *Canis* LINNAEUS, 1756

Canis mosbachensis SOERGEL, 1925
(Fig. 5—9, Table V)

Material. Represented by at least 12 individuals (MF/1341/1—35). Layer 2a: C, I^2, P^4, I_2, patella, a fragment of a phalange; layer 2c: C, a fragment of I^3, P^2, P^3, a fragment of I_2, a fragment of metacarpal bone, phalanges, 3 fragments of phalanges, 2 claws; layer 2a+b+c: 9 fragments of I^3, P^3, a fragment of P_2, M_3; slope waste: I_2, M_3, a fragment of metetarsal bone.

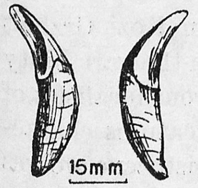

Fig. 5. *Canis mosbachensis*. C (MF/1343/1): from lingual side and from buccal side

Description. In comparison with the recent wolf, canines found are small, with weak roots. The crown of I^2 is visibly composed of three parts, as in *Canis lupus* LINNAEUS, 1758, with well-developed side lobes and a particularly well-developed cingulum. I_2 developed as in *Canis lupus*, its length is between 4.7

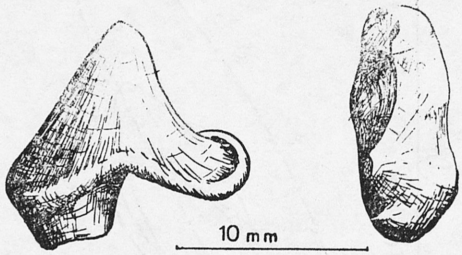

Fig. 6. *Canis mosbachensis*. P^2 (MF/1343/9): from the side and from above

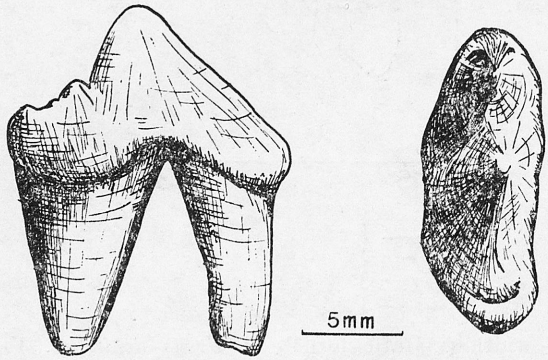

Fig. 7. *Canis mosbachensis*. P^3 (MF/1343/28): from the side and from above

and 6.3 mm, its width being between 3.4 and 5 mm (mean values of these dimensions are respectively 5.7 and 4.4 mm). I^3 has its crown sharper and narrower in comparison with the wolf. The crown of P^2 has a weakly marked paraconid situated centrally, with a visible prominence on the posterior edge. The crown of P^3 possesses a slight indentation on the outside of its anterior part. The protoconus and the paraconus of P^4 are distinctly separate. A well-developed deuterocon occurs on the labial side of the crown. The crown of M_3 is large in comparison with its counterpart in *Canis lupus*, its mean length being 5.7 mm (5.4—6 mm) and the mean width 5.1 (4.9—5.3 mm). The buccal side of the tooth is distinctly indented, much more than the lingual side. The morphology of other mentioned bone relics is identical with that in *Canis lupus*.

Discussion. Dimensions of teeth and bones in the wolf from Kozi Grzbiet are smaller than those in *Canis lupus*, whereas they remain within the variability range for the small wolf *Canis mosbachensis* known from numerous localities of Early and Middle Pleistocene of Europe. Teeth structure had features characteristic for both wolves and jackals; it is possible that Early Pleistocene wolves

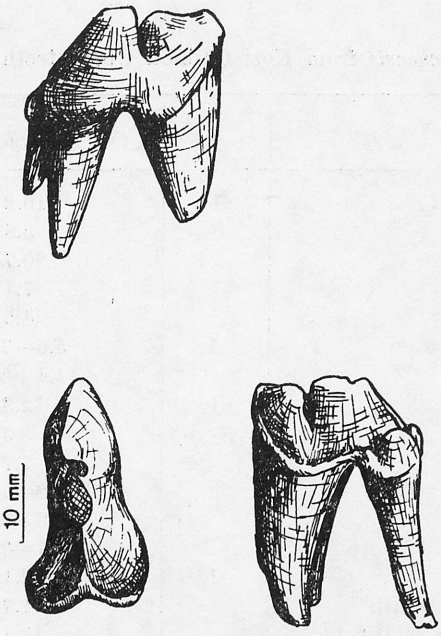

Fig. 8. *Canis mosbachensis.* P^4 (MF/1343/4): a — from buccal side, b — from lingual side and above

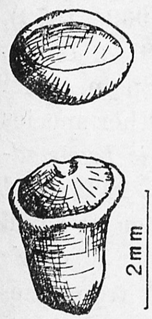

Fig. 9. *Canis mosbachechensis.* M_3 (MF/1343/30): from the side and from above

constitute an intermediate form between the two species. In spite of similarities with the extant *Canis lupus pallipes* SYKES, 1831, *Canis mosbachensis* constitutes a separate species. The observation of dimensions of *Canis mosbachensis* in the relatively short time interval yields a significant variation already noticed by KORMOS (1933). Although the increase in dimension possesses a phylogenetic aspect in European findings, the influence of ecological factors is also far from insignificant. Bone remains of *Canis mosbachensis* were recorded from sediments from the late Villafranchian till the Elster glacial. This species probably did not occur during the Holstein interglacial, although KAHLKE (1975) records its presence in sediments from Lunel-Viel. Its range lies between 3° and 22° longitude E and 41° and 51° lattitude N. Its massive presence is recorded from

Table V

Canis mosbachensis from Kozi Grzbiet. Upper teeth measurements

		N	variability range	mean
C	length	1	10.2	
	width		6.8	
	height		20.7	
I^2	length	1	7.1	
	width		4.5	
I^3	length	5	5.6—7.1	6.5
	width		4.4—5.1	4.8
P^2	length	1	12.3	
	width		5.3	
	height		7.7	
P^3	length	2	14.2—14.4	14.3
	width		5.9—5.9	5.9
	height		7.7—7.8	7.7
P^4	length	1	22.1	
	anterior width		11.7	
	posterior width		18.4	

numerous localities in East and West Germany (FEUSTEL et al. 1975; KAHLKE 1961; KURTEN 1969; MOTTL 1941; SCHAEFER 1969; THENIUS 1965), Hungary (JANOSSY 1976, 1986), Czechoslovakia (KRETZOI 1938; MUSIL 1969, 1972), Romania (KORMOS 1933), and Austria (RABEDER 1976, THENIUS 1954). It has also been occasionally recorded from sediments in Greece and Spain. Kozi Grzbiet, its only Polish locality, is also its north-easternmost one. Other species of the wolf were described from Early Pleistocene sediments. *Canis kronstadtensis* TOULA, 1909, was described from Czechoslovakia (KRETZOI, 1938) and Hungary (JANOSSY 1963, 1986). This species is chiefly characteristic for its small dimensions. JANOSSY (1963) suggests that it might be a mountain race of *Canis mosbachensis*. *Canis nerchersensis* REICHENAU, 1906, was described from Czechoslovakia (KRETZOI 1941; STEHLIK 1936), West Germany (SOERGEL 1925), and Hungary (KORMOS 1933). Both mentioned species remain within the variability range for *Canis mosbachensis*, and MUSIL'S (1972) statement to the effect that their names are synonyms for *Canis mosbachensis*, seems to be true.

Canis strandi KORMOS. 1933
(Figs. 10, 11)

Material. Layer 2a+b+c: M^1, M^2 (MF/1342/1—2).

Description. M^1 possesses a well-developed paraconus with an abruptly descending edge on the tongue-ward side, while the metaconus is shorter and smaller. The relatively well-developed protoconus is situated in the central part of the crown. A small protoconulus, developed in the form of a delicate wrinkle, can be noticed on the anterior labial edge of the protoconus, together with a distinctly elongated metaconulus in its posterior part. The hypoconus, in the shape of a ridge here, is particularly prominent. It is situated relatively far from the middle part of the tooth, what makes the talonid longer. The continuous cingulum is marked on the lingual side of the crown. The outside length of the tooth is 14.5 mm, the inside value is 8.6 mm; the crown width is 20.4 mm.

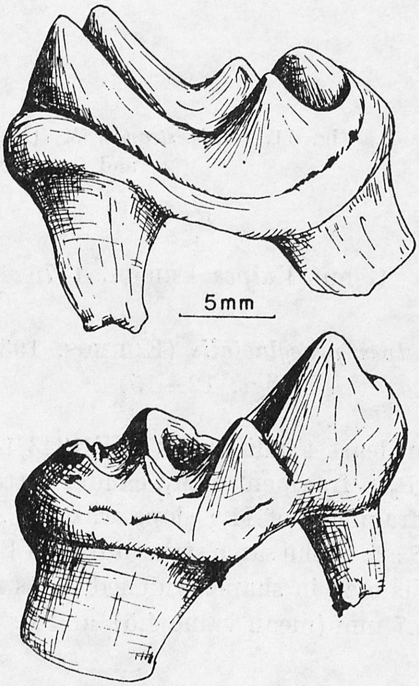

Fig. 10. *Canis strandi.* M^1 (MF/1342/1): from labial side and from lingual side

A well-developed protoconus appears in the central part of M^2. The metaconulus is reltively small, in the form of a ledge, and the protoconulus is hardly visible. The hypoconus is situated relatively far from the crown, thus elongating the talonid. The cingulum, particularly well-developed on the buccal side, forms a distinct thickening in the proximity of the paraconus. The outside and inside tooth lengths are respectively 8.1 mm and 7.1 mm, and its maximum width is 13.1 mm.

Discussion. The described teeth must have belonged to a large and strong wolf, the dimensions of which might have been alike those of Late Pleistocene wolves. However, it differed from them, among other characteristics, by teeth structure. Remains of *Canis strandi* are known from Early Pleistocene sediments in Italy (DEL CAMPANA 1913), Romania (KORMOS 1933), Czechoslovakia (KRETZOI 1941), and West Germany (HELLER 1958).

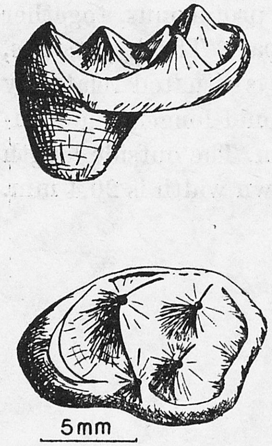

Fig. 11. *Canis strandi*. M^2 (MF/1342/2): from lingual side and from above

Genus *Vulpes* Frisch, 1775

Vulpes praeglacialis (Kormos. 1932)
(Figs. 12—15)

Material. It represents at least 4 individuals (MF/1343/1—14). Layer 2b: a phalange; layer 2c: P^1, P^2, P_3, a fragment of M_1, caudal vertebra, a claw; layer 2a+ +b+c: $2I^3$, P^1, M^1, a fragment of M_1; slope waste: C, I^2.

Description. C and I^3 are of the same structure as in *Vulpes vulpes* (Linnaeus, 1758). The crown of P^1 is oval in shape, widened in its middle. Its length oscillates between 4.3 and 4.7 mm (mean value 4.5), and its width is between 3 mm

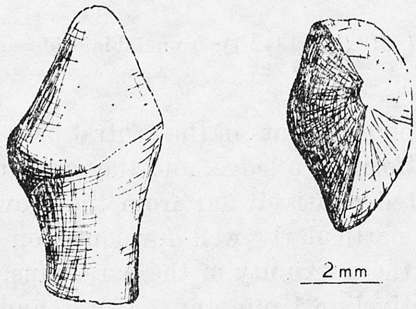

Fig. 12. *Vulpes praeglacialis*. P^1 (MF/1341/2): from the side and from above

and 3.2 mm (mean value 3.1 mm). The crown of P^2 is elongated, with straight edges, and without any tendency to widening in its distal part. Its length and width are respectively 7 mm and 2.9 mm. The general outline of the crown of M^1 is the same as in the genus *Vulpes*. The well-developed metaconulus is separated from the triple hypoconus situated more distally. The protoconulus is also

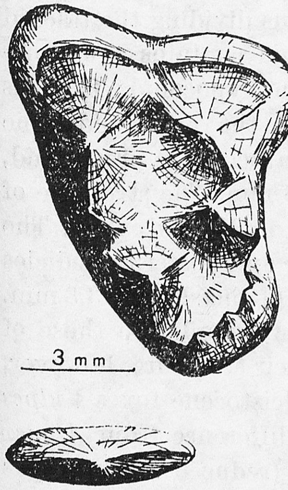

Fig. 13. *Vulpes praeglacialis.* M^1 (MF/1341/11): from above

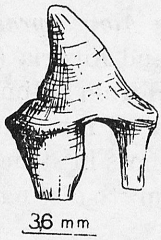

Fig. 14. *Vulpes praeglacialis.* P_3 (MF/1341/4): from the side und from above

well-developed. The looth length is 7.6 mm, and the central and posterior widths are respectively 10.6 and 8.7 mm. The crown of P_3 is slightly elongated (6.9 mm in length and 2.6 mm in width). The posterior wall of the main tubercle is slightly curved and bears traces of additional tubercles. The preserved fragment of M_1 consists of the talonid, 5.4 mm in width, which possesses a well-developed hypo-

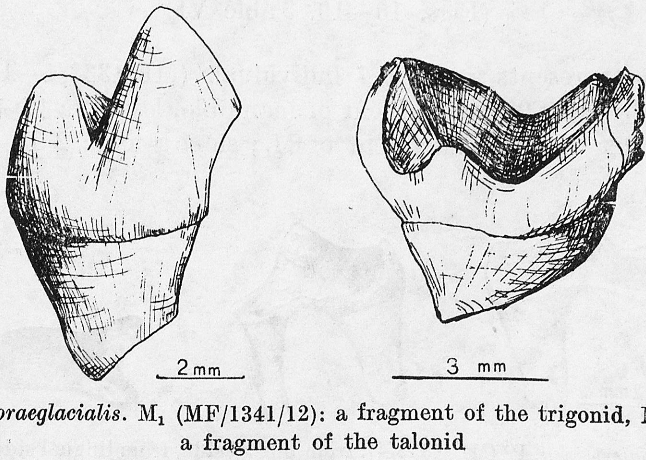

Fig. 15. *Vulpes praeglacialis.* M_1 (MF/1341/12): a fragment of the trigonid, M_1 (MF/1341/12): a fragment of the talonid

conid and entoconid. Visible between them is the edge thus dividing the talonid into two different parts. The posterior part of the talonid contains a well-developed mesoconid adjoining to the posterior edge of the hypoconid. There is no additional prominence between the metaconid and the entoconid. The fragment of the trigonid of M_1 includes a well-developed paraconid, a protoconid, and a fragment of a metaconid. Its width amounts to 4.8 mm. The structure of the phalange, the vertebra, and the claw is the same as in *Vulpes vulpes*. The length of the phalange is 23 mm, the width of the anterior and posterior pedicles are respectively 5.5 and 4.1 mm, and the minimum width of the shaft is 3.3 mm.

Discussion. The dimensions of described teeth are very similar to those of the extant Arctic fox *Alopex lagopus* LINNAEUS, 1758. Their structure, however, exhibits a greater similarity with the primitive Early Pleistocene foxes *Vulpes praeglacialis* and *Vulpes praecorsac* KORMOS, 1932. The difference from *Alopex lagopus* becomes marked in the structure of M^1 and M_1 (reduced metaconulus and hypoconus, the tooth M^1 shortened from the lingual side in *Alopex lagopus*, and, in the above-described M_1, the presence of the edge separating the entoconid from the hypoconid and of a well-developed outer edge on the talonid as in *Vulpes praeglacialis*). *Vulpes praeglacialis* has been described as *Alopex praeglacialis* from the Early Pleistocene of Hungary (KORMOS 1932) and Austria (RABEDER 1976). The presence of this species in Poland was recorded from sediments in the locality of Kamyk (KOWALSKI 1964). A slightly smaller fox, *Vulpes praecorsac*, occurred in Central Europe at the same time. Differences in structure between the two species are so minute that it is extremely difficult to distinguish heir teeth, with the exception of M_1.

Family *Mustelidae* FISCHER, 1817
Genus *Mustela* LINNAEUS, 1758

Mustela palerminea PETENYI, 1864)
(Figs. 16—19, Table VI)

Material. It represents at least 7 individuals (MF/1333/1—12). Layer 2a: P^4; layer 2b: M_1; layer 2c: a fragment of mandible, layer 2a+b+c: P^4, a fragment of M_1; layer 2b+c: a fragment of M_1; slope waste: 2 I^1, I^3, C, P_2.

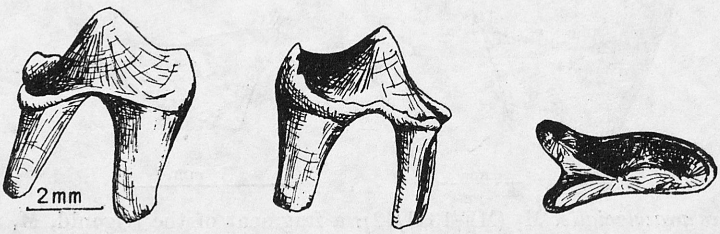

Fig. 16. *Mustela palerminea*. P^4 (MF/1333/4): from buccal side, from lingual side and from above

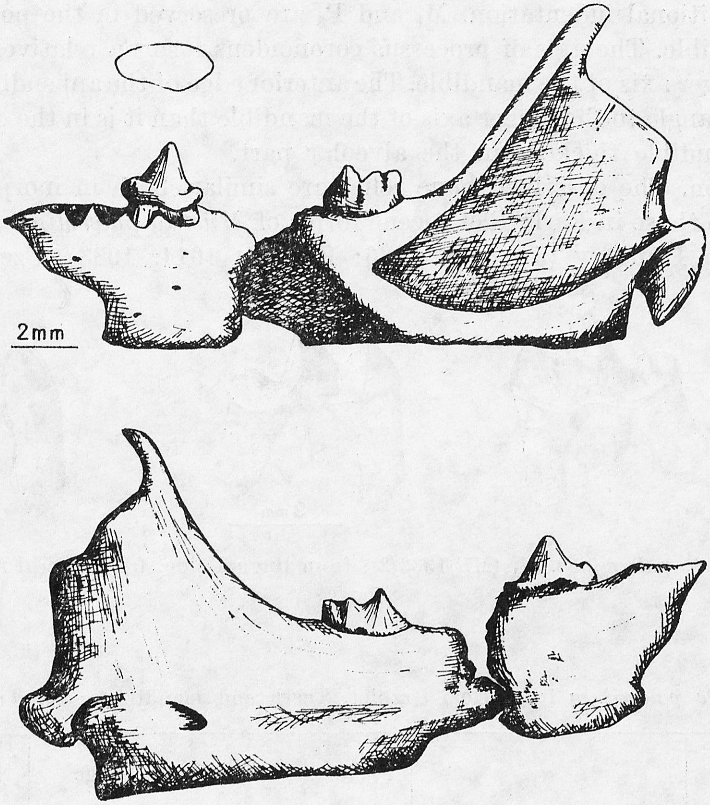

Fig. 17. ***Mustela palerminea.*** **A fragment of the mandible (MF/1333/3): from lingual side and from labial side**

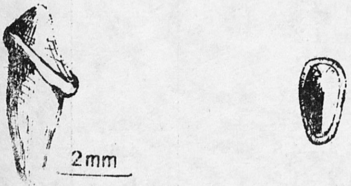

Fig. 18. *Mustela palerminea.* P_2 (MF/1333/11): from the side and from above

Description: Canine weakly curved. The crest present on the lingual side, runs toward the tooth apex. The cross-section of the tooth more convex than its counterpart in the ermine. The structure of incisors and P^4 does not exhibit any differences from that in *Mustela erminea* LINNAEUS, 1758. The crown of M_1 distinctly bigger than in extant ermines. Anterior and posterior width of the tooth are almost identical. The labial edge of the tooth is straight. Roots of P_2 are fused. Its crown is elliptical in shape. The posterior part of the crown of P_4 is better developed and without additional indentation (this indentation is a feature occasionally present in extant ermines). P_3 is double-rooted. The crown of this tooth is narrower than in *Mustela erminea*; it widens in its posterior part, without additional indentation. M_1 and P_3 are preserved in the posterior part of the mandible. The axis of processus coronoideus forms a relatively big angle with the longer axis of the mandible. The anterior edge of the appendix is inclined at a greater angle to the longer axis of the mandible than it is in the extant ermine. The mandible thickens in the alveolar part.

Discussion. The described bone relics are similar, both in morphology and structure, to those in Early Pleistocene forms of *Mustela palerminea*, the species known from Hungary (JANOSSY 1986; KORMOS 1914, 1933), Czechoslovakia

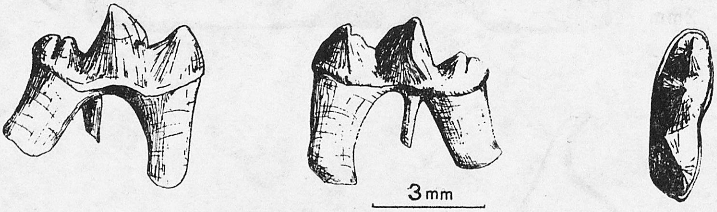

Fig. 19. *Mustela palerminea*. M_1 (MF/1333/2): from lingual side, from buccal side and from above

Table VI

Mustela palerminea from Kozi Grzbiet. Teeth and mandible measurements

		N	variability range	mean
P^4	length	1	4.4	
	anterior width		1.6	
	posterior width		2.3	
P_2	length	1	2.3	
	width		1.2	
P_3	length	1	2.4	
	width		1.1	
	height		1.4	
M_1	length	2	4.4—4.8	4.6
	anterior width	2	1.2—1.5	1.4
	central width	3	1.4—1.8	1.6
	posterior width	4	1.0—1.6	1.3
	protoconid height	3	2.0—2.3	2.2
mandible height under M_1		1	3.5	
mandible width under M_1		1	2.2	

(KRETZOI 1938), East Germany (HELLER 1958), Austria (RABEDER 1976), and France (KAHLKE 1975). KOWALSKI (1959) recorded the presence of the genus *Mustela*, similar in dimensions to *Mustela palerminea*, from Podlesice. STACH (1959) described the species *Mustela plioerminea* from the late Pliocene locality of Węże; this species does not exhibit any relation to *Mustela palerminea* or *Mustela erminea*. In comparison with the extant ermine, its slightly smaller ancestor exhibits more primitive features in the structure of the mandible and of the teeth. These include the narrower and lees solid molars and premolars (the carnassial M_1 seems to be particularly weak) with relatively straight crowns without tendencies to widening (e. g. the widening in the proximity of the protoconid in M_1, a characteristic feature for the ermine, does not occur here). The weak body of the mandible is another of those characteristics.

Mustela praenivalis Kormos, 1934
(Figs. 20—23, Table VII)

Material. Represents at least 6 individuals. Layer 2a: C; layer 2c: P^4, a fragment of the elbow bone and the pelvis; layer 2a+b+c: 3 I^3, C, P_4, a fragment of M_1, 2 fragments of the mandible; slope waste: C, a fragment of the mandible, (MF/ /1332/1—14).

Description: The structure of canines, I^3, and P^4 exhibits a fair similarity to the extant *Mustela nivalis* Linnaeus, 1758. Mandible fragments include its posterior parts with preserved M_1. Fossa masseterica reaches M_2 or the M_1/M_2 boundary not forming an acute angle. A distinct indentation can be noticed on the labial side of the mandible, under M_1, below the protoconid; three formina mentalia are situated under premolars. The crown of C is strongly elongated

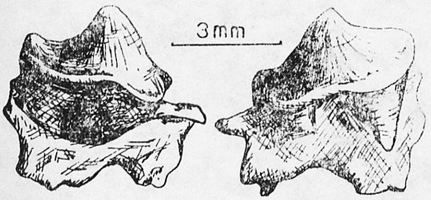

Fig. 20. *Mustela praenivalis.* P^4 (MF/1332/2): from lingual side and from buccal side

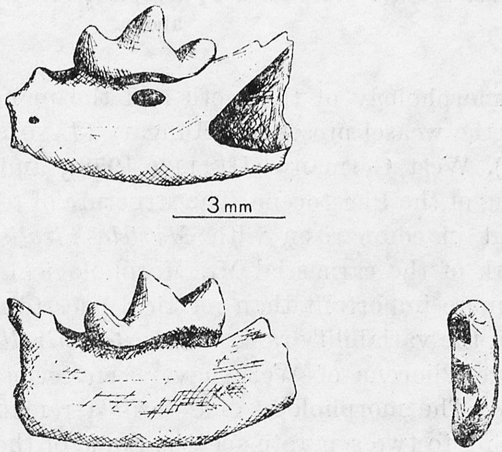

Fig. 21. *Mustela praenivalis.* A fragment of the mandible (MF/1332/14): from the outside, from the inside and M_1 from above

on the distal side. This tooth is shorter and smaller than in the weasel. P_4 is ellipsoidal in shape. Its crown is slightly widened in its posterior part. A strongly developed cingulum occurs in its central part. The crown of M_1 is relatively narrow and long in comparison with extant weasels. The tooth 1332/2 possesses a slightly widened protoconid base on the lingual side.

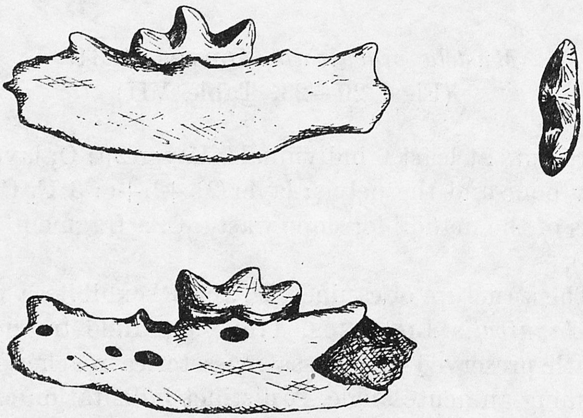

Fig. 22. *Mustela praenivalis*. A fragment of the mandible (MF/1332/11): from the inside, from the outside and M_1 from above

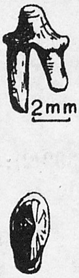

Fig. 23. *Mustela praenivalis*. P_4 (MF/1332/12): from the side and from above

Discussion. The morphology of the teeth and the mandible described corresponds to those of the weasel present in Hungary (Janossy 1963, 1976, 1978, 1986; Kormos 1933), West Germany (Heller 1958), and Austria (Rabeder 1976) at the beginning of the Pleistocene. The structure of teeth suggests a lower stage of development in comparison with *Mustela nivalis*. It is particularly seen in the poor work of the carnassial M_1. Morphological differences between the two species are more important than metrical ones (dimensions of *Mustela praenivalis* are within the variability range of *Mustela nivalis*). Small *Mustelidae* known from the Late Pliocene of Węże have been termed by Stach (1959) as *Mustela pliocenica*. The morphology of described remains, however, would point to their belonging to two separate species. Some of them exhibit a greater similarity to *Mustela praenivalis*, although they are bigger in size. On the other hand, features of others relics suggest their appartenance to a different species.

Table VII

Mustela praenivalis from Kozi Grzbiet. Teeth and mandible measurements

		N	variability range	mean
P^4	length	1	4.0	
	anterior width		1.6	
	posterior width		2.3	
P_4	length	1	1.7	
	width		0.8	
M_1	length	2	3.4—3.7	3.6
	central width	4	1.1—1.2	1.1
	protoconid height	4	1.3—1.9	1.6
mandible height under M_1		1	2.4	
mandible width under M_1		1	1.5	

Mustela strandi Kormos, 1933
(Figs. 24—27, Tables VIII—I°)

Material. Represents at least 7 individuals (MF/1334/1—18). Layer 2a: a fragment of the jaw, C, M_1, a fragment of the mandible; layer 2b: C, 2 fragments of the mandible; layer 2c: P_4; layer 2a+b+c: I^3, $2P^2$, M^1, fragments of P_4 and M_1; layer 2b+c: P_3, slope waste: a fragment of P^3, P_4, a fragment of the mandible.

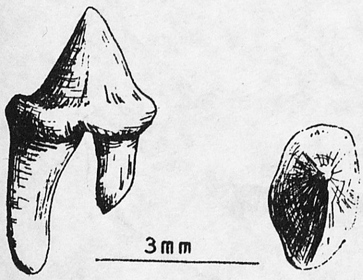

Fig. 24. *Mustela strandi.* P^2 (MF/1334/9): from the side and from above

Description. The outline of the crown of P^2 is oval. The axis of the tooth is shorter than in *Mustela palerminea.* The tooth is double-rooted.

The crown of P^3 is oval in shape. A widening of the crown, especially on its lingual side can be observed; this feature is absent in *Mustela palerminea.* The tooth is double-rooted.

The talonid of P^4 is relatively elongated in comparison with *Mustela palerminea.* M^1 does not exhibit significant differences in comparison with *Mustela palerminea.* A stronger curve occurs in the middle of the tooth length as compared with its counterpart in the extant ermine. The well developed protoconus is taller than in *Mustela erminea.* The mandible is more solid than in *Mustela*

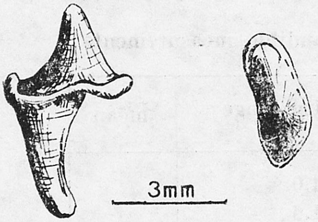

Fig. 25. *Mustela strandi*. P³ (MF/1334/17): from the side and from above

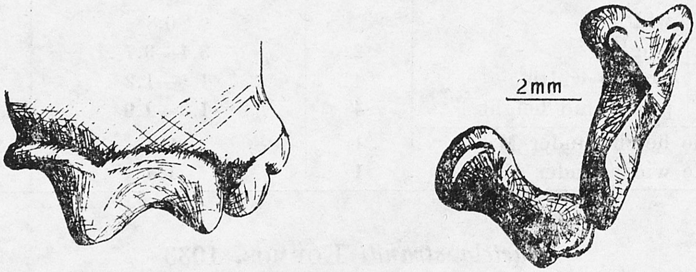

Fig. 26. *Mustela strandi*. P⁴ and M¹ (MF/1334/1): from buccal side and from above

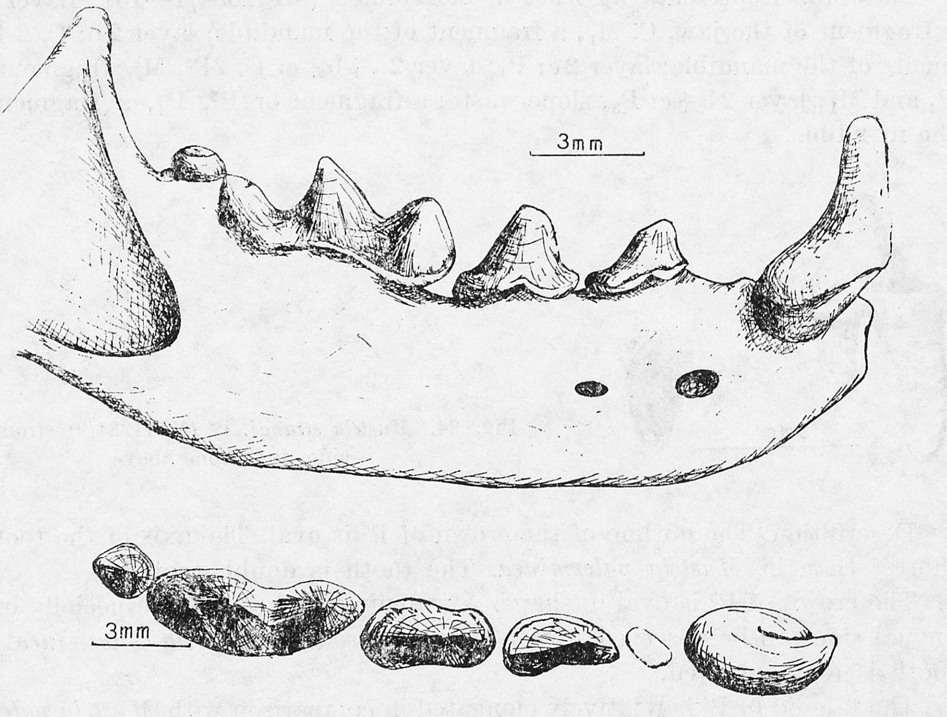

Fig. 27. *Mustela strandi*. Mandible (MF/1334/4): from the outside and from above

palerminea. Its posterior edge is less inclined towards the mandible axis than it is in the extant ermine. Fossa masseterica reaches the level of M_2 or the M_1/M_2 boundary. Two foramina mentalia are situated on the labial surface of the man-

Table VIII

Mustela strandi from Kozi Grzbiet. Upper teeth measurements

		N	variability range	mean
P_2	length	3	2.3—2.8	2.5
	width		1.5—2.0	1.9
P^3	length	1	3.4	
	width		1.3	
	length	1	5.9	
P^4	anterior width		1.8	
	posterior width		3.0	
M^1	length	2	2.7—2.7	2.7
	width		4.1—4.6	4.4

Table IX

Mustela strandi from Kozi Grzbiet. Lower teeth and mandible measurements

		N	variability range	mean
	length	3	4.7—5.7	5.3
C	width		2.5—3.6	3.0
	height		1.5—2.4	2.0
P_3	length	2	2.8—3.0	2.9
	width		1.6—2.1	1.7
P_4	length	4	3.3—3.7	3.5
	width	5	1.4—1.9	1.6
	length	4	6.2—6.7	6.5
	anterior width	5	1.8—2.2	2.0
M_1	central width	4	2.2—2.7	2.4
	posterior width	4	1.8—2.1	2.0
	protoconid height	3	2.8—3.2	3.0
	talonid length	4	1.5—1.8	1.7
M_2	length	4	1.6—2.0	1.8
	width		1.5—1.9	1.7
mandible height under M_1		3	5.5—6.3	5.7
mandiblo width under M_1		3	2.8—3.4	3.0

dible. The canine does not exhibit morphological differences in comparison with *Mustela palerminea.*

P_3 is double-rooted. Its crown is wider in its posterior part. The labial edge of the crown has a slight indentation in its middle, part. The crown of P_4 is oval, widened in its posterior part, without additional prominences. This type of asymmetry is sometimes present in *Mustela palerminea*; even so, this part of the tooth is narrower. M_1 possesses an elongated crown indented in the middle part of on the lingual side. The labial edge of the crown is almost straight or slightly curved at the level of the protoconid. M_2 is relatively short. Its dimensions correspond to those of a big *Mustela palerminea*. Its crown is slightly oval in form.

Discussion. The relics described belong to a large species of the genus *Mustela*, bigger by 1/4 of size than biggest specimens of *Mustela palerminea* and extant ermines. The analysis of teeth and mandible structure points to a higher derivation in development in comparison with *Mustela palerminea* (a more solid and taller body of the mandible, the tendency to crown surface widening in molars and premolars, especially in P_4 and M_1, strengthening of P^4); it also points to the existence of features suggesting a lower stage of development than that of *Mustela erminea*. Dimensions and morphology are similar to those of the Middle Pleistocene species *Mustela strandi* KORMOS, 1933, from Hungary (KORMOS 1933), recorded from sediments dated back to the last cooling phase in the Cromer interglacial (CHALINE 1980). KRETZOI (1965) includes this species, together with the other large species, *Mustela praeglacialis* KORMOS, 1933, from the Early Pleistocene, to the *Mustela palerminea*. However, metrical and morphological characteristics of the described relics preclude their belonging to the species *Mustela palerminea* or *Mustela erminea*. They might belong to forms constituting a link in the evolution line leading to extant species of northern Asia, e. g. *Mustela sibirica* PALLAS, 1773.

Mustela cf. *putorius* LINNAEUS 1758
(Fig. 28)

Material: layer 2a: C (MF/1335/1).

Description: The morphology of the tooth is similar to that of the canine of the extant polecat; its dimensions are slightly smaller. The length of the crown is 3.33 mm, its width is 2.75 mm, and its height — 7.76 mm. Two forms of the polecat were present in the Early Pleistocene of Europe: *Mustela putorius stromeri* KORMOS, 1933 (KRETZOI 1941; HELLER 1958), and *Mustela putorius eversmanni* LESSON, 1827 (THENIUS 1965).

Genus *Meles* BRISSON, 1762

Meles atavus KORMOS, 1914
(Figs. 29—32)

Material. Represents at least 3 individuals (MF/1337/1—8). Layer 2a: I^2, I^3, a fragment of M_1; layer 2c: C; layer 2a+b+c: I_3; slope waste: P_3, P^4.

Description. The structure of incisors as in *Meles meles* LINNAEUS, 1758. The length of I^2 is 2.9 mm, its width is 3.4 mm; the same dimensions in I^3 are respectively 3.3 and 4.4 mm. Mean values for I_3 are 3 mm (2.7 mm — 3.4 mm) in length and 2.6 mm (2.5 mm — 2.8 mm) in width. The canine is shorter and more curved than in specimens of the extant species. Its crown is 7.9 mm in

Fig. 28. *Mustela* cf. *putorius*. C (MF/1335/1)

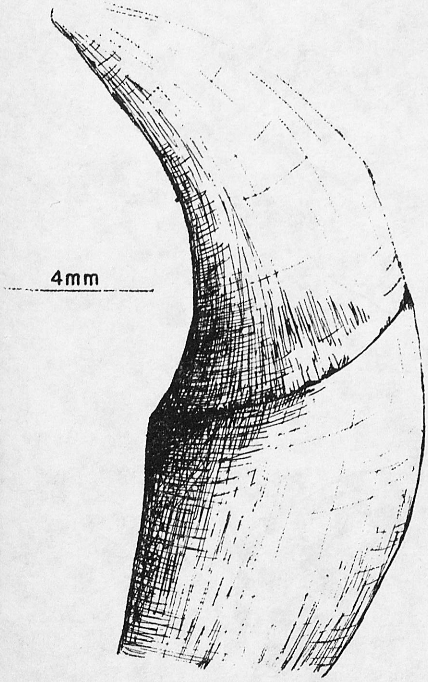

Fig. 29. *Meles atavus*. C (MF/1337/4)

length, 5.3 mm in width, and 11.2 mm in height. The crown of P^4 is triangular, with the acute angle formed by the external and central edges. The taller paraconus and the smaller metaconus are well developed. The cingulum culminates into a tubercle of considerable size on the lingual side of the tooth. The length

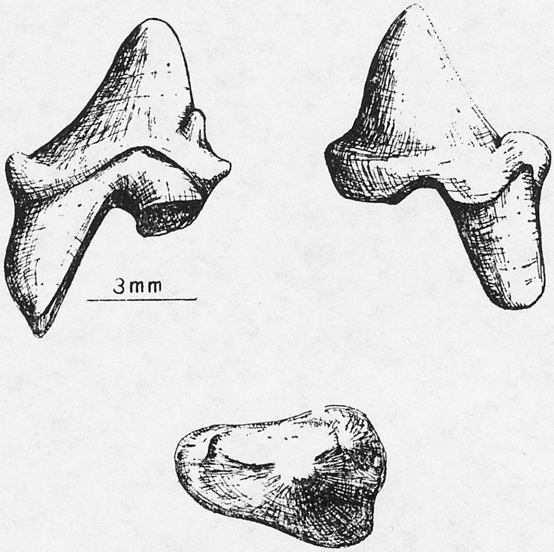

Fig. 30. *Meles atavus*. P_3 (MF/1337/8): from lingual side, from buccal side and from above

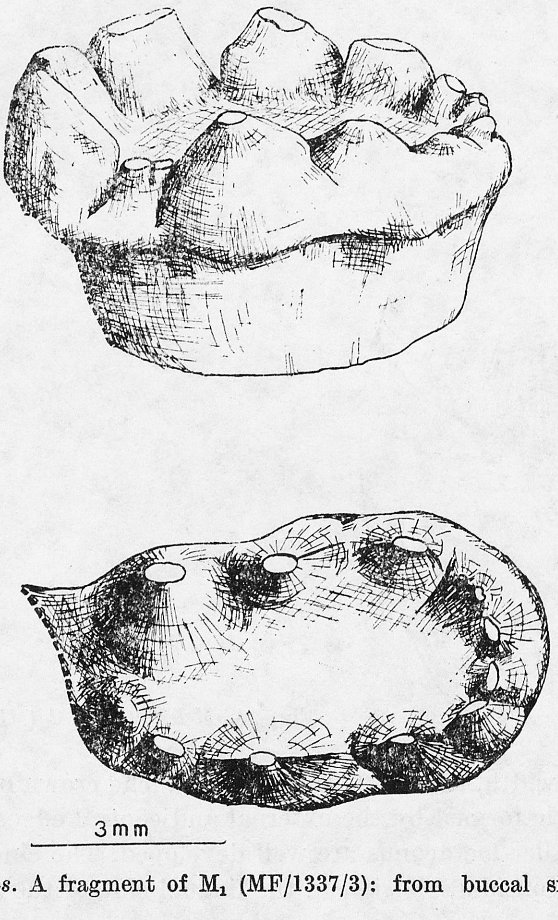

Fig. 31. *Meles atavus*. A fragment of M_1 (MF/1337/3): from buccal side and from above

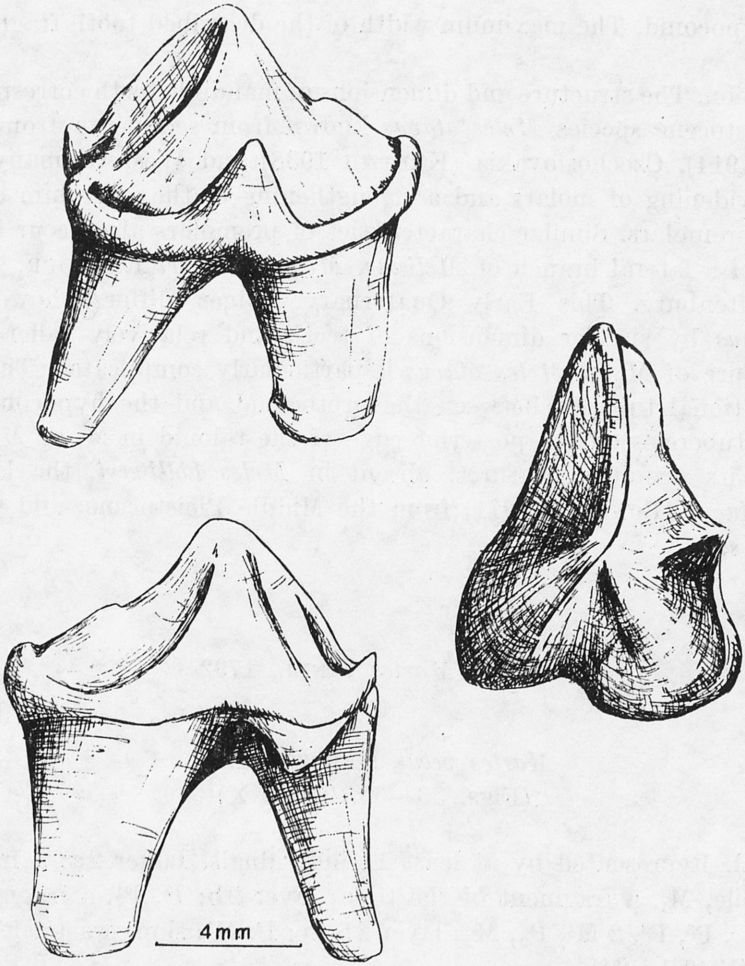

Fig. 32. *Meles atavus*. P4 (MF/1337/9): from lingual side, from buccal side and from above

of this tooth is 10.5 mm, the anterior width of the crown is 4.2 mm. This value becomes 7.6 mm when measured in posterior part of the tooth. The outline of the P_3 crown is elongated and oval (5.8 mm in length), strongly widened in its posterior part (3.6 mm). The cingulum is well developed, especially in the posterior part of the tooth. The width of the tooth measured in the anterior part of the crown is 2.6 mm; its height is 4.8 mm. The M_1 fragment possesses a talonid elongated towards the tooth axis. This talonid's length is 8.1 mm. Only the posterior wall of the protoconid is preserved in the damaged anterior part of the tooth. A well-developed hypoconid and a smaller hypoconulid occur on the buccal side of the talonid. The tooth wall on the lingual side is constituted by the massive metaconid fused with the entoconid; a small hypoconulid adjoins to the latter. The posterior edge of the talonid is formed by four minute tubercles. An additional prominence occurs between the posterior wall of the protoconid and the hypoconid. The maximum width of the described tooth fragment is 7.7 mm.

Discussion. The structure and dimensions of mandible teeth correspond to the Early Pleistocene species *Meles atavus* known from sediments from Hungary (Kormos 1914), Czechoslovakia (Kretzoi 1938) and West Germany (Heller 1958). A widening of molars and a strengthening of the cingulum can be observed in premolars. Similar characteristics of premolars also occur in a representative of a lateral branch of *Melinae*, *Meles hollitzeri* Rabeder, 1976, from Deutsch-Altenburg. This Early Quaternary badger differs, however, from *Meles atavus* by smaller dimensions of teeth and relatively taller tubercles. The structure of M_1 in *Meles atavus* is particularly complicated. The presence of an additional tubercle between the protoconid and the hypoconid, and of numerous tubercles on the posterior edge of the talonid in M_1 of *Meles atavus* constitute its primitive features, absent in *Meles hollitzeri*, the later *Meles thorali spelaeus* (Bonifay, 1971) from the Middle Pleistocene, and the extant *Meles meles*.

Genus *Martes* Pinel, 1792

Martes vetus Kretzoi, 1942
(Figs. 33—39, Table X)

Material. Represented by at least 11 individuals. Layer 2a: a fragment of the mandible, M_1, a fragment of the tibia; layer 2b: I^3, P^1, a fragment of P^4; layer 2c: P^1, P^3, P^4, 2 M^1, P_2, M_2; layer 2b+c: I^2, M^1; slope waste: P^1, P^4, 2 M^1, 5 C^1. (MF/1340/1—24).

Description. The structure of canines and incisors similar to that in other martens. The incisor is slightly wider than that in extant species of the genus *Martes*. P^1 has a small single root; this tooth is slightly longer than P^1 of *Martes*

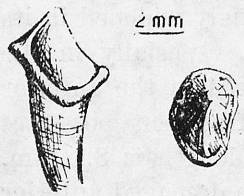

Fig. 33. *Martes vetus*. P^1 (MF/1340/5): from the side and from above

martes. The crown of P^3 is oval in shape. Its labial edge is slightly concave while the lingual one is convex. The general outline of the crown of P^4 is typical for the genus *Martes*. Its protoconus is relatively small; a well-developed cingulum occurs on the lingual side of the tooth. The tooth width measured in the proxi-

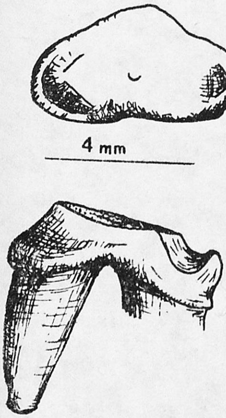

Fig. 34. *Martes vetus*. P^3 (MF/1340/8): from the side and from above

mity of the paraconus is bigger than the length of the protoconus. The length of P^4 is similar to the width of M^1. The shape of M^1 is alike its counterparts in the genus *Martes*. The lingual part of the tooth is widened, the middle part is indented on both edges, and the convex labial wall is distinctly notched. The crown is surrounded by a well-developed cingulum. P_2 is oval, slightly widened in its posterior part. The anterior wall of the single tubercle is more steeply

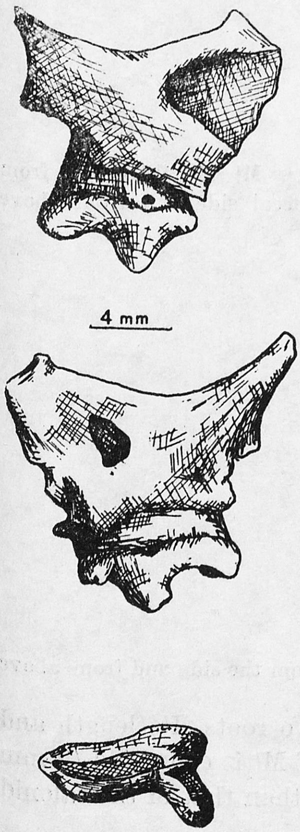

Fig. 35. *Martes vetus*. P^4 (MF/1340/17): from lingual side, from buccal side and from above

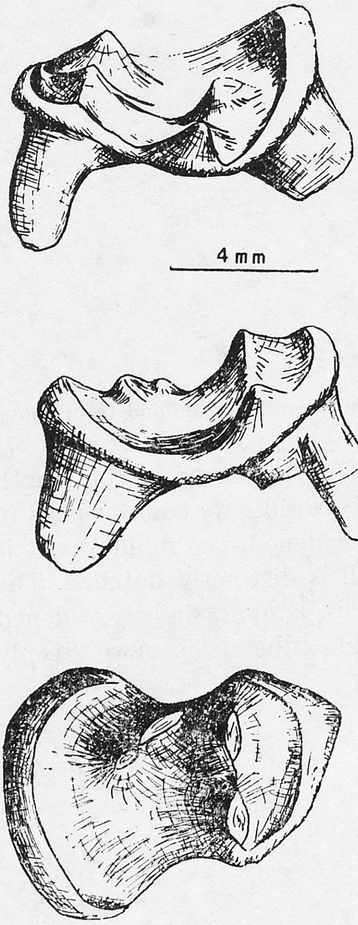

Fig. 36. *Martes vetus*. M^1 (MF/1340/18): from lingual side, from buccal side and from above

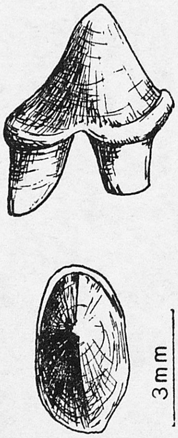

Fig. 37. *Martes vetus*. P_2 (MF/1349/12): from the side and from above

inclined than the posterior one. The tooth possesses two roots. Its length and width are respectively 4 mm and 2.5 mm. The crown of M^1 is elongated (9 mm in length). The length of the trigonid (6 mm) is greater than that of the talonid

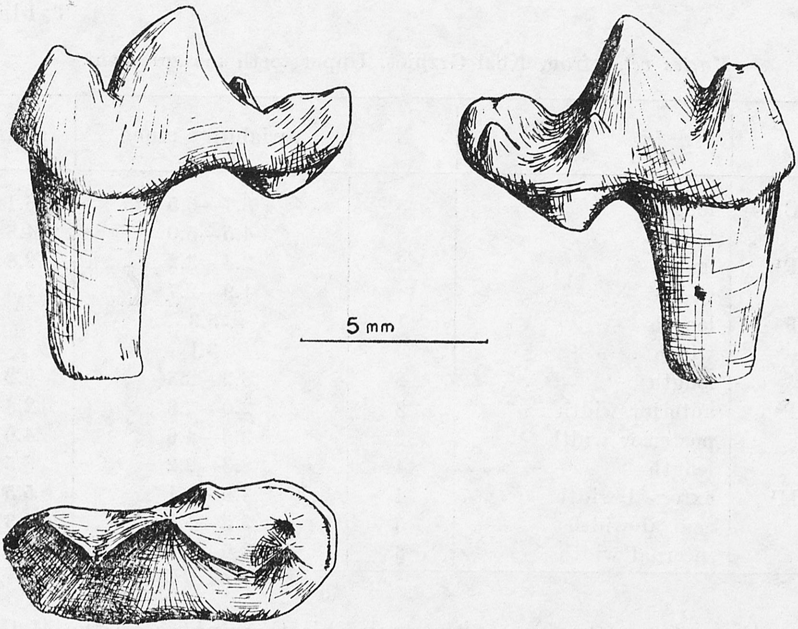

Fig. 38. *Martes vetus*. M_1 (MF/1340/2): from buccal side, from lingual side and from above

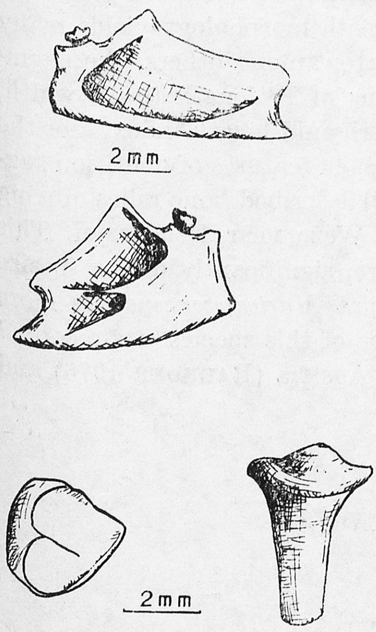

Fig. 39. *Martes vetus*. A fragment of the mandible (MF/1340/1): from the outside, from the inside M_2 from above and M_2 from the side

(2.7 mm). The metaconid is relatively small and rounded. A short hypoconid and a minute hypoconulid can be seen on the talonid. Its length (3.5 mm) is greater than that of the trigonid (2.5 mm). M_2 is slightly elongated, its length value (3.5 mm) is somewhat bigger than that of width (3.3 mm). Fossa mas-

Table X

Martes vetus from Kozi Grzbiet. Upper teeth measurements

		N	variability range	mean
C	length	5	5.7—6.5	6.1
	width		4.5—5.0	4.8
P^1	length	2	2.4—3.2	2.8
	width		1.9—2.7	2.3
P^3	length	1	5.3	
	width		3.1	
	length	2	8.2—8.3	8.2
P^4	anterior width	2	2.0—2.8	2.4
	posterior width	2	3.5—4.6	4.0
	length	4	8.3—9.2	8.5
M^1	external width	4	4.5—6.1	5.5
	central width	5	3.5—5.0	4.3
	internal width	5	3.6—4.5	4.0

seterica on the external surface of the mandible terminates on the M_1/M_2 boundary.

Discussion. Both the structure and the dimensions of described relics are similar to those of *Martes vetus*. The analysis of teeth morphology yields many features characteristic for *Martes martes*. These are, among others, the asymmetry of the crown of P^3, the similar proportions of P^4 length to M^1 width, the widening of the lingual part of M^1, a similar trigonid length index, and the degree of development of the metaconid on M_1. Such features of dentition suggest a close relation to *Martes martes*. STACH (1959) described bone relics of a big marten, *Martes wenzensis*, from the locality of Węże near Działoszyn. This species, in spite of its similarity in teeth structure, significantly differs in size from *Martes vetus*. ANDERSON (1970) supposes that *Martes wenzensis* is more probably an ancestor of *Martes vetus*. The presence of this species was recorded in Early and Middle Pleistocene sediments from Austria (RABEDER 1976) and West Germany (HELLER 1930; DEHM 1962).

Genus *Lutra* BRISSON, 1762

Lutra sp.

(Figs. 40—42, Table XI)

Material. Represents at least 12 specimens (MF/1338/1—26). Layer 2a: 4 C_1, I_3; layer 2c: 4 I^3, P^2, 2 C_1, I_3, M_1; layer 2a+b+c: I^2, 3I^3, C_1; slope waste: 5 C^1, I^3, P_2, P_4.

Description. The morphology of canines and incisors is identical with those

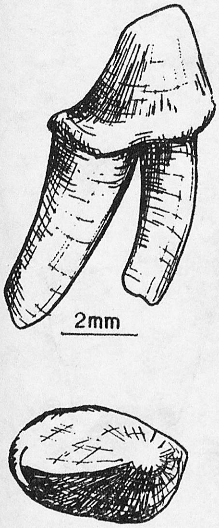

Fig. 40. *Lutra* sp. P_2 (MF/1338/20): from the side and from above

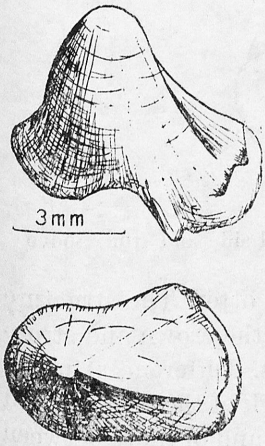

Fig. 41. *Lutra* sp. P_4 (MF/1338/21): from the side and from above

in the extant otter. The teeth P^2 and P_2 are double-rooted. Their crowns are slightly wider than in extant forms; the lack of the cingulum can be observed. The crown of P_4 is slightly elongated; it is widened in its posterior part, where a lightly indented cingulum is strongly developed. The protoconid is well--developed, too. The trigonid of M_1 is similar to that in *Lutra lutra*. Its talonid is shorter than the trigonid; more than a half of the former is occupied by a very well-developed hypoconid. The axis of the hypoconid is directed slightly towards the centre of the talonid; this significantly reduces the size of indentation on the talonid. There is no additional tubercle between the protoconid and the hypoconid; the hypoconulid is absent as well. The metaconid is weakly developed. An additional tubercle can be observed between the metaconid and the well--developed entoconid.

Discussion. The teeth described belong to a form somewhat larger than *Lutra simplicidens* THENIUS, 1965, occurring in the Early Pleistocene of Centra

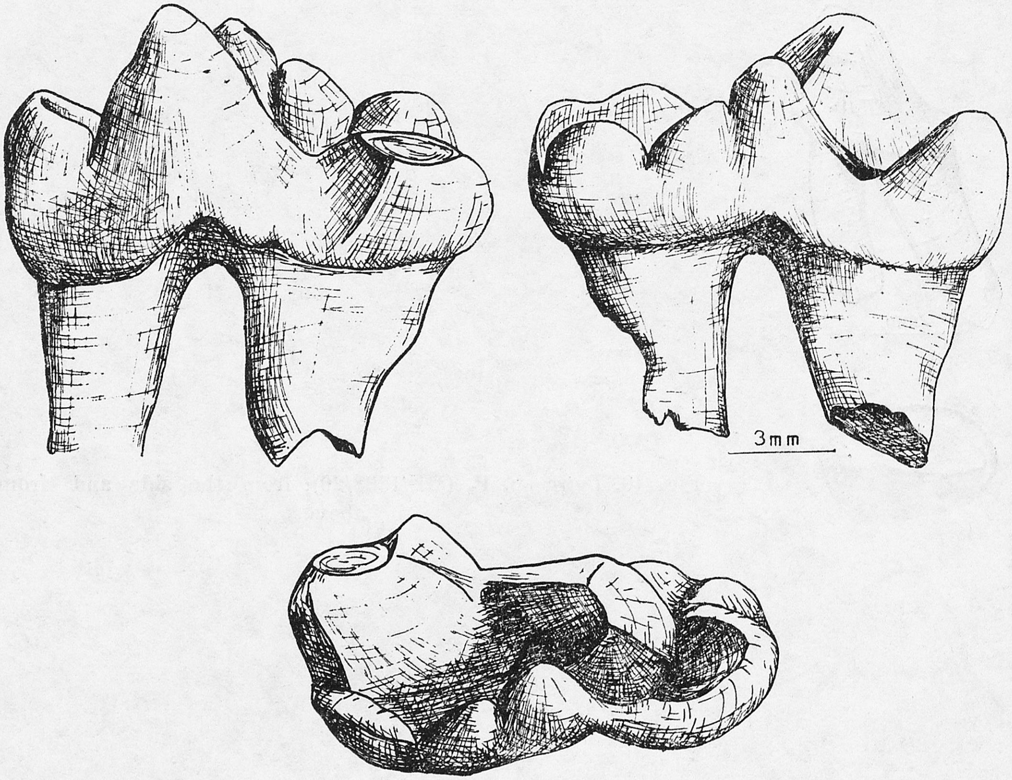

Fig. 42. *Lutra* sp. M_1 (MF/1338/13): from buccal side, from lingual side and from above

Europe; their dimensions are closer to those of the extant otter. The structure of premolars is characterized by the significant widening of the crown and stronger cingulum in comparison with the species *Lutra lutra*. Differences in the structure of M_1 are particularly important; these are: the lack of the hypoconulid and of tubercles between the protoconid and the hypoconid, and of those between the paraconid and the metaconid, which, on the contrary, are present in extant forms, and the presence of an additional tubercle between the metaconid and the entoconid which, in turn, does not occur in extant and Early Pleistocene otters. Also, the mentioned tubercles are better developed than the metaconid, and the hypoconid is better developed than it is in the extant species.

Family *Felidae* FISCHER, 1817
Genus *Felis* LINNAEUS, 1758

Felis sp.

Material. Represented by 2 individuals. Layer 2a: a phalange (MF/1344/1); layer 2c: patella (MF/1344/2), a phalange (MF/1344/3).

Description. Bone morphology points to their belonging to a small repre-

Table XI

Lutra sp. from Kozi Grzbiet. Teeth measurements

		N	variability range	mean
C^1	length	5	5.9—6.7	6.2
	width		4.7—5.4	5.0
I^2	length	3	2.4—3.8	3.3
	width		3.0—4.1	3.7
I^3	length	6	4.9—5.3	5.1
	width		3.2—4.0	3.6
P^2	length	1	3.9	
	width		2.9	
C_1	length	7	7.0—7.7	7.2
	width		4.6—5.7	5.0
I_3	length	1	2.7	
	width		2.5	
P_2	length	1	4.2	
	width		2.9	
P_4	length	1	6.6	
	width		4.0	
	length	1	13.1	
	anterior width		5.2	
M_1	central width	1	5.4	
	posterior width		6.7	
	talonid length		5.4	

sentative of the genus *Felis*. The maximum phalange length is 14 mm and 21 mm. The width of posterior epiphysis is 6.1 mm and 10.6 mm. The length of the patella is 20.5 mm; its width is 11.8 mm.

Family *Hyaenidae* GRAY, 1869
Genus *Crocuta* KAUP, 1828

Crocuta sp.
(Fig. 43)

Material. Layer 2c: coprolith (MF/1345/1).

Description. The coprolith is oval in shape, a slight groove can be seen in its middle part. The anterior edge culminates in a blunt cone, the posterior one is flattened. The maximum length is 39.4 mm, while the width is 28.4 mm.

Discussion. This coprolith is very similar in shape to those of *Percrocuta eximia* ROTH et WAGNER, 1854, from the Early Pliocene of Pikermi (MITZOPULOUS et ZAPFE 1961), *Crocuta crocuta* GOLDFUSS, 1823, from the Middle Pleistocene of LATAMME (HOOIJER 1961), *Crocuta spelaea* GOLDFUSS, 1823, from

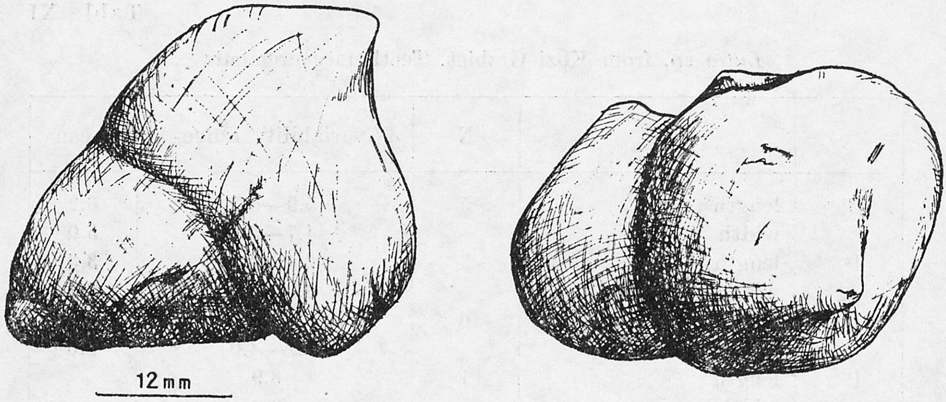

Fig. 43. *Crocuta* sp. Coprolith (MF/134. 5/1): from the side and from above

the Late Pleistocene of Brno (Thenius 1962), and the extant *Crocuta crocuta* Erzleben, 1777. Coproliths of extant hyaenas are usually smaller are more fusiform. The value of width/length ratio for the coprolith from Kozi Grzbiet is 72%; it oscillates between 65—80% in other forms of *Crocuta crocuta*. The same value for hyaenas is 40—50% (Mohr 1964). The shape of the coprolith is strongly connected with the diet. *Crocuta crocuta* coproliths are smaller and more irregular in cases of poor food and scant water (Kao 1962). As to the coprolith described, the shape of which is typical for the genus *Crocuta*, it might be ventured that the time of formation of the sediment containing this relic saw optimium conditions for the representative of this genus.

III. REMARKS

The relics described belong to 13 Early Quaternary species of *Carnivora*, 6 of which are new on the list of fossil fauna of Poland, and only a few of them are included in the extant fauna. *Ursus deningeri* is by far the dominant species in the material studied (60%); mustelids are also fairly numerous; relics of other species are scant. The greatest specific differentiation occurs in layer 2c. The overall list of the fauna composition is presented in Table XII.

The carnivore fauna association from Kozi Grzbiet embraces species characteristic for the Late Cromer fauna association. Both the determined absolute age of bone remains and the fauna allow the supposition that their deposition in sediments of the cave occurred in the same time interval as that of the formation of the fossil faunas from Voigstedt, Gombasek, Stránská Skála and Tiraspol.

Chaline (1980) dates the age of the mentioned localities to the 2nd interglaciation between glaciations A and B in the Cromer complex. Głazek et al.

(1976) suggest, on the basis of bone dating and climate-stratigraphy correlation of sediments containing bones, as well as on the basis of results of faunistic research, that the deposition of layer 2c in Kozi Grzbiet took part during the long warm period between the first overthrust of the continental glacier (Elster I) and its maximum stage (Elster II), corresponding to the interglacial profiles of Voigstaedt, Harreskov, and Olgod.

In his attempt at chronostratigraphy correlation of the Pleistocene of Poland with division units of the Quaternary in adjacent countries, LINDNER (1984) describes the layer 2 of the Kozi Grzbiet profile as an interglacial episode within the Middle Pleistocene, between the two glaciations of southern Poland, those of Nida and San, basing on paleontological and paleomagnetic data as well as on absolute datings. According to the same author, this warm period took part earlier than the Elster glacial and would correspond to the beginning of the horizon determined as Bruhnes by paleomagnetic data.

Table XII

General quantitative specification of determinable *Carnivora* relics from Kozi Grzbiet cave sediments

	Layer				Slope waste	Total
	2a	2b	2c	2abc		
Ursus deningeri	12	33	95	8	35	183
Canis mosbachensis	6	—	12	12	3	33
Canis strandi	—	—	—	2	—	2
Vulpes praeglacialis	—	1	6	5	2	14
Mustela palerminea	1	1	1	3	5	11
Mustela praenivalis	1	—	3	8	2	14
Mustela strandi	4	3	1	7	3	18
Meles atavus	3	—	1	3	2	9
Mustela cf. putorius	1	—	—	—	—	1
Martes vetus	3	3	7	2	9	24
Lutra sp.	5	—	9	5	8	27
Felis sp.	1	—	2	—	—	3
Crocuta sp.	—	—	1	—	—	1

Carnivore mammals of the Early Pleistocene of Central Europe exhibit a meagre stratigraphical value; they are of any significance as time indicators in localities where they appear for the first and the last times. Kozi Grzbiet constitutes so far the north-easternmost European locality of Early Pleistocene carnivore mammal fauna. It is also the first Polish locality containing a carnivore association from the Early Quaternary.

The fact that this cave was used as a temporary shelter (hyenas) and as hibernation lair (bears) is probably the cause of carnivore relics deposition in its sediments. Also, this cave might have served as a hiding-place for burrowing carnivores, or as a nesting spot.

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STRESZCZENIE

Praca niniejsza przedstawia opis wczesnoplejstoceńskiej fauny ssaków drapieżnych ze stanowiska Kozi Grzbiet w Górach Świętokrzyskich. Szczątki należą do 13 gatunków: *Ursus deningeri*, *Canis mosbachensis*, *Canis strandi*, *Vulpes praeglacialis*, *Mustela palerminea*, *Mustela praenivalis*, *Mustela strandi*, *Meles atavus*, *Mustela* cf. *putorius*, *Martes vetus*, *Lutra* sp., *Felis* sp. i *Crocuta* sp. Część z wymienionych gatunków to nowe formy dla fauny Polski, a tylko kilka z nich wchodzi w skład zespołu fauny współczesnej.

Gatunkiem zdecydowanie dominującym w badanym materiale jest *Ursus deningeri* (60%), a ponadto dość liczną grupę stanowią łasicowate, kości pozostałych gatunków natomiast są nieliczne.

Zespół fauny drapieżnych ssaków z Koziego Grzbietu obejmuje gatunki charakterystyczne dla późnokromerskiego zespołu faunistycznego. Podobne zespoły drapieżnych znane są między innymi ze stanowisk takich jak Voigstedt, Gombasek, Stránská Skála. Formowanie się tych kopalnych faun przypada na okres poprzedzający zlodowacenie Elster.

Kozi Grzbiet stanowi jak dotąd najdalej wysunięte na północny wschód w Europie stanowisko występowania wczesnoplejstoceńskiej fauny ssaków drapieżnych.

Przyczyną nagromadzenia się tych szczątków w osadach jaskini było prawdopodobnie wykorzystanie jej jako miejsca czasowego schronienia.

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