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Soricidae (Mammalia, Insectivora) remains from three Late Miocene localities in western Hungary

L. Gy. MÉSZÁROS[1]

(with 4 figures, 8 tables, and 4 plates)

Abstract

The Soricidae fauna of Sümeg, Csákvár and Széchenyi Hill (Hungary) is presented. The following taxa were identified in the fauna: *Dinosorex* sp., *Amblycoptus oligodon* KORMOS 1926, *Crusafontina endemica* GIBERT 1974, *Crusafontina vicina* (KRETZOI, 1954), *Blarinella dubia* (BACHMAYER & WILSON, 1970), *Paenelimnoecus repenningi* (BACHMAYER & WILSON, 1970), Soricidae gen. et sp. indet. The soricids supply new additions for the determining the detailed stratigraphic position of the localites. Based on the shrew material all the three assemblages are correlative with the Late Miocene (Sümeg: Vallesian, Csákvár and Széchenyi Hill: Turolian). The present soricids, occurred in these localities, are suggestive of well watered, wooded environments.

Introduction

Only a few shrew remains were found in the fossil microvertebrate material of the three Late Miocene karstic caves, discussed in the present paper. Nevertheless this material is very particular in the Hungarian Soricidae researches, because we have very few fossil shrew assemblages from the Miocene of Hungary. The shrew remains supplied new additions also for the precise chronological classification and the palaeoecology of the named localities.

KRETZOI (1951, 1954, 1980 and 1984) has worked out the Hipparion fauna of these fossiliferous cave sediments, and has listed the taxa, including the soricid ones, but usually without descriptions and measurements. In some details the faunal lists of the present paper differ from the determinations of KRETZOI.

[1]Department of Palaeontology, Eötvös University, H-1083 Budapest, Ludovika tér 2, Hungary

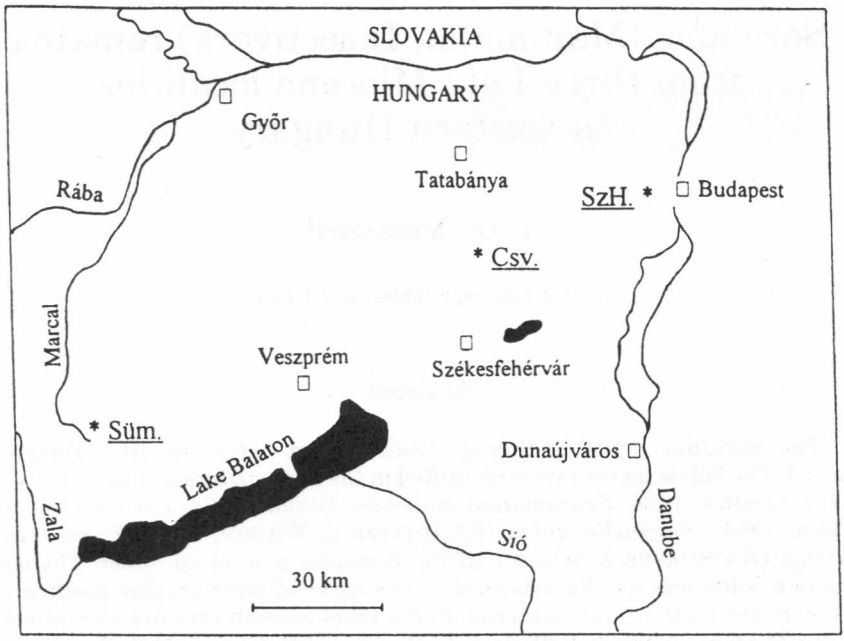

Fig. 1. Geographical situation of the studied localities.

Age	Stage	MN Zone	Locality	Soricidae species						
				Din. sp.	*Amb. ol.*	*Cr. end.*	*Cr. vic.*	*Bl. dub.*	*Pae. rep.*	Sor. ind.
Late	Turolian	12	Széchenyi H.		+					
	Turolian	11	Csákvár				+	+	+	
Miocene	Vallesian	10	Sümeg	+		+		+	+	+

Table 1. Stratigraphic position of the studied localities with the occurrences of the Soricidae taxa.

Localities

The localities (Sümeg-gerinc; Csákvár; Esterházy Cave, lowest fossiliferous layer and Széchenyi Hill, Budapest, Svájci street 14) are situated in the Hungarian Transdanubian Central Range. For the geographic situation of the sites see in Text fig. 1, the stratigraphic position and the occurrences of the shrew species are given in Table 1.

Sümeg-gerinc: This locality was a karst-fissure, near Sümeg, of which infilling sediments gave both micro- and macrofaunas. According to KRETZOI (1984), sleeping trees of owls should have been by the fissure. Accumulation of the owl pellets created a thick micro-bone layer in the sediment. From the Sümeg-gerinc site a total of 61 taxa could be identified by KRETZOI. Of these 3 are amphibians, 6 are reptiles, 5 are birds, and 47 are mammal species,

including 5 soricids. In the micromammals the insectivores are comparatively diversified, but the bats and the rodents are few in number.

Csákvár: The Esterházy Cave near Csákvár is in the Triassic dolomite of the Vértes Mountains. The excavations between 1926 and 1951 have found three main fossiliferous levels in the cave sediments. The lowest one, which was a dark grey phosphatic sandy calcareous marl, contained rich Hipparion fauna, including a few Soricidae remains (KRETZOI 1951). The shrew material only of this layer is studied here. The very rich Late Miocene fauna constituted the basis of establishing the continental biostratigraphic unit named "Csákvárium" by KRETZOI. He listed 87 taxa from this site: 3 invertebrates, 2 fishes, 3 amphibians, 6 reptiles, 6 birds and 66 mammals with 3 shrews.

Széchenyi Hill: This old locality is in Budapest, on the eastern side of the Széchenyi Hill. The remains were found in a fossiliferous yellow shale layer, which was excavated by the building operations of a new house, Svájci street 14 (KRETZOI 1984). The total amount of the fauna includes 18 taxa: 1 amphibian, 2 reptiles and 15 mammals, with 3 soricids.

	total number of the specimens			minimum number of the individuals		
	Süm.	Csv.	SzH.	Süm.	Csv.	SzH.
Din. sp.	2	-	-	1	-	-
Amb. ol.	-	-	2	-	-	1
Cr. end.	268	-	-	29	-	-
Cr. vic.	-	1	-	-	1	-
Bl. dub.	13	2	-	2	2	-
Pae. rep.	9	2	-	3	1	-
Sor. ind.	2	-	-	1	-	-

Table 2. Catalogue of the Soricidae remains from the studied localities

Material and method

The studied specimens were collected by M. KRETZOI and L. KORDOS, and were selected from the samples by the author (except for V. 11417. and V. 14044.). The whole material belong to the collection of the Geological Museum of Hungary (in the Geological Institute of Hungary). The catalogue of the soricid material of the three localities includes 301 specimens (more exactly see in Tab. 2). For the nomenclature of the anatomy see REUMER 1984 and MÉSZÁROS 1996, in press b. The measurements are taken in millimetres, after REUMER 1984. The scanning photos were made in the SEM Laboratory of the Geological Institute, Eötvös Loránd University. The abbreviations used in the tables and figures: I = incisor, A = antemolar, P = praemolar, M = molar, L = length, LL = lingual length, BL = buccal length, W = width, AW = anterior with, PW = posterior width, H = height, min. = the minimum value, mean = the mean value, max. = the maximum value, s.e. = standard error of the

mean, s.d. = standard deviation of the mean, Can Ll. = Can Llobateres, Rud. = Rudabánya, Süm. = Sümeg-gerinc, Koch. = Kochfidisch, Csv. = Csákvár, Dorn-D. = Dorn-Dürkheim, SzH = Széchenyi Hill, *Din.* sp = *Dinosorex* species, *Amb. ol.* = *Amblycoptus oligodon*, *Cr. vic* = *Crusafontina vicina*, *Cr. end.* = *Crusafontina endemica*, *Bl. dub.* = *Blarinella dubia*, *Pae. rep.* = *Paenelimnoecus repenningi*, Sor. ind. = Soricidae genus et species indet. On the photos the scales represent 1 mm.

Systematic part

Classis Mammalia LINNAEUS 1735
Order Insectivora BOWDICH 1821
Family Soricidae GRAY 1821

Subfamily Heterosoricinae VIRET & ZAPFE 1952

REUMER (1987) classified this group as family Heterosoricidae. This classification was accepted by some authors. Others did not support the view of REUMER view. They think the family rank of the heterosoricines is not necessary until it is shown that the Heterosoricinae constitute a closely knit unit of fossil shrews which represents a plesiomorphic sistergroup of all other soricid subfamilies.

Genus *Dinosorex* ENGESSER 1972

Type species: *Dinosorex sansaniensis* (LARTET, 1851)

Dinosorex sp.
Pl. 1, Fig 1

? 1984 - *Trymilus* cf. *sansaniense* LARTET 1851 - Kretzoi, p. 215 (Sümeg)

Studied material:
Sümeg: 1 left M_3, 1 right M_3 (V. 20581.)

Measurements: See Tab. 3.

		min.	mean	max.	n.
M_3	L	1.61	1.62	1.63	2
	W	0.98	1.06	1.02	2

Table 3. Measurements of *Dinosorex* sp. from Sümeg-gerinc

Description:

M_3 - The tooth is twoo-rooted. The posytcristid joins the entoconid, there is no divided entostylid. The entoconid crest is absent. Ecto- and posterocingulids are well developed.

Remarks: The available material is too small to determine this form more precisely. This form is perhaps the same what KRETZOI reported from this site as "*Trymilus* cf. *sansaniense* LARTET 1851". But, that taxon, classified nowadays as *Dinosorex*, is somewhat bigger than the present one and has entoconid crest on the lower molars.

Subfamily Soricinae FISCHER VON WALDHEIM 1817
Tribe Anourosoricini ANDERSON 1879

This group is named also as Amblycoptini KORMOS 1926 by some authors, but with the same content as Anourosoricini ANDERSON 1879.

Genus *Amblycoptus* KORMOS 1926

Type species: *Amblycoptus oligodon* KORMOS 1926

Amblycoptus oligodon KORMOS 1926
Pl. 1, Fig 2

1926 - *Amblycoptus oligodon* n. g. et n. sp. - KORMOS, p. 543. pl. 3. figs 1-5 (Polgárdi 2).
1980 - *Amblycoptus* cf. *oligodon* KORMOS 1926 - KRETZOI, p. 312 (Széchenyi Hill).
1996 - *Amblycoptus* cf. *oligodon* KORMOS 1926 - HÍR & MÉSZÁROS, p. 171, fig. 4 (Egyházasdengeleg).

Holotype: Left maxilla with five teeth, Geological Museum of Hungary (Geological Institute of Hungary), OB. 5071., Kormos (1926), p. 352, pl. 3 figs 1-5., Type locality: Polgárdi 2. (Hungary, Late Turolian, MN. 13).

Stratigraphic range: Late Miocene (Turolian, MN 12-13), Europe.

Studied material:

Széchenyi Hill: $1A^1$, $1I_1$ (V. 14044.)

Measurements: See Tab. 4.

		value	n.
A^1	L	1.91	1
	W	1.50	1
I_1	L	-	-
	H	1.27	1

Table 4. Measurements of *Amblycoptus oligodon* KORMOS 1926 from Széchenyi Hill

Description:

A^1 - This is a one-rooted, big tooth. The lingual and buccal cingulums are wide on the anterior, but narrow on the posterior part. The paracone is wide and high, without parastyle. The protocone is well developed, the metacone is thin. The posterior margin is slightly notched.

I_1 - The lower incisor is very much digested, the root is broken down, but the tooth is clearly acuspulate.

Remarks: In spite of the few present remains, the teeth are easily determinable. Among the similar genera, out of *Amblycoptus*, only *Paranourosorex* RZEBIK-KOWALSKA 1975 and *Kordosia* MÉSZÁROS 1996 has acuspulate lower incisor. The present species can be clearly divided from *Paranourosorex* by its much less dimensions. The A^1 without parastyle is a significantly different detail of *Amblycoptus oligodon* from *Kordosia*.

Relatively to the later Polgárdi ones, the paracone is wider and shorter, the protocone is bigger on the Széchenyi Hill A^1. In the present tooth the lingual margin of the paracone is concave, while in the later ones is convex. It seems a special evolutionary trend from the earliest occurrence of *A. oligodon* to the latest ones: the tooth becomes longer and mainly narrower. In the most evolved forms the paracone is like a cutting edge, wich perhaps played a prominent part in the changed nourishment.

Genus *Crusafontina* GIBERT 1974

Type species: *Crusafontina endemica* GIBERT 1974

Crusafontina endemica GIBERT 1974
Pl. 1, Fig. 3, Pl. 2, Fig 4

1975 - *Crusafontina endemica* GIBERT 1974 - Gibert, p. 118, figs 6, 7a, 7b (Can Llobateres).
1976 - *Anourosorex kormosi* BACHMAYER & WILSON 1970 - KRETZOI et al., p. 375 (Rudabánya).
1985 - *Anourosorex kormosi* BACHMAYER & WILSON 1970 - RABEDER, p. 447 (Rudabánya).
1991 - *Anourosorex kormosi* BACHMAYER & WILSON 1970 - KORDOS, p. 348 (Rudabánya).
1984 - *Amblycoptus vicinus* KRETZOI 1954 - KRETZOI, p. 215 (Sümeg).
1984 - *Anourosorex kormosi* BACHMAYER & WILSON 1970 - KRETZOI, p. 215 (Sümeg).
1996 a - *Crusafontina endemica* GIBERT 1974 - MÉSZÁROS, in press, a (Rudabánya, Sümeg).
1996 - *Crusafontina* aff. *endemica* GIBERT 1974 - MÉSZÁROS & ZIEGLER, in press (Rudabánya).

Holotype: Left mandible fragment with P_4-M_2, Nr. 9002, GIBERT (1975), p.118. Type locality: Can Llobateres (Spain, Early Vallesian, MN 9).

Stratigraphic range: Late Miocene (Vallesian, MN 9 - 10), Europe.

Studied material:

Sümeg-gerinc: 1 right maxillary fragment with P_4-M_1, 17 left and 25 right mandible fragments, 28 left I^1, 22 right I^1, 9 left A^1, 14 right A^1, 2 left A^2, 11

left P^4, 9 right P^4, 14 left M^1, 15 right M^1, 5 left M^2, 6 right M^2, 20 left I_1, 22 right I_1, 4 right A_2, 8 left M_1, 8 right M_1, 12 left M_2, 12 right M_2, 1 left M_3, 1 right M_3 The figured specimens: V. 20582. and V. 20583.

Measurements: See Tab. 5.

		min.	mean	max.	n.	s.e.	s.d.
I^1	L	2.37	2.48	2.62	8	0.0913	0.0992
	H	1.55	1.74	1.87	8	0.0838	0.1030
A^1	L	1.54	1.77	2.00	26	0.0796	0.1063
	W	1.00	1.08	1.18	26	0.0509	0.0582
A^2	L	1.08	1.10	1.03	2	0.0250	0.0250
	W	0.93	0.95	0.98	2	0.0250	0.0250
P^4	LL	1.25	1.40	1.64	13	0.0676	0.1030
	BL	2.10	2.35	2.55	13	0.0987	0.1200
	W	2.10	2.23	2.39	13	0.0555	0.0987
M^1	LL	1.74	1.91	1.98	12	0.0477	0.0651
	BL	1.88	2.09	2.17	12	0.0599	0.0791
	AW	1.96	2.17	2.28	12	0.0919	0.1050
	PW	2.05	2.19	2.33	12	0.0660	0.0772
M^2	LL	1.03	1.17	1.44	11	0.0924	0.1198
	BL	1.28	1.39	1.85	11	0.0519	0.0712
	AW	1.93	2.11	2.35	11	0.0862	0.0119
	PW	2.28	1.32	1.63	11	0.1010	0.1296
I_1	L	4.56	4.73	5.12	4	0.1975	0.2317
	H	1.12	1.16	1.19	4	0.0187	0.0249
A_2	L	1.29	1.37	1.55	6	0.0930	0.0570
	W	0.88	0.93	1.03	6	0.0570	0.0930
M_1	L	2.39	2.56	2.72	9	0.0986	0.1168
	W	1.24	1.29	1.34	9	0.0307	0.0341
M_2	L	1.54	1.77	1.86	3	0.0824	0.0704
	W	1.00	1.05	1.12	3	0.0499	0.0510
M_3	L	1.03	1.15	1.25	4	0.0824	0.0850
	W	0.30	0.59	0.75	4	0.0499	0.1715

Table 5. Measurements of *Crusafontina endemica* GIBERT 1974 from Sümeg-gerinc

Description: The detailed description and the comparisons are given in the special paper of the present author (MÉSZÁROS 1996, in press a) about this genus.

Remarks: In measurements the Sümeg *Crusafontina* material is between the Sümegian and Kochfidischian forms, but is closer to the latter.

Crusafontina vicina (KRETZOI, 1954)
Pl. 2, Fig. 5

1954 - *Amblycoptus vicinus* n. sp. - KRETZOI, p. 49 (Csákvár).
1970 - *Anourosorex kormosi* nov. spec. - BACHMAYER & WILSON p. 551, figs 3, 4, 4a, 20, 20a, 21, 22, 23, 23a, 24, 25 (Kochfidisch).
1978 - *Anourosorex kormosi* BACHMAYER & WILSON 1970 - BACHMAYER & WILSON, p. 141 pl. 2, figs, 5, 5a (Kochfidisch).
1978 - *"Anourosorex" kormosi* BACHMAYER & WILSON 1970 - STORCH, p. 424, pl. 4, figs 29-39 (Dorn-Dürkheim).
1980 - *Anourosorex kormosi* BACHMAYER & WILSON 1970 - BACHMAYER & WILSON, p. 361 (Kochfidisch).
1996 a - *Crusafontina vicina* (KRETZOI, 1954) - MÉSZÁROS, in press a, (Tardosbánya, Polgárdi 4).

Holotype: Left maxilla fragment with the incisor, two antemolars and a part of the alveole of the third one, Geological Museum of Hungary (Geological Institute of Hungary), V. 11417., KRETZOI (1954), p. 49. Type locality: Csákvár (Hungary, Early Turolian, MN 11).

Stratigraphic range: Late Miocene (Late Vallesian, MN 10 - Late Turolian, MN 13), Europe.

Studied material:
Csákvár, Esterházy Cave: the holotype (V. 11417.)

Measurements: See Tab. 6.

		value	n.
I^1	L	2.50	1
	H	1.86	1
A^1	L	2.05	1
	W	1.16	1
A^2	L	1.21	1
	W	1.02	1

Table 6. Measurements of *Crusafontina vicina* (KRETZOI, 1954) from Csákvár

Description: See in MÉSZÁROS 1996, in press a.

Remarks: This specimen was described by KRETZOI 1954 as the holotype of *Amblycoptus vicinus*, but without the morphological characters and figure. The first detailed description and the SEM photo of the specimen was given by MÉSZÁROS (1996, in press a), with the generic revision of the species. Some occurrences of Anourosorex kormosi BACHMAYER & WILSON are the synonymys of *Crusafontina vicina* (KRETZOI 1954). According to the measurements this sample is younger than Kochfidisch and Tardosbánya.

Tribe *Soricini* FISCHER VON WALDHEIM 1817
Genus *Blarinella* THOMAS 1911

Type species: *Blarinella quadraticauda* MILNE-EDWARDS 1872

Blarinella dubia (BACHMAYER and WILSON) 1970
Pl. 3, Fig. 6

partim 1954 - Soricidarum g. et sp. indet. II. - KRETZOI, p. 49. (Csákvár).
1970 - *Petenyia dubia* n. spec. - BACHMAYER & WILSON, p. 546. figs 6, 26, 27, 30, 31a (Kochfidisch).
? 1976 - *Petenyia dubia* BACHMAYER & WILSON 1970 - KRETZOI et al., p. 375 (Rudabánya).
1978 - *Petenyia dubia* BACHMAYER and WILSON 1970 - BACHMAYER & WILSON, p. 138. fig 18 (Kochfidisch).
1984 - *Petenyia dubia* BACHMAYER and WILSON 1970 - KRETZOI, p. 216 (Sümeg).
1984 - *Blarinella dubia* (BACHMAYER and WILSON) 1970 - REUMER, p. 66 pl. 20 figs 5-8 (Osztramos 9).
? 1985 - *Blarinella dubia* BACHMAYER & WILSON 1970 - RABEDER, p. 447 (Rudabánya).
1989 - *Blarinella dubia* (BACHMAYER and WILSON) 1970 - RZEBIK-KOWALSKA, p. 533 fig. 3 (Podlesice, Zalesiaki 1B).
? 1991 - *Blarinella dubia* BACHMAYER & WILSON 1970 - KORDOS, p. 348 (Rudabánya).
1995 - *Blarinella* cf. *dubia* (BACHMAYER and WILSON) 1970 - HÍR & MÉSZÁROS, p. 171, figs 3c-d (Egyházasdengeleg).

Holotype:

Left maxilla fragment with the three molars, Natural History Museum, Vienna, Div. Geol. Paleont., 1970/1387. (BACHMAYER & WILSON 1970, p. 546, figs 6, 26, 27, 30 and 31a.) Type locality: Kochfidisch (Austria, Late Vallesian, MN 10).

Stratigraphic range: Late Miocene (Early Turolian, MN 11 - Late Ruscinian, MN 14), Europe.

Studied material:

Sümeg-gerinc: 1 left mandible fragment with M_1-M_2, 1 left mandible fragment without teeth, 1 right condyle, 1 right I^1, 1 left A^1, 1 left A^2, 1 right M_1 right M^2, 1 left I_1, 1 right I_1 fragment, 1 right A_2, 1 left M_3. The figured specimens: V. 20584.

Csákvár, Esterházy Cave: 1 left mandible fragment with A_1-A_2, 1 left mandible fragment with M_3 (V. 11416.)

Measurements: See Tab. 7.

Description:

Mandible - The upper articular facet of the condyle is cylinder-shaped and makes an angle of about 45° whith the lower facet. The interarticular area is broad and centrally depressed. The lower facet has a concave upper and

lower edge. The mental foramen is placed between the protoconid and the hypoconid of M_1.

		Sümeg		Csákvár	
		value	n.	value	n.
I^1	L	1.90	1	-	-
	H	1.23	1	-	-
A^2	L	1.13	1	-	-
	W	0.87	1	-	-
M^1	LL	1.50	1	-	-
	BL	1.29	1	-	-
	AW	1.41	1	-	-
	PW	1.57	1	-	-
M^2	LL	1.31	1	-	-
	BL	1.29	1	-	-
	AW	1.52	1	-	-
	PW	1.39	1	-	-
I_1	L	3.62	1	-	-
	H	0.75	1	-	-
A_2	L	1.00	1	-	-
	W	0.86	1	-	-
M_1	L	1.49	1	-	-
	W	1.05	1	-	-
M_2	L	1.41	1	-	-
	W	0.82	1	-	-
M_3	L	1.15	1	1.25	1
	W	0.67	1	0.70	1

Table 7. Measurements of *Blarinella dubia* (BACHMAYER & WILSON, 1970) from Sümeg-gerinc and Csákvár

Teeth - There is a pigmentation on the anterior part of the lower incisor, the top of the apex and the talon of the upper incisor, and the cusps of the molars.

I^1 - The tooth is not fissident. The superior margin is straight or slightly concave. The posterior one is much convex, a wide buccal cingulum is present on it.

AA sup. - Only A^1 and A^2 are present in the studied material. A^1 is bigger than A^2. The paracone, the protocone and the hypocone are present on the first, but only the paracone and the protocone on the second antemolar.

M^1 and M^2 - They are quadrate shaped. M^1 is slightly bigger than M^2. On both teeth, the paracone is hardly lower than the metacone. The hypocone is not developed, the hypoconal flange is deeply excavated. The deep trigone basin is closed posteriorly by a metaloph. The posterior margin is slightly notched.

I_1 - The lower incisor is bicuspulate. The buccal cingulum is present only on the posterior part, but the lingual one is well developed.

AA inf. - A_1 is far less than A_2. A well developed cingulum is present on both sides of the lower antemolars.

M_1 and M_2 - The entoconid is situated very close to the metaconid and a high entoconid crest is present. The oblicristid-direct is between the protoconid and the metaconid. The postcristid runs behind the entoconid, the entostylid and the entoconid are separated by a wide valley. A cingulum is present on the buccal and the lingual side.

M_3 - The talonid is much reduced, only a single cusp is present, but the talonid basin is quite deep. The cingulum is developed only on the buccal side of the trigonid.

Remarks: In the synonymy list *B. dubia* occurres with question-mark in the Early Vallesian localities of Rudabánya quarry. This is on account of that KRETZOI et al.(1966) and after him RABEDER (1985) and KORDOS (1991) mention this taxa from the site. However MÉSZÁROS & ZIEGLER (1996, in press) studied an other sample from Rudabánya, they could not find *Blarinella* in the material. Unfortunately, the original material of KRETZOI et al.(1966) was not available for the later authors.

Subfamily and tribe Soricidae incertae sedis

The subfamiliar and tribal status of *Paenelimnoecus* is problematic. REUMER arranges it in the Allosoricini (1984), then in the Allosoricinae (1992), and gives a new diagnosis for the re-established subfamily. STORCH (1995) sees little justification for the inclusion of *Paenelimnoecus* in Allosoricines and ranges the taxon in Soricinae and leaves the tribal allocation open.

Genus *Paenelimnoecus* BAUDELOT 1972

Type species: *Paenelimnoecus crouzeli* BAUDELOT 1972

Paenelimnoecus repenningi BACHMAYER & WILSON 1970
Pl. 4, Fig. 7

1954 - Soricidarum g. et sp. indet. I. - KRETZOI, p. 49. (Csákvár).
partim 1954 - Soricidarum g. et sp. indet. II. - KRETZOI, p. 49. (Csákvár).
1970 - *Petenyiella ? repenningi* n. sp. - BACHMAYER & WILSON, p. 549, figs 7, 32, 32a, 33, 50, 50a (Kochfidish).
1978 - *Petenyiella ? repenningi* - BACHMAYER & WILSON, p. 139, fig. 3 (Kochfidish).
1984 - *Petenyiella repenningi* BACHMAYER & WILSON 1970 - KRETZOI, p. 216 (Sümeg).

Holotype:

Left lower jaw fragment with M_1-M_3, Natural History Museum, Wienna, Div. Geol. Paleont., 1970/1387., BACHMAYER & WILSON 1970, p. 549, figs 7,

32, 32a, 33, 50, 50a. Type locality: Kochfidisch (Austria, Late Vallesian, MN 10).

Stratigraphic range: Late Miocene (Early Turolian, MN 11 - Late Ruscinian, MN 13), Europe.

Studied material:

Sümeg-gerinc: 1 left mandible fragment, 3 right mandible fragments, 1 left P^4, 1 left M^1, 2 left I_1, 1 right M_1. The figured specimens: V. 20585.

Csákvár, Esterházy Cave: 1 left mandible fragment with M_1-M_3, 1 right I^1. (V. 11416.)

Measurements: See Tab. 8.

		Sümeg				Csákvár	
		min.	mean	max.	n.	value	n.
I^1	L	-	-	-	-	1.42	1
	H	-	-	-	-	1.20	1
P^4	BL	-	0.73	-	1	-	-
	LL	-	1.75	-	1	-	-
	W	-	1.25	-	1	-	-
I_1	L	2.21	2.28	2.35	2	-	-
	H	0.58	0.59	0.61	2	-	-
M_1	L	-	-	-	-	1.25	-
	W	-	-	-	-	0.61	-
M_2	L	-	1.11	-	1	1.11	-
	W	-	0.63	-	1	0.62	-
M_3	L	-	1.02	-	1	0.97	-
	W	-	0.52	-	1	0.50	-

Table 8. Measurements of *Paenelimnoecus repenningi* (BACHMAYER & WILSON, 1970) from Sümeg-gerinc and Csákvár

Description:

Mandible - Relatively to the oval upper condyloid facet, the oblong lower one is more extended. The interarticular area is narrow. The upper facet is parallel to the lower one. The coronoid process is high and narrow. The internal temporal fossa is subtriangular and higher than wide. The mandibular foramen is placed under the middle of the internal temporal fossa. The coronoid spicule is tiny. The mental foramen is situated under the middle of M_1.

I^1 - A slight buccal cingulum, but no buccal conule is present. The tooth is not fissident. The posterior margin is convex.

P^4 - It is much wider than long. There is no clearly devided protocone and hypocone on the ridge bordering the hypoconal flange. The parastyle is weak, the paracone is strong, its ridge is sharp. The hypoconal flange is deeply valleyed. The posterior emargination is well notched.

M^1 - The parastyle is broken on the studied specimen. The paracone is slightly lower than the metacone. The trigone basin is deep and is open posteriorly. The protocone is as high as the paracone. There is no separated hypocone on the ridge of the hypoconal flange. The talone basin is deep, the posterior emargination is notched.

I_1 - The present lower incisors are much digested, but they seem slightly bicuspulate.

M_1 and M_2 - The ectocingulid is week. The entoconid crest is absent. The postcristid direct is behind the entoconid, the entostylid is separated.

M_3 - The talonid is reduced to a single cusp. There is a week cingulid on the buccal side.

Remarks: The present form is distinguishable from the similar sized *Sorex minutus* by the different form of the condyle and the reduced talonid; from *Paenelimnoecus pannonicus* by the present entoconid of M_1 and M_2.

Soricidae gen. et sp. indet.
Pl. 4, Fig. 8

Studied material:
Sümeg: 1 left I^1 fragment, 1 right I^1. (V. 20586.)

Measurements: See Tab. 9.

		min.	mean	max.	n.
I^1	L	-	1.95	-	1
	W	1.02	1.07	1.12	2

Table 9. Measurements of Soricidae gen. et sp. indet. from Sümeg-gerinc

Description:
I^1 - The apex and the anterior part of the talone are concave, the posterior one is especially notched. There are no buccal cingulum and buccal conule at the posterior margin. The edge of the apex is S-shaped. The tooth is not bifid.

Conclusions

General remarks

Unfortunately the original material, described by KRETZOI (1954, 1980 and 1984) was not available in most cases for the author. There were surely more shrew specimens selected from the Sümeg material for KRETZOI then the present author, but it could not been found nowadays. Similarly the "Heterosoricinae sp." mentioned from the Széchenyi Hill sample was not

identificable in the collection of the Geological Museum of Hungary. Partly this causes that the present faunal lists differ from those of KRETZOI.

Taphonomy

However there were not taphonomical researches during the collecting work, we can get some information by the study of the remains.

KRETZOI (1984) mentions the Sümeg-gerinc fossil micro-bone sample as an accumulation of owl pellets. The quantity of the material (which was only partly seen by the author but was mentioned by KRETZOI) make us sure, that the animalian transport took very important part in the accumulation of the remains. But, the degree of the teeth corrosion (mainly the incisors), the very intensive breaking pattern of the bones and the great number of the isolated teeth suggest, that the soricids were killed and digested rather mammal predators then owls (Pl. 5, Fig. 9). This is supported by the great number of the carnivores in the fauna.

The taphonomy of the Széchenyi Hill material is more similar to the previous one. There are only a few shrew remains for the studies, but the enamel degradation is clearly visible on the surface of the *Amblycoptus* I_1, were only the dentin is present in the most part of the tooth (Pl. 1, fig. 2b).

The enamel surface on the Csákvár specimens is not digested, but the remains are fragmented, broken. It seems sure, that the transport by water played more important part in the accumulation, than in the case of the two other localities.

Stratigraphy

Based on the available soricids we can be sure that the assemblages are correlative with the Vallesian or the Turolian age. The occurred *Amblycoptus oligodon*, *Blarinella dubia*, *Paenelimnoecus repenningi*, and genus *Crusafontina* are the typical Late Miocene elements of the European fauna (Text fig. 2).

The presence of *Crusafontina vicina* suggests, that the geological age of Csákvár may not be earlier than Kochfidisch locality, Austria, the later part of MN 10 Zone, because this species does not appear before that. Only its ancestor, *C. endemica* occures in the MN 9 Zone (MÉSZÁROS, in press a). Based on the measurements, this sample is after Kochfidisch and Dorn-Dürkheim, MN 11 Zone (Text fig 3). We have to note that the chronological classification on the basis of the measurements is a little problematic in the case of Dorn-Dürkheim (see MÉSZÁROS, in press a).

Sümegian occurrence of *C. endemica* shows that the locality is older than Kochfidisch. On the basis of the measurements, this *Crusfontina* form may be intermediate between Rudabánya and Kochfidisch ones, but it is closer to the later. The possible age of Sümeg is from the upper part of the MN 9 to the lower one of the MN 10 Zone (Text fig 4).

The age of Széchenyi Hill has a great particularity in the determination of the time of the tectonic movements in the Buda Mountains and the surrounding areas. According to the former chronological classifications the locality was arranged in the lower part of the MN 12 Zone. *A. oligodon*, mentioned only in the latest part of the Turolian Age (MN 13), suggests that the fauna of this karst fissure to be correlative with the MN 13 or at least the end of the MN 12 Zone. The age of this assemblage is certainly younger than the Hungarian locality of Tardosbánya, wich is before the FAD of the named species (MÉSZÁROS, in prep. a) (Text fig 2). The measurements suggest, that the Széchenyi Hill material is very close to the Polgárdi 4 one (MÉSZÁROS, in prep, b) but is somewhat older (Text fig. 5).

Age	Stage	MN Zone	Locality	Soricidae taxa						
				Din.	*Cr. end.*	*Cr. vic.*	*Bl. dub.*	*Pae. rep.*	*Amb ol.*	Sor. ind.
Late Miocene	Turolian	13	Polgárdi 2 Polgárdi 5 Polgárdi 4							
		12	Széchenyi H. Egyházasdengeleg Tardosbánya							
		11	Dorn-Dürkheim Csákvár							
	Vallesian	10	Kochfidisch Sümeg							
		9	Rudabánya Can Llobateres							

Fig. 2. Stratigraphical occurrence of the studied Soricidae taxa

Palaeoecology

Because of the climatic turnover, there was a great change in the Soricidae fauna of Europe during the Late Miocene (RZEBIK-KOWALSKA 1995). The somewhat colder and most arid climate caused the disappearance of many small sized Crocidosoricinae shrews with the immigration of Soricinae ones.

While the larger mammals and and rodents show mainly a steppe vegetation in the Late Miocene of Central Europe, the soricids indicate not so open environments. Their occurrences in most cases connect with somewhat more humid microclimates in mountain areas or by local water bodies. The Crocidurinae, wich are adaptated to quite dry climate, are not present among the shrews. On the other hand, the relation of the subfamilies in the fossil shrew assemblages indicate not so warm and humid climate as

in the Middle Miocene. There are no Crocidosoricinae, only few or no Heterosoricinae, but numerous Soricinae in the samples.

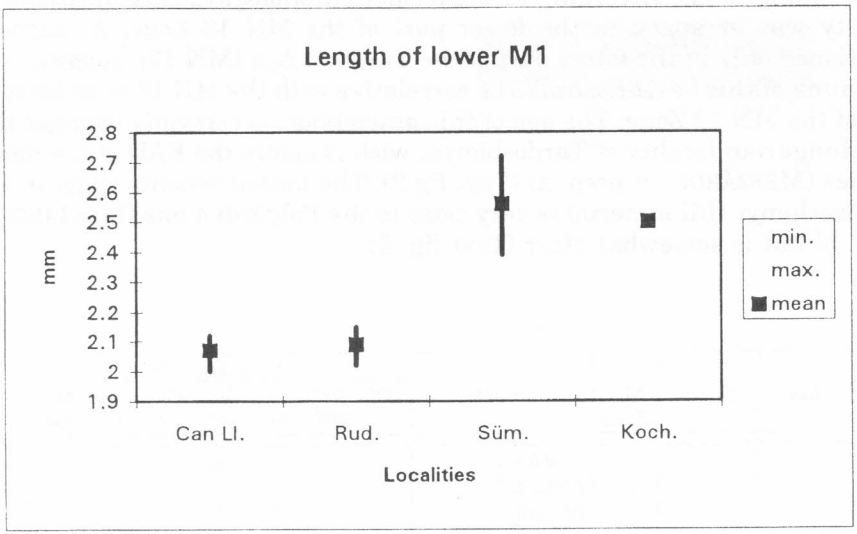

Fig. 3. The comparative diagram of the M_1 length of *Crusafontina*; the measurements are after MÉSZÁROS & ZIEGLER 1996, in press, GIBERT 1975 and BACHMAYER & WILSON 1970

Based on the very close relativity with the extant Asian species, *Anourosorex squamipes* we can see *Crusafontina* and *Amblycoptus* as indicators of well watered, wooded environments. *Crusafontina* is described from forested or at least partly wooded areas. Rudabánya should have been a basin of a relatively large area with diversified vegetation, including also forests (KORDOS, 1982). STORCH (1978) mentioned Dorn-Dürkheim as a well watered, forested biotope. Although, BACHMAYER & WILSON (1970) described Kochfidisch, as a largely open grassland, but with local bodies of water and restricted woodland areas. We do not now much about the ecology of the localities, in which material *Amblycoptus* occurred, but some datas seem to suggest, that it may have inhabited the same environment, as *Anourosorex* and *Crusafontina*.

Blarinella dubia and *Paenelimnoecus repenningi* are present in the European Soricidae fauna, after the climatic and faunal change at the beginning of the Late Miocene. Both genera have extant members in the mountain forests of Asia. We can suppose, that the named fossil species indicate similar habitats as those of their recent relatives.

The soricid fauna suggests that all the three studied localities were well watered, forested areas, in a mountain region or by a larger water body. The other fauna elements indicate either open karst areas or open water surfaces in the surroundings. On the basis of the subfamiliar relation of the samples the general climate seems relatively most arid and cooler to the Middle

Miocene, but not too extreme. This view is supported by the occurrence of many steppe taxa in the samples.

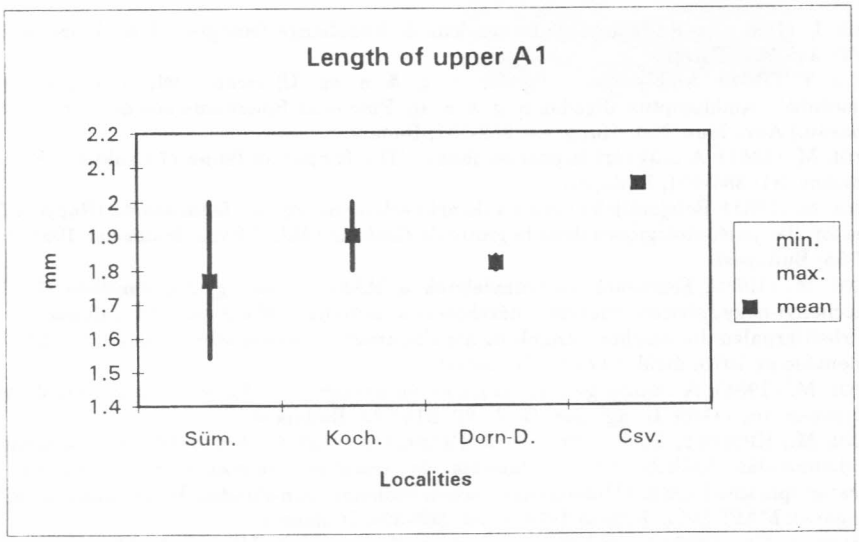

Fig. 4. The comparative diagram of the A^1 length of *Crusafontina*; the measurements are after BACHMAYER & WILSON 1970 and STORCH 1978

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In preparation

a - MÉSZÁROS, L. GY.: Late Miocene Soricidae (Mammalia, Insectivora) remains from Tardosbánya (Western Hungary).
b - MÉSZÁROS, L. GY.: An exceptionally rich Soricidae (Mammalia, Insectivora) fauna from the Late Miocene localities of Polgárdi quarry (West-Hungary).

Három dunántúli felső miocén lelőhely Soricidae (Mammalia, Insectivora) faunája

MÉSZÁROS Lukács György

A jelen cikkben szereplő három nyugat-magyarországi fosszílialelőhely mindössze néhány cickány maradványt szolgáltatott. A leletek mégis nagy jelentőségűek a hazai Soricidae kutatás számára, mert ebből a korból Magyarországról alig néhány ilyen lelőhelyet ismerünk. Az itt ismertetett karsztkitöltések Soricidae faunája nemcsak azért fontos, mert felvilágosítást ad ezen rendszertani csoport igen mozgalmas felső miocénbeli történetéről, de új adalékokat szolgáltat a lelőhelyek pontosabb geológiai korának és palaeoökológiai viszonyainak meghatározásához is.

A vizsgált mintákból a következő taxonok kerültek meghatározásra:

Sümeg-gerinc, kőfejtő

Dinosorex sp.
Crusafontina endemica (GIBERT, 1974)
Blarinella dubia (BACHMAYER & WILSON, 1970)
Paenelimnoecus repenningi (BACHMAYER & WILSON, 1970)
Soricidae gen. et sp. indet.

Csákvár, Esterházy-barlang

Crusafontina vicina (KRETZOI, 1954)
Blarinella dubia (BACHMAYER & WILSON, 1970)
Paenelimnoecus repenningi (BACHMAYER & WILSON, 1970)

Széchenyi-hegy, Svájci út 14

Amblycoptus oligodon KORMOS 1926

Bár a fauna begyűjtése során nem végeztek tafonómiai felméréseket, maguk a maradványok nyújtanak némi információt a felhalmozódás körülményeiről. KRETZOI (1984) szerint a sümeg-gerinci lelőhely kisemlős maradványai csak úgy halmozódhattak fel ilyen nagy tömegben, ha az

üledékgyűjtő karsztüreg közelében baglyok ülőfái voltak, amelyek lehulló köpeteiből képződhetett a vastag "kisemlős-réteg". A csontok és a fogak nagy mennyisége valóban állati transzportra utal. Az intenzív törési mintázat és a nagyfokú emésztettség alapján azonban az tűnik valószínűbbnek, hogy emlős ragadozók halmozták össze az anyagot. Ezt a faunában sűrűn előforduló Carnivorák is alátámasztják. A széchenyi-hegyi anyag felhalmozódása hasonló lehetett a sümeg-gerincihez. A csákvári maradványokon sokkal kisebb fokú az emésztettség, de a csontok töredékesek, sok a különálló fog. Az utóbbi esetben a víz által végzett szállítás nagyobb szerepet játszhatott a felhalmozódásban, mint az állati transzport.

A meghatározásra került Soricidae taxonok alapján a lelőhelyek kora bizonyosan késő miocén: az *Amblycoptus oligodon*, a *Blarinella dubia*, a *Paenelimnoecus repenningi*, és a *Crusafontina* tipikus képviselői ennek az időnek. A *C. endemica*, *C. vicina* és *A. oligodon* előfordulások, valamint a méretek alapján a lelőhelyek legvalószínűbb sztratigráfiai helyzete a következő:

Sümeg: Vallesien, MN 10, némileg idősebb, mint az ausztriai Kochfidisch lelőhely.

Csákvár: Vallesien, MN 11, fiatalabb, mint a németországi Dorn-Dürkheim.

Széchenyi-hegy: Turolien, MN 12 Zóna legfiatalabb vagy MN 13 Zóna legidősebb része, Tardosbánya és Polgárdi közti időszak.

Paleoökológiai szempontból a cickány fajok azt a megváltozott képet tükrözik, amely a középső-felső miocén határ után jellemzi Európát: a lehűlő és szárazodó klíma hatására eltűnnek a kisméretű Crocidosoricinaek, megritkulnak a Heterosoricinaek, helyüket átveszik az Ázsiából bevándorló Soricinaek. Bár a faunában előfordulnak sztyeppei elemek is, a cickányok ennél valamivel nedvesebb környezetre utalnak. A Soricidae társulás, összevetve egyéb faunaelemekkel, száraz éghajlaton, lokális, nyílt víztesthez vagy hegyvidéki környezethez kapcsolódó, jó vízellátottságú, erdei ökotópot jelez.

Plate 1

Figure 1. *Dinosorex* sp. from Sümeg-gerinc. a: left M_3, b: right M_3 (V. 20581.)

Figure 2. *Amblycoptus oligodon* KORMOS 1926 from Széchenyi Hill. a: left A^1, b: right I_1 (V. 14044.)

Figure 3. *Crusafontina endemica* GIBERT 1974 from Sümeg-gerinc. a: left I^1, b: left A^1, c: left A^2, d: left P^4, e: right M^1 (V. 20582.)

Plate 2

Figure 4. *Crusafontina endemica* GIBERT 1974 from Sümeg-gerinc. a: right M_1, b: left M_2, c: right M_2, d: left I_1 (V. 20583.)

Figure 5. a-b: the holotype of *Crusafontina vicina* (KRETZOI, 1954) from Csákvár (V. 11417.)

Plate 3

Figure 6. *Blarinella dubia* (BACHMAYER & WILSON, 1970) from Sümeg-gerinc. a: right I^1, b: right condyle, c: left A^1, d: left A^2, e: right M^1, f: right M^2, g: left M^3 (V. 20584.)

Plate 4

Figure 7. *Paenelimnoecus repenningi* (BACHMAYER & WILSON, 1970) from Sümeg-gerinc. a: left P^4, b: left M^1, c: left I_1, d: left condyle (V. 20585.)

Figure 8. Soricidae gen. et sp. indet. from Sümeg-gerinc. a: left I^1, b: right I^1 (V. 20586.)

Figure 9. Digested shrew incisors from Sümeg-gerinc. a-b: *Crusafontina endemica* GIBERT 1974 (V. 20587.)

Plate 1

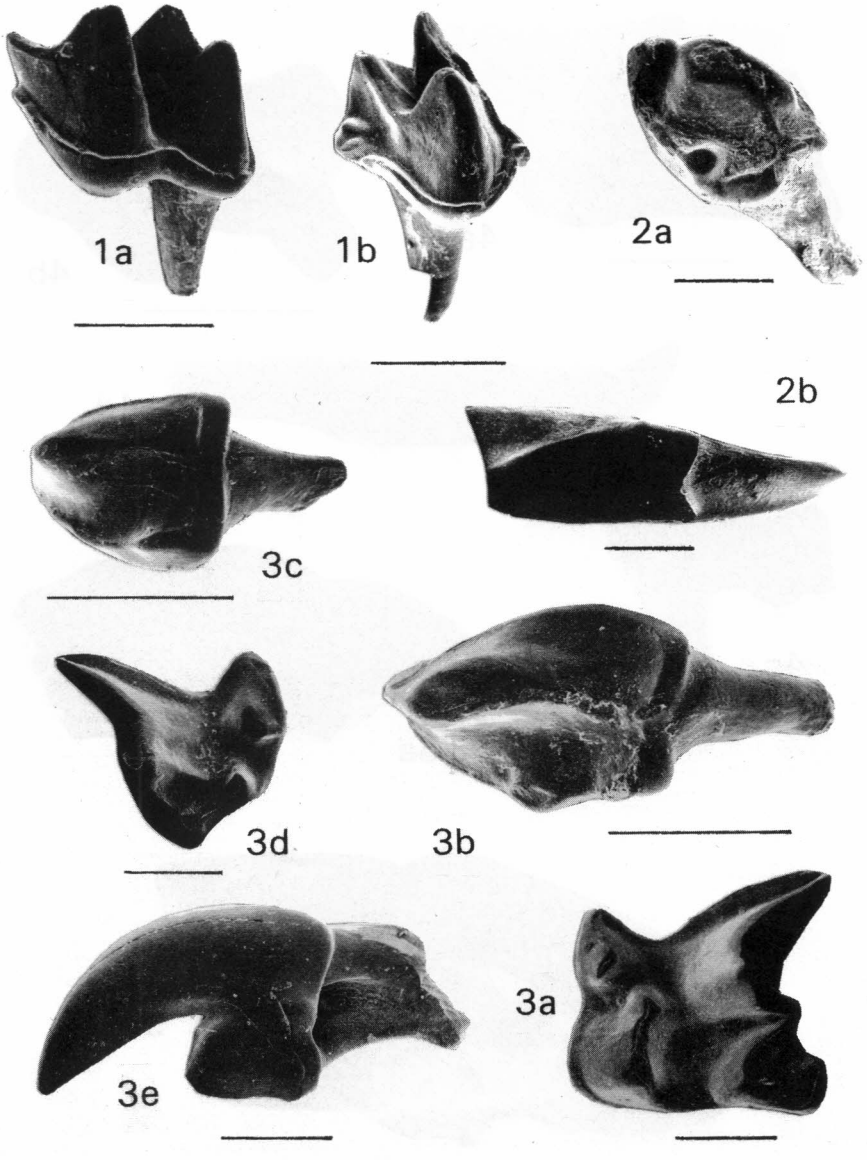

Plate 2

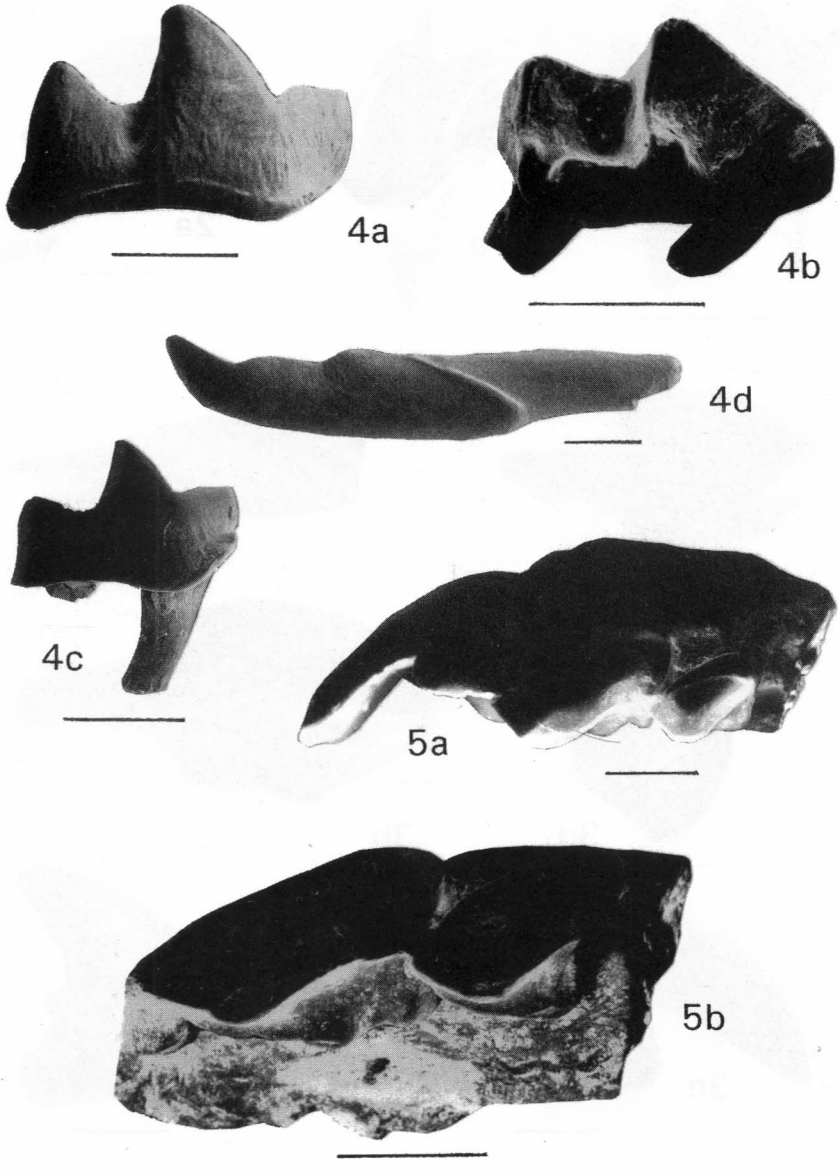

Plate 3

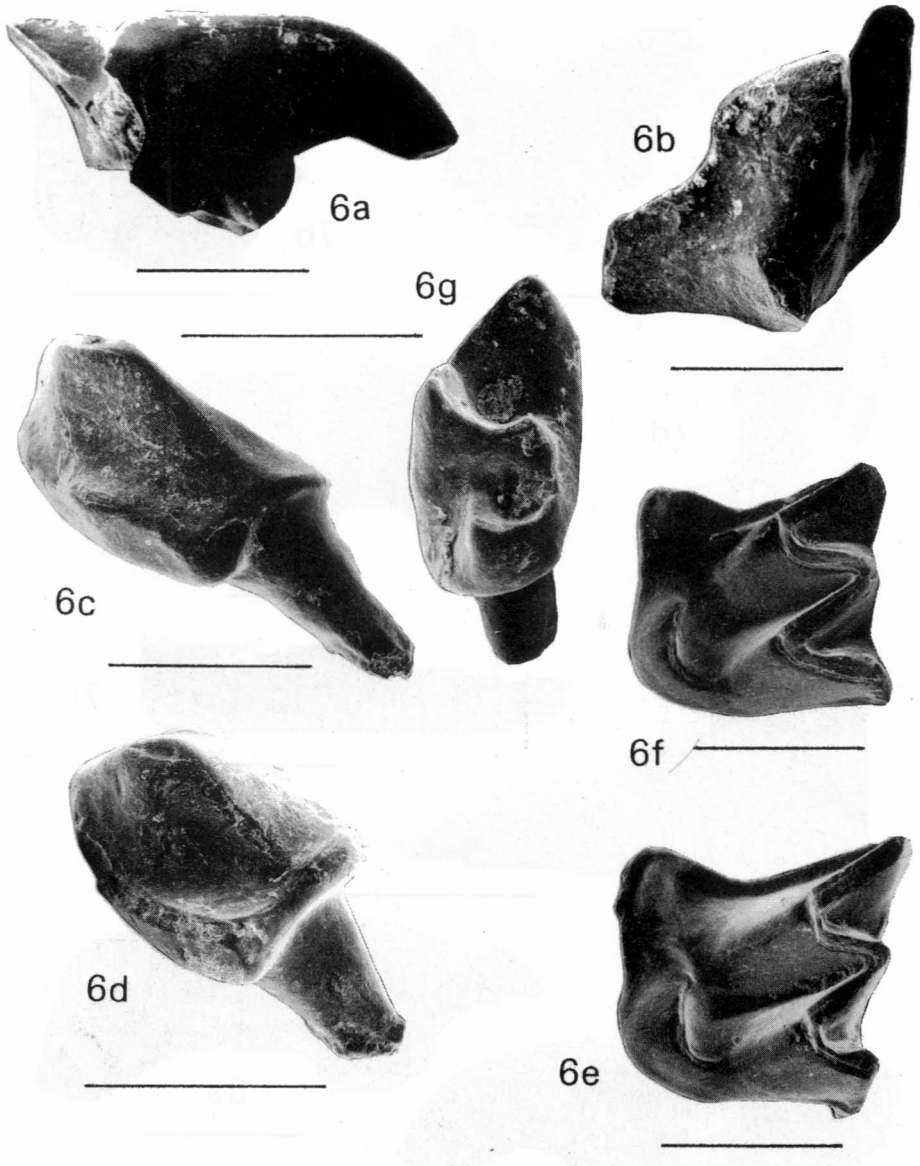

Plate 4