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Late Miocene Soricidae (Mammalia) fauna from Tardosbánya (Western Hungary)

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(With 5 figures, 6 tables and 4 plates)

The Soricidae (Mammalia, Insectivora) elements of the rich and well preserved fossil vertebrate fauna from Tardosbánya limestone quarry (Western Hungary, Gerecse Mountains) are presented. Five species could have been identified from the material: *Amblycoptus oligodon* KORMOS 1926, *Crusafontina kormosi* (BACHMAYER & WILSON, 1970), *Blarinella dubia* (BACHMAYER and WILSON, 1970), *Episoriculus gibberodon* (PETÉNYI, 1864) and *Paenelimnoecus repenningi* (BACHMAYER & WILSON, 1970). The occurrence of *Crusafontina*, *B. dubia* and *P. repenningi* indicates that the age of the sample is Late Miocene. The morphometrical studies on *C. kormosi*, and the morphology and the low relative frequency of *A. oligodon* suggest that the fauna is correlative with the Turolian MN 12 Zone. The occurrence of *A. oligodon*, *C. kormosi* and *E. gibberodon* indicates well watered, forested environment.

Introduction

The Late Miocene vertebrate fauna from Tardosbánya quarry was collected by D. JÁNOSSY (Hungarian Natural History Museum) in 1975. He gave a preliminary faunal list of the sample (1981, only in manuscript form) and deposited the material in the Geological Museum of Hungary (GMH) (in the Geological Institute of Hungary). JÁNOSSY listed the following soricids:

- "*Petenyia*"
- "*Episoriculus*", little
- "*Episoriculus*", bigger
- "*Anourosorex*"
- "*Chimarrogale-Allosorex* group"
- "*Sorex* sp. I"
- "*Sorex* sp. II".

The first report on the Tardosbánya micromammals was given by KORDOS (1985), who elaborated the *Anomalospalax* elements of the fauna. He correlated the site with MN 11-12 Zone. In his later paper, about the evolution of the Late Neogene Cricetidae in the Carpathian Basin (KORDOS 1987), he arranged Tardosbánya locality in the MN 12 Zone. The present paper displays the shrews of the material and tries to make a more detailed stratigraphical and ecological classification of the locality.

Locality

Tardosbánya is situated at the northern margin of the Transdanubian Central Range (Western Hungary), about 10 km north from Tatabánya (see Fig. 1). The remains have been found in a sediment-filled fossil shaft in the Jurassic limestone of the Gerecse Mountains, excavated by exploitation in the "red marble" quarry near Tardosbánya.

Material and method

The shrew remains were selected from the sample by the author. The catalogue of the soricid material includes 822 specimens (more exactly see in Tab. 1). The scanning photos were made in the SEM Laboratory of the Geological Institute, Eötvös Loránd University.

For the nomenclature of the morphology and the measurements see REUMER 1984. The measurements are taken in millimetres.

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, total nr. spec.

= total number of the specimens, min. nr. ind. = the minimum number of the individuals, *Amb. ol.* = *Amblycoptus oligodon*, *Cr. kor.* = *Crusafontina kormosi*, *Bl. dub.* = *Blarinella dubia*, *Ep. gibb.* = *Episoriculus gibberodon*, *Pae. rep.* = *Paenelimnoecus repenningi*.

Fig. 1. Geographic situation of Tardosbánya locality

Systematic part

Classis Mammalia LINNAEUS 1735
Order Insectivora BOWDICH 1821
Family Soricidae GRAY 1821
Subfamily Soricinae FISCHER VON WALDHEIM 1817
Tribe Anourosoricini ANDERSON 1879
(=Amblycoptini KORMOS 1926)

Genus *Amblycoptus* KORMOS 1926

Type species: *Amblycoptus oligodon* KORMOS 1926

Amblycoptus oligodon KORMOS 1926
Pl. 1, Figs 1-4

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)
1995 - *Amblycoptus* cf. *oligodon* KORMOS 1926 - HÍR & MÉSZÁROS, p. 171, figs 4 a-l (Egyházasdengeleg)
1996 - *Amblycoptus oligodon* KORMOS 1926 - MÉSZÁROS, p. 9, pl. 1, figs 2 a-b (Széchenyi Hill)

Holotype: Left maxilla with five teeth, GMH - 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: 2 left mandible fragments, 2 right mandible fragments, 4 left I^1, 6 right I^1, 1 left A^1, 2 right A^1, 1 right P^4, 1 left M^1, 1 right M^1, 1 left M^2, 13 left I_1, 20 right I_1, 1 right M_2. The figured specimens: GMH - V. 20591.

Measurements: See Tab. 2.

Description:

Mandible - The oval shaped internal temporal fossa is extremely tight. It faces slightly ahead. The mandibular foramen is situated under the anterior margin of the fossa.

I^1 - The upper incisor is not fissident. A buccal conule and cingulum are present at the basal margin of the crown. The talone is rounded, the apex is strong, but not too much sharp and down-turned. The posterior margin is convex or slightly S-shaped in buccal view.

A^1 - The enormous paracone is situated rather at the anterior 1/3 of the length of the antemolar than centrally. The small protocone is on the posterior 1/3 of the lingual cingulum. The hypocone is situated in the postero-lingual corner. The hypocone is always smaller than the protocone. Lingual, buccal and posterior cingula are well developed.

P^4 - The protruding parastyle is about in the median line of the tooth. A short and narrow parastylar crest ranges between the parastyle and the large paracone. These two elements are very close together. The protocone and the hypocone are of the same size. The hypoconal flange is bordered by a hardly visible ridge. The posterior emargination is very much concave.

M^1 - AW is only slightly less than PW. The parastyle is very strong, the metastyle is also long, but much weaker. The mesostyle is hardly developed, so the buccal margin of the first molar has a large notch. The protocone, the paracone and the metacone are strong, the trigone basin is wide. The hypocone is lower than the previous ones, the hypoconal flange is very short. LL is far less than BL.

I_1 - The mandibular incisor is acuspulate. The apex is only slightly up-turned, but in the most of the specimens is sharp. There is not cingulum on the buccal side.

A_2 - The second antemolar is unicuspid. The lingual and the buccal cingula are broad.

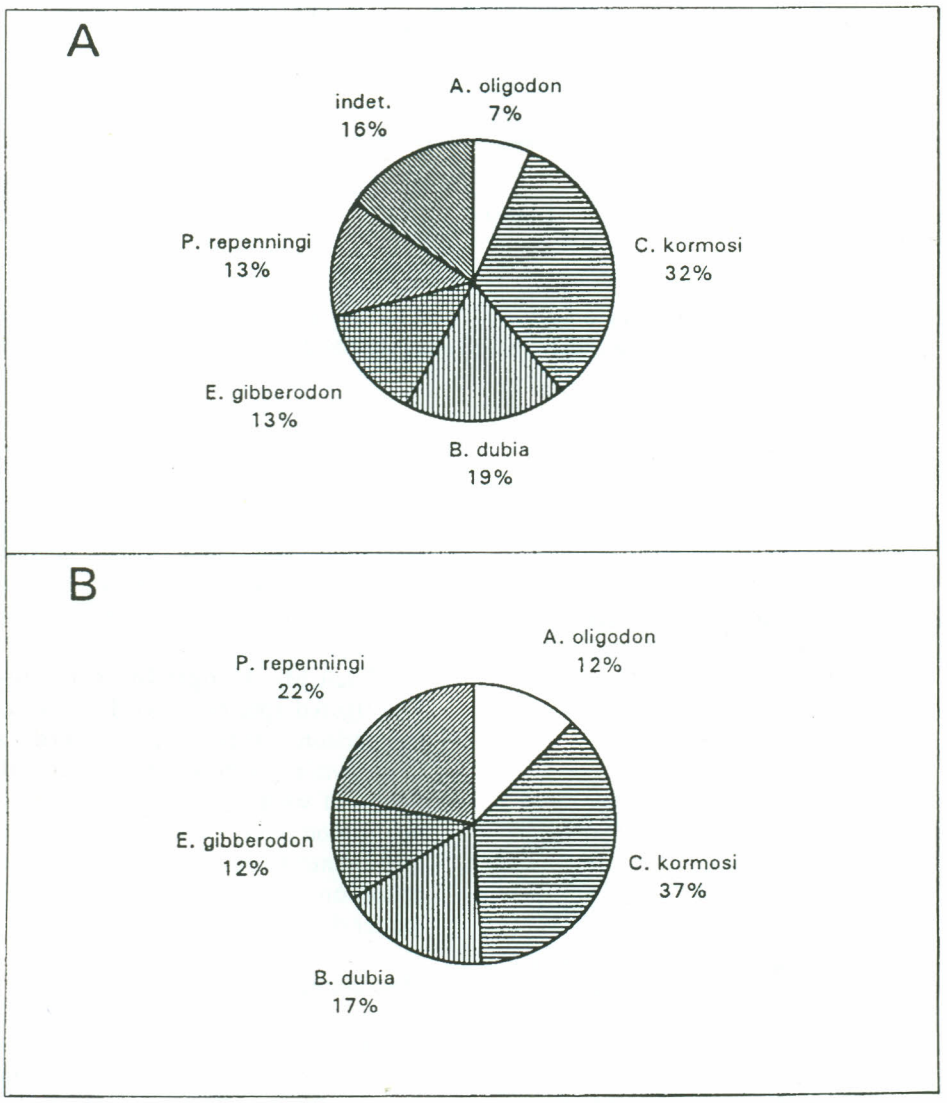

Fig. 2. Low relative frequency of *Amblycoptus oligodon* in the Tardosbánya shrew material (A = total number of the specimens, with the undeterminable middle sized ones, B = minimum number of the individuals, without the undeterminable specimens)

Remarks: Strikingly few *A. oligodon* remains were found among the Tardosbánya shrews. The low relative frequency of this species probably was not caused by the paleoecological background of the area, since the other present soricids preferred the same climate as *Amblycoptus*. The most likely explanation of the fact is that *A. oligodon* was just appeared in the time of the accumlation of the Tardosbánya cave deposits and was not so wide spread yet as in the later MN Zones, when it occurs with high relative frequency in the Hungarian faunas.

In the measurements the Tardosbánya *Amblycoptus* seems to be older than the Széchenyi

Hill and Polgárdi 2 forms (MÉSZÁROS 1996 and KORMOS 1926) if we supposed a size-growth trend. Unfortunately we can use only the A^1 measurements, because the Széchenyi Hill material is not so rich as the here studied one.

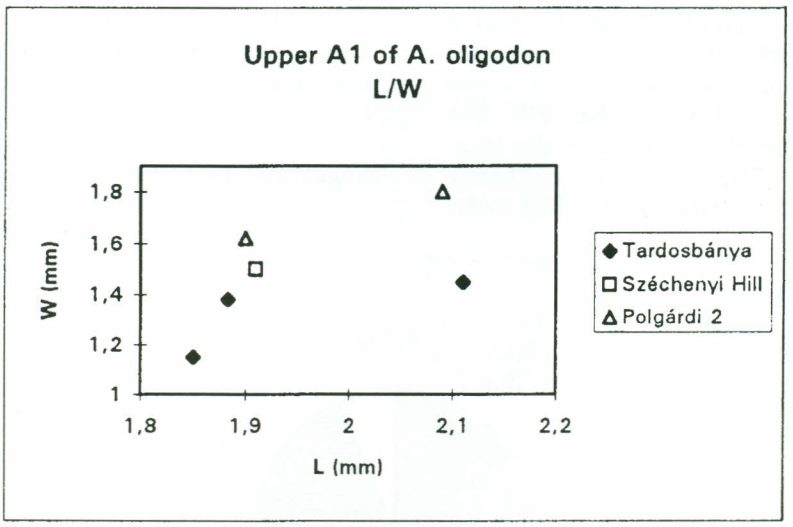

Fig. 3. Comparative diagram of *Amblycoptus oligodon* A^1 L/W for the determination of the stratigraphic position of Tardosbánya locality. The measurements of the Széchenyi Hill and Polgárdi 2 forms are after MÉSZÁROS 1996 and KORMOS 1926.

Genus *Crusafontina* GIBERT 1974

Type species: *Crusafontina endemica* GIBERT 1974

Crusafontina kormosi (BACHMAYER & WILSON, 1970)
Pl. 1, Figs 5-11

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 (Kohfidisch)
1978 - *Anourosorex kormosi* BACHMAYER & WILSON 1970 - BACHMAYER & WILSON, p. 141 pl. 2, figs, 5, 5a (Kohfidisch)
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 (Kohfidisch)
1996 - *Crusafontina vicina* (KRETZOI, 1954) - MÉSZÁROS, p. 9, pl. 12, figs 5 a-b (Csákvár)

Holotype: Right lower jaw with the complete lower dentition, BACHMAYER & WILSON (1970), p. 551, Pl. 1, fig 3, NHMV, Div. Geol. Paleont. 1970/1389. Type locality: Kohfidisch (Austria, Late Vallesian, MN 10).

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

Studied material: 8 left and 11 right maxillary fragments, 63 left and 45 right mandible fragments, 23 left I^1, 28 right I^1, 7 left A^1, 2 right A^1, 7 left A^2, 8 left P^4, 3 right P^4, 6 left M^1, 5 right M^1, 1 right M^2, 2 left M^2, 13 left I_1, 8 right I_1, 2 left A_1, 1 right A_1, 7 left M_1, 13 right M_1, 6 left M_2, 3 right M_2. The figured specimens: GMH - V. 20588. For the comparisons there was studied a very rich *Crusafontina* material from Polgárdi 4 (MN 13 Zone), of wich description is given in the in prep. publication of the present author. The measurements of the comparative material (in the collection of the GMH) are used herein in the scatter diagram.

Measurements: See Tab. 3.

Remarks: The detailed description of Tardosbánya *C. kormosi* is given in the special publication of the author (in press), in which he elaborates the *Crusafontina* remains of five Hungarian Late Miocene localities. Also the systematic problems are discussed there. In that paper he reports 245 specimen from the site. Some more *Crusafontina* remains have been found by the recent studies, which completely elaborated the Tardosbánya soricid material, so the catalogue includes 269 specimen of this genus.

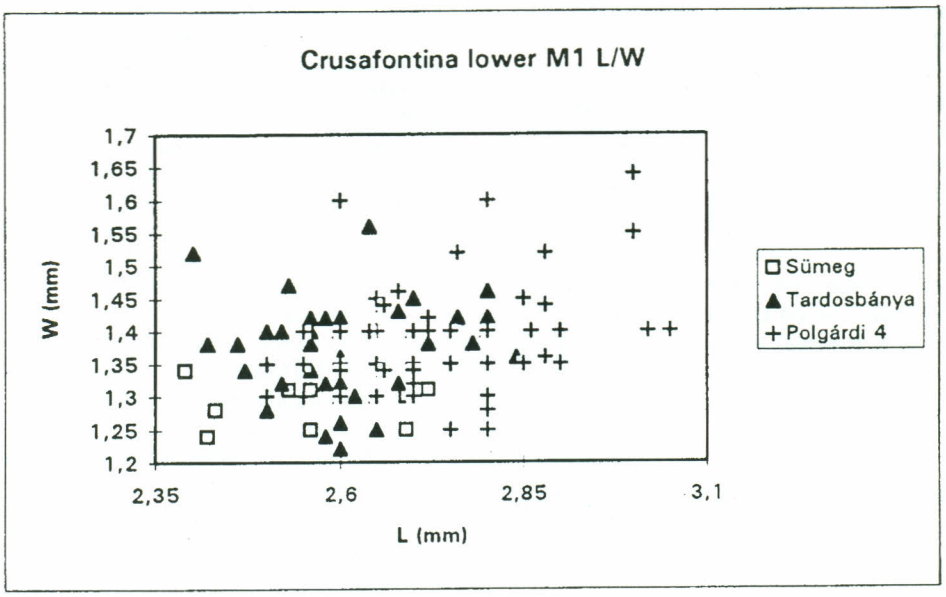

Fig. 4. Comparative diagram of *Crusafontina kormosi* M_1 L/W for the determination of the stratigraphic position of Tardosbánya locality

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

Type species: *Sorex quadraticauda* MILNE-EDWARDS 1872

Blarinella dubia (BACHMAYER and WILSON, 1970)
Pl. 2, Figs 1-10

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 (Kohfidisch)
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 (Kohfidisch)
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 & 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 & WILSON, 1970) - HÍR & MÉSZÁROS, p. 171, figs. 3 c-d (Egyházasdengeleg)
1996 - *Blarinella dubia* (BACHMAYER & WILSON, 1970) - MÉSZÁROS, p. 13, pl. 3, figs 6 a-g (Sümeg, Csákvár)

Holotype: Left mandible fragment with the three molars, Natural History Museum, Vienna, Div. Geol. Paleont., 1970/1387. (BACHMAYER & WILSON 1970, p. 546, fig. 6,) Type locality: Kohfidisch (Austria, Late Vallesian, MN 10).

Stratigraphic range: Late Miocene (Early Valesian, MN 9 - Early Ruscinian, MN 14), Europe.

Studied material: 5 left maxillary fragments, 8 right maxillary fragments, 43 left mandible fragments, 31 right mandible fragments, 18 left I^1, 11 right I^1, 1 left P^4, 4 right P^4, 5 left maxillary molars, 6 right maxillary molars, 9 left I_1, 12 right I_1, 1 left M_3. The figured specimens: GMH - V. 20592, V. 20593.

Measurements: See Tab. 4

Description:

Mandible - The upper articular facet of the condyle is cylinder-shaped and makes an angle of about 45° with the lower facet. The interarticular area is broad. The external temporal fossa extends ventrally to about the level of the centre of the condyle. The internal temporal fossa is triangular. On some specimens it is short and undivided, but on the others it is long and is subdivided by a horizontal bar. The mandibular foramen is situated at the middle of the fossa. The mental foramen is placed under the re-entrant valley of M_1.

I^1 - The tooth is not fissident. The superior and the posterior margins form a sharp angle. There is a broad buccal cingulum at the basal margin. The apex is long, sharp, but not too much down-curved. The talone is also sharp.

P^4 - The lingually placed parastyle is contacted with the paracone by a parastylar crest. The protocone forms an antero-lingual corner. The hypocone is only slightly rised from the ridge of the

hypoconal flange. The posterior emargination is hardly notched.

M^1 - M^2 - The trigone is posteriorly closed by a metaloph. AW < PW on M^1 but AW > PW on M^2. The hypocone is not developed, only the ridge is present on the deeply excavated hypoconal flange. The posterior margin is hardly concave.

I_1 - The very long mandibular incisor is bicuspulate, but a minute third cuspule originates behind the second one on many specimens. A cingulum is not appeared on the buccal side, but on the symphysal one it is broad and well developed.

A_2 - The second antemolar seems to be two-cusped in buccal view. Cingulum is present on both sides.

M_1 - M_2 - The entoconid is placed very close to the metaconid and they are contacted together by a high entoconid crest. Cingula are not too broad, but the buccal one is somewhat more developed than the lingual one.

M_3 - The talonid is not basined, it is reduced to one conid. The cingulum is weak on the buccal side.

Remarks: In the synonymy list *B. dubia* is mentioned from Rudabánya, because KRETZOI et al.(1976) and after him RABEDER (1985) and KORDOS (1991) reported this species from the site, but ZIEGLER & MÉSZÁROS (1998, in press) who studied an other sample from Rudabánya could not find *Blarinella* in the material. Unfortunately, the original material from the Early Vallesian localities of Rudabánya quarry, reported by KRETZOI et al. (1976), was not available for the later authors.

Tribus Soriculini KRETZOI 1965

Genus *Episoriculus* ELLERMAN & MORRISON-SCOTT 1951

Type species: *Sorex caudatus* HORSFIELD 1851.

Episoriculus gibberodon (PETÉNYI, 1864)

Pl. 3, Figs 1-11

1864 - *Crocidura gibberodon* PETÉNYI - PETÉNYI, pl. 1, fig. 7 (Beremend)
1934 - *Soriculus kubinyii* n. sp. - KORMOS, p. 303, Fig. 36 (Villány 3)
1937 - *Soriculus kubinyii* KORM. - KORMOS, p. 1090 (Villány 3)
1956 - *Soriculus gibberodon* (PETÉNYI) (=*Soriculus kubinyii* KORMOS) - KRETZOI, pp 61, 184 (Villány 3)
1959 - *Soriculus* (*Asoriculus* n. sg.) *gibberodon* (PETÉNYI) - KRETZOI, pp. 238, 245 (Csarnóta 2)
1962 - *Asoriculus gibberodon* (PETÉNYI) - KRETZOI, pp. 301, 342 (Csarnóta 2)
1973 a - *Episoriculus gibberodon* (PETÉNYI) - JÁNOSSY, p. 102 (Osztramos 7)
1973 b - *Episoriculus tornensis* sp. n. - JÁNOSSY, p. 50, pl 1, figs 1, 10 (Osztramos 13)
1973 b - *Episoriculus borsodensis* sp. n. - JÁNOSSY, p. 53, pl 1, figs 5, 9, 13 (Osztramos 1)
1974 - *Episoriculus tornensis* JÁNOSSY - JÁNOSSY, p. 18 (Osztramos 9)
1977 - *Episoriculus borsodensis* JÁNOSSY - JÁNOSSY & KORDOS, p. 41 (Osztramos 1)
1977 - *Episoriculus gibberodon* (PETÉNYI) - JÁNOSSY & KORDOS, p. 47 (Osztramos 7)
1977 - *Episoriculus tornensis* (PETÉNYI) - JÁNOSSY & KORDOS, p. 51 (Osztramos 13)
1978 - *Episoriculus gibberodon* (PETÉNYI) - JÁNOSSY, p. 69 (Osztramos 7)
1979 - *Episoriculus gibberodon* (PETÉNYI) - JÁNOSSY, pp. 23, 27, 34 (Csarnóta 2, Osztramos 7, Villány 3)
1981 - *Episoriculus borsodensis* JÁNOSSY, 1973 - RZSEBIK-KOWALSKA, p. 236, figs 3-4 (Podlesice 7)
1981 - *Episoriculus gibberodon* (PETÉNYI, 1864) - RZSEBIK-KOWALSKA, p. 245, fig. 6 (Weze 1)
1984 - *Episoriculus gibberodon* (PETÉNYI, 1864) - REUMER, p. 92, pl. 27, figs 3-11, pl. 28, figs1-12, pl. 29, figs 1-4, pl. 30, figs 1-4, pl 31, figs 1-2 (Osztramos 1, 7, 9, 13, Csarnóta 2, Villány 3)
1994 - *Episoriculus gibberodon* (PETÉNYI, 1864) - RZSEBIK-KOWALSKA, p. 81 (Podlesice, Zamkowa Dolna A, B, Zalesiaki 1 B, Weze 1, Rebielice Królevskie 1A, 2, Kielniki 3 B)

Type: A skull with nearly complete dentition, GMH - OB. 3685., KORMOS (1934), p. 304, fig. 36. Type localites: Beremend (Hungary, Early Villányian, MN 16) and Villány 3 (Hungary, Late Villányian, MN 17).

Stratigraphic range: Late Miocene (Turolian, MN 12) - Early Pleistocene (Biharian)

Studied material: 7 left maxillary fragments, 9 right maxillary fragments, 22 left mandible fragments, 18 right mandible fragments, 5 left I^1, 8 right I^1, 2 left P^4, 3 right P^4, 7 left maxillary molars, 6 right maxillary molars, 5 left I^1, 15 right I^1. The figured specimens: GMH - V. 20594, V. 20595.

Measurements: See Tab. 5.

Description:

Mandible - The interarticular area of the condyle is narrow, but not so much as in the tribe Anourosoricini. The upper articular facet is cylinder-shaped, the lower one is strongly elongated in lingual direction. The top of the coronoid process is rounded, its anterior margin is slightly concave. The mandibular foramen is situated under the posterior part of the internal temporal fossa. The mental foramen is below the protocone of the M_1 or somewhat behind it.

I^1 - The upper incisor is slightly fissident. The dorsal and the posterior margins form a sharp or a perpendicular angle. There is a well developed buccal cingulum on the convex posterior margin. The top of the talone is sharp.

AA sup. - There is four antemolars in the maxilla. In occlusal view $A^1 > A^2 > A^3 > A^4$ in general size. Beside the main cone there is a small extra cusplet on A^1 - A^2. A^4 is quite reduced, is not visible in buccal view, because it is hidden by the parastyle of P^4.

P^4 - The parastyle is protruding. It is connected to the well developed paracone by a narrow parastylar crest. The protocone is separated from the hypocone by a large valley. The hypoconal flange is bordered by a high ridge, on which sometimes a slightly developed extra conulule is rised. The ridge is also present on the deeply notched posterior margin.

M^1 - AW < PW. The protocone and the hypocone are separated by a wide valley. All the cones of the trigone are well developed, the trigone basin is very deep. The talone is short, because the posterior margin is deeply notched. The parastyle is shorter than the metastyle.

M^2 - It is a morphologically very similar tooth to the previous one, but AW > PW and the metastyle is about same sized as the parastyle.

M^3 - Its width less than PW of M^2. The protocone and the paracone are well developed, but the hypocone and the metacone are hardly visible. The parastyle is long.

I_1 - There are two cuspules behind the sharp, upturned apex. The anterior cuspule is slightly developed, but the posterior one is high. A buccal cingulum runs along on the whole basal margin of the mandibular incisor.

A_2 - It is two-cusped tooth. The anterior cusp is higher than the posterior one in buccal view. The cingula are well developed on both sides of the antemolar.

M_1 - M_2 - The talonid is wider than the trigonid. The entoconid crest is present. The lingual end of the postcristid and the entoconid are separated by a deep valley. The cingula are present either on the buccal or the lingual sides.

M_3 - Buccal and lingual cingula are present. The talonid is basined and both of the conids are visible on the posterior margin.

Remarks: The original type material of *Crocidura gibberodon* (reported by PETÉNYI in 1864 from Beremend, Hungary) has been lost. KORMOS (1934) described the same species from Villány 3 as *Soriculus kubinyii*. Its type material is stored in the coll. of GMH. KRETZOI (1962) classified the species as *Asoriculus*. REPENNING (1967, p. 48) ranged it in *Episoriculus* and this classification is used nowadays. JÁNOSSY (1973) described *E. tornensis* and *E. borsodensis* from Osztramos, mainly on the basis of their differences in measurements from *E. gibberodon* and other species of the genus. The separation was supported also by other morphologic characters. RZEBIK-KOWALSKA (1981) presented *Episoriculus* remains from Podlesice and Weze, of which measurements filled the gap between *E. tornensis*, *E. borsodensis* and *E. gibberodon*. She thought possible that all European *Episoriculus* forms belong to one species, *E. gibberodon* (RZEBIK-KOWALSKA 1981, pp. 244-245). REUMER (1984, p. 100), after the detailed study of all Hungarian *Episoriculus* forms has thought that most of the characters, listed by JÁNOSSY (1973) for the separation of the three species "are variable with considerable overlap", and included all these forms in *Episoriculus gibberodon*.

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, Figs 1-10

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)
1996 - *Paenelimnoecus repenningi* (BACHMAYER & WILSON, 1970) - MÉSZÁROS, p. 15, pl. 4, figs 7 a-d (Sümeg, Csákvár)

Holotype: Left lower jaw fragment with M_1-M_3, Natural History Museum, Vienna, Div. Geol. Paleont., 1970/1388. (BACHMAYER & WILSON 1970, p. 549, fig. 33.) Type locality: Kohfidisch (Austria, Late Vallesian, MN 10).

Stratigraphic range: Late Miocene (Early Vallesian, MN 9 - Late Turolian, MN 13), Europe.

Studied material: 4 left and 6 right maxillary fragments, 40 left and 47 right mandible fragments,

1 left I^1, 1 right I^1, 3 right P^4, 2 left M^1, 1 right M^1, 1 left M^2, 1 left M^3, 1 right I_1, 1 left M_1, 1 left M_3. The figured specimens: GMH - V. 20596, V. 20597.

Measurements: See Tab. 6.

Description:

Mandible - The upper facet of the condyloid process is oval, the lower one is lingually hardly elongated, the interarticular area is short and narrow. The coronoid process is high and narrow, its top is rounded. The internal temporal fossa is triangular (at two specimens subtriangular) and higher than wide. Its inferior margin is horizontal or backwards ascending. The mandibular foramen is placed under the middle or the back part of the fossa.

I^1 - A slight buccal cingulum is appearent but no buccal cingulum is present. The posterior margin is straight or slightly convex.

P^4 - The tooth is much wider than long. The weak parastyle turns towards the buccal side. It is situated close to the big paracone. There is not clearly divided hypocone on the ridge of the hypoconal flange, but the protocone is present. The posterior emargination is strongly notched.

M^1 - M^2 - The metastyle is longer than the parastyle. The mesostyle is well developed. The metacone is slightly higher than the paracone. The trigone basin is deep and usually open on M^1, but a slight metaloph is apparent on M^2 and some M^1. The protocone is as high as the paracone or only slightly lower. A tiny hypocone is present on the ridge of the hypoconal flange, but it is absent on some M^2. The posterior emargination is deeply notched.

I_1 - There is no cingulum on the buccal side of the bicuspulate mandibular incisor.

A_1 - A_2 - In buccal view a small extra conid is visible before the main conid of the lower antemolars. A_1 is far smaller than A_2.

M_1 - M_2 - Entoconid crest is not appeared. The lingual end of the postcristid is separated from the entoconid. Buccal and lingual cingulids are weak.

M_3 - The talonid is reduced to a single cusp. Weak cingulids are present both on the buccal and lingual sides.

Conclusions

Stratigraphy

KORDOS (1985) correlated Tardosbánya site with the Late Miocene MN 11-12 Zone on the basis of the *Anomalospalax* and Cricetidae elements of the fauna. This stratigraphic classification is supported also by the Soricidae.

Crusafontina, *Blarinella dubia* and *Paenelimnoecus repenningi* are the typical Late Miocene (MN 9-13) shrews of the European fauna. The presence of *Crusafontina kormosi* suggests that the geological age of the material may not be earlier than the Late Vallesian Kohfidisch locality in Austria (the end of MN 10 Zone).

On the basis of preliminary studies MÉSZÁROS (1996) did not reported *Amblycoptus* from Tardosbánya and concluded that this site should be older than Egyházasdengeleg and Széchenyi Hill (MN 12) or the Polgárdi localities (MN 13), where the named species occurs. The detailed researches show that some *Amblycoptus* is present in the fossil material, but this not changes the supposed stratigraphic order of the localities, because *Amblycoptus* occurs here in so low relative frequency, as it is not typical in the later localities (Fig. 2). We can suppose that this is the FAD of the taxon and still it was not so frequented in the fauna as in the end of the MN 12 Zone and in the MN 13 Zone. Otherwise, the Tardosbánya *Amblycoptus* make us sure that the site is younger than Csákvár and Dorn-Dürkheim (MN 11), which are older, than the FAD of this species.

The here reported form is the oldest occurrence of *Episoriculus gibberodon*. This fact also suggests Tardosbánya to be younger than Sümeg, Kohfidisch and Csákvár.

The morphometrical analyses show that the Tardosbánya *Amblycoptus* are older than Széchenyi Hill and Polgárdi 2 ones (Fig. 3). In measurements the Tardosbánya *Crusafontina* seems to be intermediate between the Sümeg and Polgárdi forms (Fig. 4).

Summarizing, on the basis of the Soricidae fauna, the probable geological age of Tardosbánya locality is Late Miocene, Turolian, the older part of the MN 12 Zone.

Ecology

Paenelimnoecus is an extinct genus, while the recent *Blarinella* lives in the mountain woods in Asia. *P. repenningi* and *B. dubia* occur in the Hipparion fauna of the European Late Miocene, but

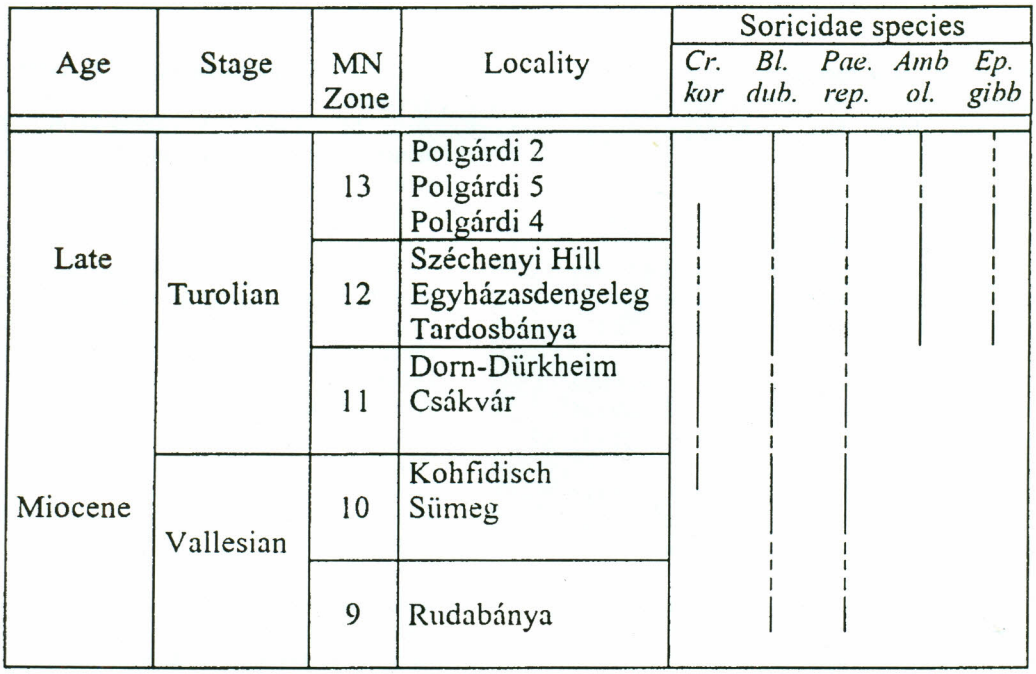

Fig. 5. Stratigraphic ocuurrence of the studied Soricidae species, with the possible geological age of Tardosbánya locality

usually in local wooded areas. On the basis of their very close relation to the extant *Anourosorex quamipes,* living in the mountain forests of SE-Asia, *Amblycoptus* and *Crusafontina* also may be the indicators of well watered, forested environments. The very similarly evolved dentition of *A. oligodon* suggests it to be adaptated to such malacophagous diet as the recent *Anourosorex.* According to REUMER (1984) *Episoriculus gibberodon* indicates the presence of open water with a good covering of wooded vegetation.

On the basis of the occured soricids we can suppose, that Tardosbánya was a well watered, forested area near to a larger water body. The presence of the open water is supported by the fishes, frogs and watermoles in the fauna (see the manuscript faunal list of JÁNOSSY, 1981).

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Table 1. Catalogue of the Tardosbánya Soricidae (* = Soricidae mandibles in the size of *Blarinella dubia* and *Episoriculus gibberodon*, but without the presence of differential characters.)

SPECIES	TOTAL NR. SPEC.	MIN. NR. IND.
Amblycoptus oligodon	55	20
Crusafontina kormosi	267	61
Blarinella dubia	154	28
Episoriculus gibberodon	108	20
Paenelimnoecus repenningi	110	36
undeterminable*	128	-

Table 2. Measurements of *Amblycoptus oligodon* KORMOS 1926 from Tardosbánya

		min.	mean	max.	n.	s.e.	s.d.
I^1	L	2.65	2.75	2.95	6	0.1033	0.1146
	H	1.90	2.03	2.15	6	0.0717	0.0827
A^1	L	1.85	1.95	2.11	3	0.1089	0.1161
	W	1.15	1.33	1.45	3	0.1178	0.1281
P^4	LL	-	1.60	-	1	-	-
	BL	-	2.45	-	1	-	-
	W	-	2.25	-	1	-	-
M^1	LL	-	1.92	-	1	-	-
	BL	-	2.42	-	1	-	-
	AW	-	2.69	-	1	-	-
	PW	-	2.15	-	1	-	-
I_1	L	4.95	5.30	5.93	16	0.2825	0.3186
	H	1.26	1.38	1.55	16	0.0536	0.0741
A_2	L	-	1.89	-	1	-	-
	W	-	1.36	-	1	-	-

Table 3. Measurements of *Crusafontina kormosi* (BACHMAYER & WILSON, 1970) from Tardosbánya

		min.	mean	max.	n.	s.e.	s.d.
I^1	L	2.40	2.73	2.94	26	0.1260	0.1556
	H	1.64	1.97	2.34	26	0.1251	0.1567
A^1	L	1.64	1.94	2.10	12	0.1000	0.1252
	W	1.18	1.36	1.58	12	0.1100	0.1233
A^2	L	0.98	1.14	1.22	5	0.0656	0.0852
	W	1.06	1.13	1.20	5	0.0384	0.0466
P^4	LL	1.44	1.72	2.00	13	0.1650	0.1863
	BL	2.34	2.57	2.77	13	0.1069	0.1249
	W	2.18	2.42	2.74	13	0.1150	0.1446
M^1	LL	1.76	2.02	2.78	11	0.1431	0.2518
	BL	1.04	2.05	2.40	11	0.3180	0.4317
	AW	2.06	2.39	2.58	11	0.1203	0.1566
	PW	2.02	2.28	2.36	11	0.0945	0.1082
M^2	LL	1.20	1.22	1.24	2	0.0200	0.0200
	BL	1.38	1.72	2.06	2	0.3400	0.3400
	AW	1.32	1.66	2.00	2	0.3400	0.3400
	PW	1.16	1.18	1.20	2	0.0200	0.0200
I_1	L	4.25	4.79	5.12	12	0.1928	0.2547
	H	1.06	1.20	1.28	12	0.0556	0.0637
M_1	L	2.38	2.61	2.84	51	0.0930	0.1165
	W	1.20	1.38	2.28	51	0.0771	0.1475
M_2	L	1.02	1.76	2.00	32	0.1235	0.1797
	W	0.96	1.10	1.66	32	0.0884	0.1408
M_3	L	0.55	0.78	1.14	6	0.2000	0.2196
	W	0.45	0.58	0.68	6	0.0756	0.0832

Table 4. Measurements of *Blarinella dubia* (BACHMAYER & WILSON, 1970) from Tardosbánya

		min.	mean	max.	n.	s.e.	s.d.
I^1	L	1.99	2.04	2.10	10	0.0388	0.0424
	H	1.21	1.24	1.28	10	0.0143	0.0176
A^4	L	-	0.45	-	1	-	-
	W	-	0.51	-	1	-	-
P^4	LL	0.85	0.94	1.05	8	0.0531	0.0612
	BL	1.43	1.48	1.55	8	0.0375	0.0428
	W	1.40	1.53	1.63	8	0.0781	0.0864
M^1	LL	1.38	1.40	1.50	9	0.0238	0.0367
	BL	1.30	1.39	1.48	9	0.0357	0.0485
	AW	1.33	1.42	1.50	9	0.0607	0.0669
	PW	1.48	1.55	1.65	9	0.0472	0.0589
M^2	LL	1.18	1.24	1.33	6	0.0354	0.0459
	BL	1.16	1.26	1.35	6	0.0375	0.0548
	AW	1.38	1.48	1.55	6	0.0556	0.0640
	PW	1.28	1.34	1.44	6	0.0444	0.0532
M^3	L	-	0.55	-	1	-	-
	W	-	1.11	-	1	-	-
I_1	L	3.30	3.54	3.72	13	0.1243	0.1423
	H	0.76	0.83	0.88	13	0.0241	0.0303
A_2	L	1.13	1.19	1.25	2	0.0625	0.0625
	W	0.70	0.76	0.83	2	0.0650	0.0650
M_1	L	1.35	1.49	1.68	18	0.0896	0.1009
	W	0.76	0.86	0.93	18	0.0398	0.0477
M_2	L	1.25	1.38	1.51	28	0.0513	0.0679
	W	0.76	0.81	0.88	28	0.0262	0.0312
M_3	L	0.95	1.08	1.18	33	0.0450	0.0577
	W	0.55	0.61	0.68	33	0.0237	0.0282

Table 5. Measurements of *Episoriculus gibberodon* (PETÉNYI, 1864) from Tardosbánya

		min.	mean	max.	n.	s.e.	s.d.
I^1	L	1.55	1.63	1.68	10	0.0305	0.0387
	H	0.98	1.09	1.20	10	0.0565	0.0664
A^1	L	-	0.95	-	1	-	-
	W	-	0.78	-	1	-	-
A^2	L	-	0.75	-	1	-	-
	W	-	0.73	-	1	-	-
A^3	L	-	0.48	-	1	-	-
	W	-	0.63	-	1	-	-
P^4	LL	0.78	0.87	0.93	9	0.0309	0.0424
	BL	1.39	1.47	1.55	9	0.0463	0.0530
	W	1.36	1.53	1.64	9	0.0654	0.0828
M^1	LL	1.29	1.40	1.55	12	0.0479	0.0637
	BL	1.30	1.40	1.55	12	0.0340	0.0564
	AW	1.30	1.44	1.56	12	0.0681	0.0798
	PW	1.41	1.59	1.68	12	0.0590	0.0746
M^2	LL	1.11	1.25	1.46	9	0.0539	0.0911
	BL	1.13	1.24	1.38	9	0.0562	0.0734
	AW	1.11	1.46	1.63	9	0.1454	0.1809
	PW	1.14	1.38	1.48	9	0.0759	0.0987
M^3	L	-	0.55	-	1	-	-
	W	-	1.10	-	1	-	-
I_1	L	2.68	2.98	3.44	14	0.1498	0.1898
	H	0.76	0.86	1.04	14	0.0443	0.0655
A_1	L	-	0.88	-	1	-	-
	W	-	0.66	-	1	-	-
A_2	L	1.10	1.27	1.40	4	0.0844	0.1081
	W	0.70	0.78	0.95	4	0.0875	0.1071
M_1	L	0.88	1.38	1.50	13	0.0970	0.1604
	W	0.75	0.92	1.48	13	0.0870	0.1662
M_2	L	1.25	1.34	1.43	18	0.0415	0.0503
	W	0.56	0.80	0.88	18	0.0380	0.0655
M_3	L	1.00	1.06	1.13	20	0.0361	0.0413
	W	0.55	0.62	0.68	20	0.0257	0.0307

Table 6. Measurements of *Paenelimnoecus repenningi* (BACHMAYER & WILSON, 1970) from Tardosbánya

		min.	mean	max.	n.	s.e.	s.d.
I^1	L	1.34	1.48	1.61	3	0.0944	0.1124
	H	0.90	1.01	1.10	3	0.0750	0.0835
P^4	LL	0.54	0.72	0.85	6	0.0672	0.0947
	BL	1.08	1.13	1.15	6	0.0229	0.0260
	W	1.04	1.25	1.40	6	0.0929	0.1141
M^1	LL	1.00	1.06	1.13	11	0.0453	0.0489
	BL	1.06	1.12	1.20	11	0.0276	0.0397
	AW	1.08	1.06	1.30	11	0.0463	0.0584
	PW	1.10	1.25	1.40	11	0.0604	0.0814
M^2	LL	0.88	0.93	1.00	7	0.0302	0.0373
	BL	0.97	1.03	1.14	7	0.0549	0.0640
	AW	1.13	1.19	1.27	7	0.0367	0.0456
	PW	1.04	1.16	1.22	7	0.0471	0.0582
I_1	L	2.30	2.33	2.36	2	0.0313	0.0313
	H	0.59	0.60	0.31	2	0.0313	0.0313
A_1	L	0.45	0.53	0.58	3	0.0522	0.0557
	W	0.38	0.44	0.55	3	0.0711	0.0759
A_2	L	0.55	0.78	0.89	9	0.1007	0.1167
	W	0.42	0.53	0.60	9	0.0429	0.0520
M_1	L	1.08	1.19	1.35	36	0.0621	0.0721
	W	0.55	0.65	0.76	36	0.0383	0.0458
M_2	L	1.02	1.14	1.30	54	0.0487	0.0650
	W	0.52	0.64	0.73	54	0.0350	0.0452
M_3	L	0.80	0.88	0.98	28	0.0383	0.0471
	W	0.45	0.53	0.65	28	0.0339	0.0429

Plates

Plate 1

Fig. 1. *Amblycoptus oligodon* KORMOS 1926, left I^1, buccal view, Tardosbánya 3/1, GMH - V. 20591, 27x

Fig. 2. *Amblycoptus oligodon* KORMOS 1926, left A^1, occusal view, Tardosbánya 3/2, GMH - V. 20591, 39x

Fig. 3. *Amblycoptus oligodon* KORMOS 1926, right M^1, occlusal view, Tardosbánya 3/2., GMH - V. 20591, 24x

Fig. 4. *Amblycoptus oligodon* KORMOS 1926, left I_1, buccal view, Tardosbánya 3/3, GMH - V. 20591, 16x

Fig. 5. *Crusafontina kormosi* (BACHMAYER & WILSON, 1970), left I^1, buccal view, Tardosbánya 3/1, GMH - V. 20588, 20x

Fig. 6. *Crusafontina kormosi* (BACHMAYER & WILSON, 1970), right A^1, occlusal view, Tardosbánya 3/1, GMH - V. 20588, 21x

Fig. 7. *Crusafontina kormosi* (BACHMAYER & WILSON, 1970), left P^4, occlusal view, Tardosbánya 3/1, GMH - V. 20588, 21x

Fig. 8. *Crusafontina kormosi* (BACHMAYER & WILSON, 1970), right M^1, occlusal view, Tardosbánya 3/1, GMH - V. 20588, 23x

Fig. 9. *Crusafontina kormosi* (BACHMAYER & WILSON, 1970), right M_1, occclusal view, Tardosbánya 3/1, GMH - V. 20588, 26x

Fig. 10. *Crusafontina kormosi* (BACHMAYER & WILSON, 1970), right M_1, buccal view, Tardosbánya 3/1, GMH - V. 20588, 26x

Fig. 11. *Crusafontina kormosi* (BACHMAYER & WILSON, 1970), right M_2, occlusal view, Tardosbánya 3/1, GMH - V. 20588, 29x

Plate 1

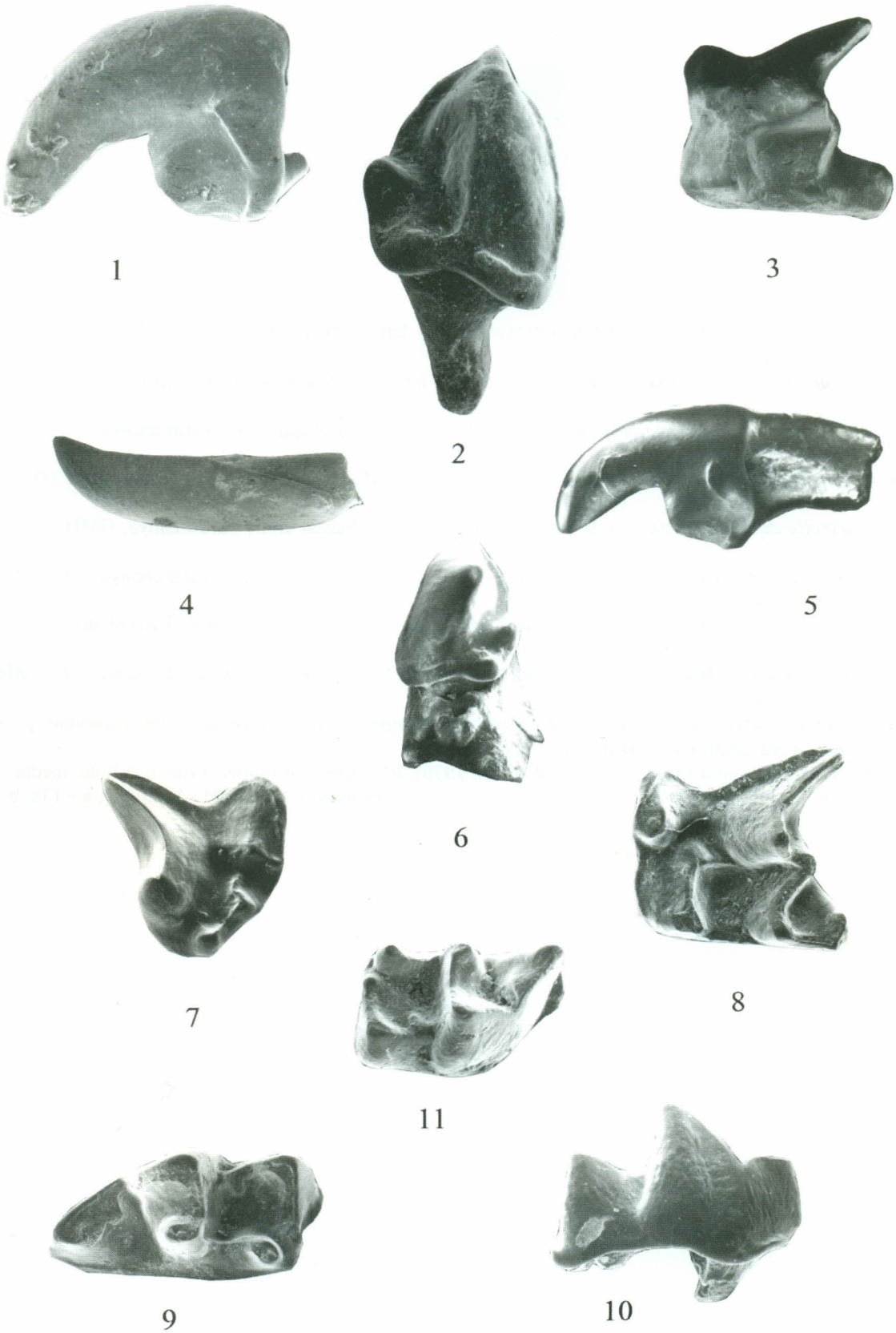


Plate 2

Fig. 1. *Blarinella dubia* (BACHMAYER & WILSON, 1970), left I^1, buccal view, Tardosbánya 3/2, GMH - V. 20592, 32x

Fig. 2. *Blarinella dubia* (BACHMAYER & WILSON, 1970), left I^1, ventral view, Tardosbánya, GMH - V. 20592, 42x

Fig. 3. *Blarinella dubia* (BACHMAYER & WILSON, 1970), left P^4, occlusal view, Tardosbánya 3/3, GMH - V. 20592, 47x

Fig. 4. *Blarinella dubia* (BACHMAYER & WILSON, 1970), right M^1-M^2, occlusal view, Tardosbánya 3/3, GMH - V. 20592, 38x

Fig. 5. *Blarinella dubia* (BACHMAYER & WILSON, 1970), right I_1, buccal view, Tardosbánya, GMH - V. 20592, 30x

Fig. 6. *Blarinella dubia* (BACHMAYER & WILSON, 1970), left I_1-M_1 buccal view, Tardosbánya 3/3, GMH - V. 20593, 29x

Fig. 7. *Blarinella dubia* (BACHMAYER & WILSON, 1970), right M_1-M_3 occlusal view, Tardosbánya, GMH - V. 20593, 32x

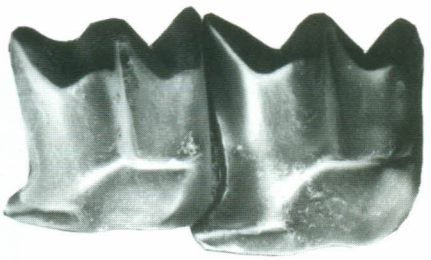
Fig. 8. *Blarinella dubia* (BACHMAYER & WILSON, 1970), left M_1-M_3 buccal view, Tardosbánya 3/2, GMH - V. 20593, 27x

Fig. 9. *Blarinella dubia* (BACHMAYER & WILSON, 1970), right condyloid process of the mandible, posterior view, Tardosbánya 3/2, GMH - V. 20593, 29x

Fig. 10. *Blarinella dubia* (BACHMAYER & WILSON, 1970), left ascendent ramus of the mandible, medial view, Tardosbánya 3/2, GMH - V. 20593, a - 13x, b - 22x

Plate 2

1



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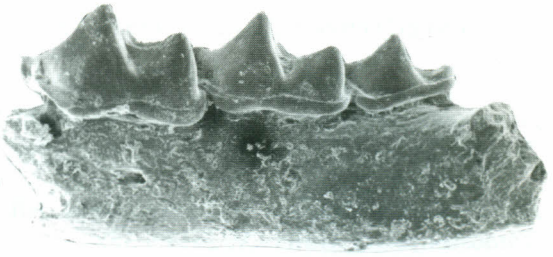

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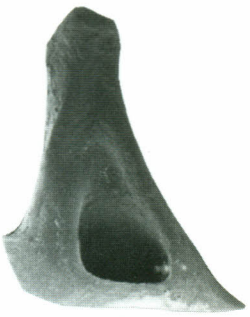
9

10 a



10 b

Plate 3

Fig. 1. *Episoriculus gibberodon* (PETÉNYI, 1864), right I^1, buccal view, Tardosbánya 3/2, GMH - V. 20594, 39x

Fig. 2. *Episoriculus gibberodon* (PETÉNYI, 1864), right I^1, ventral view, Tardosbánya 3/1, GMH - V. 20594, 46x

Fig. 3. *Episoriculus gibberodon* (PETÉNYI, 1864), right I^1-A^3, occlusal view, Tardosbánya 3/2, GMH - V. 20594, 33x

Fig. 4. *Episoriculus gibberodon* (PETÉNYI, 1864), right A^4-P^4, occlusal view, Tardosbánya 3/1, GMH - V. 20594, 33x

Fig. 5. *Episoriculus gibberodon* (PETÉNYI, 1864), left P^4, occlusal view, Tardosbánya 3/1, GMH - V. 20594, 45x

Fig. 6. *Episoriculus gibberodon* (PETÉNYI, 1864), left M^1-M^2, occlusal view, Tardosbánya 3/2, GMH - V. 20594, 32x

Fig. 7. *Episoriculus gibberodon* (PETÉNYI, 1864), left I_1, buccal view, Tardosbánya, GMH - V. 20595, 32x

Fig. 8. *Episoriculus gibberodon* (PETÉNYI, 1864), left A_1-M_3, buccal view, Tardosbánya 3/1, GMH - V. 20595, 19x

Fig. 9. *Episoriculus gibberodon* (PETÉNYI, 1864), right M_1-M_3, occlusal view, Tardosbánya 3/1, GMH - V. 20595, 19x

Fig. 10. *Episoriculus gibberodon* (PETÉNYI, 1864), left condyloid process of the mandible, posterior view, Tardosbánya 3/2, GMH - V. 20595, 35x

Fig. 11. *Episoriculus gibberodon* (PETÉNYI, 1864), left ascendent ramus of the mandible, medial view, Tardosbánya 3/1, GMH - V. 20595, 25x

Plate 3

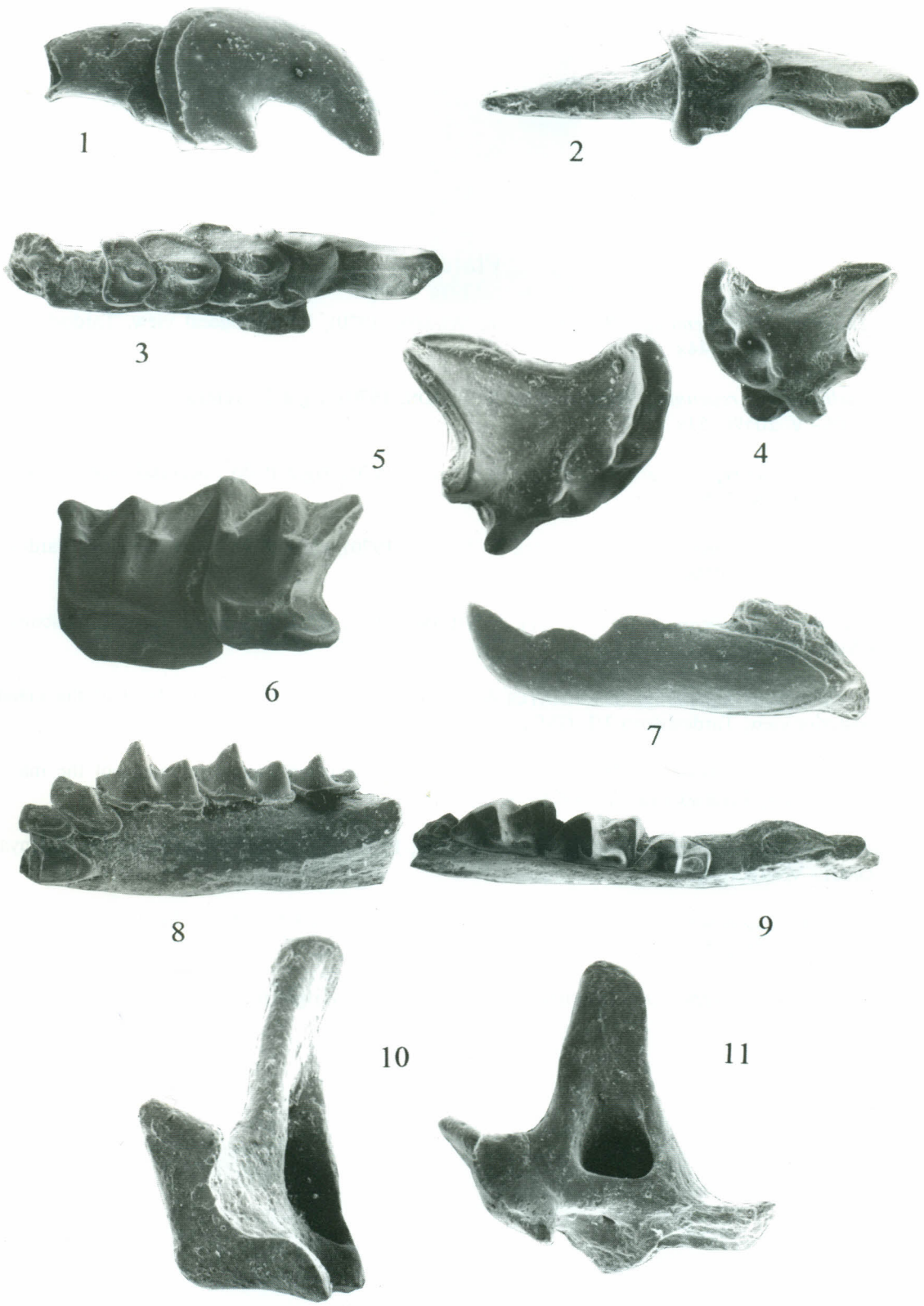


Plate 4

Fig. 1. *Paenelimnoecus repenningi* (BACHMAYER & WILSON, 1970), left I^1, buccal view, Tardosbánya 3/3, GMH - V. 20596, 44x

Fig. 2. *Paenelimnoecus repenningi* (BACHMAYER & WILSON, 1970), right I^1, ventral view, Tardosbánya 3/3, GMH - V. 20596, 52x

Fig. 3. *Paenelimnoecus repenningi* (BACHMAYER & WILSON, 1970), right P^4-M^2, occlusal view, Tardosbánya 3/2, GMH - V. 20596, 25x

Fig. 4. *Paenelimnoecus repenningi* (BACHMAYER & WILSON, 1970), right P^4-M^1, occlusal view, Tardosbánya 3/2, GMH - V. 20596, 33x

Fig. 5. *Paenelimnoecus repenningi* (BACHMAYER & WILSON, 1970), left I_1-M_1, buccal view, Tardosbánya 3/1, GMH - V. 20597, 27x

Fig. 6. *Paenelimnoecus repenningi* (BACHMAYER & WILSON, 1970), right condyloid facet of the mandible, posterior view, Tardosbánya 3/1, GMH - V. 20597, 42x

Fig. 7. *Paenelimnoecus repenningi* (BACHMAYER & WILSON, 1970), left ascendent ramus of the mandible, medial view, Tardosbánya 3/2, GMH - V. 20597, 24x

Fig. 8. *Paenelimnoecus repenningi* (BACHMAYER & WILSON, 1970), left A_1-M_3, buccal view, Tardosbánya 3/3, GMH - V. 20597, 23x

Fig. 9. *Paenelimnoecus repenningi* (BACHMAYER & WILSON, 1970), left M_2-M_3, occlusal view, Tardosbánya 3/2, GMH - V. 20597, 33x

Fig. 10. *Paenelimnoecus repenningi* (BACHMAYER & WILSON, 1970), right A_1-M_2, occlusal view, Tardosbánya 3/2, GMH - V. 20597, 38x

Plate 4