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The rhiniceros on the cover presents a nearly complete specimen of the Pleistocene *Coelodonta antiquitatis*, excaved in the layers of ozocerite in Starunia (Eastern Carpathians), 1929. This unique exhibit is shown in the Natural History Museum (Institute of Systematics and Evolution of Animals), Cracow.

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Insectivora (Mammalia) from the Early and early Middle Pleistocene of Betfia in Romania. I. Soricidae FISCHER VON WALDHEIM, 1817

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Abstract. 14 species of shrews are described from the Early and early Middle Pleistocene of the Betfia Karstic Complex. *Sorex minutissimus* ZIMMERMANN, 1780 and *Neomys* cf. *newtoni* HINTON, 1911 were found in Romania for the first time. The systematic position of the above-mentioned taxa, their measurements, illustrations and diagrams are given. The transformations and a paleoecological interpretation of shrew associations in the Betfia region is also presented.

Key-words: fossil mammals, Insectivora, Soricidae, Early and early Middle Pleistocene, Romania.

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I. INTRODUCTION

The Betfia Karstic Complex (fissure-filling system and former caves) containing a very rich vertebrate faunas is situated near the city of Oradea in Romania. It was known since the beginning of this century by the Hungarian name of Püspökfürdö. The fauna of this complex was studied by several authors more extensively, however, by Elena TERZEA from the Speological Institute in Bucharest. More than thirty years she studied rodents and carnivores and published their descriptions as well as the lists of accompanying faunas and the stratigraphic position of particular localities. The papers of last years (TERZEA 1994, 1995a and b) recapitulate her studies on this subject. In the last years HÍR and VENCZEL (1998 a and b) published also the papers on rodent fauna from the Betfia-IX.

The lists of mammalian species given by TERZEA (eg. 1973a, 1983, 1988 etc.) contain also names of insectivors although so far this group of mammals has been not studied. The present paper is the first of two concerning Insectivora from Betfia Karstic Complex and describes the Soricidae. The second one will deal with Talpidae and Erinaceidae.

The age and the chronology of particular Betfia localities is based here on the biochronology given by TERZEA in her last papers (1994 and 1995a, b). Besides the different time scale (eg. "Mammalian Ages" scale) TERZEA also uses the regional chronostratigraphy of the Netherlands (Eburonian, Waalian, Menapian, Bavelian, Cromerian). To compare the transformation of shrew fauna with those giving by TERZEA for other mammals this scale is also cited below although, according to some authors, it is not correct on account of the distance separating both areas and different material used for its construction (pollen). Concerning Betfia-IX there is some disagreement in its dating between TERZEA and HÍR and VENCZEL (personal communication). HÍR and VENCZEL are sure that they excavated exactly the same fissure as TERZEA because they consulted the place with TERZEA's collaborator Dr JURCSÁK. They distinguish two main layers in B-IX. The lower layer (B-IX/C) is, according to them, a little older than the upper one (B-IX/B), althougt this age difference is unimportant. The list of rodents in B-IX/B is nearly the same as in the B-IX of TERZEA. According to TERZEA, hers as well as HÍR's and VENCZEL's materials of B-IX come from two different fissures. She thinks that their B-IX/C may be in reality younger than they suppose, contemporaneous with B-VII/1. That way it would be a little younger than the B-IX of hers (see TERZEA 1995a, Table 1). As the fauna of shrews is exactly the same in B-IX of TERZEA and in B-IX/B and B-IX/C of HÍR and VENCZEL I decided to treat them as belonging to one locality of the same age. B-IX could be a little older than B-VII/1 because, although both localities contain such Miocene/Pliocene survivors as Asoriculus and Petenyia, they are only in a vestigal quantity in B-VII/1.

In the present paper measurements were taken according to the pattern presented in REUMER (1984). The highest number of identical elements (e. g. right first lower molars, M_1) has been assumed to be the minimum number of individuals – MNI.

The material that this paper deals with, comes from the excavations carried out by the Speological Institute "E. Racovitza", together with the Museum of Oradea, in seven fossiliferous localities at Betfia and it was kindly made available to me for study purpose, by Dr Elena TERZEA.

Most fossil materials mentioned in this paper are housed in the collections of the Institute of Speology "Emil RACOVITZA" (ISER) in Bucharest and a big part of Betfia-IX material is in the Museum in Oradea (Muzeu Tarii Crisurilor – MTC), in Romania.

Comparative specimens marked MF/ belong to the Institute of Systematics and Evolution of Animals (ISEZ) Polish Academy of Sciences in Kraków (Poland).

I am particularly grateful to Drs. Elena TERZEA, János HÍR and Marton VENCZEL who gave me the Insectivora materials to study. I am indebted to Mr. Marek KAPTURKIEWICZ for the illustrations.

II. SYSTEMATIC PART

Family Soricidae FISCHER VON WALDHEIM, 1817

Subfamily Soricinae FISCHER VON WALDHEIM, 1817

Tribe Soricini FISCHER VON WALDHEIM, 1817

Genus *Sorex* LINNAEUS, 1758

Sorex minutus LINNAEUS, 1766

M a t e r i a l. The list of the material is given in Table I. It contains remains of maxillae and mandibles with processes except the angular process and teeth (or isolated upper and lower teeth) with the exception of $A^1 – A^2$, M^3 and A_1.

D e s c r i p t i o n o f m a t e r i a l a n d c o m p a r i s o n w i t h o t h e r E u r o p e a n p o p u l a t i o n s. A description of detailed morphology and synonymy of the fossil *S. minutus* can be found in REUMER (1984) and RZEBIK-KOWALSKA (1991). The remains from the Betfia localities mentioned above differ in size and morphology neither between them nor from other fossil European populations. They also agree in these features with recent *S. minutus* collected on Polish territory.

M e a s u r e m e n t s. See Tables II and III.

Table I

Sorex minutus LINNAEUS, 1766

Localities	Number of fragmentary maxillae and detached upper teeth	Number of fragmentary mandibles and detached lower teeth	Total	Minimum number of individuals
Betfia-XIII	1	22	23	5
Betfia-X	0	1	1	1
Betfia-XI	0	3	3	1
Betfia-IX	8	129	137	58
Betfia-VII/1	16	78	94	13
Betfia-V	0	3	3	1
Betfia-VII/3	9	35	44	4
Betfia-VII/4	0	1	1	1

Table II

Sorex minutus LINNAEUS, 1766. Dimensions of upper dentition (in mm).

		Betfia-XIII				Betfia-IX				Betfia-VII/1						Betfia-VII/3			
		min.	x	max.	n	min.	x	max.	n	min.	x	max.	n	sd	cv	min.	x	max.	n
I^1	L (bucc.)	–	–	–	–	–	–	–	–	–	1.13*	–	1	–	–	–	1.10	–	1
	L of talon	–	–	–	–	–	–	–	–	–	0.63	–	1	–	–	–	0.58	–	1
	H of talon	–	–	–	–	–	–	–	–	–	0.81	–	1	–	–	–	0.91	–	1
A^3	L (occl.)	–	–	–	–	0.62	0.64	0.67	2	–	–	–	–	–	–	–	–	–	–
	W (occl.)	–	–	–	–	0.60	0.61	0.63	2	–	–	–	–	–	–	–	–	–	–
A^4	L (occl.)	–	–	–	–	0.48	0.52	0.56	2	–	–	–	–	–	–	–	–	–	–
	W (occl.)	–	–	–	–	0.54	0.55	0.57	2	–	–	–	–	–	–	–	–	–	–
A^5	L (occl.)	–	–	–	–	–	0.52	–	1	–	–	–	–	–	–	–	–	–	–
	W (occl.)	–	–	–	–	–	0.59	–	1	–	0.42	–	1	–	–	–	–	–	–
P^4	L (bucc.)	–	1.15	–	1	1.21	1.29	1.38	5	1.09	1.21	1.39	6	0.10	8.26	1.07	1.16	1.26	2
M^1	L (max.)	–	–	–	–	1.21	1.24	1.27	5	1.13	1.19	1.24	7	0.04	3.36	1.15	1.23	1.35	4
	L (med.)	–	–	–	–	0.97	1.01	1.05	5	0.85	0.94	1.00	8	0.05	5.32	0.92	0.93	0.95	4
	W (max.)	–	–	–	–	1.27	1.31	1.40	4	1.21	1.29	1.37	7	0.06	4.65	1.35	1.37	1.39	4
M^2	L (max.)	–	–	–	–	1.10	1.14	1.19	4	–	1.04	–	1	–	–	–	0.98	–	1
	L (med.)	–	–	–	–	0.92	0.93	0.94	5	–	0.81	–	1	–	–	–	0.80	–	1
	W (max.)	–	–	–	–	1.20	1.27	1.33	4	–	1.22	–	1	–	–	–	1.16	–	1

* – specimen slightly damaged

S y s t e m a t i c p o s i t i o n and d i s t r i b u t i o n. A very small size of the specimens, fissident I^1, A^5 totally visible from the buccal side of the maxilla, P^4 with high parastyle, big L-shaped protocone and weak hypocone, M^1-M^2 with high metalophs, narrow on the top and bending towards the anterior coronoid process, weak or absent coronoid spicule, high internal temporal fossa continuing to the tip of the coronoid process, high condyloid process, the mental foramen placed below P_4/M1 or below the trigonid of M_1 (but not farther than M_1 protoconid), tricuspulate, delicate I_1 with weak cingulum, M_1-M_2 with high endoconid crests and mesoconids in unworn teeth, M_3 with basined long talonid provided with hypoconid and entoconid allow us to consider them to be *S. minutus*.

Another small *Sorex* species such as *S. subminutus* described by SULIMSKI (1962) from the Early Pliocene of Węże 1 in Poland, *S. praeminutus* described by HELLER (1963) from the Biharian of Deinsdorf in Germany and *S. biharicus* described by TERZEA (1970) from the Late Pleistocene in Romania are not considered as good species because their size and characters lie within the range of variation of *S. minutus* (see JAMMOT 1977, RZEBIK-KOWALSKA 1991).

Sorex minutus LINNAEUS, 1766.

	Betfia-XIII						Betfia-X				Betfia-XI				Betfia-IX					
	min.	x	max.	n	sd	cv	min.	x	max.	n	min.	x	max.	n	min.	x	max.	n	sd	cv
I_1 L (bucc.)	–	2.92	–	1	–	–	–	–	–	–	–	–	–	–	2.73	2.76	2.78	3	–	–
I_1 W (bucc.)	0.69	0.71	0.75	3	–	–	–	–	–	–	–	–	–	–	0.60	0.66	0.72	7	0.04	6.06
P_4 L (bucc.)	0.69	0.80	0.91	3	–	–	–	–	–	–	–	–	–	–	0.85	0.90	0.94	10	0.03	3.33
P_4 W (occl.)	0.41	0.51	0.61	3	–	–	–	–	–	–	–	–	–	–	0.49	0.52	0.54	6	0.02	3.85
M_1 L (occl.)	1.06	1.19	1.26	6	0.07	5.88	–	–	–	–	–	–	–	–	1.07	1.20	1.28	44	0.04	3.33
M_1 W (occl.)	0.64	0.69	0.74	5	–	–	–	–	–	–	–	–	–	–	0.63	0.67	0.73	43	0.03	4.48
M_2 L (occl.)	1.03	1.08	1.13	7	0.03	2.78	–	–	–	–	–	1.10	–	1	1.00	1.05	1.11	57	0.02	1.90
M_2 W (occl.)	0.59	0.65	0.70	7	0.04	6.15	–	–	–	–	0.66	0.67	0.68	2	0.58	0.63	0.68	52	0.03	4.76
M_3 L (bucc.)	0.85	0.92	0.96	5	–	–	–	–	–	–	–	0.94	–	1	0.85	0.92	1.00	31	0.04	4.35
M_3 W (occl.)	0.47	0.51	0.55	5	–	–	–	–	–	–	–	0.49	–	1	0.46	0.52	0.60	28	0.03	5.77
M_1–M_3 L (occl.)	–	3.11	–	1	–	–	–	–	–	–	–	–	–	–	2.96	3.12	3.25	12	0.09	2.88
H of mandible below M_2	0.88	0.93	0.98	8	0.03	3.23	–	0.83	–	1	–	–	–	–	0.74	0.89	1.00	89	0.06	6.74
H of ascending ramus	–	3.05	–	1	–	–	–	–	–	–	–	–	–	–	2.96	3.14	3.34	16	0.10	3.18
W of coronoid process	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.44	0.57	0.65	19	0.06	10.53
H of condyloid process	1.35	1.40	1.46	3	–	–	–	–	–	–	–	1.38	–	1	1.24	1.39	1.54	19	0.07	5.04
W of interarticular area	0.40	0.42	0.45	3	–	–	–	–	–	–	–	0.50	–	1	0.36	0.47	0.57	28	0.05	10.64

S. biharicus described from Romania is known so far only from its type locality, Cave Magura. According to TERZEA (1970) it differs from *S. minutus* by the presence of the bicuspide A_1, which in *S. minutus* is essentially unicuspid. Unfortunately, in the rich material of the smallest *Sorex* from Betfia, not one A_1 has been found and the problem of *S. biharicus* validity is still open.

S. minutus, recently widely distributed in Eurasia, is also very widespread as fossil, from nearly all countries of Europe (RZEBIK-KOWALSKA 1998). Its oldest remains were found in the Early Pliocene localities (MN14, MN15) of Poland (RZEBIK-KOWALSKA 1991), Germany (DAHLMANN and STORCH 1996), Hungary (REUMER 1984), Romania (RADULESCU et al. 1995) and Slovakia (FEJFAR 1966). The Late Pliocene and Pleistocene European localities also yielded abundant remains of this shrew (RZEBIK-KOWALSKA 1998). The species did not change much during this long period.

Sorex minutissimus ZIMMERMANN, 1780

M a t e r i a l. The list of specimens is given in Table IV. It contains two first lower incisors I_1 and two fragments of mandibles, one with M_1-M_2 and the second with a coronoid and part of the condyloid processes.

Table IV

Sorex minutissimus ZIMMERMANN, 1780

Locality	Number of fragmentary maxillae and detached upper teeth	Number of fragmentary mandibles and detached lower teeth	Total	Minimum number of individuals
Betfia-VII/3	0	4	4	1

Table III

Dimensions of lower dentition (in mm)

Betfia-VII/1						Betfia-V				Betfia-VII/3						Betfia-VII/4			
min.	x	max.	n	sd	cv	min .	x	max .	n	min .	x	max .	n	sd	cv	min .	x	max .	
2.82	2.84	2.86	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
0.58	0.65	0.72	5	–	–	–	–	–	–	0.62	0.65	0.69	2	–	–	–	–	–	–
0.81	0.86	0.92	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
0.46	0.49	0.51	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1.10	1.19	1.24	19	0.04	3.36	–	–	–	–	1.06	1.18	1.22	5	–	–	–	–	–	–
0.59	0.66	0.72	19	0.04	6.06	–	–	–	–	0.60	0.66	0.73	5	–	–	–	–	–	–
0.96	1.04	1.11	20	0.04	3.85	–	1.13	–	1	0.98	1.02	1.05	5	–	–	–	–	–	–
0.54	0.61	0.67	20	0.04	6.56	–	0.67	–	1	0.60	0.62	0.63	5	–	–	–	–	–	–
0.82	0.90	0.95	4	–	–	–	–	–	–	0.92	0.96	0.99	3	–	–	–	0.97	–	1
0.47	0.52	0.59	4	–	–	–	–	–	–	0.51	0.55	0.60	3	–	–	–	0.50	–	1
3.10	3.12	3.14	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
0.73	0.89	1.03	62	0.07	7.86	0.86	0.87	0.89	2	0.81	0.88	0.94	13	0.04	4.54	–	–	–	–
2.58	2.95	3.14	6	0.25	8.47	–	–	–	–	2.26	2.85	3.15	4	–	–	–	–	–	–
0.48	0.56	0.64	7	0.05	8.93	–	–	–	–	0.47	0.51	0.52	4	–	–	–	–	–	–
1.15	1.37	1.45	5	–	–	–	–	–	–	–	1.23	–	1	–	–	–	–	–	–
0.40	0.48	0.53	8	0.04	8.33	–	0.46	–	1	0.44	0.46	0.51	4	–	–	–	–	–	–

D e s c r i p t i o n o f t h e m a t e r i a l a n d c o m p a r i s o n w i t h s p e c i m e n s f r o m a n o t h e r c o u n t r i e s. A detailed description of most mandible and dentition elements of fossil *S. minutissimus* as well as its distribution in time and space in Europe are given in RZEBIK-KOWALSKA (1991, 1995). The specimens from Betfia-VII/3 do not differ essentially from other known remains of this form.

M e a s u r e m e n t s. See Table V.

Table V

Sorex minutissimus ZIMMERMANN, 1780.
Dimensions of mandible and lower dentition (in mm)

		Betfia-VII/3			
		min.	x	max.	n
I_1	L (bucc.)	–	2.46	–	1
	W (bucc.)	0.6 1	0.63	0.65	2
M_1	L (occl.)	–	1.04	–	1
	W (occl.)	–	0.65	–	1
M_2	L (occl.)	–	0.94	–	1
	W (occl.)	–	0.61	–	1
M_3	L (bucc.)	–	0.80	–	1
	W (occl.)	–	0.51	–	1
M_1-M_3	L (occl.)	–	2.76	–	1
H of mandible below M_2		0.7 5	0.80	0.85	2
H of ascending ramus		–	2.72	–	1
W of interarticular area		–	0.43	–	1

S y s t e m a t i c   p o s i t i o n   a n d   d i s t r i b u t i o n. Very small size, comparatively massive mandible with distinct external temporal fossa and a clear coronoid spicule, mental foramen situated below the buccal re-entrant valley of M_1 and not farther to the front of the mandible than the tip of its protoconid, a comparatively low condyloid process, massive I_1 and M_3 with a short talonid indicate that these remains belong to *S. minutissimus*. It differs from *S. minutus* first of all by a shorter and more massive I_1 and by a more posterior position of the mental foramen (see Figs.1 and 2).

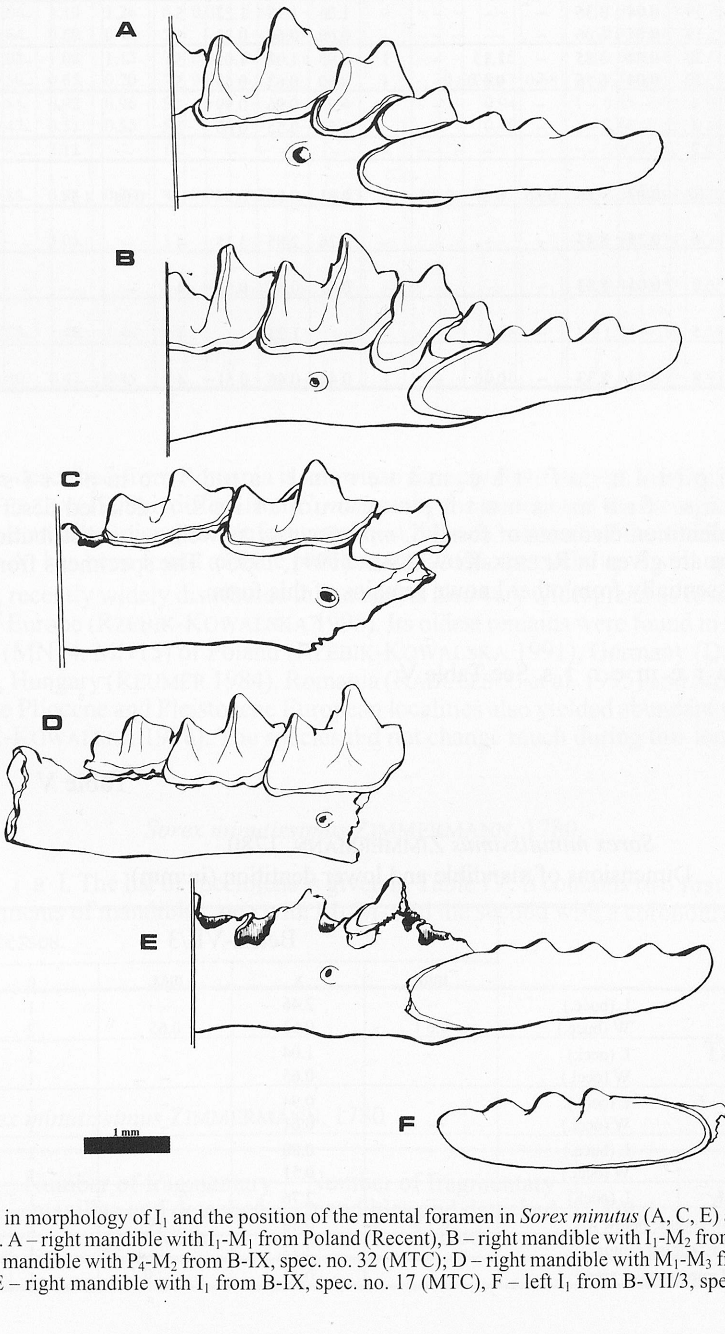

Fig. 1. Difference in morphology of I_1 and the position of the mental foramen in *Sorex minutus* (A, C, E) and *Sorex minutissimus* (B, D, F). A – right mandible with I_1-M_1 from Poland (Recent), B – right mandible with I_1-M_2 from East Siberia (Recent), C – right mandible with P_4-M_2 from B-IX, spec. no. 32 (MTC); D – right mandible with M_1-M_3 from B-VII/3, spec. no. 3 (ISER), E – right mandible with I_1 from B-IX, spec. no. 17 (MTC), F – left I_1 from B-VII/3, spec. no. 4 (ISER).

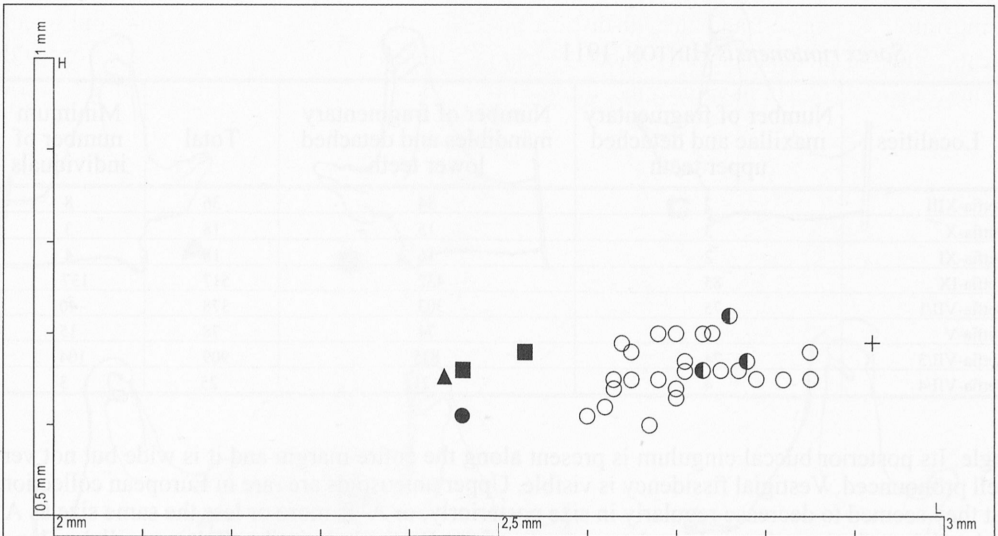

Fig. 2. Scatter-diagram showing the length (L) and height (H) (bucc.) of I_1 in *Sorex minutissimus* from Mamutowa Cave in Poland (black tringle), B-VII/3, ISER (black circle), Eastern Siberia, Recent (black squares) and *Sorex minutus* from Poland, Recent (white circles), B-XIII, ISER (cross), B-IX (black/white circles).

Today *S. minutissimus* is widely distributed from Finland in the west to eastern Siberia and Sakhalin Island in the east (JUDIN 1989). During the cold periods of the Pleistocene, however, it occured much more in western and southern Europe (RZEBIK-KOWALSKA 1998). It was found at the end of the Early Pleistocene in localities of Poland (RZEBIK-KOWALSKA 1991) and Germany (KOENIGSWALD 1973), in the Middle Pleistocene in localities of northern France (JAMMOT 1974) and Bulgaria (POPOV 1989) and during the Late Pleistocene it was still present in France (H. DE BALSAC 1940), Germany (BRUNNER 1957, MALEC 1978, HAHN and KOENIGSWALS 1977), Poland (RZEBIK-KOWALSKA 1991) and England (RZEBIK 1968) and in the Holocene in the High Tatra Mountains in Slovakia (SCHAEFER 1970).

The discovery, for the first time, of *S. minutissimus* remains in the cold period of the end of the Early Pleistocene as far south as Romania (Betfia-VII/3, Bavelian, probably a cooling event between two mild phases, see p.) and in the Middle Pleistocene of Bulgaria confirms our supposition about the possibility of its presence throughout Europe if only the conditions were suitable. It withdrew to the northeast (to its present range) at the end of the last glaciation.

Sorex runtonensis HINTON, 1911

M a t e r i a l. The list of material is given in Table VI. It contains fragments of maxillae and mandibles with all kinds of teeth and processes except for the angular process.

D e s c r i p t i o n o f t h e m a t e r i a l a n d c o m p a r i s o n w i t h o t h e r E u r o p e a n p o p u l a t i o n s. The original, although limited description is to be found in the paper of HINTON (1911). More details on specimens from West Runton were added by HARRISON (1996). The description of mandibles and lower teeth of *S. runtonensis* from Poland was also given by RZEBIK-KOWALSKA (1991).

Specimens from Betfia localities do not differ much in their morphology from other European populations, although these from Betfia-XIII, X and XI are a little smaller.

As the description of *S. runtonensis* I^1 does not exist, isolated specimens of I^1 from Betfia localities could only tentatively be referred to this species as they are distinctly bigger than these of *S. minutus* and smaller than these of *S. araneus*. The apex of I^1 and its pointed talon are placed at a sharp

Table VI

Sorex runtonensis HINTON, 1911

Localities	Number of fragmentary maxillae and detached upper teeth	Number of fragmentary mandibles and detached lower teeth	Total	Minimum number of individuals
Betfia-XIII	2	34	36	8
Betfia-X	3	15	18	3
Betfia-XI	2	16	18	4
Betfia-IX	85	432	517	137
Betfia-VII/1	75	303	378	40
Betfia-V	4	74	78	15
Betfia-VII/3	74	835	909	104
Betfia-VII/4	4	21	25	3

angle. Its posterior buccal cingulum is present along the entire margin and it is wide but not very well pronounced. Vestigial fissidency is visible. Upper unicuspids are rare in European collections but they seemed to decrease regularly in size posteriorly, or A^4 is more or less the same size as A^5. As in all described specimens P^4 and upper molars from Betfia look similar. P^4 has a well developed parastyle and protocone. The protocone is placed in the central part of the anterior side of the tooth and it is connected to the hypocone by a curving crest. The hypocone is individualised from the lingual cingulum. M^1 and M^2, subquadrate in shape, have well developed hypocones and indistinct metalophs. M^1 is larger than M^2. The posterior emargination of P^4, M^1 and M^2 is moderately developed. M^3 is large in its lingual side and has a well developed protocone basin. The hypocone is present but is not directly connected to the protocone.

The mandible of *S. runtonensis* is rather delicate. In general, the coronoid process is tall and narrow, although some specimens have wider tips. This part of the mandible (the coronoid process) seems the most variable in size and morphology. The greatest difference between the highest and the lowest ascending ramus have been found in specimens from Betfia-IX and V and it equals 0.45 mm (n = 88 and 18 respectively), and between the widest and the narrowest tip of the coronoid process in specimens from Betfia-IX where it equals 0.35 mm (n = 91). It turned out, however, that this variability is not greater than in specimens of the recent *S. araneus* from Poland studied for comparison. These values equal correspondingly 0. 49 mm and 0.31 mm (n = 39). For the morphological variety of the coronoid and condyloid processes from Betfia see Figs 3 and 4.

The external temporal fossa is deep and provided with a longitudinal bar parallel to the posterior border of the process. It reaches to the level of the upper sigmoid notch. The coronoid spicule is small and very close to the coronoid process tip. The internal temporal fossa is high and triangular, its shallow part extends to the tip of the process. In some specimens this fossa is provided with a horizontal bar. The condyloid process is rather high. As a rule two mandibular foramina are placed under the posterior corner of the internal temporal fossa although some authors (e. g. HARRISON 1996) write about only one. External pterygoid fossa and pterygoid spicule are moderately developed. The mental foramen lies under the trigonid of M_1. Tricuspulate I_1 and A_1 are long. M_1 is bigger than M_2 and its buccal cingulum is more undulate. The molars are characterized by a high endoconid crests. M_3 is unreduced.

M e a s u r e m e n t s. See Tables VII and VIII.

S y s t e m a t i c p o s i t i o n a n d d i s t r i b u t i o n. The dimensions and morphology of upper teeth and of the coronoid and condyloid processes refer these medium size (intermediate between *S. minutus* and *S. araneus*) specimens of *Sorex* to *S. runtonensis*. According to VAN DER MEULEN (1973), JAMMOT (1977) and HARRISON (1996) three other *Sorex* species of medium size (*S. aranoides* HELLER, 1930, *S. helleri* KRETZOI, 1959 and *S. kennardi* HINTON, 1911) are synonyms of *S. runtonensis*.

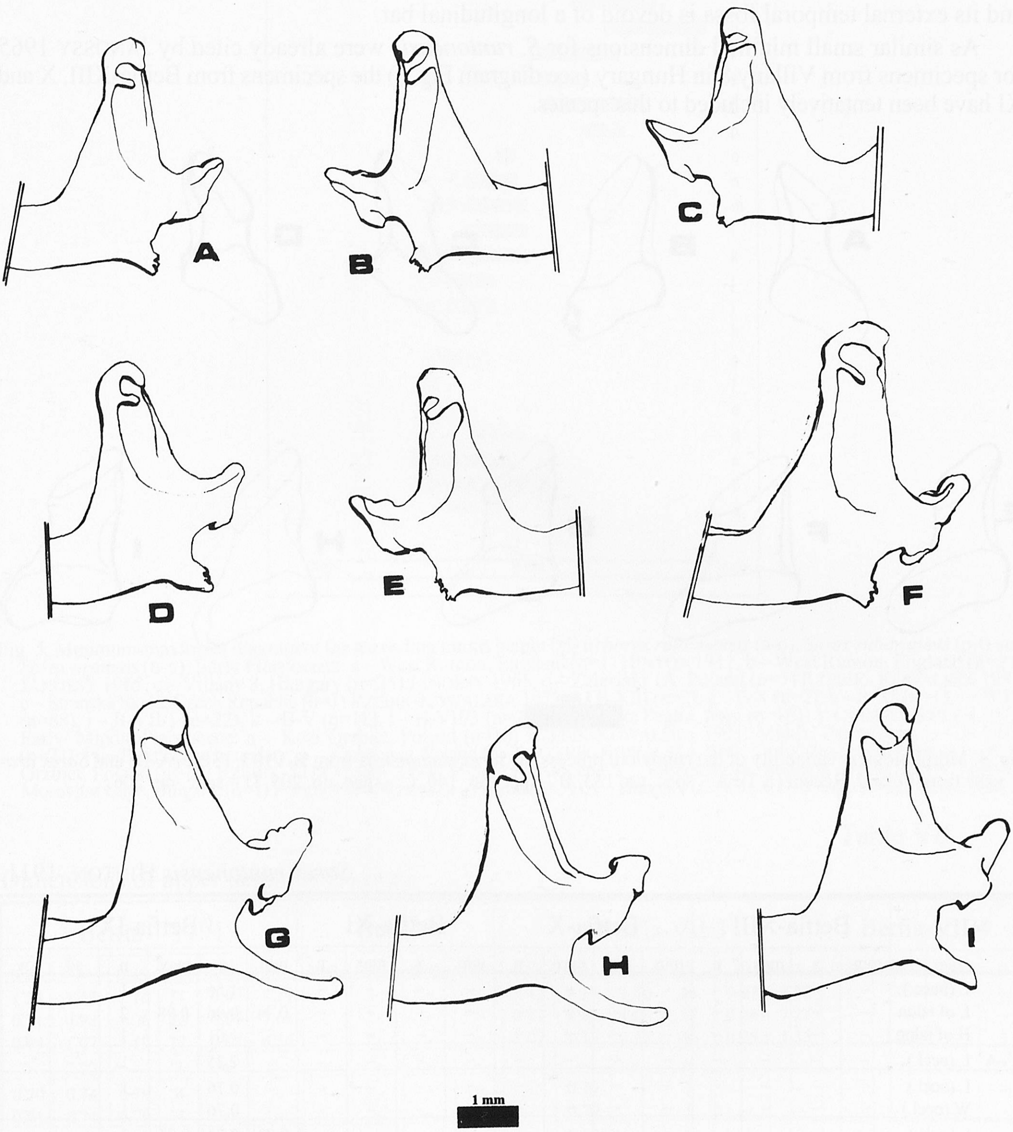

Fig. 3. Morphological variability of the coronoid process in *Sorex runtonensis* from Betfia-IX (A-E) and *Sorex araneus* from Poland, Recent (F-I); A – spec. no. 126, B – spec. no. 129, C – spec. no. 191, D – spec. no. 158, E – spec. no. 183 (all B-IX specimens from MTC).

As mentioned above, dimensions of specimens from Betfia-XIII, X and XI are a little smaller than these of the typical population from West Runton (HINTON 1911, JÁNOSSY 1965) or of most other populations described from Europe (RZEBIK-KOWALSKA 1972, 1991, VAN DER MEULEN 1973). Such small dimensions has *S. bor* described by REUMER (1984) from the Early Pliocene Osztramos 9 in Hungary but also known from the Late Pliocene and the Early Pleistocene localities. However, the morphology of upper teeth and of the ascending ramus of the mandible in *S. bor* and *S. runtonensis* are different. Specimens from all localities of Betfia are characterized by prominent hypocones in the upper P^4 and in molars as well as by a longitudinal bar in the external temporal fossa. On the other hand, hypocones of correspondent teeth in *S. bor* are weakly developed or absent and its external temporal fossa is devoid of a longitudinal bar.

As similar small minimal dimensions for *S. runtonensis* were already cited by JÁNOSSY 1965 for specimens from Villány 8 in Hungary (see diagram Fig. 5) the specimens from Betfia-XIII, X and XI have been tentatively included to this species.

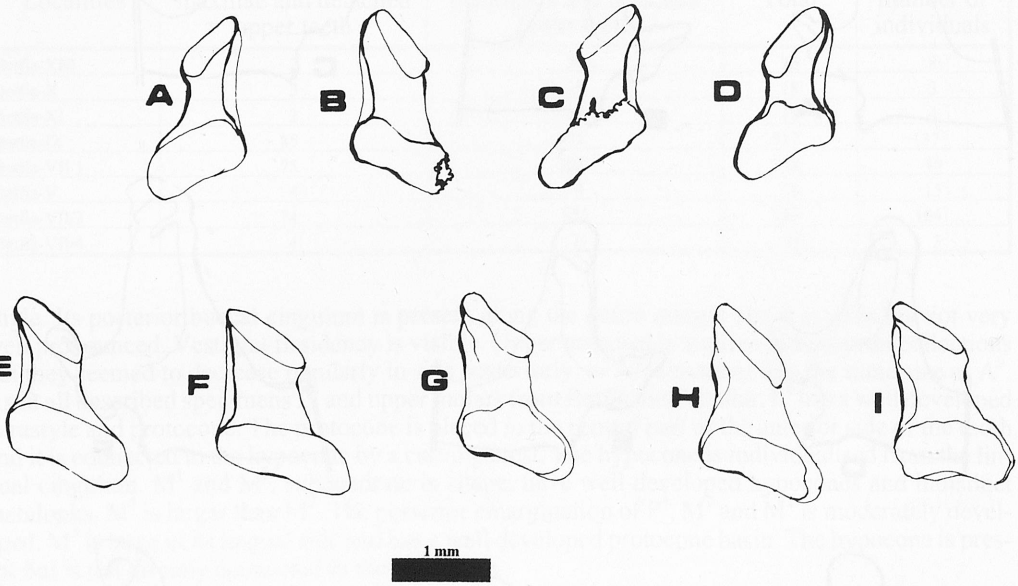

Fig. 4. Morphological variability of the condyloid process in *Sorex runtonensis* from B-VII/3, ISER (A-D) and *Sorex araneus* from Poland, Recent (E-I); A – spec. no. 133, B – spec. no. 149, C – spec. no. 205, D – spec. no. 206.

Sorex runtonensis HINTON, 1911.

		Betfia-XIII				Betfia-X				Betfia-XI				Betfia-IX					
		min.	x	max.	n	min.	x	max.	n	min.	x	max	n	min.	x	max.	n	sd	cv
I^1	L (bucc.)	–	–	–	–	–	–	–	–	–	–	–	–	–	1.56	–	1	–	–
	L of talon	–	–	–	–	–	–	–	–	–	–	–	–	0.94	0.96	0.98	2	–	–
	H of talon	–	–	–	–	–	–	–	–	–	–	–	–	–	1.01	–	1	–	–
A^1–A^5	L (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	–	2.25	–	1	–	–
A^1	L (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	–	0.76	–	1	–	–
	W (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	–	0.76	–	1	–	–
A^2	L (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	0.73	0.74	0.76	3	–	–
	W (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	0.66	0.71	0.73	3	–	–
A^3	L (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	0.62	0.64	0.67	2	–	–
	W (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	0.64	0.65	0.67	2	–	–
A^4	L (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	0.50	0.54	0.57	4	–	–
	W (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	0.53	0.57	0.62	4	–	–
A^5	L (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	0.37	0.49	0.54	5	–	–
	W (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	0.50	0.54	0.57	5	–	–
P^4	L (bucc.)	–	1.34	–	1	–	1.32	–	1	–	–	–	–	1.28	1.37	1.46	31	0.04	2.92
M^1	L (max.)	1.25	1.27	1.29	2	1.29	1.35	1.40	3	1.30	1.32	1.35	2	1.26	1.34	1.39	22	0.09	6.72
	L (med.)	1.02	1.03	1.05	2	1.07	1.09	1.11	3	1.00	1.02	1.05	2	0.93	1.06	1.12	22	0.04	3.77
	W (max.)	1.39	1.40	1.42	2	1.54	1.55	1.56	2	1.46	1.48	1.50	2	1.41	1.50	1.60	21	0.06	4.00
M^2	L (max.)	1.18	1.19	1.20	2	–	–	–	–	–	–	–	–	1.13	1.19	1.28	15	0.04	3.36
	L (med.)	0.87	0.89	0.92	2	–	–	–	–	–	–	–	–	0.93	0.98	1.04	16	0.03	3.06
	W (max.)	1.30	1.34	1.38	2	–	–	–	–	–	–	–	–	1.34	1.39	1.50	14	0.04	2.88
M^3	L (max.)	–	–	–	–	–	–	–	–	–	–	–	–	–	0.69	–	1	–	–
	W (max.)	–	–	–	–	–	–	–	–	–	–	–	–	–	1.15	–	1	–	–

* – specimen slightly damaged

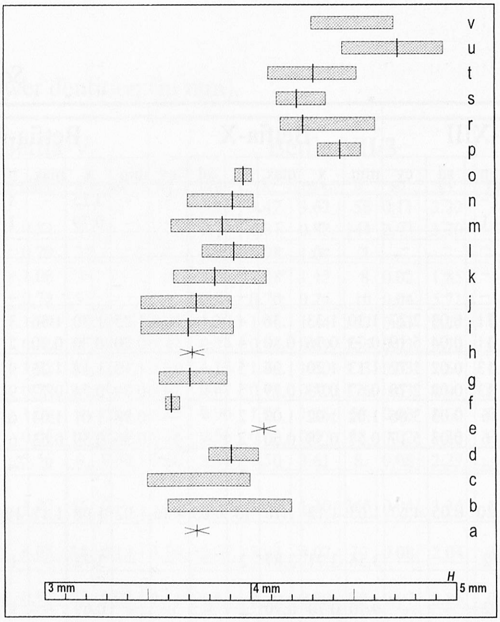

Fig. 5. Minimum-maximum diagram of the ascending ramus height (H) in *Sorex runtonensis* (a-o), *Sorex subaraneus* (p-t) and *Sorex araneus* (u-v); Early Pleistocene: a – West Runton, England (n=1) HINTON 1911, b – West Runton, England (n=21) JÁNOSSY 1965, c – Villány 8, Hungary (n=25) JÁNOSSY 1965, d – Zalesiaki 1A, Poland (n=7) RZEBIK-KOWALSKA 1991, e – Stránská Skála, Czech Republic (n=1) RZEBIK-KOWALSKA 1972, f – B-XIII (n=2), g – B-X (n=2), h – B-XI (n=1), i – B-IX (n=88), j – B-VII/1 (n=22), k – B-V (n=18), l – B-VII/3 (n=70), m –Monte Peglia, Italy (n=16)) VAN DER MEULEN 1973; Early/ Middle Pleistocene: n – Kozi Grzbiet, Poland (n=10) RZEBIK-KOWALSKA 1991; Middle Pleistocene: o – B-VII/4 (n=22); Plio/Pleistocene boundary: p – Kadzielnia, Poland (n=2) RZEBIK-KOWALSKA 1991; Early/Middle Pleistocene: r – Kozi Grzbiet, Poland (n=15) RZEBIK-KOWALSKA 1991; Middle Pleistocene: s – Verbeshnitsa, Bulgaria (n=10) POPOV 1988, t – Morovitsa Cave, Bulgaria (n=7) POPOV 1989; Recent: u – Poland (n=39), v – Hungary (n=60) (all Betfia specimens from ISER).

Table VII

Dimensions of upper dentition (in mm)

Betfia – VII/1						Betfia-V				Betfia-VII/3						Betfia-VII/4			
min.	x	max.	n	sd	cv	min.	x	max.	n	min.	x	max.	n	sd	cv	min.	x	max.	n
1.53	1.63	1.76	11	0.07	4.29	–	–	–	–	1.42	1.55	1.70	46	0.07	4.52	–	–	–	–
0.71	0.92	1.06	22	0.07	7.61	–	–	–	–	0.71	0.83	1.00	55	0.06	7.23	–	–	–	–
0.99	1.07	1.19	17	0.07	6.54	–	–	–	–	1.02	1.15	1.27	46	0.05	4.35	–	1.22	–	1
–	2.22	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
0.70	0.74	0.79	4	–	–	–	–	–	–	–	0.79	–	1	–	–	–	–	–	–
0.61	0.71	0.76	4	–	–	–	–	–	–	–	0.70	–	1	–	–	–	–	–	–
0.62	0.67	0.74	4	–	–	–	–	–	–	–	0.70	–	1	–	–	–	–	–	–
0.59	0.68	0.76	3	–	–	–	–	–	–	–	0.69	–	1	–	–	–	–	–	–
0.62	0.63	0.64	4	–	–	–	–	–	–	–	0.62	–	1	–	–	–	–	–	–
0.53	0.61	0.66	4	–	–	–	–	–	–	–	0.61	–	1	–	–	–	–	–	–
0.38	0.49	0.56	4	–	–	–	–	–	–	–	0.53	–	1	–	–	–	–	–	–
0.42	0.49	0.52	4	–	–	–	–	–	–	0.49	0.52	0.56	2	–	–	–	–	–	–
0.41	0.46	0.53	6	0.05	10.87	–	–	–	–	–	0.52	–	1	–	–	–	–	–	–
0.47	0.53	0.60	7	0.04	7.55	–	–	–	–	–	0.57	–	1	–	–	–	–	–	–
1.30	1.38	1.48	17	0.05	3.62	1.44	1.47	1.50	2	1.30	1.43	1.52	52	0.06	4.20	–	–	–	–
1.26	1.33	1.44	21	0.04	3.01	1.30	1.36	1.45	4	1.30	1.35	1.42	34	0.04	2.96	1.32	1.37	1.42	2
0.94	1.03	1.12	22	0.05	4.85	0.90	1.03	1.12	4	0.97	1.05	1.15	41	0.04	3.81	1.04	1.07	1.12	3
1.39	1.49	1.60	21	0.06	4.03	1.43	1.53	1.63	4	1.41	1.53	1.70	30	0.07	4.57	1.53	1.57	1.67	2
1.13	1.18	1.23	12	0.04	3.39	–	1.28	–	1	1.17	1.21	1.30	14	0.03	2.48	–	–	–	–
0.92	0.96	1.05	13	0.04	4.17	–	0.97	–	1	0.95	0.98	1.04	15	0.02	2.04	–	–	–	–
1.27	1.39	1.46	14	0.06	4.32	–	1.52	–	1	1.33	1.44	1.53	12	0.06	4.17	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	0.74	–	1	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	1.15	–	1	–	–	–	–	–	–

Sorex runtonensis HINTON, 1911.

		Betfia-XIII						Betfia-X						Betfia-XI						Betfia-IX					
		min.	x	max.	n	sd	cv	min.	x	max.	n	sd	cv	min.	x	max.	n	sd	cv	min.	x	max.	n	sd	cv
I_1	L (bucc.)	–	–	–	–	–	–	–	–	–	–	–	–	–	3.25	–	1	–	–	3.04	3.27	3.47	15	0.11	3.36
	W (bucc.)	–	0.81	–	1	–	–	–	–	–	–	–	–	–	0.79	–	1	–	–	0.66	0.76	0.84	34	0.04	5.26
A_1	L (bucc.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.81	0.88	0.93	10	0.04	4.54
P_4	L (bucc.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.99	1.05	1.16	30	0.05	4.76
	W (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.57	0.66	0.75	37	0.04	6.06
M_1	L (occl.)	1.28	1.32	1.38	11	0.03	2.27	1.30	1.33	1.36	4	–	–	1.25	1.30	1.36	3	–	–	1.25	1.33	1.42	184	0.04	3.01
	W (occl.)	0.70	0.77	0.84	11	0.04	5.19	0.73	0.76	0.80	4	–	–	0.70	0.70	0.70	2	–	–	0.69	0.78	0.85	189	0.03	3.85
M_2	L (occl.)	1.13	1.16	1.20	13	0.02	1.72	1.13	1.20	1.26	5	–	–	1.10	1.18	1.25	9	0.04	3.39	1.10	1.17	1.25	188	0.03	2.56
	W (occl.)	0.68	0.72	0.75	13	0.02	2.78	0.67	0.73	0.79	5	–	–	0.70	0.74	0.77	9	0.03	4.05	0.63	0.72	0.80	190	0.03	4.17
M_3	L (bucc.)	0.92	0.98	1.02	6	0.03	3.06	1.02	1.02	1.03	2	–	–	0.98	1.01	1.04	6	0.03	2.97	0.88	0.99	1.12	94	0.04	4.04
	W (occl.)	0.54	0.58	0.62	6	0.03	5.17	0.57	0.58	0.60	2	–	–	0.56	0.59	0.63	6	0.02	3.39	0.48	0.57	0.62	93	0.03	5.26
M_1-M_3	L (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3.30	3.47	3.71	57	0.09	2.59
H of mandible below M_2		1.00	1.07	1.16	20	0.05	4.67	1.03	1.12	1.18	13	0.05	4.46	1.02	1.08	1.17	10	0.05	4.63	1.00	1.09	1.27	289	0.05	4.59
H of ascending ramus		3.59	3.62	3.66	2	–	–	3.56	3.71	3.87	2	–	–	–	3.72	–	1	–	–	3.47	3.70	3.92	88	0.10	2.70
W of coronoid process		0.67	0.69	0.72	2	–	–	0.70	0.70	0.70	2	–	–	–	0.69	–	1	–	–	0.55	0.72	0.90	91	0.07	9.72
H of condyloid process		–	1.53	–	1	–	–	–	1.60	–	1	–	–	–	1.62	–	1	–	–	1.43	1.57	1.80	57	0.08	5.09
W of interarticul ar area		–	0.49	–	1	–	–	0.51	0.56	0.59	2	–	–	–	0.52	–	1	–	–	0.42	0.51	0.61	107	0.05	9.80

The oldest record of *S. runtonensis* in Europe is given by MAIS and RABEDER (1984), who cited it from Deutsch-Altenburg 30A in Austria, locality dated from the Pliocene/Pleistocene boundary. Besides, this species is known from localities of other 11 countries, dated from the Early to the Late Pleistocene (RZEBIK-KOWALSKA 1998). In general, the remains from the Late Pleistocene were described as belonging to *S. kennardi* HINTON, 1911. HARRISON (1996) proving, that *S. kennardi* is one more synonym of *S. runtonensis*.

In Romania *S. runtonensis* was already mentioned by TERZEA (1994) from Betfia-VII/3.

Sorex cf. *subaraneus* HELLER, 1958

M a t e r i a l. The list of the material is given in Table IX. It contains isolated upper teeth I^1 and P^4 and fragments of mandibles with all teeth with the exception of A_1 and processes except of the angular process.

Table IX

Sorex cf. *subaraneus* HELLER, 1958

Localities	Number of fragmentary maxillae and detached upper teeth	Number of fragmentary mandibles and detached lower teeth	Total	Minimum number of individuals
Betfia-XIII	0	2	2	1
Betfia-IX	2	7	9	4
Betfia-V	0	1	1	1
Betfia-VII/3	5	3	8	3

Table VIII

Dimensions of mandible and lower dentition (in mm).

Betfia-VII/1						Betfia-V						Betfia-VII/3						Betfia-VII/4					
min.	x	max.	n	sd	cv	min.	x	max.	n	sd	cv	min.	x	max.	n	sd	cv	min.	x	max.	n	sd	cv
3.11	3.32	3.56	8	0.16	4.82	–	–	–	–	–	–	3.21	3.42	3.62	56	0.11	3.22	–	–	–	–	–	–
0.74	0.80	0.88	41	0.03	3.75	0.76	0.79	0.84	4	–	–	0.74	0.81	0.88	144	0.03	3.70	–	0.85	–	1	–	–
0.74	0.85	0.97	10	0.07	8.23	0.73	0.76	0.79	2	–	–	0.90	0.98	1.04	3	–	–	–	–	–	–	–	–
0.88	1.01	1.14	15	0.07	6.93	0.99	1.03	1.08	2	–	–	1.06	1.08	1.13	8	0.02	1.85	–	–	–	–	–	–
0.54	0.66	0.79	16	0.06	9.09	0.66	0.69	0.72	3	–	–	0.65	0.70	0.74	10	0.04	5.71	–	–	–	–	–	–
1.28	1.36	1.43	67	0.03	2.21	1.27	1.33	1.39	15	0.04	3.01	1.30	1.36	1.44	157	0.03	2.21	1.36	1.39	1.42	2	–	–
0.69	0.78	0.90	72	0.04	5.13	0.78	0.81	0.86	17	0.02	2.47	0.74	0.81	0.89	156	0.03	3.70	0.81	0.83	0.84	3	–	–
1.07	1.19	1.28	69	0.04	3.36	1.12	1.16	1.22	23	0.03	2.59	1.15	1.20	1.30	173	0.03	2.50	1.16	1.20	1.24	5	–	–
0.63	0.72	0.79	72	0.03	4.17	0.67	0.74	0.79	25	0.03	4.05	0.67	0.75	0.80	176	0.03	4.00	0.72	0.76	0.79	5	–	–
0.88	0.98	1.05	31	0.04	4.08	0.95	1.00	1.09	9	0.04	4.00	0.90	1.00	1.06	58	0.03	3.00	0.98	0.98	0.98	2	–	–
0.48	0.57	0.64	31	0.03	5.26	0.53	0.59	0.66	10	0.04	6.78	0.56	0.60	0.67	58	0.02	3.33	0.58	0.58	0.59	2	–	–
3.35	3.54	3.74	14	0.10	2.82	3.34	3.46	3.56	6	0.09	2.60	3.41	3.50	3.61	8	0.08	2.29	–	3.49	–	1	–	–
1.03	1.13	1.31	180	0.09	7.96	1.10	1.16	1.27	56	0.04	3.45	1.10	1.19	1.30	365	0.04	3.36	1.14	1.18	1.23	18	0.03	2.54
3.47	3.74	3.91	22	0.12	3.21	3.63	3.83	4.08	18	0.13	3.39	3.77	3.93	4.07	70	0.08	2.04	3.93	3.97	4.01	2	–	–
0.60	0.74	0.91	34	0.07	9.46	0.69	0.78	0.92	22	0.05	6.41	0.67	0.79	0.90	99	0.07	8.86	0.73	0.77	0.87	5	–	–
1.35	1.50	1.67	21	0.09	6.00	1.41	1.54	1.67	15	0.06	3.90	1.43	1.57	1.73	65	0.08	5.09	–	–	–	–	–	–
0.44	0.54	0.63	32	0.04	7.41	0.51	0.58	0.67	20	0.05	8.62	0.45	0.55	0.67	121	0.05	9.09	0.51	0.53	0.55	3	–	–

Description of the material and comparison with other European populations. The original description is given by HELLER (1958) and more detailed by RZEBIK-KOWALSKA (1991).

As seen above specimens of *S.* cf. *subaraneus* from Betfia are very scarce and incomplete. In morphology they do not differ from other European populations and from the Recent *Sorex araneus* LINNAEUS, 1758.

Their upper P^4 is characterized by a large parastyle, large protocone and distinct hypocone. The prominent hypocones are also present in upper molars $M^1 - M^2$ but their metalophs are of the moderate height. As in typical *S. subaraneus* the ascending and horizontal rami of the mandible are comparatively massive and their coronoid process, although variable, is comparatively wide. The internal temporal fossa is high. The condyloid process varies in height, but its interarticular area is always wide. The entoconid crests of lower molars are not very high.

On the other hand the specimens from all Betfia localities are on the average smaller than other fossil populations known so far from Europe and the ascending ramus of their mandible is evidently lower.

The specimens from Betfia localities do not differ much between themselves, although the youngest ones seem to be a little bigger.

Measurements. See Table X and XI.

Systematic position and distribution. The size of specimens which are somewhat bigger then these in *S.runtonensis* present in the same Betfia localities and the shape of the coronoid and condyloid processes which, altough variable, are more massive and wider from these in *S. runtonensis* of the same localities refer these specimens to *S. subaraneus* (RZEBIK-KOWALSKA 1991). However their evidently smaller dimensions than those known in *S. subaraneus* arouse some problems. It is interesting, however, that most species from Betfia seem to be on an average smaller, than their counterparts from other parts of Europe, e. g. from Poland. Maybe it is the result of the southern position of the Betfia localities. This species was probably very rare in Romania during the Early and Middle Pleistocene.

Table X

Sorex cf. *subaraneus* HELLER, 1958. Dimensions of upper dentition (in mm)

		Betfia-IX				Betfia-VII/3			
		min.	x	max.	n	min.	x	max.	n
I^1	L (bucc.)	–	–	–	–	–	1.73*	–	1
	L of talon	–	–	–	–	–	0.98	–	1
	H of talon	–	–	–	–	–	1.29	–	1
P^4	L (bucc.)	–	1.51	–	1	1.46	1.49	1.53	4

* – specimen slightly damaged

Table XI

Sorex cf. *subaraneus* HELLER, 1958. Dimensions of mandible and lower dentition (in mm)

		Betfia-XIII				Betfia-IX				Betfia-V				Betfia-VII/3			
		min.	x	max.	n	min.	x	max.	n	min.	x	max.	n	min.	x	max.	n
I_1	L (bucc.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	W (bucc.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
P_4	L (bucc.)	–	–	–	–	–	1.21	–	1	–	–	–	–	–	–	–	–
	W (occl.)	–	–	–	–	–	0.69*	–	1	–	–	–	–	–	–	–	–
M_1	L (occl.)	–	1.48	–	1	1.42	1.42	1.42	3	–	1.31	–	1	–	1.48	–	1
	W (occl.)	–	0.87	–	1	0.82	0.85	0.88	2	–	0.81	–	1	–	0.87	–	1
M_2	L (occl.)	–	–	–	–	1.23	1.25	1.28	3	–	1.15	–	1	–	–	–	–
	W (occl.)	–	–	–	–	0.76	0.78	0.80	2	–	0.97	–	1	–	–	–	–
M_3	L (bucc.)	–	–	–	–	–	1.06	–	1	–	–	–	–	–	–	–	–
	W (occl.)	–	–	–	–	–	0.65	–	1	–	–	–	–	–	–	–	–
H of mandible below M_2		1.34	1.35	1.36	2	1.20	1.25	1.30	4	–	1.32	–	1	1.34	1.35	1.36	2
H of ascen- ding ramus		–	4.09	–	1	3.95	3.96	3.98	2	–	–	–	–	–	4.09	–	1
W of coronoid process		–	0.86	–	1	0.76	0.77	0.78	2	–	–	–	–	–	0.86	–	1
H of condyloid process		–	–	–	–	1.60	1.69	1.78	2	–	–	–	–	–	–	–	–
W of interarticular area		–	0.61	–	1	0.56	0.61	0.67	2	–	–	–	–	–	0.61	–	1

* – specimen slightly damaged

S. subaraneus was described by HELLER in 1958 from the German Middle Pleistocene locality Erpfingen. Today it is known from many European localities (RZEBIK-KOWALSKA 1998). The oldest specimens refered to *S. subaraneus* come from Montoussé 5 in France, dated to the Late Pliocene (MN17) (CLOT et al. 1976). The youngest remains of this species, from the Late Pleistocene, were cited from La Combe Grenal, also from France (JAMMOT 1977). In Romania *S. subaraneus* was mentioned from the Middle Pleistocene of the Gesprengberg Cave (TERZEA 1983) and Feldioara-Cariera and Rotbav-Dealul Tiganilor (RADULESCU and SAMSON 1985). The comparison of *S. subaraneus* from those localities with specimens from Betfia was impossible because Romanian authors give neither description nor measurements.

The morphological variability in *S. subaraneus* and in other Pleistocene *Sorex* species [see *Sorex* (*Drepanosorex*) *margaritodon*] are generally known and their discrimination presents problems. According to JAMMOT (1977) morphologically variable *S. subaraneus* could be ancestral to the extant *S. araneus*, *S. coronatus* and may be other chromosome races of *S. araneus*. According to palaeontological data, however, *S. subaraneus* and *S. araneus* coexisted in the Pleistocene (RZEBIK-KOWALSKA 1998).

Genus *Sorex* LINNAEUS, 1758

Subgenus *Drepanosorex* KRETZOI, 1941

Sorex (*Drepanosorex*) *praearaneus* KORMOS, 1934

M a t e r i a l. The list of the material is given in Table XII. It contains upper teeth such as I^1, A^5, P^4 and $M^1 - M^2$ and fragments of mandibles with all types of teeth and processes with the exception of the angular process.

Table XII

Sorex (*Drepanosorex*) *praearaneus* KORMOS, 1934

Localities	Number of fragmentary maxillae and detached upper teeth	Number of fragmentary mandibles and detached lower teeth	Total	Minimum number of individuals
Betfia-XIII	7	43	50	9
Betfia-X	2	3	5	2
Betfia-XI	0	3	3	2

D e s c r i p t i o n o f t h e m a t e r i a l a n d c o m p a r i s o n w i t h o t h e r E u r o p e a n p o p u l a t i o n s. The original description of this species is to be found in KORMOS (1934) and the amended diagnosis, detailed description, systematic position, generic status and synonymy were published by REUMER (1984, 1985). A description of the upper jaws, missing in REUMER's papers, is presented in the paper by RZEBIK-KOWALSKA (1991).

In general, dimensions of *S.* (*D.*) *praearaneus* from Betfia-XIII, X and XI lie within the range of variation of the European populations and, in general, their morphology is also compatible with other populations of this species. However, in specimens from Betfia-XIII, X and XI the degree of exoedaenodonty seems to be a little higher, the hypocones in last upper premolar P^4 and upper molars $M^1 - M^2$ are more robust and the mental foramen in the mandible is situated more anteriorly, not below the trigonide of M_1 as mentioned by REUMER (1984) but below the P_4 or P_4/M_1 transition (in only one specimen from Betfia-XIII the mental foramen was situated below the trigonid of the M_1). There are no size and morphological differences between specimens from particular localities of Betfia.

M e a s u r e m e n t s. See Tables XIII and XIV.

S y s t e m a t i c p o s i t i o n a n d d i s t r i b u t i o n. Such characters as comparatively large size, the presence of a fissident upper I^1, the exoedaenodonty and a somewhat weaker pigmentation of the dentition, the large condyle and the presence of a high entoconid crest in the lower molars allow us assign specimens from Betfia-XIII, X and XI to the subgenus *Drepanosorex*. Their dimensions, limited robustness and exoedaenodonty refer them to *S.* (*D.*) *praearaneus*. This species is known from the Late Pliocene (MN17) localities of Hungary, Poland and The Netherlands, the Early Pleistocene of Poland, The Netherlands, Italy and Ukraine and the Middle and Late Pleistocene of Ukraine (RZEBIK-KOWALSKA 1998).

Table XIII

Sorex (*Drepanosorex*) *praearaneus* KORMOS, 1934.
Dimensions of upper dentition (in mm)

		Betfia-XIII				Betfia-X			
		min.	x	max.	n	min.	x	max.	n
I^1	L (bucc.)	–	1.94	–	1	–	–	–	–
	L of talon	–	1.13	–	1	–	–	–	–
	H of talon	–	1.31	–	1	–	–	–	–
A^5	L (occl.)	0.58	0.64	0.68	3	–	–	–	–
	W (occl.)	0.68	0.74	0.79	3	–	–	–	–
P^4	L (bucc.)	1.61	1.68	1.74	4	–	1.75	–	1
M^1	L (max.)	1.50	1.53	1.55	2	–	1.55	–	1
	L (med.)	1.21	1.22	1.24	2	–	1.31	–	1
	W (max.)	1.70	1.78	1.86	2	–	1.84	–	1
M^2	L (max.)	–	1.27	–	1	–	1.35	–	1
	L (med.)	–	1.03	–	1	–	1.10	–	1
	W (max.)	–	1.66	–	1	–	1.52	–	1

Table XIV

Sorex (*Drepanosorex*) *praearaneus* KORMOS, 1934. Dimensions of mandible and lower dentition (in mm)

		Betfia-XIII						Betfia-X				Betfia-XI			
		min.	x	max.	n	sd	cv	min.	x	max.	n	min.	x	max.	n
I_1	L (bucc.)	–	4.02	–	1	–	–	–	4.18*	–	1	–	3.92*	–	1
	W (bucc.)	0.95	0.99	1.02	6	0.03	3.03	–	1.17	–	1	–	1.07	–	1
A_1	L (bucc.)	1.12	1.16	1.19	4	–	–	–	–	–	–	–	1.23	–	1
P_4	L (bucc.)	1.14	1.25	1.34	6	0.07	5.60	–	–	–	–	–	1.31	–	1
	W (occl.)	0.81	0.89	0.96	7	0.05	5.62	–	–	–	–	–	0.88	–	1
M_1	L (occl.)	1.48	1.55	1.63	15	0.04	2.58	–	–	–	–	1.51	1.54	1.57	2
	W (occl.)	0.91	0.98	1.04	15	0.04	4.08	–	–	–	–	0.99	1.01	1.03	2
M_2	L (occl.)	1.27	1.35	1.43	16	0.05	3.70	–	–	–	–	1.25	1.31	1.38	2
	W (occl.)	0.82	0.89	0.96	17	0.04	4.49	–	–	–	–	0.88	0.91	0.94	2
M_3	L (bucc.)	1.03	1.10	1.16	10	0.05	4.54	–	–	–	–	–	1.11	–	1
	W (occl.)	0.64	0.69	0.72	11	0.03	4.35	–	–	–	–	–	0.75	–	1
M_1–M_3	L (occl.)	3.78	3.98	4.09	6	0.15	3.76	–	–	–	–	–	4.07	–	1
H of mandible below M_2		1.39	1.51	1.65	26	0.06	3.97	1.45	1.59	1.74	2	1.43	1.49	1.56	3
H of ascending ramus		4.74	4.86	4.97	8	0.08	1.65	–	4.84	–	1	–	–	–	–
W of coronoid process		1.03	1.11	1.23	8	0.08	7.20	–	0.99	–	1	–	–	–	–
H of condyloid process		1.82	1.94	2.11	6	0.10	5.15	–	1.70*	–	1	–	–	–	–
W of interarticular area		0.66	0.72	0.78	10	0.04	5.55	–	0.72	–	1	–	–	–	–

* – specimen slightly damaged

Sorex (*Drepanosorex*) *margaritodon* KORMOS, 1930

M a t e r i a l. The list of specimens is given in Table XV. It contains fragments of maxillae and mandibles with all types of teeth and processes with the exception of the angular process.

D e s c r i p t i o n o f t h e m a t e r i a l. The original description of *S.* (*D.*) *margaritodon* is to be found in KORMOS (1930) who, however, did not give a formal diagnosis of this species but in the next paper (1935), enlarged the description and gave some comparisons with other Soricinae species.

Table XV

Sorex (*Drepanosorex*) *margaritodon* KORMOS, 1930

Localities	Number of fragmentary maxillae and detached upper teeth	Number of fragmentary mandibles and detached lower teeth	Total	Minimum number of individuals
Betfia-IX	137	248	385	82
Betfia-VII/1	31	85	116	16
Betfia-V	0	5	5	2
Betfia-VII/3	12	27	39	5
Betfia-VII/4	0	3	3	1

According to KORMOS (1930, 1935) the following items of the description were important as diagnostic features: the tooth pigment orange-red or light-orange colour, upper unicuspids $A^1 - A^5$ strong and a very characteristic (pearl-shaped where used, they stand very tightly side by side, A^1 and A^2 considerable larger than more or less equal in size small $A^3 - A^5$), mandible strong and massive with an unusually polymorphous coronoid process, fairly strong condyloid process, long and narrow angular process, high internal temporal fossa reaching almost to the top of the coronoid process, strong the first lower incisor I_1 and antemolars $A_1 - P_4$, the mental foramen situated under the posterior border of P_4, and one or two mandibular foramina present.

Thanks to the new material from Betfia-IX, VII/1, VII/2, V and VII/3 some more details can be added to that descriptions.

S. (*D.*) *margaritodon*, the big species of *Drepanosorex*, is characterized by a considerably exoedaenodont dentition with a light-orange pigmentation. The pigment covers aproximately half of the height of the crowns measured from their tips. The upper incisor I^1 is fissident. The upper unicuspids A^1 -A^2 are large, always longer than broad. The next ones, A^3, A^4 and A^5 are smaller, always broader than long with A^4 usually slightly smaller than A^3 and A^5. The hypocones in P^4 and upper molars are strongly developed. The metalophs are present in M^1 and M^2, and M^1, more or less square in shape, is always visibly larger than rather a rectangular M^2.

As mentioned by KORMOS (1930) the coronoid process and whole ascending ramus of the mandible are extremaly polimorphous. In general 4 types of this ramus can be distinguished.

1. The first one is characterized by the coronoid process typical for *Drepanosorex*: more or less wide on the top and relatively narrow on the level of the upper sigmoid notch (it is, therefore, of nearly the same width over its whole height) and by the very high condyloid process (See Fig. 6C).

2. The second type is characterized by the same (as in point 1) shape of the coronoid process and by the low condyloid process (see Fig. 6D).

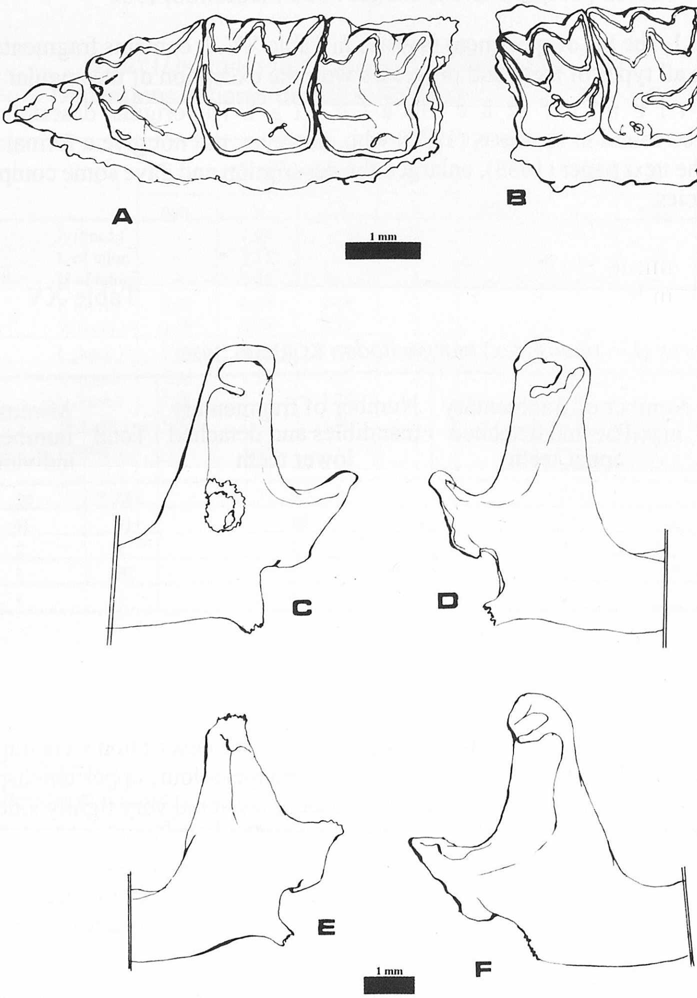

Fig. 6. Differences in morphology of M^1-M^2 in *Sorex* (*D.*) *savini* (A) (Zalesiaki 1A, Poland, spec. no. MF/1927/6) and *Sorex* (*D*). *margaritodon* (B) (B-IX, spec. no. 2); morphological variability of coronoid and condyloid processes in *Sorex* (*D*). *margaritodon* (C – F) see p. 17; C – B-VII/3, spec. no. 9, D – B-IX, spec. no 85, E – B-IX, spec. no. 84, F – B-IX, spec. no. 3 (all B-IX specimens from MTC).

3. The third one has the coronoid process typical for *Sorex* species, that is narrow on the top and wide on the level of the upper sigmoid notch and by the high condyloid process (see Fig. 6F).

4. The last type has the same coronoid process (as in point 3) and a low condyloid process (see Fig. 6E).

In Betfia-IX among 84 specimens with both processes 53 (63.10%) represented the type no. 3, 18 (21.43 %) specimens type no. 2, 10 (1.90%) specimens type no. 1 and 3 (3.57 %) type no. 4.

The variability of other characters, such as the position of the mental foramen (under P_4, P_4/M_1, or under anterior root of M_1), the number of mandibular foramina (one or two) and the shape of the upper sigmoid notch (narrow or rather wide) are independent of the mentioned above types of processes indicating a strong polymorhous morphology of the mandible of *Sorex* (*Drepanosorex*) *margaritodon*, and especially of its ascending ramus.

The lower teeth of *S.* (*D*). *margaritodon* are massive. A_1 and especially P_4 are bulbous, the buccal overhang of P_4 over the root is insignificant. The entoconid crest of the lower molars is very high, their lingual cingula are wide and the buccal ones are narrower and undulate.

In general, there is no difference in size and morphology between specimens from 5 studied localities.

M e a s u r e m e n t s. See Tables XVI and XVII.

S y s t e m a t i c p o s i t i o n a n d d i s t r i b u t i o n. The combination of characters such as relatively large size, the presence of a fissident I^1, the exoedaenodonty and somewhat weaker pigmentation of the dentition, a large condyloid process and the presence of a high entoconid crest in lower molars allow us to assign the specimens from Betfia-IX, VII/1, V, VII/3 and VII/4 to the subgenus *Drepanosorex*.

According to REUMER (1985) four species of the subgenus *Drepanosorex* are present in Europe: *S.* (*D.*) *savini* described by HINTON in 1911 from the English locality, West Runton, dated from the Early Pleistocene, *S.* (*D.*) *margaritodon* described by KORMOS in 1930 from the Romanian locality Püspökfürdö (now probably Betfia-II or IV) and dated from the Early Pleistocene, *Sorex* (*Drepanosorex*) *praearaneus* described by KORMOS in 1934 as *Sorex praearaneus* from the Hungarian locality Villány-Kalkberg (now Villány 3) and dated from the Late Pliocene (MN17) and *S.* (*D.*) *austriacus* described by KORMOS in 1937 from Hundsheim in Austria and dated from the Middle Pleistocene. In 1988 HORÁČEK and LOŽEK described from Petersbuch (Germany) one more species of this group – *S.* (*D.*) *postsavini*, dated from the Middle Pleistocene. Its systematic position and affinity with other species of this subgenus are not clear (RZEBIK-KOWALSKA 1991). *S.* (*D.*) *pachyodon* PASA, 1947 described as *Sorex pachyodon* from the Early Pleistocene locality of Soave in Italy

Table XVI

Sorex (*Drepanosorex*) *margaritodon* KORMOS, 1930. Dimensions of upper dentition (in mm)

		Betfia-IX						Betfia-VII/1						Betfia-VII/3			
		min.	x	max.	n	sd	cv	min.	x	max.	n	sd	cv	min.	x	max.	n
I^1	L (bucc.)	1.70	1.93	2.07	4	–	–	2.08	2.19	2.34	7	0.10	4.57	2.08	2.16	2.26	3
	L of talon	0.90	1.07	1.20	6	0.10	9.35	1.13	1.24	1.36	11	0.08	6.45	1.06	1.19	1.33	4
	H of talon	1.33	1.41	1.53	3	–	–	1.21	1.34	1.45	9	0.08	5.97	1.32	1.34	1.35	4
A^1–A^5	L (occl.)	3.41	3.43	3.45	2	–	–	–	–	–	–	–	–	–	–	–	–
A^1	L (occl.)	1.00	1.09	1.20	7	0.07	6.42	0.97	1.05	1.14	3	–	–	–	–	–	–
	W (occl.)	0.90	0.98	1.04	7	0.05	5.10	1.01	1.04	1.09	3	–	–	–	–	–	–
A^2	L (occl.)	0.99	1.05	1.13	9	0.05	4.76	–	0.98	–	1	–	–	–	–	–	–
	W (occl.)	0.92	0.97	1.09	9	0.05	5.15	–	0.80	–	1	–	–	–	–	–	–
A^3	L (occl.)	0.74	0.83	1.05	13	0.08	9.64	0.76	0.80	0.87	4	–	–	–	–	–	–
	W (occl.)	0.79	0.87	1.05	13	0.07	8.05	0.74	0.87	0.95	4	–	–	–	–	–	–
A^4	L (occl.)	0.61	0.67	0.74	15	0.04	5.97	0.66	0.69	0.72	2	–	–	–	–	–	–
	W (occl.)	0.73	0.79	0.92	15	0.05	6.33	0.72	0.78	0.85	2	–	–	–	–	–	–
A^5	L (occl.)	0.61	0.70	0.75	22	0.04	5.71	0.62	0.67	0.72	3	–	–	–	–	–	–
	W (occl.)	0.61	0.76	0.84	20	0.05	6.58	0.65	0.79	0.89	3	–	–	–	0.87	–	1
P^4	L (bucc.)	1.59	1.72	1.84	44	0.06	3.49	1.61	1.70	1.77	10	0.05	2.94	1.63	1.71	1.74	5
M^1	L (max.)	1.49	1.57	1.64	51	0.04	2.55	1.51	1.57	1.66	10	0.04	2.55	1.52	1.58	1.66	4
	L (med.)	1.24	1.34	1.45	55	0.04	2.98	1.23	1.32	1.46	14	0.06	4.54	1.32	1.38	1.43	4
	W (max.)	1.71	1.84	1.96	50	0.07	3.80	1.80	1.88	1.97	10	0.06	3.19	1.87	1.93	2.02	4
M^2	L (max.)	1.25	1.37	1.49	33	0.06	4.38	1.35	1.40	1.44	8	0.03	2.14	1.32	1.36	1.40	2
	L (med.)	1.06	1.18	1.32	37	0.06	5.08	1.12	1.19	1.22	10	0.03	2.52	1.18	1.20	1.22	2
	W (max.)	1.59	1.73	1.87	33	0.07	4.05	1.67	1.76	1.81	10	0.05	2.84	1.77	1.78	1.79	2
M^3	L (max.)	0.81	0.84	0.89	4	–	–	–	–	–	–	–	–	–	–	–	–
	W (max.)	1.35	1.42	1.53	4	–	–	–	–	–	–	–	–	–	–	–	–

Table XVII

Sorex (*Drepanosorex*) *margaritodon* KORMOS, 1930. Dimensions of mandible and lower dentition (in mm)

	Betfia-IX						Betfia-VII/1						Betfia-V				Betfia-VII/3						Betfia-VII/4			
	min.	x	max.	n	sd	cv	min.	x	max.	n	sd	cv	min.	x	max.	n	min.	x	max.	n	sd	cv	min.	x	max.	n
I_1 L (bucc.)	3.96	4.19	4.54	13	0.19	4.53	3.91	4.10	4.20	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
I_1 W (bucc.)	0.85	1.08	1.17	32	0.07	6.48	1.04	1.11	1.17	11	0.04	3.60	–	–	–	–	1.09	1.12	1.15	2	–	–	–	–	–	–
A_1 L (bucc.)	1.14	1.22	1.35	15	0.06	4.92	1.27	1.28	1.29	2	–	–	–	–	–	–	1.12	1.17	1.23	2	–	–	–	1.30	–	–
P_4 L (bucc.)	1.10	1.27	1.43	39	0.06	4.72	1.25	1.28	1.36	4	–	–	–	–	–	–	1.19	1.27	1.40	3	–	–	–	1.29	–	1
P_4 W (occl.)	0.80	0.91	1.13	42	0.08	8.79	0.87	0.92	0.94	5	–	–	–	–	–	–	0.94	0.98	1.00	3	–	–	–	1.05	–	1
M_1 L (occl.)	1.48	1.61	1.74	109	0.05	3.10	1.46	1.61	1.70	27	0.05	3.11	–	1.60	–	1	1.57	1.66	1.72	9	0.05	3.01	–	1.77	–	1
M_1 W (occl.)	0.92	1.03	1.19	108	0.05	4.85	0.96	1.02	1.13	29	0.03	2.94	–	1.02	–	1	1.03	1.09	1.13	9	0.03	2.75	–	1.24	–	1
M_2 L (occl.)	1.27	1.38	1.50	96	0.06	4.35	1.34	1.41	1.54	26	0.05	3.55	–	1.41	–	1	1.44	1.47	1.51	5	–	–	–	1.53	–	1
M_2 W (occl.)	0.81	0.94	1.05	96	0.05	5.32	0.87	0.95	1.04	29	0.04	4.21	–	0.97	–	1	0.99	1.02	1.04	5	–	–	–	0.92	–	1
M_3 L (bucc.)	1.01	1.13	1.28	52	0.06	5.31	1.04	1.13	1.23	14	0.05	4.42	–	–	–	–	–	1.23	–	1	–	–	–	–	–	–
M_3 W (occl.)	0.60	0.73	0.83	51	0.05	6.85	0.56	0.72	0.79	16	0.06	8.33	–	–	–	–	–	0.80	–	1	–	–	–	–	–	–
M_1–M_3 L (occl.)	3.83	4.07	4.30	39	0.14	3.44	4.11	4.13	4.15	2	–	–	–	–	–	–	–	4.33	–	1	–	–	–	–	–	–
H of mandible below M_2	1.40	1.60	1.85	129	0.10	6.25	1.46	1.66	1.82	44	0.07	4.22	1.67	1.71	1.73	3	1.46	1.64	1.90	14	0.13	7.93	–	1.46	–	1
H of ascending ramus	4.82	5.23	5.84	68	0.24	4.59	5.00	5.12	5.33	5	–	2.34	–	–	–	–	5.14	5.34	5.50	4	–	–	–	–	–	–
W of coronoid process	0.95	1.21	1.61	75	0.16	13.22	1.16	1.19	1.22	7	–	1.68	–	–	–	–	1.08	1.23	1.41	5	–	–	–	–	–	–
H of condyloid process	2.00	2.40	2.78	64	0.17	7.08	2.10	2.42	2.67	11	0.20	8.26	–	2.57	–	1	2.26	2.45	2.75	5	–	–	–	–	–	–
W of interarticular area	0.61	0.78	0.95	88	0.06	7.69	0.74	0.84	1.08	14	0.10	11.9	–	0.66	–	1	0.68	0.76	0.82	5	–	–	–	–	–	–

has been considered a synonym of *S.* (*D.*) *praearaneus* and *S.* (*D.*) *tasnadii* KRETZOI, 1941 described as *Sorex tasnadii* from the Early Pleistocene Hohensülzen in Germany as a synonym of *S.* (*D.*) *savini*. This last synonymy KRETZOI suggested himself in his paper of 1965. The data on distribution of *Drepanosorex* species in Europe are to be found in RZEBIK-KOWALSKA (1998).

The comparison of *S.* (*D.*) *praearaneus* specimens from Betfia-XIII, X and XI as well as from the Polish localities (RZEBIK-KOWALSKA 1991) with these of *S.* (*D.*) *margaritodon* from Betfia-IX – VII/4 showed that these two species differ exclusively by their size and the degree of exoedaenodonty, *S.* (*D.*) *praearaneus* being smaller and its dentition less bulbous. Although dimensions of both species overlap a little, averages are always much higher in *S.* (*D.*) *margaritodon*, especially those concerning measurements of the condyle.

As indicated above, REUMER (1985) considered *S.* (*D.*) *margaritodon* a good species. On the other hand JAMMOT (1977) emphasised the fact that the dimentions of *S.* (*D.*) *margaritodon* and *S.* (*D.*) *savini* considerably overlap and some elements of description of both species are very similar. In this situation JAMMOT considered the material from *S. margaritodon* type locality of Püspökfürdö as *S.* (*D.*) cf. *savini*. RZEBIK-KOWALSKA (1991) was also inclined to synonymize these two species.

In his paper of 1935 KORMOS wrote that *S. margaritodon* is near in size and has many characters common with *Sorex savini* HINTON, 1911, but differs from it by very characteristic (pearl-shaped) upper unicuspids, a longer first lower incisor I_1 and a narrower angular process. Today we know that the proportion and shape of unicuspids are typical for all species of *Sorex* (*Drepanosorex*), the length of I_1 measured on numerous specimens seemed to be similar in both forms and the angular process is so seldom present in the material that its usefulness to discrimination of both species is limited.

However, the analysis of abundant material of *S.* (*D.*) *margaritodon* from 5 Betfia localities demonstrated that there are some differences between these two taxa. *S.* (*D.*) *margaritodon* seems to be intermediate in size between *S.* (*D.*) *praearaneus* and *S.* (*D.*) *savini*. Besides, it differs from *S.* (*D.*) *savini* by having the upper molar M^1 bigger and different in shape from M^2. It is almost square in the occlusal view while a smaller M^2, is rather rectangular (see Fig. 6B). For example the M^1 L (max.)/M^2 L (max.) ratio in *S.* (*D.*) *margaritodon* equals 1.10 – 1.22 (n = 21). In both teeth distinct metalophs are present.

In *S.* (*D.*) *savini* both teeth, M^1 and M^2, are more or less square and almost of the same size (see Fig. 6A). The above mentioned ratio is 1.00 – 1.04 (n = 4). In both molars metalophs are very low or absent. These differences in size and morphology indicate that *S.* (*D.*) *margaritodon* is a separate species.

From all characters stressed by KORMOS (1937) as important for separating *S.* (*D.*) *margaritodon* and *S.* (*D.*) *austriacus* (KORMOS, 1937) only size and the exoedaenodonty of teeth turned out to be useful (RABEDER 1972).

Summarising, *S.* (*D.*) *praearaneus*, *S.* (*D.*) *margaritodon* and *S.* (*D.*) *austriacus* differ only by their size and the degree the exoedaenodonty, *S.* (*D.*) *praearaneus* being the smallest and most primitive and *S.* (*D.*) *austriacus* the biggest. Only *S.*(*D.*) *savini* can be distinguished to some extant by the morphology of its upper molars M^1 and M^2.

According to REUMER (1984) the species of *Drepanosorex* form a morphological sequence. From the geologically oldest (MN17) and most primitive *S.* (*D.*) *praearaneus* through *S.* (*D.*) *margaritodon* and *S.* (*D.*) *savini* to the most specialized and youngest (Early/Middle Pleistocene) *S.* (*D.*) *austriacus* they increase in dimensions, exoedaenodonty and enlargement of the condyle. This evolutionary lineage is clearly visible at Betfia where in younger localities *S.* (*D.*) *praearaneus* is replaced by *S.* (*D.*) *margaritodon*.

However, the supposition of one evolutionary lineage disagrees with paleontological data concernig the subgenus *Drepanosorex* because *S.* (*D.*) *praearaneus* or its descendant lasted longer than was generally supposed. According to data from literature it was present in Europe from the Late Pliocene (MN17) to the Late Pleistocene. On the other hand, *S.* (*D.*) *margaritodon* is known from the Plio/Pleistocene boundary, the Early Pleistocene and now also from the beginning of the Middle Pleistocene (Betfia-VII/4), *S.* (*D.*) *savini* from the Early Pleistocene to the Middle/Late Pleistocene boundary and *S.* (*D.*) *austriacus* from the Early/Middle and Middle Pleistocene (RZEBIK-KOWALSKA 1998). The revision of *S.* (*D.*) *praearaneus* material is needed to clarify this problem.

Sorex sp.

M a t e r i a l. The list of specimens is given in Table XVIII. It contains fragments of mandibles with coronoid and condyloid processes and teeth with the exception of A_1 and M_3.

D e s c r i p t i o n o f m a t e r i a l. The mandible is slender. Its coronoid process is narrow and the condyloid process is high. The mental foramen lies below the premolar – P_4.

M e a s u r e m e n t s. See (Table XIX).

Table XVIII

Sorex sp.

Locality	Number of fragmentary maxillae and detached upper teeth	Number of fragmentary mandiblesand detached lower teeth	Total	Minimum number of individuals
Betfia-IX	0	8	8	3

Table XIX

Sorex sp. Dimensions of mandible and lower dentition (in mm)

		Betfia-IX					
		min.	x	max.	n	sd	cv
I_1	L (bucc.)	–	–	–	–	–	–
	W (bucc.)	0.68	0.69	0.71	2	–	–
P_4	L (bucc.)	–	1.02	–	1	–	–
	W (occl.)	–	0.64	–	1	–	–
M_1	L (occl.)	1.40	1.42	1.43	3	–	–
	W (occl.)	0.81	0.81	0.82	2	–	–
M_2	L (occl.)	1.20	1.23	1.25	3	–	–
	W (occl.)	0.74	0.75	0.76	3	–	–
H of mandible below M_2		1.12	1.21	1.72	7	0.06	4.96
H of ascending ramus		3.50	3.92	4.18	3	–	–
W of coronoid process		0.64	0.74	0.99	3	–	–
H of condyloid process		1.18*	1.91*	2.02	5	–	–
W of interarticular area		0.50	0.57	0.61	5	–	–

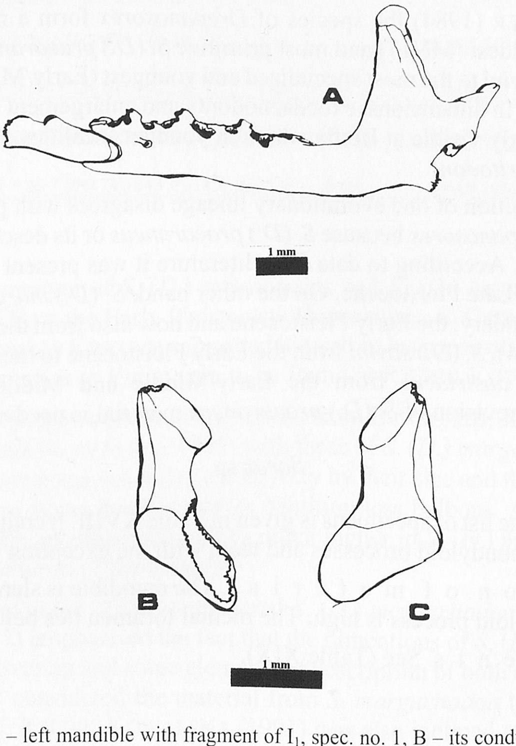

Fig. 7. *Sorex* sp. from B-IX. A – left mandible with fragment of I_1, spec. no. 1, B – its condyloid process (posterior view) (MTC), C – condyloid process of *S. runtonensis* for comparison.

S y s t e m a t i c p o s i t i o n. The size of 8 mandibles from Betfia-IX lies in the range of variation of *S. runtonensis* from this and other localities described in this paper. The only exception seems to be the condyloid process, which is higher and more slender (see Fig. 8B). Unfortunately among 5 processes present in the material 4 are slightly damage. Nevertheless they are bigger

(1.81* – 1.91* – 2.02, n = 5) than these of *S. runtonensis* in Betfia-IX (1.43 – 1.56 – 1.80, n = 46) and e.g. in Zalesiaki 1A and Kozi Grzbiet in Poland (1.58 – 1.85, n = 12, RZEBIK-KOWALSKA 1991 and in Obłazowa 2 in Poland (1.76 – 1.79, n = 4, HARRISON 1996).

As morphology is concerned 8 mandibles from Betfia-IX do not differ from these of *S. runtonensis* except in the position of the mental foramen which lies more forwards, below P_4 (see Fig. 8A). Such a position is present only in some specimens of *S.* (*Drepanosorex*) species or in *S. minutus*.

Tribe Blarinellini REUMER, 1998

Genus *Petenyia* KORMOS, 1934

Petenyia hungarica, KORMOS, 1934

M a t e r i a l. The list of the material is given in Table XX. It contains small remains of maxillae and mandibles with all types of teeth and processes with the exception of the angular process. In Betfia-IX more complete mandibles are present.

Table XX

Petenyia hungarica KORMOS, 1934

Localities	Number of fragmentary maxillae and detached upper teeth	Number of fragmentary mandibles and detached lower teeth	Total	Minimum number of individuals
Betfia-XIII	2	25	27	15
Betfia-X	1	4	5	2
Betfia-XI	6	2	8	2
Betfia-IX	50	106	156	47
Betfia-VII/1	1	6	7	3

D e s c r i p t i o n o f m a t e r i a l a n d c o m p a r i s o n w i t h o t h e r E u r o p e a n p o p u l a t i o n s. This species is well known from the Pliocene and the Early Pleistocene localities of Europe. Besides the description given by KORMOS 1934 for the typical population from Villány-Kalkberg (now Villány 3), a detailed description of morphology of this form can be found e. g. in REUMER (1984) and RZEBIK-KOWALSKA (1989). In general, specimens from Betfia localities do not differ in size and morphology from specimens from type locality and from other European populations. Small differences are connected probably with the young geological age of specimens from Betfia, because they are similar to specimens from Poland localities also dated from the Pleistocene. In comparison to old, Pliocene specimens, in both, Poland and Romania Pleistocene populations, the lower border of some I^1 apexes is not stright but slightly curved in "S", some P^4 have a more distinct and more protruding parastyles and protocones and these teeth acquired trapezoidal, not a triangular shape, the horizontal ramus of mandibles is less convex than in the geologicaly older specimens, the mental foramen is placed more posteriorly, below the posterior root of M_1, not between the trigonids and talonids and there are two mandibular foramina, while in the Pliocene Hungarian material there is only one. There are no morphological and size differences between specimens from particular localities of Betfia.

M e a s u r e m e n t s. See Tables XXI and XXII.

S y s t e m a t i c p o s i t i o n a n d d i s t r i b u t i o n. Such characters as: nearly straight posterior margins of P^4 and upper molars M^1 and M^2, short and massive mandible with the mental foramen situated below the posterior root of M_1, a large coronoid process with the coronoid spicule protruding, dividing the external temporal fossa into two parts roughly equal in size, a broad lower condylar facet and interarticular area, dark red (almost black) pigmentation of teeth, lower molars with high entoconid crests and M_3 with a single cusped talonid allow us to as-

Table XXI

Petenyia hungarica KORMOS, 1934. Dimensions of upper dentition (in mm)

		Betfia-XIII				Betfia-X				Betfia-XI				Betfia-IX						Betfia-VII/1			
		min.	x	max.	n	min.	x	max.	n	min.	x	max.	n	min.	x	max.	n	sd	cv	min.	x	max.	n
I^1	L (bucc.)	–	–	–	–	–	–	–	–	–	–	–	–	2.40	2.45	2.52	8	0.04	1.63	–	–	–	–
	L of talon	–	–	–	–	–	–	–	–	–	–	–	–	1.18	1.27	1.33	12	0.04	3.15	–	–	–	–
	H of talon	–	–	–	–	–	–	–	–	–	1.42*	–	1	1.28	1.34	1.40	11	0.04	2.98	–	–	–	–
A^1–A^4	L (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	–	2.15	–	1	–	–	–	–	–	–
A^1	L (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	1.04	1.07	1.11	2	–	–	–	–	–	–
	W (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	0.68	0.72	0.77	2	–	–	–	–	–	–
A^2	L (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	0.80	0.84	0.89	2	–	–	–	–	–	–
	W (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	0.64	0.65	0.66	2	–	–	–	–	–	–
A^3	L (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	0.52	0.56	0.58	3	–	–	–	–	–	–
	W (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	0.59	0.60	0.62	3	–	–	–	–	–	–
A^4	L (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	0.25	0.27	0.30	4	–	–	–	0.30	–	1
	W (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	0.22	0.26	0.31	4	–	–	–	0.43	–	1
P^4	L (bucc.)	–	1.54	–	1	–	–	–	–	–	1.55	–	1	1.45	1.51	1.59	18	0.04	5.30	–	1.54	–	1
M^1	L (max.)	–	–	–	–	–	–	–	–	–	1.45*	–	1	1.43	1.48	1.57	27	0.04	2.70	–	1.45	–	1
	L (med.)	–	–	–	–	–	–	–	–	–	1.33	–	1	1.25	1.33	1.40	27	0.03	2.26	–	1.35	–	1
	W (max.)	–	–	–	–	–	–	–	–	–	1.54	–	1	1.47	1.58	1.67	25	0.05	3.16	–	1.58	–	1
M^2	L (max.)	–	–	–	–	–	1.31	–	1	–	1.31	–	1	1.33	1.39	1.47	22	0.04	2.88	–	–	–	1
	L (med.)	–	1.14	–	1	–	1.18	–	1	1.16	1.17	1.18	2	1.17	1.23	1.29	26	0.03	2.44	–	–	–	1
	W (max.)	–	–	–	–	–	1.45	–	1	–	1.52	–	1	1.42	1.52	1.62	22	0.05	3.29	–	–	–	1
M^3	L (max.)	–	–	–	–	–	–	–	–	–	–	–	–	0.60	0.63	0.68	5	–	–	–	–	–	1
	W (max.)	–	–	–	–	–	–	–	–	–	–	–	–	1.06	1.14	1.23	5	–	–	–	–	–	1

* - specimen slightly damaged

Table XXII

Petenyia hungarica KORMOS, 1934. Dimensions of mandible and lower dentition (in mm)

		Betfia-XIII						Betfia-X						Betfia-XI				Betfia-IX						Betfia-VII/1			
		min.	x	max.	n	sd	cv	min.	x	max.	n	sd	cv	min.	x	max.	n	min.	x	max.	n	sd	cv	min.	x	max.	n
I_1	L (bucc.)	3.80	3.96	4.11	3	-	–	–	–	–	–	–	–	–	–	–	–	3.64	3.86	4.06	9	0.16	4.14	–	3.95	–	1
	W (bucc.)	0.94	0.97	1.00	6	0.02	2.06	–	–	–	–	–	–	–	–	–	–	0.95	0.98	1.02	13	0.02	2.04	–	0.99	–	1
A_1	L (bucc.)	0.74	0.75	0.76	2	–	–	–	–	–	–	–	–	–	–	–	–	0.71	0.74	0.78	3	–	–	–	–	–	–
P_4	L (bucc.)	–	1.18	–	1	–	–	–	–	–	–	–	–	–	–	–	–	0.99	1.11	1.23	8	0.08	7.21	–	1.11	–	1
	W (occl.)	0.82	0.85	0.88	2	–	–	–	–	–	–	–	–	–	–	–	–	0.78	0.82	0.86	9	0.03	3.66	–	0.87	–	1
M_1	L (occl.)	1.43	1.45	1.48	5	–	–	–	–	–	–	–	–	–	1.35	–	1	1.37	1.44	1.50	50	0.03	2.08	–	1.42	–	1
	W (occl.)	0.94	0.96	0.98	5	–	–	–	–	–	–	–	–	–	0.91	–	1	0.87	0.94	1.05	46	0.03	3.19	–	1.02	–	1
M_2	L (occl.)	1.26	1.31	1.37	13	0.03	2.29	1.28	1.30	1.31	4	–	–	1.28	1.28	1.29	2	1.25	1.33	1.39	59	0.03	2.26	1.25	1.27	1.30	4
	W (occl.)	0.79	0.86	0.92	14	0.04	4.65	0.83	0.84	0.88	4	–	–	0.87	0.88	0.89	2	0.81	0.87	1.01	56	0.04	4.60	0.83	0.87	0.95	4
M_3	L (bucc.)	1.09	1.13	1.17	9	0.03	2.65	1.14	1.15	1.17	3	–	–	1.15	1.15	1.16	2	1.01	1.12	1.19	49	0.03	2.68	–	–	–	–
	W (occl.)	0.60	0.63	0.67	9	0.02	3.17	0.64	0.68	0.71	3	–	–	0.66	0.66	0.66	2	0.60	0.70	0.81	44	0.06	1.57	–	–	–	–
M_1–M_3	L (occl.)	3.79	3.81	3.84	2	–	–	–	–	–	–	–	–	–	3.76	–	1	3.70	3.84	4.02	36	0.07	1.82	–	–	–	–
H of mandible below M_2		1.52	1.63	1.72	10	0.07	4.29	1.38	1.46	1.53	3	–	–	1.50	1.53	1.57	2	1.43	1.55	1.66	50	0.05	3.23	1.50	1.54	1.60	1
H of ascending ramus		4.33	4.39	4.46	4	–	–	–	–	–	–	–	–	–	–	–	–	4.20	4.39	4.63	28	0.10	2.28	–	–	–	–
W of coronoid process		0.99	1.02	1.07	3	–	–	–	–	–	–	–	–	–	–	–	–	0.89	1.01	1.10	25	0.06	5.94	–	–	–	–
H of condyloid process		1.87	1.97	2.08	4	–	–	–	1.93	–	1	–	–	–	–	–	–	1.70	1.87	2.02	34	0.08	4.28	–	–	–	–
W of inter-articular area		0.68	0.75	0.84	5	–	–	–	0.59	–	1	–	–	–	–	–	–	0.58	0.72	0.85	39	0.06	8.33	–	–	–	–

sign these remains to *P. hungarica* KORMOS, 1934. *P. neglecta* KRETZOI, 1943 described from the Early Pleistocene of Püspökfürdö (today Betfia-II or IV) is considered to be a synonym of *P. hungarica* (REUMER 1984).

Petenyia hungarica was described in Hungary, from Villány-Kalkberg (now Villány 3) dated from the Late Pliocene (MN17). It shows, however, a remarkably long stratigraphic range, from the Miocene/Pliocene boundary (Maramena in Greece, MN13/14, DOUKAS et al. 1995) to the end of the Early Pleistocene (Urşilor Cave in Romania, TERZEA 1983). Its only data from the Miocene (Eichkogel, Austria, MN 11, DAXNER-HÖCK and RABEDER 1970 and RABEDER 1970) is given without any drawings, and practically without any description or measurements, and it is uncertain (see RZEBIK-KOWALSKA 1998). So far *P. hungarica* is known from about 60 localities of 11 European countries (RZEBIK-KOWALSKA 1998). The genus is also known from Asia (STORCH et al. 1998) and probably also from North America (HIBBARD and JAMMOT 1971 and HARRIS 1998). It was already mentioned in Romania (FERU et al. 1978, RADULESCU and SAMSON 1986, TERZEA 1983, 1994). In her paper from 1994 the author listed *P. hungarica* from Betfia-XIII, X, XI, IX and VII/1. All localities from Romania are dated from the Early Pleistocene. On the European distribution of *P. hungarica* see RZEBIK-KOWALSKA 1998).

Tribe *Beremendiini* REUMER, 1984

Genus *Beremendia* KORMOS, 1934

Beremendia fissidens (PETÉNYI, 1864)

M a t e r i a l. The list of specimens is given in Table XXIII. It contains small fragments of maxillae and mandibles and all types of isolated upper and lower teeth, which prevail in the material. Only in Betfia-IX fragments of maxillae with teeth and undamaged mandibles with teeth and processes (with the exception of an angular process) are present.

Table XXIII

Beremendia fissidens (PETÉNYI, 1864)

Localities	Number of fragmentary maxillae and detached upper teeth	Number of fragmentary mandibles and detached lower teeth	Total	Minimum number of individuals
Betfia-XIII	22	44	66	11
Betfia-X	7	6	13	2
Betfia-XI	2	2	4	1
Betfia-IX	180	186	366	50
Betfia-VII/1	47	65	112	15
Betfia-VII/2	1	2	3	1
Betfia-V	16	36	52	10
Betfia-VII/3	210	251	461	52
Betfia-VII/4	4	7	11	2

D e s c r i p t i o n o f m a t e r i a l a n d c o m p a r i s o n w i t h o t h e r E u r o p e a n p o p u l a t i o n s. Besides the original description given by PETÉNYI for *Crossopus fissidens* from Beremend 1 (Hungary) in 1864, a very detailed characteristic of this species, its measurements, illustrations and comparison with similar taxa are to be found in RZEBIK-KOWALSKA (1976) and REUMER (1984).

In general the size and morphology of *B. fissidens* from all the discussed localities of Betfia agree with these characters in other European specimens. However, although all of their dimensions lie within the range of variation of already known populations, they are on an average smaller from their ancestors living in the Pliocene of Europe. For example, the minimum-maximum diagram (Fig. 8) shows that the average length of M_1 which increased during the Pliocene, began to diminish since the Pliocene/Pleistocene boundary. This is especially well visible on the material from Betfia, nine localities of which present a very long sequence, being dated from the Eburonian to the middle of the Cromerian.

As in other populations (see RZEBIK-KOWALSKA 1976), in Betfia material I^1, P^4, I_1 and M_3 belonged to the most variable teeth. Talons of I^1 (on the buccal side) vary from relatively narrow to a very broad ones and their crown/root contact lines ran either obliquely or perpendicularly to the long axis of the skull. In some specimens the lingual part of P^4 may be relatively broad, while in others it is narrow, tongue-shaped. In general, one deep groove is visible on the lingual side of I_1. If the second groove is present it is always very shallow and lies in the extension of the root groove. A degree of talonid reduction in M_3 is also variable in specimens from Betfia. Most teeth are devoid of entoconids, but specimens with small entoconids or almost devoid of the talonids also occur.

Besides the size, the Pleistocene *B. fissident* from Betfia differ by its morphology of upper molars: M^1 and M^2. In contrast with the Pliocene specimens from Poland some M^1 and M^2 from Betfia are characterized by split mesostyles, the character extremely rare in the Pliocene upper molars. A single such tooth was found in Poland, at Rebielice Królewskie 1A.

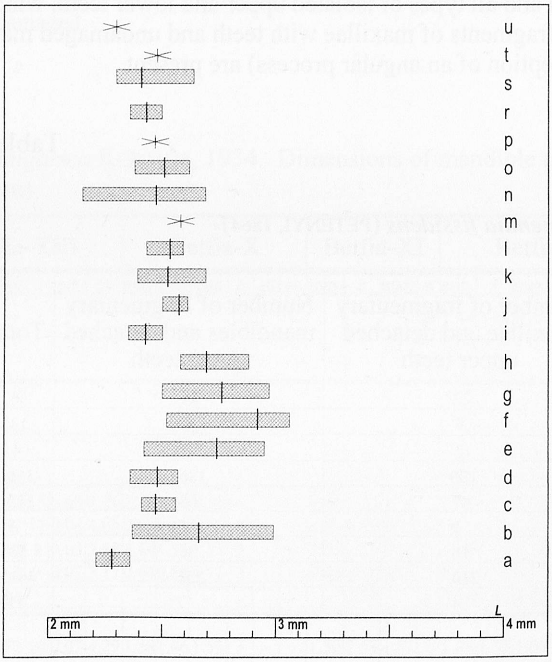

Fig. 8. Minimum-maximum diagram of the M_1 lenght (L) in *Beremendia fissidens*. Early Pliocene: a – Węże 1, Poland (n=7), b – Csarnóta, Hungary (n=44); Late Pliocene: c – Rębielice Królewskie 2, Poland (n=8), d – Rębielice Królewskie 1A, Poland (n=10), e – Osztramos 7, Hungary (n=49), f – Villány 3, Hungary (n=24), g – Osztramos 3/2, Hungary (n=12), h – Tegelen, The Netherlands (n=7); Plio/Pleistocene boundary: i – Kadzielnia, Poland (n=4); Early Pleistocene: j – Kamyk, Poland (n=5), k – B-XIII (n=14), l – B-X (n= 3), m – B-XI (n= 1), n – B-IX (n=65), o – B-VII/1 (n=18), p – B-VII/2 (n=1), r – B-V (n=4), s –B-VII/3 (n=78); Early/Middle Pleistocene: t – Kozi Grzbiet, Poland (n=1); Middle Pleistocene: u – B-VII/4 (n=1). All data according to RZEBIK-KOWALSKA 1976 and REUMER 1984 (all Betfia specimens from ISER).

Besides, a part of the upper M^1 and M^2 which in *B. fissident* are characterized by a very high metaloph, in all localities of Betfia-VII (VII/1, VII/2, VII/3 and VII/4) had the metaloph very low or they were completely devoid of it. In Betfia-VII/3 where the number of M^1 equals 62, the percentage of teeth without metaloph equals 40%. As those teeth were isolated one could suppose that they belonged to another taxon, but their size and other characters rather exclude this possibility.

M e a s u r e m e n t s. See Tables XXIV and XXV.

S y s t e m a t i c p o s i t i o n a n d d i s t r i b u t i o n. Relatively large size, strongly fissident I^1 and long and acuspulate I_1, emargination of P^4 and upper molars conspicuous, an endoconid crest in the lower molars present, talonid of M_3 reduced, the coronoid process short and the condyloid process with the lower facet placed far anteriorly in the relation to the lower sigmoid notch refer these specimens to *Beremendia fissidens*. In Europe only two species of this genus are known. The second one, *B. minor* RZEBIK-KOWALSKA, 1976 , differs by its considerably smaller size. *B. fissidens*, even more ubiquitous than *P. hungarica*, was found in more than 100 localities in 17 European countries. Assemblages in which it occurs, point to different climates and environments and are dated from the Early Pliocene to the beginning of the Middle Pleistocene. It is also known from Asia (STORCH et al. 1998).

B. fissident was already mentioned in Romania from the older Late Pliocene (MN16 and MN17) localities by RADULESCU and SAMSON (1987) and RADULESCU and al. (1993). It was also cited from the Early and Middle Pleistocene of this country (FERU et all. 1978, RADULESCU and SAMSON 1986, TERZEA 1983, 1994). In her paper of 1994 the author listed *Beremendia fissidens* from Betfia-XIII, X, XI, IX, VII/1, V, VII/3 and VII/4. On the European distribution of *B. fissidens* see RZEBIK-KOWALSKA 1998.

Tribe Blarinini KRETZOI, 1965

Genus *Blarinoides* SULIMSKI, 1959

Blarinoides mariae SULIMSKI, 1959

M a t e r i a l. Betfia-XIII. 1 left I^1, 1 right I^1, 1 right P^4 and 1 distal fragment of right I_1. Minimum number of individuals equals 1 (see Table XXVI).

D e s c r i p t i o n o f m a t e r i a l s. Although only 4 teeth (two of them used and one damaged) have been found there can be no doubt that they belong to *Blarinoides mariae*. Their morphology and size do not vary from the typical material described by SULIMSKI (1959) from Węże 1 in Poland and from other European materials. The description of *B. mariae* (besides of SULIMSKI's 1959) can be found in RZEBIK-KOWALSKA (1976) and REUMER (1984).

Table XXVI

Blarinoides mariae SULIMSKI, 1959

Locality	Number of fragmentary maxillae and detached upper teeth	Number of fragmentary mandibles and detached lower teeth	Total	Minimum number of individuals
Betfia-XIII	3	1	4	1

M e a s u r e m e n t s. See Table XXVII.

All maesuremenst, except of the buccal length (occlusal view) of P^4 are only approximate because the teeth are worn and damaged.

Beremendia fissidens (PETÉNYI, 1864).

		Betfia-XIII						Betfia-X				Betfia-XI				Betfia-IX					
		min.	x	max.	n	sd	cv	min.	x	max.	n	min.	x	max.	n	min.	x	max.	n	sd	cv
I^1	L (bucc.)	3.44	3.61	3.81	3	–	–	–	3.90	–	1	–	3.45	–	1	3.33	3.72	4.00	16	0.18	4.84
	L of talon	1.52	1.57	1.62	4	–	–	–	–	–	–	–	1.36	–	1	1.32	1.59	1.89	26	0.14	8.80
	H of talon	2.17	2.38	2.47	4	–	–	–	–	–	–	–	2.25	–	1	2.05	2.33	2.68	28	0.13	5.58
A^1–A^4	L (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4.01	–	1	–	–
A^1	L (occl.)	1.47	1.47	1.48	2	–	–	–	–	–	–	–	1.58	–	1	1.46	1.73	1.95	7	0.15	8.67
	W (occl.)	1.07	1.10	1.13	2	–	–	–	–	–	–	–	1.02	–	1	1.06	1.19	1.35	7	0.09	7.56
A^2	L (occl.)	–	1.25	–	1	–	–	–	–	–	–	–	–	–	–	1.42	1.55	1.73	4	–	–
	W (occl.)	–	1.05	–	1	–	–	–	–	–	–	–	–	–	–	1.09	1.15	1.29	5	–	–
A^3	L (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.97	1.07	1.20	7	0.10	9.35
	W (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.94	1.00	1.06	7	0.05	5.00
A^4	L (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.63	0.67	0.71	4	–	–
	W (occl.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.61	0.68	0.76	4	–	–
P^4	L (bucc.)	2.64	2.77	2.96	4	–	–	2.89	2.94	2.99	2	–	–	–	–	2.59	2.80	3.03	43	0.09	3.21
M^1	L (max.)	2.26	2.37	2.49	9	0.07	2.54	–	2.46	–	1	–	–	–	–	2.28	2.45	2.63	42	0.08	3.26
	L (med.)	1.74	1.84	1.97	9	0.09	4.89	1.91	1.93	1.96	2	–	–	–	–	1.80	1.91	2.05	49	0.06	3.14
	W (max.)	2.45	2.54	2.74	9	0.09	3.54	–	2.79	–	1	–	–	–	–	2.41	2.62	2.79	42	0.09	3.43
M^2	L (max.)	1.86	1.96	2.05	8	0.07	3.57	–	2.04	–	1	–	–	–	–	1.82	1.97	2.13	37	0.07	3.55
	L (med.)	1.44	1.55	1.63	7	0.06	3.87	–	1.50	–	1	–	–	–	–	1.45	1.56	1.67	41	0.06	3.85
	W (max.)	2.25	2.45	2.69	8	0.15	6.12	–	2.54	–	1	–	–	–	–	2.30	2.50	2.76	40	0.10	4.00
M^3	L (max.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.82	0.90	0.99	5	–	–
	W (max.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.46	1.58	1.67	7	0.08	5.06

Beremendia fissidens (PETÉNYI, 1864).

		Betfia-XIII						Betfia-X				Betfia-XI				Betfia-IX					
		min.	x	max.	n	sd	cv	min.	x	max.	n	min.	x	max.	n	min.	x	max.	n	sd	cv
I_1	L (bucc.)	6.13	6.37	6.65	3	–	–	–	–	–	–	–	–	–	–	5.61	6.31	6.91	23	0.34	5.39
	W (bucc.)	1.40	1.49	1.60	12	0.06	4.03	–	–	–	–	–	–	–	–	1.23	1.40	1.54	45	0.07	5.00
A_1	L (bucc.)	–	–	–	–	–	–	–	1.60	–	1	–	–	–	–	1.32	1.45	1.74	11	0.12	8.28
P_4	L (bucc.)	1.81	1.92	2.10	7	0.10	5.21	–	2.00	–	1	–	–	–	–	1.73	1.99	2.25	25	0.15	7.54
	W (occl.)	1.30	1.37	1.45	7	0.06	4.38	–	1.34	–	1	–	–	–	–	1.20	1.40	1.53	22	0.09	6.43
M_1	L (occl.)	2.39	2.52	2.69	14	0.09	3.57	2.43	2.53	2.59	3	–	2.58	–	1	2.15	2.47	2.69	65	0.09	3.64
	W (occl.)	1.48	1.62	1.70	13	0.06	3.70	1.66	1.72	1.78	4	–	1.53	–	1	1.40	1.61	1.75	64	0.07	5.59
M_2	L (occl.)	2.06	2.15	2.28	15	0.06	2.79	2.12	2.15	2.18	3	–	–	–	–	1.94	2.14	2.25	65	0.06	2.80
	W (occl.)	1.29	1.38	1.58	14	0.05	3.62	1.33	1.44	1.51	3	–	–	–	–	1.19	1.35	1.50	66	0.06	4.44
M_3	L (bucc.)	1.56	1.61	1.71	7	0.06	3.73	–	1.67	–	1	–	1.70	–	1	1.38	1.58	1.75	35	0.08	5.06
	W (occl.)	0.83	0.91	1.10	7	0.06	6.59	–	1.09	–	1	–	0.90	–	1	0.82	0.92	1.04	35	0.05	5.43
M_1-M_3	L (occl.)	6.05	6.18	6.35	3	–	–	–	6.26	–	1	–	–	–	–	5.55	6.01	6.26	20	0.18	2.99
H of mandible below M_2		2.40	2.59	2.78	16	0.10	3.86	2.72	2.76	2.80	2	–	–	–	–	2.26	2.50	2.86	55	0.15	6.00
H of ascending ramus		–	–	–	–	–	–	–	–	–	–	–	–	–	–	5.99	6.41	6.90	28	0.28	4.37
W of coronoid process		–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.20	1.44	1.72	37	0.12	8.33
H of condyloid process		3.48	3.59	3.71	2	–	–	–	–	–	–	–	–	–	–	3.18	3.47	3.97	38	0.19	5.47
W of inter–articular area		1.28	1.29	1.31	2	–	–	–	–	–	–	–	–	–	–	1.20	1.4 1	1.69	44	0.13	9.22

S y s t e m a t i c   p o s i t i o n   a n d   d i s t r i b u t i o n. Relatively large size, intensely dark red pigmentation, strong, nonbifid I^1 [both specimens were strongly used but looking from the upper side on its distal parts one can see that they are narrow, while in bifid I^1 of

Table XXIV

Dimensions of upper dentition (in mm)

Betfia-VII/1						Betfia-VII/2				Betfia-V						Betfia-VII/3						Betfia-VII/4			
min.	x	max.	n	sd	cv	min.	x	max.	n	min.	x	max.	n	sd	cv	min.	x	max.	n	sd	cv	min.	x	max.	n
3.56	3.87	4.31	7	0.25	6.46	–	–	–	–	3.24	3.56	3.94	7	0.24	6.74	3.30	3.58	3.88	16	0.19	5.31	–	*	–	–
1.48	1.61	1.83	13	0.11	6.83	–	–	–	–	1.35	1.54	1.75	9	0.12	7.79	1.27	1.48	1.74	34	0.13	8.78	–	1.73	–	1
2.26	2.39	2.60	11	0.10	4.18	–	–	–	–	2.09	2.29	2.55	7	0.15	6.55	2.09	2.28	2.88	33	0.17	7.46	–	2.45	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.82	1.88	1.93	5	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.20	1.23	1.26	6	0.02	1.63	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.67	1.76	1.87	6	0.08	4.54	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.01	1.05	1.10	6	0.03	2.86	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.29	–	1	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.11	–	1	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2.74	2.91	3.13	10	0.12	4.12	–	–	–	–	2.87	2.89	2.91	2	–	–	2.42	2.68	3.10	63	0.17	6.34	–	2.77	–	1
2.37	2.49	2.59	16	0.06	2.41	–	–	–	–	2.38	2.39	2.41	2	–	–	2.22	2.40	2.85	45	0.11	4.58	–	2.34	–	1
1.81	1.92	2.15	17	0.08	4.17	–	–	–	–	1.92	1.99	2.07	2	–	–	1.76	1.91	2.11	65	0.08	4.19	–	1.80	–	1
2.45	2.75	3.01	10	0.16	5.82	–	–	–	–	2.58	2.62	2.66	2	–	–	2.31	2.56	2.84	41	0.11	4.30	–	2.47	–	1
1.81	1.97	2.10	7	0.10	5.08	–	2.13	–	1	–	1.91	–	1	–	–	1.71	1.85	2.06	13	0.10	5.40	–	–	–	–
1.48	1.58	1.65	11	0.05	3.16	–	1.66	–	1	–	1.55	–	1	–	–	1.36	1.51	1.64	26	0.07	4.64	–	–	–	–
2.32	2.52	2.61	8	0.10	3.97	–	2.53	–	1	–	2.41	–	1	–	–	2.10	2.39	2.53	13	0.13	5.48	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table XXV

Dimensions of mandible and lower dentition (in mm)

Betfia-VII/1						Betfia-VII/2				Betfia-V						Betfia-VII\3						Betfia-VII/4			
min.	x	max.	n	sd	cv					min.	x	max.	n	sd	cv	min.	x	max.	n	sd	cv	min.	x	max.	n
–	6.10	–	1	–	–	–	6.37	–	1	5.80	6.30	6.56	7	0.25	3.97	5.70	6.18	6.87	26	0.31	5.02	–	6.02	–	1
1.36	1.48	1.58	11	0.06	4.05	–	1.41	–	1	1.31	1.43	1.51	11	0.07	4.89	1.30	1.40	1.61	48	0.07	5.00	1.32	1.37	1.45	3
–	1.53	–	1	–	–	–	–	–	–	–	–	–	–	–	–	1.31	1.34	1.39	3	–	–	–	–	–	–
1.89	2.01	2.24	5	–	–	–	–	–	–	–	–	–	–	–	–	1.89	2.02	2.16	7	0.09	4.45	–	–	–	–
1.13	1.31	1.40	6	0.11	8.40	–	–	–	–	–	–	–	–	–	–	1.25	1.38	1.51	8	0.11	7.97	–	–	–	–
2.38	2.51	2.62	18	0.06	2.39	–	2.47	–	1	2.36	2.43	2.50	4	–	–	2.30	2.41	2.64	78	0.08	3.32	–	2.30	–	1
1.42	1.57	1.81	20	0.08	5.09	–	1.54	–	1	1.38	1.46	1.58	4	–	–	1.38	1.52	1.70	60	0.07	4.46	–	1.52	–	1
1.95	2.16	2.28	26	0.08	3.70	–	–	–	–	2.00	2.07	2.20	7	0.06	2.90	1.96	2.12	2.30	87	0.09	4.24	2.11	2.18	2.30	2
1.27	1.34	1.47	26	0.05	3.73	–	–	–	–	1.25	1.31	1.38	7	0.06	4.58	1.20	1.32	1.45	65	0.06	4.54	–	1.36	–	1
1.46	1.65	1.98	11	0.14	8.48	–	–	–	–	1.44	1.49	1.55	2	–	–	1.41	1.51	1.63	18	0.06	3.97	–	–	–	–
0.89	0.96	1.18	11	0.08	8.33	–	–	–	–	0.85	0.86	0.87	2	–	–	0.75	0.84	0.94	17	0.05	5.95	–	–	–	6
5.81	6.19	6.38	5	–	–	–	–	–	–	–	5.89	–	1	–	–	5.94	5.96	5.98	2	–	–	–	–	–	–
2.40	2.63	2.91	15	0.14	5.32	–	–	–	–	2.27	2.48	2.64	10	0.11	4.43	2.26	2.43	2.72	31	0.13	5.35	–	2.35	–	1
–	–	–	–	–	–	–	–	–	–	–	5.79	–	1	–	–	6.05	6.14	6.23	2	–	–	–	–	–	–
1.47	1.49	1.51	3	–	–	–	–	–	–	–	1.31	–	1	–	–	1.34	1.42	1.50	3	–	–	–	–	–	–
3.34	3.54	3.86	3	–	–	–	–	–	–	3.10	3.26	3.43	2	–	–	3.21	3.59	4.08	7	0.28	7.80	–	–	–	–
1.36	1.42	1.46	3	–	–	–	–	–	–	1.27	1.29	1.31	2	–	–	1.20	1.30	1.41	7	0.07	5.38	–	–	–	–

Beremendia fissident they are wide in this place (see Fig. 9 A, D, E)], strong cuspulate I_1 with the internal side of the crown smooth and P^4 with a well developed hypocone and weak emargination (see Fig. 9D, E, F, G, H) refer these teeth to *B. mariae*. In Europe it appeared for the first time in the Early

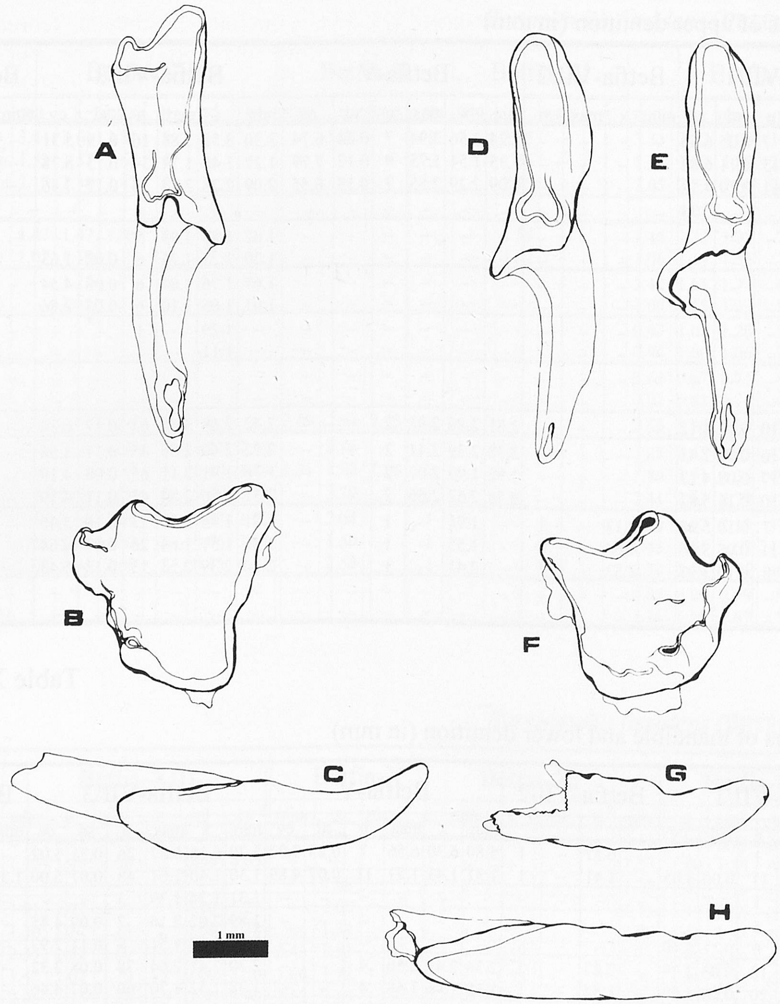

Fig. 9. Differences in morphology of *Beremendia fissidens* (A-C) and *Blarinoides mariae* (D-H). A – left I^1 from B-XIII, spec. no. 7, B – left P4 from B-IX, spec. no. 15, C – wright I_1 from B-XIII, spec. no. 18, D – left I^1 from Rębielice Królewskie (Poland), E – left I^1 from B-XIII, spec. no. 3, F – right P^4 from B-XIII, spec. no. 1, G – right I_1 (damaged) from B-XIII, spec. no. 1, H – right I_1 from Węże 1 (Poland), spec. no. MF/186 (all Betfia specimen from ISER).

Table XXVII

Blarinoides mariae SULIMSKI, 1959. Dimensions of upper and lower dentition (in mm). Betfia-XIII

		Specimen no.			
		1	2	3	4
P^4	L (bucc.)	2.64	-	-	-
I^1	L (max.)	-	2.98	3.45	-
	L of talon	-	1.32	1.40	-
	H of talon	-	1.82	2.26	-
I_1	H (bucc.)	-	-	-	1.44

Pliocene localities and it is known in about 30 localities in 12 European countries. In Romania RADULESCU et al. (1993, 1995) mentioned it from the Early Pliocene of Dranic 0 (MN15a) and Dranic 3 (MN15b), RADULESCU and SAMSON (1984) from the Late Pliocene of Debren 1 (MN16a) and RADULESCU et al. (1995) also from the Late Pliocene of Podari (MN16a). The youngest remains of this species come from the Early Pleistocene locality of Kamyk in Poland (RZEBIK-KOWALSKA 1976, 1998). Betfia-XIII is the second youngest locality in Europe, where *B. mariae* survived.

Tribe Neomyini MATSCHIE, 1909

Genus *Asoriculus* KRETZOI, 1959

Asoriculus gibberodon (PÉTENYI, 1864)

M a t e r i a l. The list of the material is given in Table XXVIII. It contains three I^1, one fragment of maxillae with A^4-M^1 and fragments of mandibles with all types of teeth and processes with the exception of the angular process.

D e s c r i p t i o n o f t h e m a t e r i a l. A very detailed description of *A. gibberodon* made on the basis of the Hungarian materials from several Early and Late Pliocene localities dated from MN14 – MN17 is given by REUMER (1984). Like specimens from Hungary the Early Pleistocene specimens from Betfia are also very variable in morphology. In general, however, they do not differ from those described by REUMER (1984). Their size lies also within the range of variation of the Hungarian specimens. Looking at the size of the Pliocene Hungarian *A. gibberodon* we observed a slight increase of their dimensions from the oldest (MN14) to the youngest (MN17) localities. However, the Early Pleistocene specimens from Betfia are not bigger than the Pliocene ones. They rather fall within the medium dimensions characteristic for this species in the Pliocene. So far, *A. gibberodon* was listed from several Early Pleistocene localities of Europe but the authors did not give any of its measurements. There were no differences in size and morphology between specimens from particular localities of Betfia.

Table XXVIII

Asoriculus gibberodon (PÉTENYI, 1864)

Localities	Number of fragmentary maxillae and detached upper teeth	Number of fragmentary mandibles and detached lower teeth	Total	Minimum number of individuals
Betfia-XIII	0	1	1	1
Betfia-X	0	5	5	3
Betfia-XI	2	8	10	4
Betfia-IX	1	16	17	10
Betfia-VII/1	1	2	3	1

M e a s u r e m e n t s. See Tables XXIX and XXX.

S y s t e m a t i c p o s i t i o n a n d d i s t r i b u t i o n. The remains cited above clearly belong to the tribe Neomyini. In the Early Pleistocene representatives of two genera of this tribe, *Neomys* and *Asoriculus*, were present in European localities. Specimens from Betfia, althought very scant and fragmentary, have been assigned to the genus *Asoriculus*. To this genus established by KRETZOI in 1959, HUTTERER (1994) transfered all fossil species known in Europe under the generic name of *Episoriculus*. HUTTERER proved that they were not congeneric with *Episoriculus caudatus* HORSFIELD, 1851 and *E. leucops* HORSFIELD, 1855 which are living today in south-eastern Asia.

Asoriculus differs from *Neomys* by several morphological characters, e. g., in *Asoriculus* the posterior border of the crown of the upper incisor I^1 in contact with a root is straight, whereas in

Table XXIX

Asoriculus gibberodon (PÉTENYI, 1864). Dimensions of upper dentition (in mm)

		Betfia-XI				Betfia-IX				Betfia-VII/1			
		min.	x	max.	n	min.	x	max.	n	min.	x	max.	n
I^1	L (bucc.)	1.45	1.48	1.51	2	–	–	–	–	–	1.75	–	1
	L of talon	0.62	0.63	0.65	2	–	–	–	–	–	0.75	–	1
	H of talon	1.07	1.08	1.10	2	–	–	–	–	–	1.21	–	1
A^4	L (occl.)	–	–	–	–	–	0.31	–	1	–	–	–	–
	W (occl.)	–	–	–	–	–	0.61	–	1	–	–	–	–
P^4	L (bucc.)	–	–	–	–	–	1.67	–	1	–	–	–	–
M^1	L (max.)	–	–	–	–	–	1.59	–	1	–	–	–	–
	L (med.)	–	–	–	–	–	1.32	–	1	–	–	–	–
	W (max.)	–	–	–	–	–	1.94	–	1	–	–	–	–

Table XXX

Asoriculus gibberodon (PÉTENYI, 1864). Dimensions of mandible and lower dentition (in mm)

		Betfia-XIII				Betfia-X				Betfia-XI				Betfia-IX						Betfia-VII/1			
		min.	x	max.	n	min.	x	max.	n	min.	x	max.	n	min.	x	max.	n	sd	cv	min.	x	max.	n
I_1	L (bucc.)	–	–	–	–	–	–	–	–	–	3.28	–	1	–	–	–	–	–	–	–	3.27	–	1
	H (bucc.)	–	–	–	–	–	0.76*	–	1	0.81	0.83	0.86	2	–	0.82	–	1	–	–	–	0.84	–	1
A_1	L (bucc.)	–	–	–	–	–	–	–	–	–	0.89	–	1	–	–	–	–	–	–	–	–	–	–
P_4	L (bucc.)	–	–	–	–	–	–	–	–	1.25	1.31	1.38	2	–	1.16	–	1	–	–	–	1.04*	–	1
	W (occl.)	–	–	–	–	–	–	–	–	0.75	0.79	0.83	2	–	0.79	–	1	–	–	–	–	–	–
M_1	L (occl.)	–	–	–	–	1.45	1.48	1.50	3	1.36	1.39	1.43	4	1.37	1.43	1.49	4	–	–	–	1.44	–	1
	W (occl.)	–	–	–	–	0.98	1.00	1.01	3	0.85	0.87	0.93	4	0.83	0.87	0.91	4	–	–	–	0.87	–	1
M_2	L (occl.)	–	–	–	–	–	1.30	–	1	1.21	1.27	1.31	4	1.22	1.35	1.44	5	–	–	–	1.24	–	1
	W (occl.)	–	–	–	–	–	0.89	–	1	0.76	0.79	0.84	4	0.77	0.84	0.94	6	0.08	9.52	–	0.80	–	1
M_3	L (bucc.)	–	1.02	–	1	–	–	–	–	1.05	1.09	1.13	2	1.05	1.09	1.12	4	–	–	–	–	–	–
	W (occl.)	–	0.56	–	1	–	–	–	–	0.58	0.60	0.60	2	0.61	0.65	0.70	4	–	–	–	0.59	–	1
H of mandible below M_2		–	–	–	–	–	1.25	–	1	1.19	1.22	1.23	4	1.21	1.32	1.45	10	0.07	5.30	–	1.43	–	1
H of ascending ramus		–	3.87	–	1	–	3.55	–	1	–	–	–	–	3.62	3.89	4.21	6	0.26	6.68	–	–	–	–
W of coronoid process		–	0.78	–	1	–	0.77	–	1	–	–	–	–	0.76	0.79	0.84	6	0.03	3.80	–	–	–	–
H of condyloid process		–	1.90	–	1	–	–	–	–	–	1.89	–	1	1.81	1.94	2.08	5	–	–	–	–	–	–
W of interarticular area		–	0.37	–	1	–	–	–	–	–	0.47	–	1	0.38	0.42	0.50	8	0.05	11.90	–	–	–	–

*– specimen slightly damaged

Neomys it is undulate (Fig. 10 A, D). The lower incisor I_1 has its anterior part (between the apex and main cusp) much shorter than in *Neomys* (see Fig. 10 B, C, E, F). In *Asoriculus* the ratio of the overall length of I_1 (A) to that of its anterior part (B) ranges 2.7 to 3.0 and more, whereas in *Neomys* it does not exceed 2.5. In *Asoriculus* the buccal cingulum of the lower molars is more undulate than in *Neomys* and the lower edge of the lingual cingulum is navicular whereas in *Neomys* it is straight. The mental foramen in *Asoriculus* is situated more posteriorly (behind the buccal re-entrant valley of M_1) whereas in *Neomys* it lies before or under this valley. The ascending ramus of *Asoriculus* is also different. The anterior and posterior borders of the coronoid process are rather parallel in its upper part and it does not deflect bucally (exteriorly), while in *Neomys* borders are convergent in the

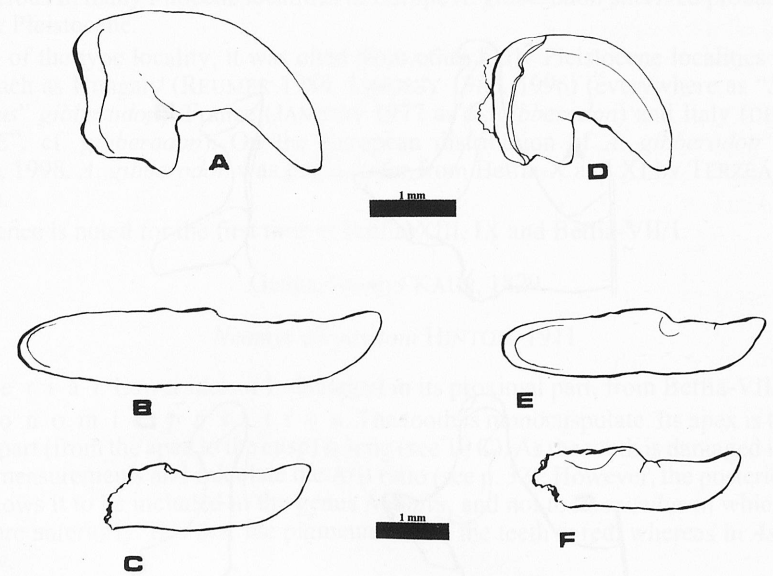

Fig. 10. Differences in morphology of I^1 and I_1 in *Neomys* (A-C) and *Asoriculus* (D-F). A – right I^1 of *N. fodiens* (Poland, Recent), B – right I_1 of *N. fodiens* (Poland, Recent), C – right I_1 of *N.* cf. *newtoni* from B-VII/3, spec. no. 1, D – right I^1 of *A. gibberodon* from B-XI, spec. no. 1, E – right I_1 of *A. gibberodon* from Osztramos 7, spec. no. MF/1779/1, F – right I_1 of *A. gibberodon* from B-X, spec. no. 1 (all Betfia specimen from ISER).

apex direction and the coronoid process deflect more or less bucally. The coronoid spicule in *Asoriculus* is placed much lower, about half-way between the upper sigmoid notch and the tip of the coronoid. In *Neomys* it lies always higher. The upper sigmoid notch is more closed in *Asoriculus* and in *Neomys* it is more open. The interarticular area of the condyle is wider in *Asoriculus* than in *Neomys* (Fig. 11) and the pigmentation in *Asoriculus* is lighter.

The oldest remains of *Asoriculus* were found on the European continent in the Late Miocene (MN13) localities. ?"*Episoriculus*" sp. comes from Santa Margarida in Portugal (ANTUNES and MEIN 1995) and "*Episoriculus*" from Solobrena in Spain (CROCHET 1986). Rare in the Late Miocene they became very common in European Pliocene and the Early Pleistocene localities. Outside of Europe their representatives were found also in Asia (KOTLIA 1991) and unexpectedly in north-western Africa (JAEGER 1975, RZEBIK-KOWALSKA 1988), where the subfamily Soricinae does not occur today. The African form ("*Episoriculus*" *maghrebiensis* RZEBIK-KOWALSKA, 1988) can certainly be placed in the genus *Asoriculus*. On the other hand the taxonomic status of *Episoriculus repenningi* described by KOTLIA (1991) from the Late Pliocene of north-western India needs revision. It is not clear whether it has characters of the European *Asoriculus* or of *Episoriculus* from sout-eastern Asia.

As the morphological variability of fossil remains belonging to "*Episoriculus*" was great, in Europe two to six species have been ranked among this genus. They were: *A. gibberodon* (PÉTENYI, 1864), described as *Crocidura gibberodon* from the Early Pleistocene locality of Beremend (identified by JÁNOSSY 1986 as Beremend 1-3) in Hungary, *A. castellarini* (PASA, 1947) from the Early Pleistocene of Soave in Italy, *A. tornensis* JÁNOSSY, 1973 from the Early Pliocene (MN14) of Osztramos 13 in Hungary, *A. borsodensis* JÁNOSSY, 1973 from the Early Pliocene (MN14) of Osztramos 1 in Hungary, *A. adroveri* JAMMOT, 1977 from the Late Pliocene locality on Medas Islands in Spain and *A. thenii* (MALEZ and RABEDER, 1984) from the Early Pleistocene of Podumci 1 in Croatia.

Based on the abundant materials from Hungary REUMER (1984) included two species, "*E*". *tornensis* and "*E*". *borsodensis*, in "*E*". *gibberodon*. Since nobody has revised the poorly described

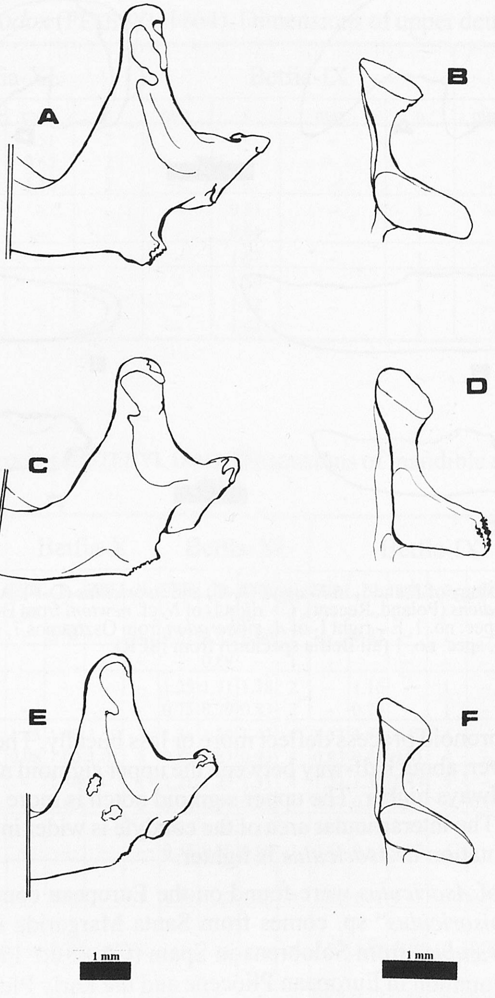

Fig. 11. Differences in morphology of the coronoid and condyloid processes in *Neomys* (A-B) and *Asoriculus* (C-F). A – *N. fodiens* from Poland (Recent), B – *N. anomalus* from Poland (Recent), C and D – *A. gibberodon* from Layna, spec. no. MF/1780/1, E – *A. gibberodon* from B-X, spec. no. 3 (ISER), F – *A. gibberodon* from B-IX, spec. no. 2 (MTC).

scanty materials of "*E*". *castellarini* it cannot be decided whether it really belongs to a separate species or if it is also one more synonyme of "*E*". *gibberodon* (REUMER 1984). "*E*". *adroveri* was described by JAMMOT (1977) in his unpublished thesis and its first published record (as nomen nudum) was made by CROCHET in 1986. It was not found elsewhere.

In this situation only two of these six species seem to be valid. They are: *A. gibberodon* and *A. thenii*.

In comparison to *A. gibberodon*, *A. thenii* is much bigger and massive. As mentioned above, dimensions of *Asoriculus* from Betfia-XIII, X, XI, IX and B-VII/1 are not very high and they belong to *A. gibberodon*.

The oldest remains of *A. gibberodon* were probably found in Brisighella, Italy, locality dating back to the Late Miocene (MN13) (DE GIULI 1989, "*E*". aff. *gibberodon*) and in Greece at Maramena dating to the Miocene/Pliocene boundary (MN13/MN14) (DOUKAS et al. 1995, as *A. gibbero-*

don). Numerous in many Pliocene localities in Europe *A. gibberodon* survived probably to the end of the Early Pleistocene.

Besides of the type locality, it was cited from other Early Pleistocene localities of Europe in countries such as Hungary (REUMER 1984, JÁNOSSY 1986, 1996) (everywhere as "*Soriculus*" or "*Episoricuus*" *gibberodon*), France (JAMMOT 1977 as *E. gibberodon*) and Italy (DE GIULI et al. 1990 as "*E*". cf. *gibberodon*). On the European distribution of *A. gibberodon* see RZEBIK-KOWALSKA 1998. *A. gibberodon* was listed so far from Betfia-X and XI by TERZEA (1994) as *E. gibberodon*.

Its presence is noted for the first time at Betfia-XIII, IX and Betfia-VII/1.

Genus *Neomys* KAUP, 1829

Neomys cf. *newtoni* HINTON, 1911

M a t e r i a l. Lower incisor I_1 damaged in its proximal part, from Betfia-VII/3.

T a x o n o m i c   p o s i t i o n. The tooth is monocuspulate. Its apex is turned up and its anterior part (from the apex to the cusp) is long (see 10 C). As the tooth is damaged it is not possible to take measurements and calculate the A/B ratio (see p. 32). However, the posterior position of the cusp allows it to be included in the genus *Neomys*, and not to *Asoriculus* in which this cusp is situated more anteriorly. Besides, the pigmentation of the teeth is red, whereas in *Asoriculus* it is light yellow.

In the Early Pleistocene sediments of Europe only one *Neomys* species was present. It was *N. newtoni* described by HINTON (1911) from West Runton in England, the locality dated from the Early Pleistocene. In spite of the poor material, the lower I_1 from Betfia-VII/3 belongs most probably to this species. This would be the first record of *N. newtoni* in Romania.

N. newtoni is known from the Early and Middle Pleistocene localities of Europe. In the Early Pleistocene, besides the type locality, it was also listed the from Czech Republic (FEJFAR 1964), Germany (MAUL 1990), Poland (RZEBIK-KOWALSKA 1991) and in the Middle Pleistocene from Poland (RZEBIK-KOWALSKA 1991), France (JAMMOT 1977), Germany (KOENIGSWALD et all. 1991), Italy (VAN DER MEULEN 1973) and England (BISHOP 1982). On the detailed European distribution of *N. newtoni* see RZEBIK-KOWALSKA 1998.

Tribe Anourosoricini ANDERSON, 1879

Genus *Amblycoptus* KORMOS, 1926

Amblycoptus cf. *oligodon* KORMOS, 1926

M a t e r i a l. The material consists of one upper first molar M^1 and was found in Betfia-XIII.

D e s c r i p t i o n   o f   t h e   m a t e r i a l. The tooth, almost square in its occlusal outline, is large and massive. It is characterized by the great parastyle and subduaed mesostyle. The posterior margin of the tooth is considerably concave (see Fig. 12).

M e a s u r e m e n t s. The buccal length (BL) – 2.06 mm, lingual length (LL) – 1.85 mm, anterior width (AW) – 2.09 mm, posterior width (PW) – 2.06 mm, PW/AW ratio = 0.99.

S y s t e m a t i c   p o s i t i o n. The characteristic features such as size, massiveness, great emphasis of the parastyle and reduced mesostyle indicate that this tooth belongs to the tribe Anourosoricini and the genus *Amblycoptus* KORMOS, 1926. So far four fossil genera and several species of this tribe have been described (RZEBIK-KOWALSKA 1998). The tooth from Betfia-XIII belongs most probably to *A. oligodon* KORMOS, 1926, which is the unique species of this genus [*A. topali* JÁNOSSY, 1972 and *A. jassiae* DOUKAS, 1995 have been recently included to the genus Kordosia (MÉSZÁROS 1997)]. In comparison with upper M^1 of *Paranourosorex* RZEBIK-KOWALSKA, 1975 the molar from Betfia-XIII is evidently smaller. It has also different proportions than M^1 in *Crusafontina* GIBERT, 1974, which is rectangular. It differs also from the first upper molar of Kordosia MÉSZÁROS,1997 because in this last forms the posterior side of M^1 is straight and shorter then the anterior one (the PW/AW ratio is lesser than one), while in *Amblycoptus* the posterior side is

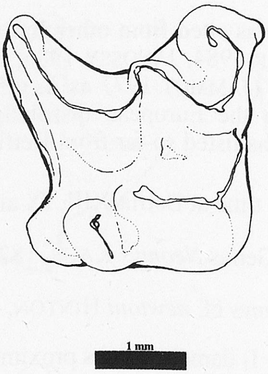

Fig. 12. *Amblycoptus* cf. *oligodon* from B-XIII. Right M^1, spec. no. 1 (ISER).

characterized by the conspicuous emargination and both sides (anterior and posterior) of M^1 are almost equal (the PW/AW ratio is close to one) (MÉSZÁROS 1997).

As the representatives of the above mentioned Anourosoricini lived during the Late Miocene and Pliocene and *Amblycoptus* did not survived Miocene/Pliocene boundary the presence of this form in the Pleistocene assemblage has been considered as accidental and it was not taken into account in the faunal list of Betfia-XIII. Nevertheless it is the first record of *Amblycoptus* in Romania.

Subfamily Crocidurinae MILNE-EDWARDS, 1868-1874.

Genus *Crocidura* WAGLER, 1832

Crocidura kornfeldi KORMOS, 1934

M a t e r i a l. The list of the material is given in table XXXI. It contains fragments of maxillae and mandibles with all types of teeth and processes or isolated teeth with the exception of M^3 and the angular process.

Table XXXI

Crocidura kornfeldi KORMOS, 1934

Localities	Number of fragmentary maxillae and detached upper teeth	Number of fragmentary mandibles and detached lower teeth	Total	Minimum number of individuals
Betfia-XIII	1	0	1	1
Betfia-X	10	24	34	12
Betfia-XI	15	25	40	6
Betfia-IX	4	40	44	18
Betfia-VII/1	2	12	14	4
Betfia-V	0	1	1	1
Betfia-VII/3	31	81	112	20
Betfia-XII	0	6	6	3

D e s c r i p t i o n o f t h e m a t e r i a l a n d c o m p a r i s o n w i t h o t h e r E u r o p e a n p o p u l a t i o n s. The species is known from the Late Pliocene and Early Pleistocene localities of Europe. A detailed description and measurements of this form are given in REUMER (1984).

In comparison to Hungarian material studied by REUMER (1984) *C. kornfeldi* from Betfia differed slightly by the presence of rather distinct hypocones in the upper molars M^1 and M^2 (poorly individualized in Hungary specimens) and a rather wide and protruding buccal cingula in the lower molars (narrow in Hungary specimens). Besides, among 2 preserved fragments with upper unicuspids, one A^3 was slightly bigger than A^2, and in the second specimen A^3 was smaller than A^2 (according to REUMER 1984 in *C. kornfeldi* A^3 is bigger than A^2).

In the holotype, which represents the upper jaw, hypocones of M^1 and M^2 are rather low. Unfortunately there are no second unicuspid A^2 in the holotype.

The specimens from Betfia do not differ morphologically in particular localities but by average their dimensions increase slightly with geological age. In some dimensions (e. g. L of M_1) they are however smaller than specimens from the much older locality of Villany 3 (Late Pliocene, MN17, REUMER 1984). In the Pleistocene *Crocidura kornfeldi* from Betfia the length of M_1 equals 1.30 – 1.52 (x = 1.42, n = 80), while e. g. in Villany 3 the same dimension of M_1 equals 1.29 – 1.75 (x = 1.51, n = 91). They even exceed maximum dimensions of the recent *C. lucodon* from Poland, the lenght of M_1 of which equals 1.47 – 1.55 (x = 1.51, n = 12). Either *C. kornfeldi* did not increase its size in the geological time at all, or the material from Hungary was not homogeneous. However, in the Late Pliocene of Europe only one species of *Crocidura*, *C. kornfeldi*, was known so far.

M e a s u r e m e n t s. See Tables XXXII and XXXIII.

S y s t e m a t i c p o s i t i o n a n d d i s t r i b u t i o n. The relatively small size [intermediate between the size of the recent *C. suaveolens* (PALLAS, 1811) and *C. leucodon* (HERMANN, 1780)] and the massive appearence of *Crocidura* specimens from Betfia allow atribution to *Crocidura kornfeldi* KORMOS, 1934. Beside the small differences (see above) their morphology is also similar. Their upper P^4 has the parastyle protruding, its protocone is situated in the middle of the anterior side of the tooth and the hypocone is very small or absent. Upper molars (M^1 and M^2) are relatively short and broad. The M^1 W/L ratio equals 1.37 – 1.68, x = 1.48, n = 21,

Table XXXII

Crocidura kornfeldi KORMOS, 1934. Dimensions of upper dentition (in mm)

		Betfia-XIII				Betfia-X				Betfia-XI						Betfia-VII/1				Betfia-VII/3					
		min.	x	max.	n	min.	x	max.	n	min.	x	max.	n	sd	cv	min.	x	max.	n	min.	x	max.	n	sd	cv
I^1	L (bucc.)	–	1.88	–	1	1.68	1.83	1.99	3	1.67	1.72	1.76	3	–	–	–	–	–	–	1.65	1.80	1.90	9	0.08	4.44
	L of talon	–	0.85	–	1	0.76	0.78	0.82	4	0.72	0.75	0.81	3	–	–	–	–	–	–	0.75	0.80	0.86	11	0.04	5.00
	H of talon	–	1.23	–	1	1.20	1.30	1.40	3	1.17	1.21	1.24	3	–	–	–	–	–	–	1.20	1.29	1.39	11	0.07	5.43
A^1-A^3	L (occl.)	–	–	–	–	–	–	–	–	–	2.30	–	1	–	–	–	–	–	–	–	–	–	–	–	–
A^1	L (occl.)	–	–	–	–	–	1.27	–	1	–	1.24	–	1	–	–	–	–	–	–	1.15	1.20	1.25	2	–	–
	W (occl.)	–	–	–	–	–	0.82	–	1	–	0.75	–	1	–	–	–	–	–	–	0.75	0.78	0.82	2	–	–
A^2	L (occl.)	–	–	–	–	–	–	–	–	0.81	0.82	0.84	2	–	–	–	–	–	–	–	–	–	–	–	–
	W (occl.)	–	–	–	–	–	–	–	–	–	0.60	–	2	–	–	–	–	–	–	–	–	–	–	–	–
A^3	L (occl.)	–	–	–	–	–	–	–	–	0.66	0.69	0.73	2	–	–	–	–	–	–	–	0.85	–	1	–	–
	W (occl.)	–	–	–	–	–	–	–	–	–	0.57	–	1	–	–	–	–	–	–	–	0.75	–	1	–	–
P^4	L (bucc.)	–	–	–	–	–	1.73	–	1	1.62	1.71	1.80	2	–	–	–	1.88	–	1	1.83	1.89	1.96	2	–	–
M^1	L (max.)	–	–	–	–	1.23	1.34	1.43	5	1.30	1.37	1.42	4	–	–	1.35	1.44	1.53	2	1.40	1.48	1.53	10	0.04	2.70
	L (med.)	–	–	–	–	0.83	0.92	1.01	5	0.88	1.00	1.07	4	–	–	0.98	0.99	1.00	2	1.05	1.09	1.15	9	0.04	3.67
	W (max.)	–	–	–	–	1.86	1.99	2.10	5	1.93	2.02	2.17	4	–	–	2.01	2.08	2.15	2	2.08	2.16	2.28	10	0.06	2.78
M^2	L (max.)	–	–	–	–	1.18	1.19	1.21	2	1.14	1.20	1.23	5	–	–	–	–	–	–	1.20	1.30	1.39	8	0.06	4.61
	L (med.)	–	–	–	–	0.82	0.92	0.97	5	0.85	0.94	1.00	6	0.06	6.38	–	–	–	–	0.90	1.00	1.05	11	0.04	4.00
	W (max.)	–	–	–	–	1.67	1.77	1.86	5	1.73	1.76	1.81	3	–	–	–	–	–	–	1.91	1.99	2.11	11	0.07	3.52

* – specimen slightly damaged

Crocidura kornfeldi KORMOS, 1934.

		Betfia-X						Betfia-XI						Betfia-IX					
		min.	x	max.	n	sd	cv	min.	x	max.	n	sd	cv	min.	x	max.	n	sd	cv
I_1	L (bucc.)	3.28	3.33	3.38	2	–	–	2.92	3.05	3.19	2	–	–	–	3.29	–	1	–	–
	W (bucc.)	0.79	0.80	0.82	3	–	–	0.77	0.81	0.87	6	0.04	4.94	0.80	0.84	0.84	3	–	–
A_1	L (bucc.)	–	1.00	–	1	–	–	0.98	1.06	1.14	2	–	–	1.11	1.14	1.17	2	–	–
P_4	L (bucc.)	1.05	1.18	1.29	3	–	–	–	1.24	–	1	–	–	1.20	1.28	1.43	12	0.06	4.69
	W (occl.)	0.77	0.80	0.83	3	–	–	–	0.81	–	1	–	–	0.83	0.91	1.00	12	0.05	5.49
M_1	L (occl.)	1.30	1.38	1.45	13	0.04	2.90	1.32	1.37	1.44	5	–	–	1.30	1.42	1.50	28	0.05	3.52
	W (occl.)	0.98	1.03	1.08	13	0.03	2.91	0.95	1.04	1.11	5	–	–	0.98	1.06	1.14	27	0.05	4.72
M_2	L (occl.)	1.24	1.31	1.40	15	0.05	3.82	1.24	1.29	1.35	11	0.04	3.10	1.23	1.35	1.43	26	0.05	3.70
	W (occl.)	0.84	0.91	0.97	16	0.04	4.40	0.86	0.90	0.95	11	0.03	3.33	0.83	0.95	1.04	26	0.04	4.21
M_3	L (bucc.)	0.96	1.10	1.18	6	0.09	8.18	1.05	1.14	1.21	5	–	–	1.11	1.15	1.21	12	0.04	3.48
	W (occl.)	0.54	0.61	0.66	6	0.04	6.56	0.57	0.64	0.68	5	–	–	0.61	0.66	0.70	12	0.03	4.54
M_1-M_3	L (occl.)	3.61	3.76	3.93	3	–	–	–	3.64	–	1	–	–	3.82	3.89	4.02	10	0.07	1.80
H of mandible below M_2		1.20	1.31	1.42	16	0.06	4.58	1.20	1.32	1.38	9	0.08	6.01	1.24	1.39	1.55	27	0.09	6.47
H of ascending ramus		4.16	4.32	4.48	2	–	–	–	4.19	–	1	–	–	4.11	4.31	4.51	6	0.14	3.25
W of coronoid process		0.78	0.85	0.92	2	–	–	–	0.84	–	1	–	–	0.72	0.88	1.02	8	0.11	12.5 0
H of condyloid process		–	1.57	–	1	–	–	–	1.67	–	1	–	–	1.45	1.54	1.68	8	0.09	5.84

otherwise the W/L ratio is on average 1.5. For comparison the same ratio in *C. leucodon* and *C. suaveolens* is smaller. It equals 1.30 – 1.45, x = 1.37, n = 10 in the first and 1.30 – 1.37, x = 1.33, n = 11 in the second species. Analogically to *C. kornfeldi*, in Betfia specimens the internal temporal fossa of the mandible is bordered ventrally by a thick bar and the foramen mentale is always situated below P_4 or P_4/M_1.

In contradiction to *C. leucodon* their upper molars are short and broad (see above), the buccal cingulum of the lower molars is less undulate and the lower edge of the lingual cingulum is not straight but navicular. Besides the external pterygoid fossa is strongly excavated, the pterygoid boss well developed and the coronoid proces broad because its anterior and posterior edges diverge in the direction of the condyloid process. In *C. leucodon* the external pterygoid fossa is shallow, the pterygoid boss hardly visible and the coronoid process rather narrow because in the upper part its anterior and posterior edges are more or less parallel.

C. kornfeldi was described for the first time by KORMOS from the Late Pliocene (MN17) Hungarian locality of Villány-Kalkberg-Nord, known today as Villány 3. From the Late Pliocene (MN17) localities it was also reported by REUMER (1984) at Osztramos 3/2 (Hungary), by FEJFAR and HORÁČEK (1983) at Ctiněves (the Czech Republic) and at Plešivec and Včeláre 3 (Slovakia). This period is so far the oldest one in which *Crocidura* remains of known species were found in Europe. Its presence in the Early Pliocene (MN15) of Ivanowce in Slovakia (FEJFAR 1964) was not confirmed by this author in his paper of 1966.

C. kornfeldi was also reported from Deutsch-Altenburg 30A in Austria dated from the Pliocene/Pleistocene boundary (MAIS and RABEDER 1984), and from other Early Pleistocene localities of southern Europe such as Nagyharsányhegy 2, Osztramos 2, 8 and 14, Somssichhegy 1, Villány 5 (REUMER 1984) and Beremend 16 (JÁNOSSY 1996) in Hungary, Deutsch-Altenburg 2A, 2C1 and 4B (MAIS and RABEDER 1984) in Austria, Betfia-IX (TERZEA 1988, 1994) in Romania, Tourkobounia 2, 3 and 5 (REUMER and DOUKAS 1985) in Greece and Casablanca 1 and Victoria Cave I as *C.* cf. *kornfeldi* (AGUSTÌ and MOYÀ-SOLÀ 1991) in Spain.

Table XXXIII

Dimensions of mandible and lower dentition (in mm)

Betfia-VII/1						Betfia-V				Betfia-VII/3						Betfia-XII			
min.	x	max.	n	sd	cv	min.	x	max.	n	min.	x	max.	n	sd	cv	min.	x	max.	n
–	3.25	–	1	–	–	–	–	–	–	3.14	3.31	3.52	11	0.13	3.93	–	–	–	–
0.80	0.81	0.83	2	–	–	–	–	–	–	0.78	0.87	0.95	18	0.05	5.75	–	–	–	–
1.12	1.15	1.18	2	–	–	–	–	–	–	–	1.17	–	1	–	–	–	–	–	–
1.21	1.23	1.25	2	–	–	–	1.37	–	1	1.17	1.25	1.30	3	–	–	–	–	–	–
0.83	0..84	0.85	2	–	–	–	0.94	–	1	0.81	0.88	0.94	3	–	–	–	–	–	–
1.35	1.41	1.48	6	0.06	4.25	–	1.47	–	1	1.37	1.45	1.52	28	0.04	2.76	–	1.44	–	1
1.01	1.06	1.10	6	0.03	2.83	–	1.15	–	1	1.03	1.10	1.17	28	0.03	2.73	–	1.09	–	1
1.27	1.34	1.42	5	–	–	–	1.41	–	1	1.31	1.38	1.47	34	0.04	2.90	–	–	–	–
0.87	0.93	1.05	5	–	–	–	1.04	–	1	0.84	0.97	1.09	35	0.05	5.15	–	–	–	–
1.07	1.12	1.20	4	–	–	–	–	–	–	1.09	1.16	1.23	17	0.04	3.45	–	–	–	–
0.61	0.63	0.66	4	–	–	–	–	–	–	0.62	0.67	0.72	17	0.03	4.48	–	–	–	–
–	3.87	–	1	–	–	–	–	–	–	3.83	3.90	3.98	4	–	–	–	–	–	–
1.31	1.43	1.65	6	0.12	8.39	–	1.61	–	1	1.36	1.49	1.70	42	0.09	6.04	1.47	1.50	1.52	3
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	0.84	–	1	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	1.38	–	1	–	–	–	1.57	–	1

Cocidura cf. *obtusa* KRETZOI, 1938

M a t e r i a l. The list of the material is given in Table XXXIV. It contains only mandibles with all types of teeth and processes with the exception of the angular process.

D e s c r i p t i o n o f t h e m a t e r i a l. The mandible is relatively large and stout. Its horizontal ramus is high, bulged bucally and slightly concave lingually. Its lower margin is a little concave under M_1/M_2. The ascending ramus is high and leaning slightly backwards. The anterior margin of the coronoid process is almost straight and has a slight bulge on the level of the condyloid process. The posterior margin is slightly concave. The tip of the coronoid process is broad and blunt. The coronoid spicule is distinct and placed high, near the tip of the process. The external temporal fossa is well developed and deep in its upper part. It extends ventrally to about the level of the centre of the condyloid process. The condyloid process is relatively large. Its upper facet is narrow and oval and it makes an angle of about 45° with the lower facet. The lower one is broad and its anterior part is narrower than the posterior one. It is centrally depressed. The external pterygoid fossa is very shallow and the pterygoid boss is hardly visible. The internal temporal fossa is large, reaching to 3/5 way up the coronoid process. Its lower margin is thickened and protruding . The mandibular foramen is large and placed under the posterior corner of the internal temporal fossa.

Table XXXIV

Crocidura cf. *obtusa* KRETZOI, 1938

Locality	Number of fragmentary maxillae and detached upper teeth	Number of fragmentary mandibles and detached lower teeth	Total	Minimum number of individuals
Betfia-IX	0	6	6	4

The mental foramen lies in the posterior part of a deep groove, below the root of P_4 or between the roots of P_4 and M_1.

Teeth are massive. I_1 is not very long and is monocuspulate. Its apex is only slightly upturned. The buccal cingulum is moderately broad but protruding. A_1 is large, elongated antero-posteriorly and single-cusped. It is hidden underneath P_4 for less than half its length. Its buccal and lingual cingula are very broad and protruding. P_4 is typical for *Crocidura*, a pointed, tetrahedron-shaped tooth. Its cingulum is equally strong on both sides.

The lower molars are also typical for *Crocidura*. M_1 is very broad. Its buccal re-entrant valley opens high above the cingulum. The entoconid crest is not very high and the hypolophid is separated from the entoconid. The anterior cingulum is broad and protruding, the buccal one is a little narrower, protruding and extremely undulated, the lingual cingulum is flat, sometimes hardly visible. The lower edge of the lingual cingulum in M_1 and other molars is almost straight. M_2 is a little smaller than M_1. Its buccal re-entrant valley opens a little lower and the buccal cingulum is less undulated. The talonid of M_3 is reduced to a single cusp, the hypoconid.

Measurements. See Table XXXV.

Systematic position and distribution. Such characters as the large size (see Fig. 13), massive teeth, undulate buccal cingulum (especially in M_1) and an almost straight lower edge of the lingual cingulum in the lower molars, a high and blunt coronoid process, a very shallow external pterygoid fossa and a very small or lacking pterygoid spicule differ the six specimens from Betfia-IX dated from the Early Pleistocene from other specimens of *Crocidura* present also in this locality and from *Crocidura* specimens from the remaining Betfia localities studied here.

In the Early Pleistocene two species of large *Crocidura* are cited: *C. zorzii* PASA, 1942 described from Soave in Italy and a little smaller *C. obtusa* KRETZOI, 1938 described from Gombasek in Slovakia.

Besides of the type locality Soave, *C. zorzii* was also mentioned from the Middle Pleistocene localities in Italy (BARTOLOMEI 1964, BARTOLOMEI and PASA 1970), from Germany (BRUNNER 1957) and France (JAMMOT 1973) and from the Late Pleistocene in Italy (PASA 1952, BARTOLOMEI 1964) and Bulgaria (POPOV 1989).

Table XXXV

Crocidura cf. *obtusa* KRETZOI, 1938. Dimensions of mandible and lower dentition (in mm)

		Betfia-IX					
		min.	x	max.	n	sd	cv
I_1	L (bucc.)	3.67	3.68	3.69	2	–	–
	W (bucc.)	0.94	0.96	0.98	4	–	–
A_1	L (bucc.)	1.20	1.28	1.36	2	–	–
P_4	L (bucc.)	1.25	1.32	1.45	5	–	–
	W (occl.)	0.94	0.98	1.03	5	–	–
M_1	L (occl.)	1.55	1.57	1.59	6	0.02	1.27
	W (occl.)	1.18	1.20	1.22	6	0.01	0.82
M_2	L (occl.)	1.44	1.48	1.54	6	0.04	2.70
	W (occl.)	1.03	1.05	1.10	6	0.03	2.86
M_3	L (bucc.)	1.25	1.33	1.36	5	–	–
	W (occl.)	0.73	0.74	0.76	5	–	–
M_1-M_3	L (occl.)	4.17	4.32	4.38	5	–	–
H of mandible below M_2		1.65	1.69	1.77	6	0.04	2.37
H of ascendin gramus		4.82	4.99	5.30	4	–	–
W of coronoid process		1.00	1.06	1.12	5	–	–
H of condyloid process		1.72	1.83	1.97	5	–	–

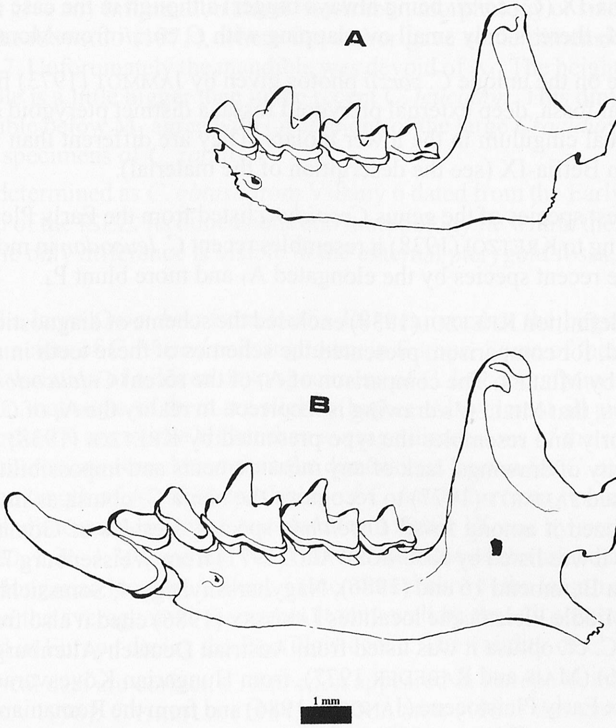

Fig. 13. A – *Crocidura kornfeldi* from B-IX, spec. no. 3 (ISER), B – *Crocidura* cf. *obtusa* from B-IX, spec. no. 3 (ISER).

According to PASA (1942, 1947) the mandible of *C. zorzii* is characterized by a high ascending ramus leaning backwards and massive condyloid process. Besides, its I_1 is short and robust, A_1 and P_4 dilated, the lower molars (especially M_1) are robust and M_3 is oval in its crown outline with an elongated talonid in the shape of a small unique cusp.

Unfortunately the shortness of I_1 and robustness of the teeth are not supported by any measurements and drawings and it is difficult to decided to what degree they are diagnostic. Besides, measurements show, that there is an overlapping of some dimensions of *C. zorzii* with the dimensions of the recent *C. leucodon*.

So far *C. zorzii* was considered to be the largest among fossil and living *Crocidura* species. This fact may however result from a small number of specimens used for comparison and a poor knowledge of individual variation of particular elements of the jaw and teeth in fossil *Crocidura* species. Even the dimensions of the ascending ramus, which was regarded as diagnostic, overlap with this dimensions in the recent *C. leucodon* making identification difficult. On the other hand, it is possible that identification of the smallest *Crocidura zorzii* (e.g. from the Late Pleistocene of Montorio) was incorrect, these specimens belong to another species and *C. zorzii* was indeed the largest species of this genus.

Characters which, according to PASA (1942, 1947), also differentiate *C. zorzii* from other species of *Crocidura* (e. g. the morphology of M_3) are common in all other species of this genus.

The comparison of dimensions given by PASA (1947) for *C. zorzii* from its typical locality with dimensions of large *Crocidura* specimens from Betfia-IX indicates a partial overlapping of such dimensions as the height of the mandible below M_2 and the length of lower molars $M_1 – M_3$ (*C. zorzii* being larger) but the dimensions of the ascending ramus do not overlap in these two forms and this process is higher in *C. zorzii* (see Fig. 14).

All remaining accessible measurements of *C. zorzii* also overlap with dimensions of the large *Crocidura* from Betfia-IX (*C. zorzii* being always bigger) although in the case of the length of the lower molars $M_1 - M_3$ there is only small overlapping with *C. zorzii* from Montorio.

Characters visible on the unique *C. zorzii* photos given by JAMMOT (1973) from La Fage are: a high internal temporal fossa, deep external pterygoid fossa, a distinct pterygoid spicule and a navicular line of the lingual cingulum in the lower molars. They are different than these characters in large *Crocidura* from Betfia-IX (see the description of the material).

The second largeest species of the genus *Crocidura* listed from the Early Pleistocene of Europe is *C. obtusa*. According to KRETZOI (1938) it resembles recent *C. leucodon* in morphology and size, but it differs from the recent species by the elongated A_1 and more blunt P_4.

In support of his definition KRETZOI (1938) enclosed the scheme of diagnostic teeth of the newly described species and, for comparison, presented the schemes of these teeth in recent *C. leucodon* and *C. russula* made by MILLER. The comparison of A_1 of the recent *C. leucodon* with its presentation by MILLER shows, that MILLER's drawing is incorrect. In reality the A_1 of *C. leucodon* is elongated antero-posteriorly and resembles the type presented by KRETZOI (1938) as belonging to *C. obtusa*. The bad quality of drawings, lack of any measurements and impossibility of finding the *C. obtusa* holotype caused JAMMOT (1977) to recognize the name C. obtusa as invalid. Nevertheless some authors recognized it among fossil *Crocidura* species. Besides of Gombasek, in the Early Pleistocene localities it was listed by KOENIGSWALD (1971) from Weissenburg 7 (Germany) and by JÁNOSSY (1996) from Beremend 16 and (1986), Nagyharsányhegy 4, Somssichhegy 2 and Villány 6 (Hungary). In the Middle Pleistocene localities JÁNOSSY (1986) cited it also from Tarkö and Várhegy (Hungary). As C. cf. obtusa it was listed from Austrian Deutsch-Altenburg 9, dated from the Late Pliocene (MN16) (MAIS and RABEDER 1977), from Hungarian Kövesvarad and Osztramos 8 and 14, dated from the Early Pleistocene (JÁNOSSY 1986) and from the Romanian Urşilor Cave, also of the Early Pleistocene age (TERZEA 1983).

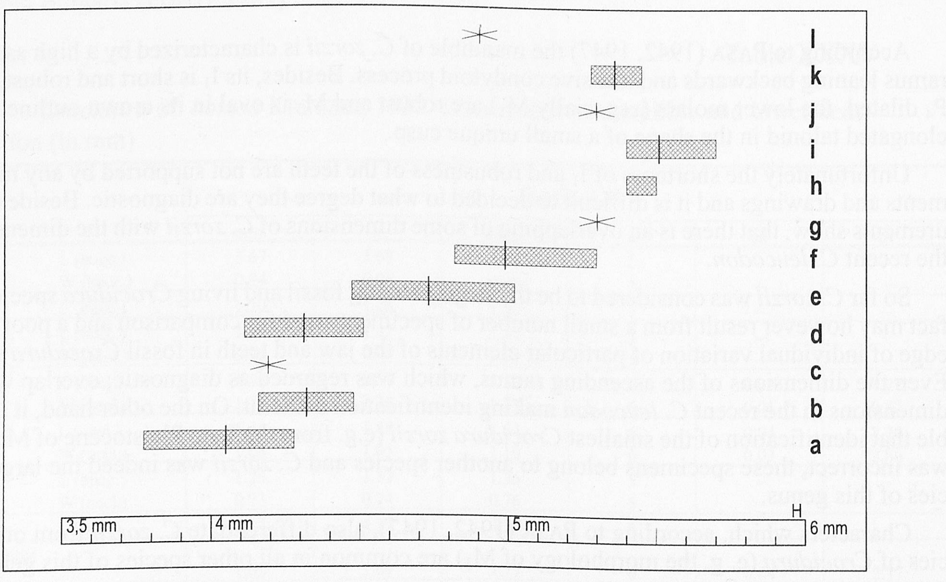

Fig. 14. Minimum-maximum diagram of the ascending ramus height (H) in *Crocidura suaveolens* (a), *Crocidura kornfeldi* (b-d), *Crocidura leucodon* (e), *Crocidura obtusa* (f- g) and *Crocidura zorzii* (h - l); a – Recent: Poland (n=11); Early Pleistocene: b – B-X, ISER (n=2), c – B-XI, ISER (n=1), d – B-IX, MTC (n=6); e – Recent: Poland (n=12); Early Pleistocene: f – Betfia-IX, ISER (n=4), g – Weissenburg, Germany (n=1) KOENIGSWALD 1971, h – Soave, Italy PASA 1947; Middle Pleistocene: i – La Fage, France (n=6) JAMMOT 1973, j – Breitenberghöhle, Germany (n=1) BRUNNER 1957, k – Morovitsa Cave, Bulgaria (n=3) POPOV 1989; Late Pleistocene: l – Montorio, Italy (n=1) PASA 1952.

In all papers mentioned above authors reported only the presence of *C. obtusa* in a particular locality. They did not give any information about its number, morphology or size. The only exception is the paper of KOENIGSWALD (1971), where the author gave some dimensions of one mandible from Weissenburg 7. Unfortunately the mandible was devoid of A_1. The height of the ascending ramus of this mandible is a little bigger than in the recent *C. leucodon*. This dimension as well as the height of the mandible below M_2 agree with dimensions of the large *Crocidura* from Betfia-IX and with some smaller specimens of *C. zorzii*.

One specimen determined as *C. obtusa* from Villány 6 dated from the Early Pleistocene is present in the collection of the ISEZ. Its dimensions and morphology lie within the range of variation of *C. leucodon*, and the only difference is visible in the external pterygoid fossa, which in Hungarian specimen is deeper.

Characters of the large *Crocidura* from Betfia-IX mentioned at the beginning of this chapter agree best with characters of *C. leucodon* living today in Europe. Some of their dimensions lie also within the range of variation of a dozen or so specimens of *C. leucodon* from the Polish population used for comparison, but some of them are slightly higher. Also almost all average dimensions of *Crocidura* from Betfia-IX are a little higher than average dimensions of the recent species. On the other hand, these dimensions were lower than the dimensions known for *C. zorzii* and its morphology is different. The length of A_1 of 24 specimens of *C. leucodon* from Poland equals 1.11 – 1.30 (average 1.17). This dimension in large *Crocidura* from Betfia IX was by average higher and for 3 specimens was: 1.20, 1.26, 1.36 (average 1.27). In one specimen determined as *C. obtusa* from the Early Pleistocene Hungarian locality, Villany 6 (mentioned above) the length of A_1 equals 1.24 and is rather higher than the average in *C. leucodon*. It may well be that *C. obtusa* is a valid name of a species which lived in Europe during the Plio/Pleistocene. The validity of *C. obtusa* is still open.

If palaeontological data are correct, *C. leucodon* appeared in Europe in the Middle Pleistocene (RZEBIK-KOWALSKA 1998). CATZEFLIS (1984) and REUMER (1986) thought however, that it appeared in Europe from the Middle East only after the last interglacial. According to data cited above *C. leucodon* was absent from Europe in the Early Pleistocene. The presence of a large *Crocidura* in the Early Pleistocene, smaller and different from *C. zorzii* and larger than *C. leucodon* indicates that we probably have to recognize another species of this genus – e. g. *C. obtusa*. Among shrews there is a tendency to increase of the dimensions with geological time. It is therefore hardly probable that in the Early Pleistocene lived large *C. leucodon* which diminished its size with geological time. The revision of the European fossil *Crocidura* species is badly needed.

III. THE AGE OF BETFIA LOCALITIES AND THE HISTORY OF SORICIDAE AT BETFIA KARSTIC COMPLEX

Table XXXVI contains the list of fauna of particular Betfia localities.

Betfia-XIII represents the oldest fauna of Romania with the appearence of the genus *Allophaiomys*. In the continental deposits of the Holarctic region this event is commonly recognized as the beginning of the Quaternary. In Betfia-XIII *Allophaiomys* was represented by the primitive form, *A. pliocaenicus deucalion* (TERZEA 1995a). On the other hand, some survivors from the Pliocene were still present. The composition of the fauna indicates that Betfia-XIII can be placed at the beginning of the Biharian (Middle Eburonian) period (TERZEA 1994, 1995a). This period is characterised by the deterioration of the climate. However, the presence in B-XIII of such thermophilous forms as *Macaca sylvana*, *Muridae* or *Gliridae* allows us to define the age of- BXIII as probably "a warming phase in the middle of this glacial complex" (TERZEA 1995a).

As shrews are concerned, all forms in B-XIII represented the survivors from the previous periods. One of the oldest forms known since the Miocene/Pliocene boundary, *P. hungarica*, and a little younger *Beremendia fissidens*, the first appearence of which was noted in the Early Pliocene (MN14), were the most abundant (52% of all shrew species) in this locality (see Tables XXXVII).

Table XXXVI

Localities and faunas of shrews

Species	Localities									
	B-XIII	B-X	B-XI	B-IX	B-VII/1	B-VII/2	B-V	B-VII/3	B-XII	B-VII/4
Blarinoides mariae	+	-	-	–	–	–	–	–	–	–
Sorex (D.) praearaneus	+	+	+	–	–	–	–	–	–	–
Asoriculus gibberodon	+	+	+	+	+	–	–	–	–	–
Petenyia hungarica	+	+	+	+	+	–	–	–	–	–
Sorex cf. *subaraneus*	+	–	–	+	–	–	+	+	–	–
Beremendia fissidens	+	+	+	+	+	+	+	+	–	+
Sorex minutus	+	+	+	+	+	–	+	+	–	+
Sorex runtonensis	+	+	+	+	+	–	+	+	–	+
Crocidura kornfeldi	+	+	+	+	+	–	+	+	+	–
Sorex (D.) margaritodon	–	–	–	+	+	–	+	+	–	+
Crocidura cf. *obtusa*	–	–	–	+	–	–	–	–	–	–
Sorex sp.	–	–	–	+	–	–	–	–	–	–
Neomys cf. *newtoni*	–	–	–	–	–	–	–	+	–	–
Sorex minutissimus	–	–	–	–	–	–	–	+	–	–

On the other hand, *Blarinoides mariae* also known since the Early Pliocene, was found in small number. It was its unique appearence in the Betfia Karstic Complex. Other very old species known since the Miocene/Pliocene boundary, *Asoriculus gibberodon*, was also very rare. In Betfia-XIII, the genus *Sorex* was represented by four taxa (44%). The most numerous were the large size *S.* (*D.*) *praearaneus* and medium size *S. runtonensis*.

Although some thermophilous species of mammals were still present in the assemblage of B-XIII, *Crocidura kornfeldi* constituted only 2% of shrew fauna. In this locality *Soricidae* were represented by a high (9) number of species. Unique tooth of *A.* cf. *oligodon* found in B-XIII has not been enumerated in the list of species of this locality as probably foreign element to this assemblage (see p. 36).

According to TERZEA (1995a), at Betfia-X the fauna of rodents shows a significant renewal. Many archaic forms are replaced by new ones and *Allophaiomys pliocenicus pliocenicus* was recorded for the first time in this locality. The species composition and the degree of development of

Table XXXVII

Betfia-XIII

Species	EG	MNI	%MNI	%MNI
S. minutus	f	5	9.62	
S. runtonensis	f	8	15.39	26.93
S. cf. *subaraneus*	f	1	1.92	
S. (D.) praearaneus	f	9	17.31	17.31
A. gibberodon	f	1	1.92	1.92
∑	**f**	**24**	**46.16**	**46.16**
C. kornfeldi	s	1	1.92	1.92
∑	**s**	**1**	**1.92**	**1.92**
B. mariae	o	1	1.92	1.92
P. hungarica	o	15	28.85	28.85
B. fissidens	o	11	21.25	21.15

A. pliocenicus allowed us to place the mammalian assemblage of Betfia-X in the Early Biharian (Early Waalian) (Terzea 1988). The fauna of Betfia-XI seems to be of about the same age or a little younger (Terzea 1994, 1995a). From the climatic point of view B-X and B-XI represent "temperate-warm phases". It is clearly visible in the fauna of shrews. In these both localities *C. kornfeldi* was very common and the most numerous (48% in B-X and 30% in B-XI) of all shrew species (see Tables XXXVIII and XXXIX). As concerns the Pliocene survivors only *B. mariae* is lacking. On the other hand, *A. gibberodon* was more numerous than in B-XIII (12% and 20% respectively) and among *Sorex* species *S. runtonensis* prevailed.

Faunas of Betfia-IX and VII/1 had a more evolved *Allophaiomys pliocaenicus* and therefore were a little younger than B-X and B-XI (middle and upper parts of Waalian respectively). The Pliocene survivors, *Mimomys tornesis* and *Ungaromys nanus*, as well as the thermophilous *Macaca sylvana*, appear for the last time in these localities and the presence of *Lemmus* aff. *lemmus* and *Gulo schlosseri* is observed in B-VII/1a (Terzea 1995a). This last fauna is probably connected with "a short phase of cooling in the middle of Waalian" (Terzea 1994, 1995a).

In Betfia-IX forest species constituted 71% of the shrew assemblage (see Table XL). *S.* (*D.*) *praearaneus* disappeared and at B-IX had been replaced by larger and more exoedaenodont form, *S.* (*D.*) *margaritodon*. As always, the most numerous (more than 33%) was *S. runtonensis*. Comparatively abundant was also *S. minutus* (about 14%). The oldest forms, *A. gibberodon* and particularly *P. hungarica* appeared for the last time in greater number (2.5% and 11% respectively) at B-IX.

Table XXXVIII

Betfia-X

Species	EG	MNI	%MNI	%MNI
S. minutus	f	1	4.00	16.00
S. runtonensis	f	3	12.00	
S. (D.) praearaneus	f	2	8.00	8.00
A. gibberodon	f	3	12.00	12.00
Σ	**f**	**9**	**36.00**	**36.00**
C. kornfeldi	s	12	48.00	48.00
Σ	**s**	**12**	**48.00**	**48.00**
P. hungarica	o	2	8.00	8.00
B. fissidens	o	2	8.00	8.00
Σ	**o**	**4**	**16.00**	**16.00**

Table XXXIX

Betfia-XI

Species	EG	MNI	%MNI	%MNI
S. minutus	f	1	5.00	25.00
S. runtonensis	f	4	20.00	
S. (D.) praearaneus	f	2	10.00	10.00
A. gibberodon	f	4	20.00	20.00
Σ	**f**	**11**	**55.00**	**55.00**
C. kornfeldi	s	6	30.00	30.00
Σ	**s**	**6**	**30.00**	**30.00**
P. hungarica	o	2	10.00	10.00
B. fissidens	o	1	5.00	5.00
Σ	**o**	**6**	**30.00**	**30.00**

Only in this locality two species of *Crocidura* were found together. They were: *C. kornfeldi* and *C.* cf. *obtusa*, which constituted, however, only 5 % of the shrew fauna. The shrew assemblage of Betfia-IX was the richest of all Betfi aassemblages and consisted of 10 species of the *Soricidae*.

At Betfia-VII/1 there were only 7 species of shrews. The genus *Sorex* was represented by three taxa. *S. runtonensis* was again the most numerous, and *S. minutus* (as in most localities) was represented in smaller numbers. In Betfia-VII/1, the oldest Pliocene forms were still present there were: *A. gibberodon*, *P. hungarica* and *B. fissidens* but first two species were very rare (1% and 3% respectively, see Table XLI). *C. kornfeldi* was also rare.

So far, the fauna of Betfia-VII/2 has not been studied in detail. However, according to Table 1 given by TERZEA (1995a) this locality is dated to the second half of the Early Pleistocene (Early Biharian, Middle Menapian). It is a little older than Betfia-V, dated by TERZEA (1995a) to the Late Menapian. The palaeontological data suggest that the climate in the Menapian was continental.

The only shrew found, so far, in B-VII/2 was ubiquitous *B. fissidens* (Table XLII).

On the basis of the degree of evolution of Arvicolidae Betfia-V is dated to the Late Biharian (Late Menapian). A new wave of immigrants (especially among large mammals) appeared in this area (TERZEA 1995a). Besides, the first occurence of such rodents as *Microtus hintoni*, *Lagurus*

Table XL

Betfia-IX

Species	EG	MNI	%MNI	%MNI
S. minutus	f	58	14.04	48.91
S. runtonensis	f	137	33.17	
S. cf. *subaraneus*	f	4	0.97	
S. sp.	f	3	0.73	
S. (D.) margaritodon	f	82	19.85	19.85
A. gibberodon	f	10	2.42	2.42
∑	**f**	**294**	**71.18**	**71.18**
C. kornfeldi	s	18	4.36	5.33
C. cf. *obtusa*	s	4	0.97	
∑	**s**	**22**	**5.33**	**5.33**
P. hungarica	o	47	11.38	11.38
B. fissidens	o	50	12.11	12.11
∑	**o**	**97**	**23.49**	**23.49**

Table XLI

Betfia-VII/1

Species	EG	MNI	%MNI	%MNI
S. minutus	f	13	14.13	57.61
S. runtonensis	f	40	43.48	
S. (D.) margaritodon	f	16	17.39	17.39
A. gibberodon	f	1	1.09	1.09
∑	**f**	**70**	**76.09**	**76.09**
C. kornfeldi	s	4	4.35	4.35
∑	**s**	**4**	**4.35**	**4.35**
P. hungarica	o	3	3.26	3.26
B. fissidens	o	15	16.30	16.30
∑	**o**	**18**	**19.56**	**19.56**

transsylvanicus and *Mimomys savini* noted. Among shrews *Sorex* species were still dominant (more than 60%). Besides *S. runtonensis* (50%), the second common species was *B. fissidens* (33%) (see Table XLIII). The quantity of *C. kornfeldi* was vestigial.

Table XLII

Betfia-VII/2

Species	EG	MNI	%MNI	%MNI
B. fissidens	o	1	100.00	100.00

Betfia-VII/3 is younger than B-V and placed by TERZEA (1995a) in the Bavelian interglacial, corresponding to an alternation of two mild phases separated by a cooling event, when *Lemmus lemmus* and *Gulo schlosseri* appeared.

It seems, that these changes also influenced shrew fauna. The most interesting species connected with this cooling event was *S. minutissimus*, a shrew unknown so far not only in the Betfia Karstic Complex but also in other Romanian localities. As mentioned above (p. 7), it inhabits today the taiga zone in a very severe climatic conditions. During the colder phases of the Pleistocene it invaded western and southern Europe reaching as far as France, England and Bulgaria (RZEBIK-KOWALSKA 1995, 1998). On the other hand a clearly increased amount of *Crocidura* (to 10.53%, see Table XLIV) in B-VII/3 indicates that some part of this shrew assemblage must represent one of two mild phases of the Bavelian interglacial.

Table XLIII

Betfia-V

Species	EG	MNI	%MNI	%MNI
S. minutus	f	1	3.33	
S. runtonensis	f	15	50.00	56.66
S. cf. *subaraneus*	f	1	3.33	
S. (D.) margaritodon	f	2	6.66	6.66
∑	f	**19**	**63.33**	**63.33**
C. kornfeldi	s	1	3.33	3.33
∑	s	**1**	**3.33**	**3.33**
B. fissidens	o	10	33.34	33.34
∑	o	**10**	**33.34**	**33.34**

Besides *S. minutissimus* the second new form known so far neither in Betfia Karstic Complex nor in other Romanian localities noted in B-VII/3 is *Neomys* cf. *newtoni*. As in the case of *S. minutissimus* it was its first and last appearence in this complex. In general, *N. newtoni* is rarely found in fossil materials and always in small number.

The early Middle Pleistocene fauna of Betfia-VII/4 ends the biochronological succession of the Betfia Karstic Complex. *Mimomys savini* (the last representative of the genus), an advanced species of *Microtus* (*M.agrestis*), as well as new forms such as *Lagurus transiens* and *Mammuthus trogontherii* have been found in this assemblage. The lithological and palaeonological data show a succession of three climatic fluctuations, correlated with Glacial A, Interglacial II and Glacial B of the Cromerian Complex (TERZEA 1994). In shrew fauna we can see the predominance of *Sorex* species. Until the end of the Biharian the survivor from the Early Pliocene, *B. fissidens*, was present and

Table XLIV

Betfia-VII/3

Species	EG	MNI	%MNI	%MNI
S. minutus	f	4	2.10	
S. minutissimus	f	1	0.53	
S. runtonensis	f	104	54.74	58.95
S. cf. *subaraneus*	f	3	1.58	
S. (D.) margaritodon	f	5	2.63	2.63
∑	**f**	**117**	**61.58**	**61.58**
C. kornfeldi	s	20	10.53	10.53
∑	**s**	**20**	**10.53**	**10.53**
N. cf. *newtoni*	w	1	0.53	0.53
∑	**w**	**1**	**0.53**	**0.53**
B. fissidens	o	52	27.36	27.36
∑	**o**	**52**	**27.36**	**27.36**

Table XLV

Betfia-XII

Species	EG	MNI	%MNI	%MNI
C. kornfeldi	s	3	100.00	100.00

Table XLVI

Betfia-VII/4

Species	EG	MNI	%MNI	%MNI
S. minutus	s	1	14.29	57.15
S. runtonensis	s	3	42.86	
S. (D.) margaritodon	s	1	14.29	14.29 1
∑	**s**	**5**	**71.44**	**71.44**
B. fissidens	o	2	28.56	28.56
∑	**o**	**2**	**28.56**	**28.56**

constituted still more than 1/4 of all fauna of shrews (see Table XLVI). The lack of *Crocidura* species could indicate that the shrew assemblage of B-VII/4 represented rather a cool phase (stage) of this period, but the material seems to be too scarce to permit so far-reaching conclusions.

IV. PALEOECOLOGICAL INTERPRETATION OF SORICID ASSOCIATIONS

Only the Soricidae from Betfia-localities are presented in the tables. The minimum number of individuals (MNI) has been estimated on the basis of the greatest number of the most numerously preserved element (mainly M_1 or M_2). The tables show also the percentages of individuals of different species and genera in particular localities studied. To reconstruct the palaeoenvironment of the shrew fauna found in fossil localities, the division of soricids into groups established by REUMER (1984) (and modified by RZEBIK-KOWALSKA 1994) as palaeoecological indicators has been used. The names of these ecological groups (EG) are as follow: "forest" (marked "f"), "steppe" (marked "s"), "wet" (marked "w"), "opportunist" (marked "o") and "indeterminate (marked "i").

In general, shrews do not appear to be very good indicators of the palaeoenvironment. The differences in the number of members of ecological groups in particular localities may be also connected with taphonomic factors, eg. with different predatory species responsible for the accumulation of shrew remains.

On the basis of the shrew fauna of the Betfi alocalities the following palaeoecological picture can be obtained.

In general the shrew fauna of the Betfi aKarstic Complex is a typical one for the Early and Early/Middle Pleistocene of Central Europe. It reflects the climatic and environmental changes which took place in the Quaternary in connection with the alternation of the glacials and the interglacials.

In the majority of Betfia localities *Sorex* species predominated indicating most probably humid forests environment. In almost all Early Biharian they were accompanied by *A. gibberodon* belonging to a similar ecological group. They constituted together from 46% to 70% of shrew associations. Among *Sorex* species the most interesting was *S. minutissimus* which has been found in B-VII/3 dating to a cooling event in the Bavelian interglacial (TERZEA 1995a). This smallest of all *Sorex* species is a particularly good indicator of the continental climate and of the boreal environment.

Shrews of the genus *Crocidura* are connected today with mild climate and a rather open area. The palaeontological data indicates that in the past they prefered also the same ecological conditions. During the Pleistocene, in the southern Europe their quantity clearly increased in the Interglacials. In the Interglacials they entered also sporadicaly the northwestern part of the continent (REUMER 1984, RZEBIK-KOWALSKA 1995). Among ten assemblages of shrews studied from the Betfia Karstic Complex *C. kornfeldi* was present in eight but mostly in a very small numbers (1.9%-4.4% of shrew assemblage). Only in 2 localities, B-X and B-XI, its participation was great and equaled corespondingly 48% and 30% of shrew fauna. These localities were dated by TERZEA (1995a) to the Early (B-X) and Early/Middle Waalin (B-XI), otherwise to the periods characterized by the mild climate. In B-VII/3 and B-XII dating by TERZEA (1995a, personal communication) as the Bavelian interglacial and characterized also by mild conditions, the amount of *C. kornfeldi* increased in the first to 10.5 % of shrew assemblage and in the second shrews were represented exclusively by several specimens of *C. kornfeldi* (see Table XLV).

The only representative of a "wet" group in the Betfi aComplex indicating the presence of open water bodies in the area, was *N.* cf. *newtoni*, found only once in B-VII/3.

The common and numerous group of shrews in the Betfi aKarstic Complex were the "opportunists". They composed between 16% and 52 % of shrew fauna. As they are found in cool and warm climates and in both steppe and forest environments, unfortunately they cannot help us in the palaeoecological analysis.

Summarizing we can say that according to the composition of shrew fauna in the Betfia Karstic Complex the temperate climate and forest environment prevailed in that territory during the Early Pleistocene. The only evident warming of climate and certain tendency to the deforestation can be seen in the middle of the Early Biharian (Early and Early/Middle Waalian) and is represented by fauna of B-X and B-XI. The second such period can be seen at the end of the Early Pleistocene, but it is less distinct. It is represented by fauna of B-XII and partly of B-VII/3 (Bavelian).

A cooling event in the fauna of shrews could be traced in B-VII/3 when *Sorex minutissimus* appears besides such boreal species as *Lemmus lemmus* and *Gulo gulo*.

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