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Insectivore mammals from the Late Miocene of the Republic of Moldova

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Remains of Erinaceidae, Talpidae, Soricidae and Heterosoricidae were found in eight Late Miocene localities with the '*Hipparion* fauna' in the Republic of Moldova. The number of individuals is not high and their remains are fragmentary, however, the species composition is large. Three to six taxa of hedgehogs, four to five moles, and nine to ten taxa of shrews have been identified. Erinaceidae are represented by *Schizogalerix sarmaticum*, *Parasorex socialis*, ?*Erinaceus* sp., and undetermined Galericinae and Erinaceinae. The Talpidae include *Ruemkelia* sp., *Desmanella* sp., *Proscapanus metastylidus* n. sp., *Proscapanus* cf. *austriacus*, and undetermined species. ?*Miosorex* sp., *Crusafontina* cf. *endemica*, ?*Crusafontina* cf. *kormosi*, ?*Amblycoptus* sp., undetermined Anourosoricini, *Hemisorex suchovi*, *Petenyia* cf. *dubia*, ?*Asoriculus* sp. and "*Paenelimnoecus*" *repenningi* represent the Soricidae, whereas *Dinosorex grycivensis* was the only representative of the Heterosoricidae. The remains are described, measured and illustrated, and their systematic position and distribution are discussed. Both the insectivore remains abundance and their taxonomic diversity varies among the localities. The most numerous and diverse (three hedgehogs, three moles and three shrews) assemblages were found in the early Late Miocene (MN9) locality Bužor I. The younger (MN10-MN11) localities Kejnar and Čiobruči yielded respectively five (Erinaceidae and Soricidae) and four (Talpidae and Soricidae) species, and in the remaining late Late Miocene localities (MN12-MN13) only one to three species were present. Unfortunately, the small number of specimens and species in most localities do not allow for a reconstruction of the transformation of the insectivore fauna in the Late Miocene. However, the fossil assemblages found in the Miocene of Moldova are similar to assemblages found in the other European localities of that time. In general, the European insectivore fauna (especially moles and hedgehogs) was much more diversified in the Miocene than today. It is also visible in the Late Miocene of Moldova.

Key words: Mammalia, Erinaceomorpha, Soricomorpha, Late Miocene, the Moldova Republic.

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I. INTRODUCTION

In the Republic of Moldova, Late Miocene deposits crop out over a large area and represent shallow marine, deltaic, fluvial, and lacustrine environments. Numerous *Hipparion* faunas are represented in different stratigraphical positions and facies (Figs 1, 2; LUNGU & RZEBIK-KOWALSKA in press).

During the last ten years, rich *Hipparion* faunas of the Vallesian-type were found in the Bessarabian and Chersonian beds (LUNGU & BILINKIS 1979; LUNGU & ČEMYRTAN 1986; LUNGU 1990). Localities with the *Hipparion* fauna from the Maeotian beds (Early Turolian) of Eastern Europe (e.g. Taraklija, Čimišlija, and Čobruči) have also yielded assemblages of terrestrial vertebrates.

This work reviews the Late Miocene Moldavian hedgehogs, moles and shrews by revising the older material and describing newly collected specimens.

Measurements of specimens were taken according to the methods applied by DE JONG (1988) for the Erinaceidae, by HUTCHISON (1974) for the Talpidae, and by REUMER (1984) for the Soricidae. Homologous elements (e.g. right first lower molar m1) were chosen to avoid repeated representation of the same individual.

The teeth I1, i1, and a1 were measured along their buccal side, all other teeth on the occlusal surface. Abbreviations: L = maximal length, W = maximal width, and H = maximal height, DS = diameter of the shaft (talpid humeri).

The specimens described are housed in the collection of the Tiraspol State University (TSU) in Kišinev (the Republic of Moldova).

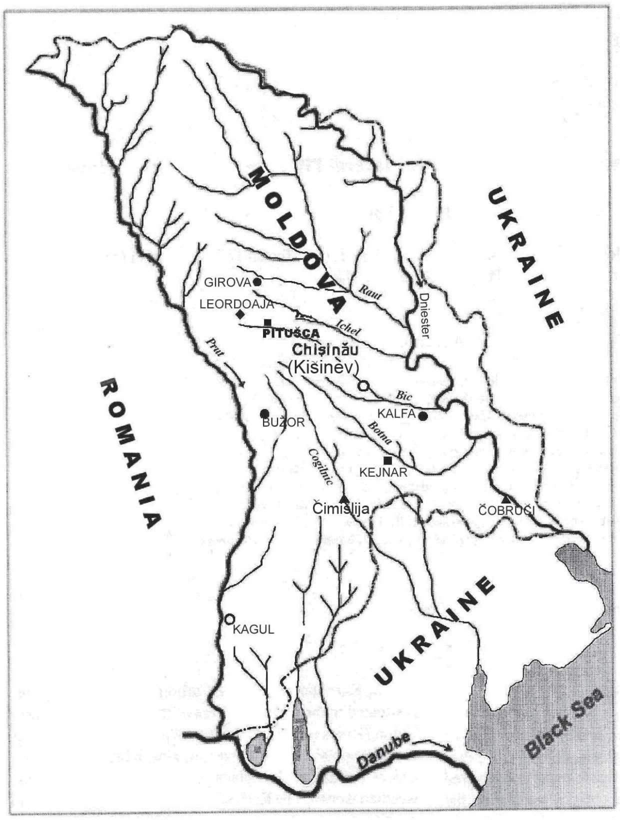

Fig. 1. The Late Miocene localities of the *Hipparion* fauna in the Republic of Moldova in which insectivore mammals were found. ● – Localities of the *Hipparion* fauna in the Bessarabian beds; ■ – Localities of the *Hipparion* fauna in the Chersonian beds; ▲– Localities of the *Hipparion* fauna in the Maeotian beds; ◆– Localities of the *Hipparion* fauna in the Pontion beds.

Stratigraphic scale							Localities containing terrestrial vertebrates:
A				B			
Epoch	Regional Subdivision	Substages	Horizon	Epoch	Regional Subdivision	Zones MN	
Late Miocene	Pontian		Late	Katalonian	Turolian	13	
			Early				Leordoaja•, Veverica-2 Bachmut, Beleneşt
	Maeotian		Late			12	Tudora Čimišlija•, Gura-Galbenij
			Early			11	Čobruči•, Taraklija
	Sarmatian	Chersonian (Late Sarmatian)	Late		Vallesian	10	Respopen Pituşca•
			Early				Kejnar•, Tiraspol, Pocšešt
		Bessarabian (Middle Sarmatian)	Late			9	Varnica, Isacovo, Bužor-2, Veverica-1
			Middle				Kalfa•, Otovasca, Braila, Mileštij Mič
			Early				Gidigič, Prunkul, Petrikan, Girova•, Bužor•-1, Jaloven
		Volynian (Early Sarmatian)	Late	Aragonian	Astaracian	8	
			Early				Severinovka

Fig. 2. Stratigraphic position of the Late Miocene localities with terrestrial fauna from the Republic of Moldova. A – stratigraphy of the marine beds; B – stratigraphy of the continental beds; • – localities with insectivore mammals.

II. SYSTEMATIC PALAEONTOLOGY

Class **Mammalia** LINNAEUS, 1758

Superorder **Insectivora** sensu NOVACEK, 1986

Order **Erinaceomorpha** GREGORY, 1910

Family **Erinaceidae** FISCHER VON WALDHEIM, 1814

Subfamily **Galericinae** POMEL, 1848

Genus ***Schizogalerix*** ENGESSER, 1980

Schizogalerix sarmaticum (LUNGU, 1981)

Figs 3 A-I, 12 A-B

Material. One P4, one buccal fragment of M1, two M2, one buccal fragment of M2, two lingual fragments of M2, one M3, one lingual fragment of M3, one p3, one p4, four m1, one talonid of m1, three m2, and one m3. Minimum number of individuals = 4. Bužor I, MN9 (coll. TSU-Bužor-1).

Description. The P4 is characterized by a small but distinct parastyle, a large protocone located anteriorly in relation to the hypocone, a prominent hypocone but lower than the protocone and by a very bulbous metastyle. A strong posterior cingulum is also present. There is only one buccal fragment of the M1, the protocone and hypocone are absent. The tooth has a divided mesostyle and an elongated metastyle. Its protoconule is small, parastyle very small, antero-buccal and postero-buccal cingula narrow, and the buccal cingulum absent. The M2 is almost rectangular in occlusal view because its metastyle is short and parastyle hardly visible. It has eight cusps (the paracone, double mesostyle, metacone, protoconule, metaconule, protocone, and hypocone). The largest

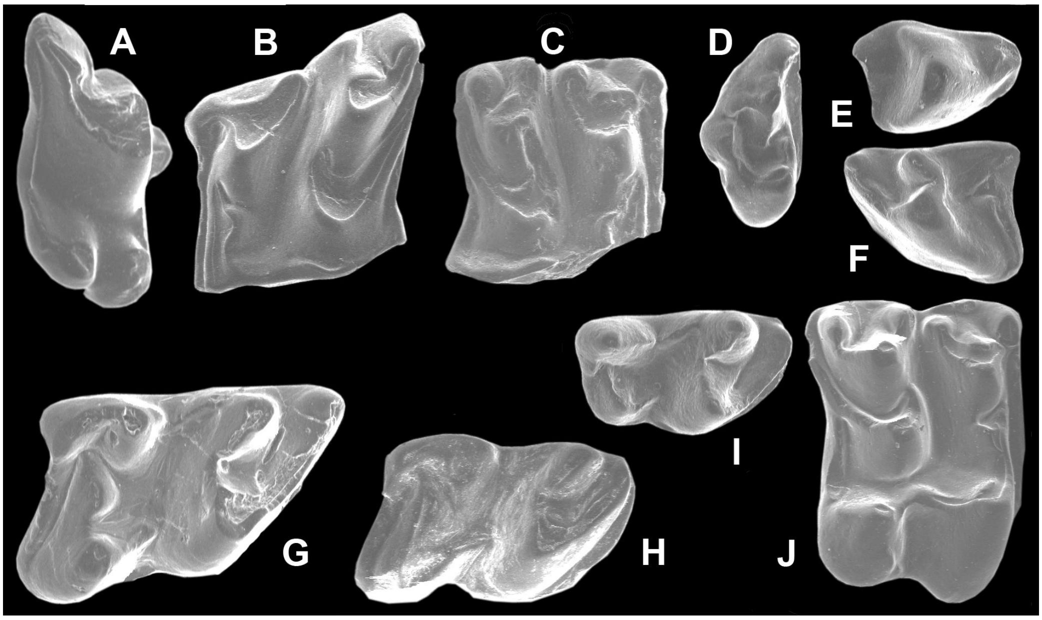

Fig. 3. *Schizogalerix sarmaticum* (LUNGU, 1981) from Bužor I: A – right P4, TSU-Bužor-1/1; B – left fragment of M1, TSU-Bužor-1/1; C – right fragment of M2, TSU-Bužor-1/1; D – right M3, TSU-Bužor-1/1; E – right p3, TSU- Bužor-1/1; F – left p4, TSU-Bužor-1/1; G – right m1, TSU-Bužor-1/1; H – right m2, TSU-Bužor-1/1; I – right m3, TSU-Bužor-1/1. *Schizogalerix* cf. *sarmaticum* from Pituška: J – right M2, TSU-Pituška- 1/1. All in occlusal view (× 15).

cusp is the protocone, the smallest is the elongated protoconule. The parastyle is hardly visible. There is no connection between the protocone and metaconule. The mesostyle is divided. It forms two small cones, the anterior larger than the posterior one. A deep valley separates lingually the protocone and the hypocone, but the posterior arm of the protone is united with the anterior arm of the hypocone. The well developed cingula are present only in antero-buccal and postero-buccal parts of the tooth as well as below the paracone. The M3 is of a subtriangular shape in occlusal view. It has a complicated morphology because it consists of five cusps (parastyle, paracone, metacone, protoconule and protocone). Its highest cusp is the protocone, the protoconule is the smallest. The furrow (groove) of the divided mezostyle is present, but its two cusps are hardly visible. The parastyle is very well developed. The anterior arm of the protocone joins with the posterior arm of the protoconule. It does not join the anterior cingulum. The single cingulum is present in the anterior side of the tooth.

In principle, the p3 is unicuspid although a very small cusp, the parastyle, is present in front of its crown. The main cusp, the paraconid, is situated centrally. Three crests run from the top of this cusp: one, rather blunt, to the parastyle, and two remaining ones, much sharper, to the postero-buccal and postero-lingual corners of the tooth. A talonid-like shelf is present. It is wider on its lingual side. The very short cingulum is visible on the both sides of the paraconid. The tooth has two roots. The p4 has a large trigonid and a short talonid. The predominant cusp of the trigonid is the paraconid. The trigonid is lingually open. The talonid is wider in its lingual side. The well developed cingulum is present only in the posterior side of the tooth. The short ridge, runnning from this cingulum to the base of the paraconid/metaconid wall, divides the talonid into two (buccal and lingual) parts. Two roots are present. The m1 is large and its anterior side is pointed. The trigonid is narrower and shorter than the talonid. In an unused tooth, the posterior arm of the hypoconid ends at a small but distinct hypoconulid, half way to the entoconid. The anterior cingulum is very well developed (large and protruded), the lingual cingulum is absent, the buccal cingulum is situated below the reentrant valley and the posterior cingulum runs towards the entostylid. The entoconid is elongated in an antero-posterior direction. The large entostylid is very well developed. The m2 has a long trigonid (more or less as long as the talonid) and its anterior side is rounded. All m2 are heavily worn, therefore some morphological detail is obscure. Most probably the hypoconulid was absent but the long entoconid and the large entostylid are visible. The cingula are similar to those in m1 with the exception of the buccal cingulum which is absent only below the hypoconid. The m3 is proportionally small and its talonid is short. The hypoconulid and entostylid are absent. The anterior, lingual and posterior cingula are similar to those in m2, but the buccal one is present below the protoconid.

Measurements. See Tables I and II.

Systematic position and distribution. The short and wide M2 with the divided mesostyle and the posterior arm of the protocone connected with the hypocone (instead of the metaconule) indicates that this tooth as well as other hedgehog teeth of corresponding size to the size of M2 belong to *Schizogalerix* ENGESSER, 1980.

Apart from the unnamed *Schizogalerix* (*Schizogalerix* sp.) from North Africa (Algeria and Morocco; ENGESSER 1980), 12 species from Europe, Asiatic Turkey and Kazakhstan are currently known, including: "*S.*" *iliensis* KORDIKOVA, 2000 described from Kazakhstan (MN4-MN5), *S. pasalarensis* ENGESSER, 1980 from Turkey (MN5), *S. pristina* ZIEGLER, 2003 from Austria (MN5), *S. anatolica* ENGESSER, 1980 (MN7+8) and *S. sinapensis* SEN, 1990 (MN9), both from Turkey, *S. voesendorfensis* (RABEDER, 1973) (MN9-MN10) and *S. zapfei* (BACHMAYER & WILSON, 1970) (MN10-MN12), both from Austria, *S. iberica* (MEIN & MARTÍN SUÁRES, 1994) from Spain (MN10-MN14), *S. moedlingensis* (RABEDER, 1973) from Austria (MN11-MN12), *S. macedonica* DOUKAS,1995 (in DOUKAS et al. 1995) from Greece (MN13), and *S. depereti* (CROCHET, 1986) from France (MN14-MN15). Additionally, in 1981 LUNGU described a new species, *Galerix sarmaticum*, from Moldova (MN9). The revision of the material showed that the Moldavian remains also belong to the genus *Schizogalerix*. The original description was published

Table I

Measurements of upper and lower teeth (in mm) of European *Schizogalerix*

	S. sarmaticum Bužor I Moldova MN9	*S. pristina* Mühlbach Austria MN5 (ZIEGLER 2003a)	*S. voesendorfensis* Vösendorf Austria MN9-MN10 (RABEDER 1973)	*S. zapfei* Kohfidish Austria MN10-MN12 (BACHMAYER and WILSON 1970)	*S. iberica* Otura 1 Spain MN10-MN14 (MEIN and MARTIN SUAREZ 1994)	*S. moedlingensis* Eichkogel Austria MN11-MN12 (RABEDER 1973)	*S. macedonica* Maramena Greece MN13 (DOUKAS et al. 1995)	*S. depereti* France MN14-MN15 (CROCHET 1986)
P4 L	2.30	–	2.12-2.47 n=12	2.50	2.22	–	2.41	–
L M2 W	2.08 2.80	1.86-2.04 n=8 2.65-2.82	1.91-2.12 n=15 2.56-2.81	– –	1.96-1.97 n=2 2.62-2.64	1.97-2.06 n=3 2.90-2.90 n=2	2.13-2.39 n=8 3.29-3.61	2.49-2.75 n=4 3.19-3.63
L M3 W	1.33 1.78	1.08-1.33 n=3 1.74-1.93	1.16-1.22 n=3 1.91-2.00	– –	1.20-1.23 n=2 1.74-1.86	1.22-1.36 n=4 2.06-2.15	1.16-1.16 n=2 1.94 -2.00	1.50-1.67 n=4 2.10-2.30
L p3 W	1.55 1.06	1.50-1.74 n=3 0.79-0.91	1.54-1.77 n=8 0.81-0.96	1.30-1.50 n=? 0.80-1.00 n=?	1.52-1.59 n=2 0.83-0.91	1.57-1.63 n=2 0.93-0.99	1.61 1.03	1.73-2.12 n=4 1.04-1.23
L p4 W	1.79 1.35	1.71 1.26	1.61-1.85 n=8 1.07-1.22	1.60-2.00 n=? 1.20-1.30 n=?	1.94-1.98 n=3 1.28-1.30	1.56-1.68 n=3 1.25-1.33	1.81-1.94 n=3 1.29-1.35	2.16-2.69 n=6 1.45-1.63
L m1 W	3.02- 3.06 n=3 1.82-1.94 n=4	2.79 1.81	2.35-2.85 n=22 1.66-1.93	2.60-2.90 n=? 1.80-2.10 n=?	2.86-2.98 n=5 1.80-1.99	– –	3.03 2.13	3.22-3.52 n=3 2.13-2.39
L m2 W	2.65-2.78 n=2 1.60-1.64	– –	2.16-2.43 n=20 1.51-1.89 n=19	2.30-2.70 n=? 1.60-1.90 n=?	2.43-2.51 n=2 1.63-1.76	2.15-2.38 n=5 1.77-1.89 n=3	2.52-2.77 n=5 1.74-2.06	2.72-3.20 n=5 2.09-2.28
L m3 W	2.11 1.16	– –	1.76-2.10 n=17 1.01-1.38	2.00-2.10 n=? 1.20-1.40 n=?	1.69-2.05 n=3 1.27-1.42	1.91-1.94 n=2 1.04-1.10	– –	2.35-2.51 n=2 1.37-1.58

in the Russian language and in foreign literature the species was cited only once by ŞTIUCĂ (2003) [as *Schizogalerix* ex gr. *sarmatica* (LUNGU, 1981)].

Besides slightly smaller older forms and the visibly larger younger taxon, *S. depereti*, the remaining species of *Schizogalerix* are more or less similar in size.

Morphologically, *S. sarmaticum* differs from "*S.*" *iliensis*, *S. pasalarensis* and *S. pristina* by the presence of well divided mesostyles in the upper molars and by elongated entoconids and entostylids in the lower molars. Also, in contrast to "*S.*" *iliensis* it has a small parastyle, the protoconule

Table II

Measurements of upper and lower teeth (in mm) of *Schizogalerix* from Kazakhstan and Turkey. *Taken from scatter-diagrams (ENGESSER 1980)

	S. sarmaticum Bužor I Moldova MN9	“*S.*” *iliensis* Aktau Mountains Kazakhstan MN4-MN5 (KORDIKOVA 2000)	*S. pasalarensis** Paşalar Turkey MN5 (ENGESSER 1980)	*S. anatolica** Eskihisar Turkey MN7+8 (ENGESSER 1980)	*S. sinapensis* Sinap Tepe Turkey MN9 (SEN 1990)
P4 L	2.30	?2.35-255 n=7	2.35	2.18-2.48 n=13	2.30
L	2.08	?2.21-2.35	1.96-2.07	1.96-2.25	2.09
M2		n=9	n=3	n=22	
W	2.80	?3.13-3.24	3.04-3.25	3.07-3.43	3.08
L	1.33-1.39	1.58-1.71	–	–	–
M3	n=2	n=4			
W	1.73-1.78	1.83-2.08	–	–	–
L	1.55	1.56-1.67	1.48	1.40-1.68	–
p3		n=8		n=16	
W	1.06	0.89-1.11	0.96	0.84-1.03	–
L	1.79	2.10-2.43	1.79-1.89	1.63-1.91	–
p4		n=8	n=6	n=20	
W	1.35	1.40-1.66	1.24-1.49	1.13-1.50	–
L	3.02-3.06 n=3	–	2.67-2.84	2.43-2.91	–
m1			n=3	n=26	
W	1.93-1.97 n=4	–	1.81-1.88	1.66-2.22	–
L	2.65-2.78	–	2.32-2.40	2.20-2.56	–
m2	n=4		n=2	n=23	
W	1.60-1.64	–	1.59-1.73	1.59-1.90	–
L	2.11	2.23-2.23	–	–	–
m3		n=2			
W	1.16	?1.33-1.38	–	–	–

in M1 and M2 are not united with the anterior cingulum, and the hypolophids in m1 and m2 are not connected with the posterior cingulum. The teeth of *S. pasalarensis* differ from those of *S. sarmaticum* by the presence of a weak parastyle, but moreover by the lack of a labial cingulum in M1 and M2. The teeth from Bužor I are slightly larger than those in *S. pristina*, and besides in the upper molars the anterior arm of the hypocone joins the posterior arm of the protocone, while in *S. pristina* these arms are separated by a notch.

In comparison with *S. anatolica* which has a distinct parastyle in the upper M2, very narrow trigonids and a posterior cingulum united with the hypolophid in lower molars, *S. sarmaticum* has a weak parastyle in M2, posterior cingulum separated from the hypolophid and only the trigonid of its m1 is narrow.

Cotrary to *S. sinapensis*, *S. sarmaticum* has a less undulated buccal side of the upper molars, a one-armed protoconule, and a very small parastyle separated from the paracone by a shallow groove. The lower molars of *S. sinapensis* are unknown.

From *S. voesendorfensis* the Bužor I teeth differ by a more complicated structure of M3 (with a protoconule and a trace of the mesostyle), a shorter talonid in p4, the absence of entoconid crests and the presence of elongated entoconids and entostylids in lower molars.

S. sarmaticum differs from *S. iberica* by the presence of a conical hypocone without the posthypocrista in M2 (probably also in M1 but the lingual fragment of this tooth is lacking), by a more complicated structure of the M3 (with a large parastyle), by the posterior cingulum reaching the entostylid and by the presence of elongated entoconids and entostylids in lower molars.

S. moedlingensis and *S. sarmaticum* differ by the presence of small parastyles in M1 and M2 in the latter. *S. sarmaticum* also lacks continuous anterior, labial and posterior cingula but possesses elongated entoconids and entostylids in its lower molars.

Specimens from Bužor I differ from *S. macedonica* by the lack of an additional cusp between the protocone and hypocone and by the very small parastyles in M1 and M2.

S. sarmaticum is smaller than *S. depereti*. It also has elongated entoconids and entostylids in the lower molars which are absent in *S. depereti*.

The specimens from Bužor I are most similar to *S. zapfei*. In both species the lower molars have enlarged entoconids and elongated entostylids. Unfortunately, the upper molars of *S. zapfei* are unknown. They are, however, present in *S. attica* described by RÜMKE in 1976 from Greece. According to ENGESSER (1980) *S. attica* is identical with *S. zapfei* and the name "*attica*" is a synonym of "*zapfei*". Indeed, the lower molars of these two species are identical, characterized by large (double) entoconids because both have elongated entostylids. If *S. attica* and *S. zapfei* are synonymous, then the upper molars of the first species should be identical with those in *S. zapfei*. They are, however, different from the upper molars of *S. sarmaticum*. Contrary to *S. attica*/*S. zapfei*, the upper molars of *S. sarmaticum* have a small parastyle, conical hypocone in M2, and a different M3 with a protoconule, a trace of a mezostyle and the junction of the anterior arm of the protocone with protoconule (not with the anterior cingulum). These characters distinguish *S. sarmaticum* from *S. zapfei* and support its species status.

Schizogalerix cf. **s*armaticum*** (LUNGU, 1981)

Fig. 3 J

Material. One isolated M2. Minimum number of individuals = 1. Pituška, MN10 (coll. TSU-Pituška-1).

Description. Besides its larger size, and the conical, well developed parastyle, the M2 from Pituška is morphologically identical with the M2 of *S. sarmaticum* described from Bužor I.

Measurements. M2: L = 2.17 mm, W = 3.03 mm.

Systematic position. This tooth possesses a divided mesostyle and a connection between the posterior arm of the protocone and hypocone which identify it as belonging to the Galericinae genus *Schizogalerix.* The detailed morphology suggests a relationship with *S. sarmaticum* or the similar *S. zapfei* (which is characterized by a better developed parastyle). However, it is more probable that it belongs to *S. sarmaticum* which lived in this area earlier, in the beginning of the Late Miocene (Bužor I, MN9). As other insectivore species its dimensions slightly increased and morphology changed with geological age. Additional material is needed in order to identify more precisely the tooth from Pituška.

Genus ***Parasorex*** VON MEYER, 1865

Parasorex socialis VON MEYER, 1865

Fig. 4 A-F

Material. One I1, one P3, one M3, one p4, two m1 (one damaged, the anterolingual part of the trigonid is lacking) and three m2 (one broken and stuck together). Minimum number of individuals = 2. Kejnar, MN10 (coll. TSU-Kejnar-1).

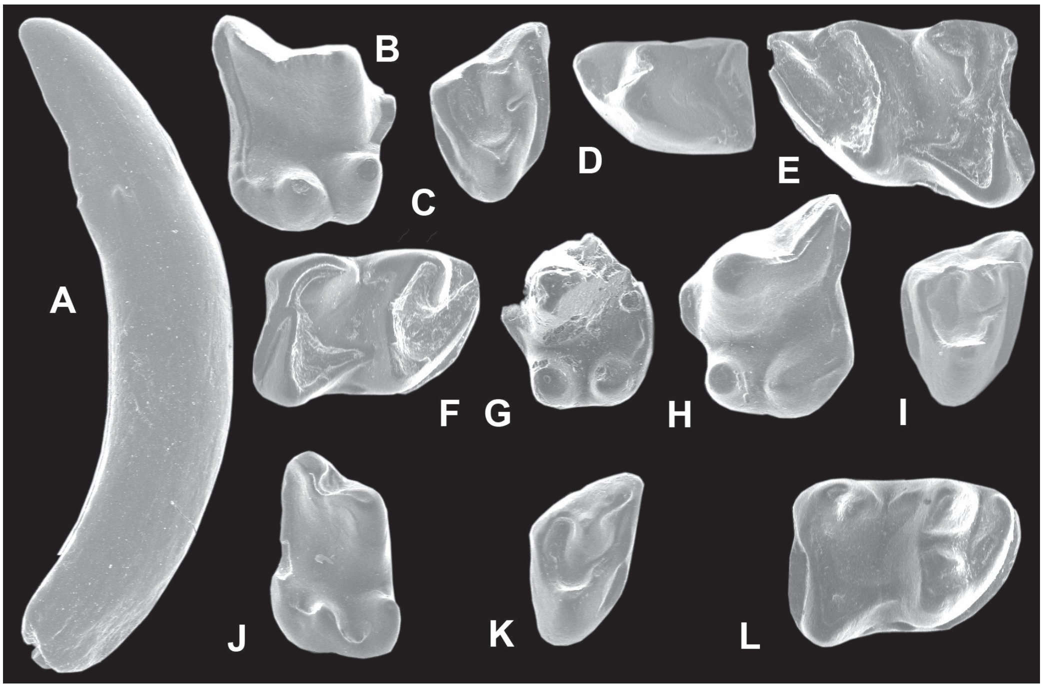

Fig. 4. *Parasorex socialis* VON MEYER, 1865 from Kejnar: A – left I1, TSU-Kejnar-1/1; B – right P3, TSU-Kejnar-1/1; C – right M3, TSU-Kejnar-1/1; D – left p4, TSU-Kejnar-1/1; E – left m1, TSU-Kejnar-1/1; F – right m2, TSU-Kejnar-1/1. ?*Parasorex socialis* from Čimišlija: G – left fragment of P3, TSU-Čimišlija-1/1; H – left P4, TSU-Čimišlija-1/1; I – right M3, TSU-Čimišlija-1/1. Galericinae gen. et sp. indet. from Bužor I; J – right P3 or P4, TSU-Bužor-1/1; K – right M3, TSU-Bužor-1/1; L – right m2, TSU-Bužor-1/3. All in occlusal view (× 15).

Description. The I1 has a convex anterior surface and flattened posterior surface. The postero-buccal ridge is prominent, the postero-lingual is less so and it does not reach the tip of the tooth. The root curves posteriorly. Its upper surface is convex and lower surface is flat. The P3 is massive. The highest cusp is the paracone, the parastyle is small but well individualized. The tooth has two lingual cusps, the protocone and the hypocone. The cusps are conical and well isolated from one another. The hypocone is larger than the protocone. The anterior and posterior cingula are large and protruded. The buccal and lingual cingula are absent. The M3 has four cusps (the parastyle, the paracone, the protocone and the metacone), although the trace of the protoconule is present. The highest cusp is the protocone, then the paracone and the smallest is the metacone. The ridges connecting these cusps border the central basin. The mesostyle is undivided. The anterior arm of the protocone is separated from the paracone by a narrow furrow. The parastyle is very well developed. The anterior cingulum is long and protruded, the posterior cingulum is short, situated in the middle of the posterior wall of the crown.

The p4 has a large trigonid and a short talonid. The talonid is formed by a ridge, higher in its lingual side. The metaconid is smaller and lower than the protoconid. The paraconid is low but distinct. Cingula are absent. The m1 is relatively large. The anterior side of the crown is pointed and the paraconid is well developed. The largest cusp is the entoconid, the protoconid and the metaconid are more or less of the same height. There is a deep notch between both cusps. The hypolophid and the posterior cingulum do not reach the top of the entoconid. The entostylid is absent. The anterior cingulum continues below the top of the protoconid. The m2 is smaller than m1 and the anterior side of the crown is rounded. Additionally, it is similar to m1. In one specimen the buccal cingulum is also present below the re-entrant valley of the tooth.

Measurements. See Table III.

Systematic position and distribution. The P3 with two lingual cusps (the protocone and the hypocone) preserved among the Galericinae specimens from Kejnar indicates that this subfamily may be represented by *Galerix symeonidisi* DOUKAS, 1986, *Parasorex socialis* VON MEYER, 1865 or one of the *Schizogalerix* species. Other representatives of Galericinae possess the P3 with one lingual cusp. However, teeth of *G. symeonidisi* differ from those in Kejnar by a much narrower P3 and M3, a different shape of the p4 paraconid and much longer buccal cingulum in m1 and m2. Besides, *G. symeonidisi* is known from older localities (MN4-MN6) and so far it has never been found in the MN10 zone. The specimens from Kejnar cannot represent *Schizogalerix* because there is no connection (with the exception of one tooth which is very worn) between the posterior cingulum and the posterior arm of the entoconid in their lower molars. This connection is characteristic for all *Schizogalerix* forms.

The hedgehog teeth from Kejnar are most similar to teeth of *Parasorex socialis.* Their size (see Table III) and morphology lie in the range of variation of the latter.

P. socialis was described from Steinheim in Germany, dated to MN7+8. Besides Steinheim and several other localities in Germany (all dated to MN7+8, ZIEGLER 2005), this form was also cited from Switzerland (MN7+8, ENGESSER 1972), Austria (MN7+8, ZIEGLER & DAXNER-HÖCK 2005), Romania (MN7+8, ?MN9, RZEBIK-KOWALSKA 2005), Spain (MN7+8-MN10, HOEK OSTENDE & FURIÓ 2005), and France (as *P.* aff. *socialis*, MN10, CROCHET & GREEN 1982). The locality from Moldova represents the most eastern position of its range.

Table III

Measurements of upper and lower teeth (in mm) of *Parasorex socialis*

	P. socialis Kejnar MN10	*P. socialis* Petersbuch 6, 10, 18, 31, 35, 48 Germany MN7+8 (ZIEGLER 2005)	*P. socialis* Anwil Switzerland MN7+8 (ENGESSER 1972)	*P. socialis* Pedregueras 2A Spain MN9 (DE JONG 1988)	*P.* aff. *socialis* Montredon France MN10 (CROCHET and GREEN 1982)
L	1.83	1.65-2.42	–	1.95-2.12 n=3	1.93-2.31
P3		n=179			n=10
W	2.07	1.54–2.17	–	1.56-2.09 n=4	1.54-1.80
L	1.29	1.15-1.59	1.22-1.30	1.16-1.42 n=5	1.13-1.37
M3		n=137	n=4		n=9
W	1.75	1.76-2.42	1.88-2.00	1.76-2.06 n=4	1. 66-2.18
L	1.85	1.52-2.40	–	1.81-1.90	1.92-2.14
p4		n=335		n=4	n=9
W	1.23	1.03-1.69	–	1.20-1.30	1.12-1.27
L	2.64	2.62-3.55	2.72	2.99	2.73-3.01 n=4
m1		n=423			
W	1.81-1.82 n=2	1.64-2.35	1.88	1.82	1.70-1.90 n=5
L	2.36-2.40	2.17-3.04	2.54	2.43-2.68 n=3	2.21-2.49
m2	n=2	n=426			n=9
W	1.50-1.53	1.47-2.07	1.38	1.64-1.93 n=7	1.47-1.72

? ***Parasorex socialis*** VON MEYER, 1865

Fig. 4 G-I

Material. One P3 (with its buccal part broken), one P4, one M1 (with the buccal part damaged), one M3 and one trigonid of m1. Minimum number of individuals = 1. Čimišlija, MN12 (coll. TSU-Čimišlija-1).

Description. The massive lingual fragment of the P3 preserved in the material does not differ from this part of the tooth described from Kejnar. The P4 is also massive, but more robust and larger than the P3. Its largest cusp is the conical paracone. The parastyle is small but present. The protocone and hypocone are also conical. The hypocone is lower, but larger than the protocone. The posterior cingulum is large, the remaining ones absent. The M1 has its buccal part broken. Cusps that are present include the protoconule, the metaconule, the protocone and the hypocone. The protocone is the largest cusp, the protoconule the smallest. The posterior arm of the protocone is continuous with the anterior arm of the hypocone. There is no connection between the protocone and the metaconule. The anterior and posterior cingula are present, the lingual one absent. The M3 and the trigonid of m1 are identical with these teeth described as *P. socialis* from Kejnar.

Measurements. P 4: L = 2.04 mm, W = 2.09 mm; M3: L = 1.25 mm, W = 1.87 mm.

Systematic position. The small hedgehog teeth found in Čimišlija represent one form and they are different from the large ones described from the same locality as ?*Erinaceus* sp. As mentioned above (p. 20), the P3 found in the material has two lingual cusps, a character present only in such Galericinae as *Parasorex socialis*, *Galerix symeonidisi* and species of the genus *Schizogalerix*. As the mesostyle of M3 from Čimišlija is undivided it can be dismissed as belonging to *Schozogalerix*. As concerns *Galerix symeonidisi* its M3 seems slightly narrower, the parastyle smaller and the parastyle of its P4 also smaller than in Čimišlija teeth. In addition, *G. symeonidisi* is older, known from localities dated to MN4-MN6.

The teeth of the small hedgehog from Čimišlija are most similar to teeth of *P. socialis*. Their size lies in the range of variation of teeth from different Petersbuch localities dated to MN7+8 (ZIEGLER 2005), and the M3 does not differ much from this tooth in Kejnar. Also morphology, especially of the M3 present in both localities, seems identical. As the material is very limited and the time gap between last presence of *P. socialis* known so far is great (Spain, MN9, DE JONG 1988; France as *P.* aff. *socialis*, MN10, CROCHET & GREEN 1982; Kejnar, MN10 this paper), the specimens from Čimişlija are tentatively identified as ?*P. socialis*.

Galericinae gen. et sp. indet.

Fig. 4 J-L

Material. One P3 or P4, one M3, and one m2. Minimum number of individuals = 1. Bužor I, MN9 (coll. TSU-Bužor-1).

Description. The most characteristic feature of the P3 (or P4) is its complete lack of a parastyle and, in result, the very short buccal side of the tooth. It consists of a high paracone, and lower protocone and hypocone. From the top of the paracone a sharp ridge (style) runs to the rounded postero-buccal corner of the tooth. The protocone is only slightly larger than the hypocone. A wide valley separates the protocone and the hypocone. A short cingulum is situated in the postero-buccal side of the tooth. The M3 is rather small and its occlusal view is subtriangular. The largest cusp is the protocone, the paracone is little smaller, the metacon is vestigial. Its parastyle is well developed and the mesostyle undivided. The anterior arm of the protocone joins the anterior cingulum. This cingulum is very well developed. The buccal, lingual and posterior cingula are absent. The m2 is massive. Its trigonid and talonid are more or less of the same size and its anterior side is rounded. The entoconid is large. The hypolophid runs directly to the top of the entoconid so the entostylid is absent. The anterior cingulum is well developed, the buccal one is present only below the protoconid, the posterior cingulum ends in the middle of the posterior wall of the crown, and the lingual one is absent.

Measurements. P3 or P4: L = 1.30 mm, W = 2.08 mm; M3: L = 1.05 mm, W = 1.83 mm; m2: L = 2.40 mm, W = 1.61 mm.

Systematic position. The size of the teeth listed above, different from the size of *S. sarmaticum* and Erinaceinae gen. et sp. indet. described from the same locality, indicates that they may belong to a single taxon. The morphology of the M3 suggests that teeth are from the subfamily Galericinae. However, the lack of the regular central basin in the M3 (the parastyle, paracone and metacone do not lie in one line because the paracone is situated more lingually than the remaining cusps) indicates that this tooth rather represents the genera *Schizogalerix* or *Lantanotherium* FILHOL, 1888 [especially *L. sansaniense* (LARTET, 1851)] than *Galerix* POMEL, 1848 or *Parasorex* VON MEYER, 1865, where cusps in M3 lie around the central basin. On the other hand, the tooth from Bužor I has an undivided mesostyle, which precludes it from the genus *Schizogalerix*. Besides, the upper P3 (or P4) with a very short buccal side do not resemble those in *Schizogalerix*, *Lantanotherium* and other genera (additionally, in many collections the upper teeth or the M3 of *L. sansaniense* are unknown). Only more abundant material can help in the generic and specific identification.

Subfamily **Erinaceinae** FISCHER VON WALDHEIM, 1814

Genus ***Erinaceus*** LINNAEUS, 1758

?***Erinaceus*** sp.

Fig. 5 A-C

Material. Two I2, one upper C, three i1, one i2, one lower c, and two mandible fragments (left and right, both glued together from three parts, probably belonging to one animal), one with i1 and p4-m2 and the second with p4-m2. Minimum number of individuals = 2, Čimišlija, MN12 (coll. TSU-Čimišlija-1).

Description. The I2 is unicuspid. Two crests run from its top to the middle of the anterior and posterior sides of the tooth. The posterior crest is more distinct. The buccal side of the crown is slightly convex, the lingual one straight in the anterior and slightly concave in its posterior part. The cingulum is absent. The tooth has one root. The upper C is also unicuspid with two crests running from its top to the middle of its anterior and posterior sides. The posterior crest is longer and curved slightly upwards on its back side. The buccal and lingual cingula are wide, but the former is less protruded. The tooth has two roots.

The horizontal ramus of the mandible is very large. One mental foramen present in the left mandible is situated below the posterior root of the p4. The i1 and its root are massive. The buccal side of the crown is convex and the lingual one straight. The unicuspid i2 is low and wide. A distinct crest runs in the middle of its crown, from the anterior to posterior side of the tooth. At the back the crest ends in a small cusp. One root is situated in the posterior part of the tooth. The cingulum is absent. The lower c is large, much larger than the i2. Its massive cusp is situated in the anterior part of the crown and the posterior part of the crown is very low. A distinct crest runs from the top of the tooth forward, the short one is situated in the middle of the low, posterior part of the crown. It ends in a small cusp. A trace of a cingulum is visible in the anterobuccal part of the crown. The p4 has a high and distinct paraconid and protoconid but a low metaconid. The talonid is extremely short. The buccal, not very protruded cingulum, is present. The m1 and m2 are massive. The m1 is larger and its anterior side is pointed. The anterior side of the m2 is rounded. In both teeth the strongest cusp of the talonid is the entoconid. The talonid basin is deep and open bucally and lingually. The entostylids are absent. A faint cingulum is present on the anterior sides of the teeth and a large cingulum is on the buccal sides of the teeth.

Measurements. See Table IV.

Systematic position. As mentioned above, the mandibles present in the material were stuck together, but their parts fit well to each other, so they certainly belong to these two specimens. It can be seen that the number of teeth in one of the mandibles is reduced because between the i1 and p4 present, there are only three alveoli belonging to one-rooted i2, c and p2. This indicates

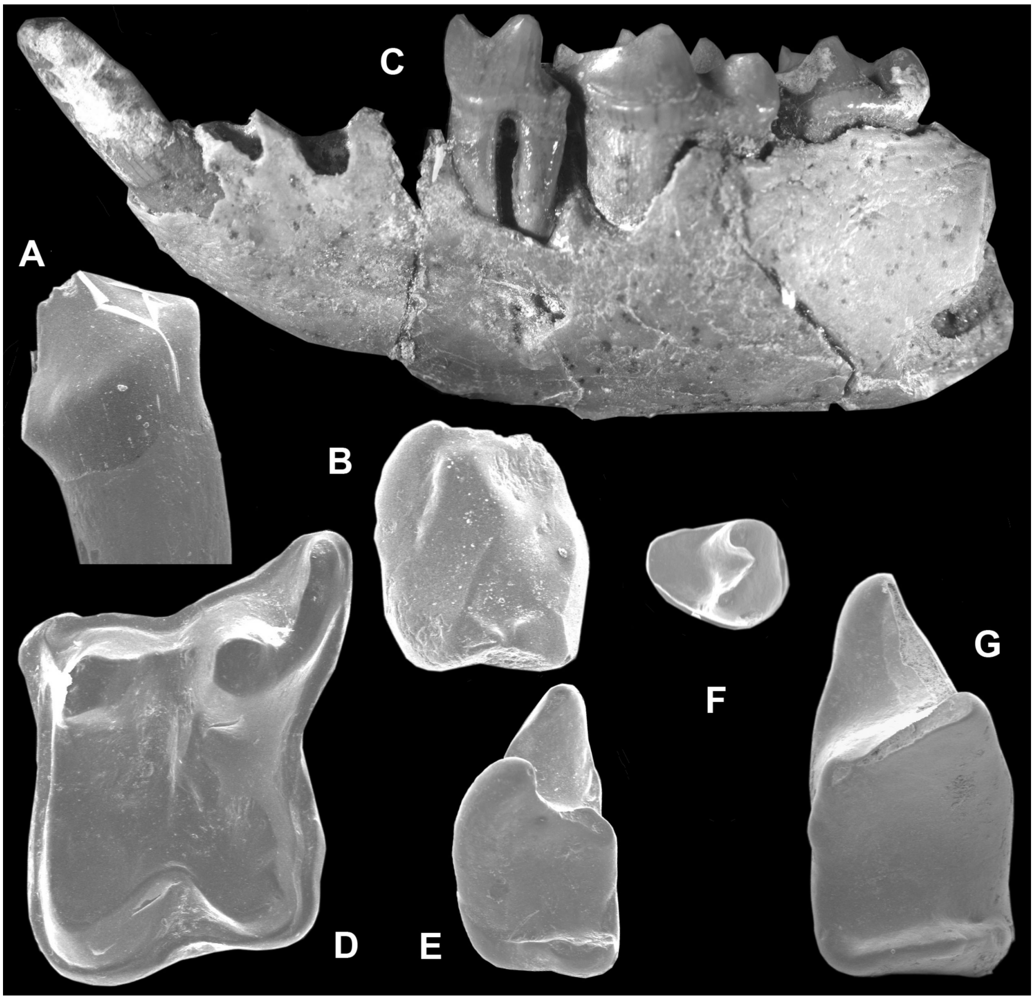

Fig. 5. ?*Erinaceus* sp. from Čimišlija: A – left I2, buccal view, TSU-Čimišlija-1/1; B – right i2, occlusal view, TSU-Čimišlija-1/1 (x 15); C – left fragment of mandible with i1 and p4-m2, buccal view, TSU-Čimišlija-1/1, (x 3). Erinaceinae gen. et sp. indet. 1 from Bužor I: D – left M1, occlusal view, TSU-Bužor-1/1; E – left p4, posterior view, TSU-Bužor-1/1; F – left m3, occlusal view, TSU-Bužor-1/1. Erinaceinae gen. et sp. indet. 2 from Leordoaja: G – right p4, posterior view, TSU-Leordoaja-1/1 (× 15).

that the hedgehog from Čimišlija represents the subfamily Erinaceinae. It is characterized by the presence of eight teeth in half of the lower jaw (2i, 1c, 2p and 3m) while in the Galericinae this number equals 11 (3i, 1c, 4p and 3m). In this situation, the largest Galericinae species of the genus known so far, *Deinogalerix* FREUDENTHAL, 1972, cannot be taken into consideration, especially since it is still much larger than the specimens from Čimišlija.

In the Miocene, the following genera of the Erinaceinae were present in Europe: *Dimylechinus* HÜRZELER, 1944, dated to MN1 and MN2, *Amphechinus* AYMARD, 1849 (MN1, MN2, MN4, MN6 and MN7+8), *Atelerix* POMEL, 1848 (MN7+8), *Mioechinus* BUTLER, 1948 (MN4 and MN7+8), *Postpalerinaceus* CRUSAFONT & VILLATA, 1947 (MN10) and *Erinaceus* LINNAEUS, 1758 known from the zone MN13 or MN13-MN14 (ZIEGLER 1999; MEIN & GINSBURG 2002).

A comparison of sizes of species belonging to the genera mentioned above indicates that all are smaller than the hedgehog from Cimišlija with the exception of *Amphechinus robinsoni* GIBERT, 1974. This species was described from Spanish localities Manchones I and II, dated to MN7+8.

Table IV

Measurements of mandible, upper and lower teeth (in mm) of ?*Erinaceus* sp. and *Erinaceus roumanicus**.

	?*Erinaceus* sp. Čimišlija MN10	*E. roumanicus* Poland Recent	*E. roumanicus* Europe** Recent
L	2.00-2.23	–	–
I2	n=2		
W	1.51-1.56	–	–
L	–	–	–
i1			
W	2.40	1.89-2.36	–
L	2.66	–	–
i2			
W	2.14	–	–
L	3.65	2.69-3.23 n=10	–
c			
W	2.22	1.89-2.40 n=11	–
L	3.86-3.91	2.36-3.83	–
p4	n=2	n=14	
W	2.77-2.80	2.05-2.82	–
L	6.46-6.47	5.39-6.22	4.70-6.60
m1	n=2	n=14	n=20
W	3.87-3.88	3.30-3.95	–
L	5.39-5.40	4.62-5.48	–
m2	n=2	n=14	
W	3.63-3.65	3.01-3.56	–
H of mandible below m2	8.41-8.45 n=2	5.81-7.63 n=9	–

* See Hutterer (2005); **Holz and Niethammer (1990)

However, its morphology (a very small metaconid and the lack of the buccal cingulum in P_4) differs from the Čimišlija specimens which have a well developed metaconid and clear, although not protruded, buccal cingulum in this tooth.

As concerns the size and morphology of the hedgehog from Čimišlija, it resembles the Recent *Erinaceus roumanicus* Barrett-Hamilton, 1900 living today in the territory of Moldova. The only exception is the size and robustness of the horizontal ramus of the mandible. It is clearly more massive and larger in the fossil specimens (see Table V). As the teeth present in the fossil material are not diagnostic and the size of the horizontal ramus considerably surpasses the size of known *Erinaceus* species, the hedgehog remains from Čimišlija are tentatively described as ?*Erinaceus* sp.

Erinaceinae gen. et sp. indet. 1

Fig. 5 D-F.

Material. One ?P2, one M1, one p4 and one m3. Minimum number of individuals = 1. Bužor I, MN9 (coll. TSU-Bužor-1).

Description. The upper ?P2 is unicuspid. The cusp is situated closer to the anterior side of the tooth. One sharp crest runs from the tip of the cusp to the middle of the posterior cingulum. The crown is oval in an occlusal view, although its anterior part is slightly wider than the posterior one. The tooth has two roots and well developed cingula all around. The M1 is large and slightly worn. It is characterized by 5 cusps (the paracone, metacone, protocone, hypocone and metaconule), the highest is the metacone and the largest is the protocone. The metaconule is weak and separated from the protocone/hypocone crest by a shallow valley. The parastyle is very small and the metastyle is well developed (elongated). The mesostyle is undivided. Well-developed cingula are present all around the crown. The tooth has three (two buccal and one lingual) roots.

The p4 is also large and massive. Its highest cusp is the protoconid but the paraconid is only a little lower and slightly bulbous. The tip of the metaconid is broken so its height is not known. The talonid is reduced to the lingual cusp (hypoconulid). A large cingulum is present on the buccal and posterior sides of the crown. A trace of it is also visible below the trigonid valley which is rather deep. The m3 consists of the trigonid only. The curved paralophid extends along the lingual side of the crown but not close to the trigonid basin. Wide anterior, buccal and posterior cingula are present. The buccal cingulum is protruded.

Measurements. ?P2: L = 1.81 mm, W = 1.16 mm; M1: L = 3.38 mm, W = 4.54 mm; p4: L = 2.68 mm, W = 1.61 mm; m3: L = 1.51 mm, W = 1.23 mm.

Systematic position. The relative size of the teeth described above indicates that they represent one taxon. Their comparatively large size, the morphology of m3 reduced to the

Table V

Measurements of upper and lower teeth (in mm) of different *Reumkelia* species of body size similar to specimens from Čobruči and Čimišlija (Moldova)

	Ruemkelia sp. Čobruči MN11	*Ruemkelia* sp. Čimišlija MN12	*R. vinea* (STORCH, 1978) Austria MN11 (RÜMKE 1985)	*R. turolense* (RÜMKE, 1985) Spain MN12 (RÜMKE 1985)	*R. major* (RÜMKE, 1985) Spain MN12-MN13 (RÜMKE 1985)	*R. dekkersi* (RÜMKE, 1985) Spain, Greece MN13-MN13/MN14 (RÜMKE 1985)	*R. pontica* (SCHREUDER, 1940) Hungary, Spain, Greece MN13-MN13/MN14 (RÜMKE, 1985)	*R. bifida* (ENGESSER, 1980) Turkey MN14 (RÜMKE 1985)	*R. brailloni* (RÜMKE, 1985) France, Spain MN14-16 (RÜMKE 1985)
L	–	1.52	1.24-1.31	1.15-1.53	1.29-1.60	1.29-1.56	–	1.54-1.70	1.40-1.65
P3			n=3	n=25	n=13	n=60		n=10	n=18
W	–	1.31	1.00-1.12	1.00-1.26	1.15-1.49	1.02-1.37	–	1.08-1.24	1.12-1.37
L	–	1.43	1.36-1.47	1.33-1.63	1.44-1.58	1.25-1.54	–	1.51-1.53	1.43-1.70
M3			n=6	n=23	n=6	n=54		n=2	n=14
W	–	2.21	2.04-2.24	1.98-2.27	2.04-2.24	1.75-2.27	–	2.07-2.08	1.95-2.24
L	–	0.84	–	–	–	–	–	–	–
?i2, i3, c									
W	–	0.93	–	–	–	–	–	–	–
L	–	1.52-1.56	1.49-1.76	1.53-1.82	1.65-1.79	1.44-1.73	–	1.53-1.68	1.42-1.75
p4		n=3	n=18	n=30	n=12	n=45		n=5	n=9
W	–	0.91-0.98	1.04-1.23	1.01-1.33	1.09-1.37	0.93-1.20	–	1.06-1.22	1.20-1.36
L	2.50	–	2.19-2.36	2.18-2.53	2.40-2.59	2.09-2.39	2.41-2.52	2.20-2.56	2.33-2.58
m2			n=14	n=15	n=3	n=47	n=3	n=9	n=14
W	1.70	–	1.44-1.74	1.59-1.79	1.68-1.86	1.50-1.79	1.66-1.95	1.64-1.80	1.70-1.95

trigonid and the M1 with only one lingual root (according to BUTLER 1948 it occurs exclusively in the "true" hedgehogs) indicate that these specimens belong to the subfamily Erinaceinae. A comparison of their size with the size of other Miocene hedgehogs of this subfamily (*Erinaceus*, *Atelerix*, *Dimylechinus*, *Postpalerinaceus*, *Mioechinus*, and *Amphechinus*) indicates that specimens from Bužor I are smaller. Additionally, the morphology of the M1 (the elongated metastyle and the concave buccal side) excludes it from *Erinaceus*, *Atlerix* and *Mioechinus*, in which the buccal side is more or less straight. The extremely deep buccal side in the M1 of *Dimylechinus*, as well as its old age (MN1-MN2), and the large size of *Postpalerinaceus* [e.g. in *P. intermedius* (GAILLARD, 1899) – M1: L = 4.55 mm, W = 5.01 mm; p4: L = 3.63 mm, W = 2.38 mm; m3: L = 2.18 mm, W = 1.74 mm (MEIN & GINSBURG 2002); in *P. vireti* CRUSAFONT & VILLATA, 1947 – M1: L = 6.10 mm, W = 6.10 mm; p4: L = 3.52-3.84 mm, W = 2.58-2.65 mm, n = ?; M3: L = 2.64 mm, W = 1.75 mm (CRUSAFONT & VILLATA 1947)] also allow us to exclude these taxa from the Bužor I material. Only the teeth of *Amphechinus* are approximate in size to the Bužor I teeth, especially those of *A. golpeae* GIBERT, 1974 (p4: L = 2.64 mm, W = 1.84 mm; m3: L = 1.92 mm, W = 1.36 mm; GIBERT 1975). This species was described by GIBERT (1974) from the Middle Miocene (MN7+8) locality Hostalets in Spain. However, the upper teeth of *A. golpeae* are unknown and the morphology of its lower teeth and those from Bužor I are not quite uniform. The labial cingulum, the metaconid and the talonid in its p4 are weak, while in the p4 from Bužor I the cingulum and metaconid are better developed but the talonid is limited to the lingual cusp only. On the other hand, the m3 of both forms are more or less similar. As in the taxa cited above, more material is needed to precisely identify the Erinaceinae from Bužor I.

The presence of the three forms of hedgehogs (*S. sarmaticum*, Galericinae gen. et sp. indet., and Erinaceinae gen. et sp. indet. 1) in one locality may be surprising, however, they belong to two subfamilies and clearly differ in size.

Erinaceinae gen. et sp. indet. 2

Fig. 5 G

Material. One p4. Minimum number of individuals = 1. Leordoaja, MN13 (coll. TSU-Leordoaja-1).

Description. The p4 is large. It has a very high protoconid, and slightly lower paraconid. The metaconid is small. The valley between the para- and protoconid is large, U-shaped. The talonid is very short in the form of a posterior cingulum. The buccal cingulum is very delicate, the anterior and lingual cingula are absent.

Measurements. p4: L = 3.88 mm, W = 2.20 mm.

Systematic position. The tooth is very large, larger than the p4 of all other species of the subfamily Galericinae. In addition, its paraconid is considerably elevated. This character, according to BUTLER (1948), is typical for the Erinaceinae hedgehogs.

In zone MN13, apart from the smaller Galericinae representatives of the genus *Erinaceus* are also present. The p4 from Leordoaja lies in the range of variation of this tooth in the genus *Erinaceus*, but its morphology is slightly different. It is not as massive and its paraconid/protoconid valley is more open (U-shaped), while in other species of *Erinaceus* it is narrow, V-shaped. More material is needed in order to correctly identify the genus and species of the Leordoaja hedgehog.

Family **Talpidae** FISCHER VON WALDHEIM, 1814

Subfamily **Desmaninae** THOMAS, 1912

Ruemkelia RZEBIK-KOWALSKA & PAWŁOWSKI, 1994

Nomenclatorial comment. The genus *Dibolia* was established by LATREILLE (1829) for a leaf beetle. In 1985 C. G. RÜMKE introduced the generic name *Dibolia* for Desmaninae moles and indicated *D. dekkersi* n. sp. as the type species. RZEBIK-KOWALSKA and PAWŁOWSKI (1994), after contacting C. G. RÜMKE proposed the new *Ruemkelia* name to replace the junior homonym. However, some authors (e.g., HUTTERER 1995) are of opinion that *Archaeodesmana* TOPACHEVSKY & PASHKOV, 1983 is available as a replacement name for *Dibolia* RÜMKE 1985. As the *Archaeodesmana* type species, *Desmana pontica* SCHREUDER, 1940 may not be congeneric with '*Dibolia*' *dekkersi*, we prefer to use the name *Ruemkelia* until a revision of the systematics of the Desmaninae is done.

Ruemkelia sp.

Fig. 6 A-D

Material. One m2. Minimum number of individuals = 1. Čobruči, MN11 (coll. TSU-Čobruči-1). One P3, one M3, one i2, or i3, or c, and three p4. Minimum number of individuals = 2. Čimišlija, MN12 (coll. TSU-Čimišlija-1).

Description. The P3 is heavy and its main cusp, the paracone, is situated more or less in the center of the tooth. The lingual widening is formed by the cingulum. The cingulum runs around the tooth with the exception of its anterobuccal part. It is large and very protruded, especially in the lingual side. The tooth had three roots, one of them very small. The M3 has a sub-triangular outline of the crown. Its anterior side is long and straight, the postero-buccal side is strongly convex. The parastyle forms a small, cingular cusp. The mesostyle is deeply divided, the large protoconule well individuallized, and the metaconule strong. The anterior cingulum is connected with the tip of the protoconule. A trace of the cigulum is also present below the protoconule protocone valley. Three roots are present.

The lower incisor (?i2, ?i3) or canine (c , which is also incisiform, has a convex buccal side, flat lingual side and concave posterior side. A large and protruding cingulum runs around the posterior

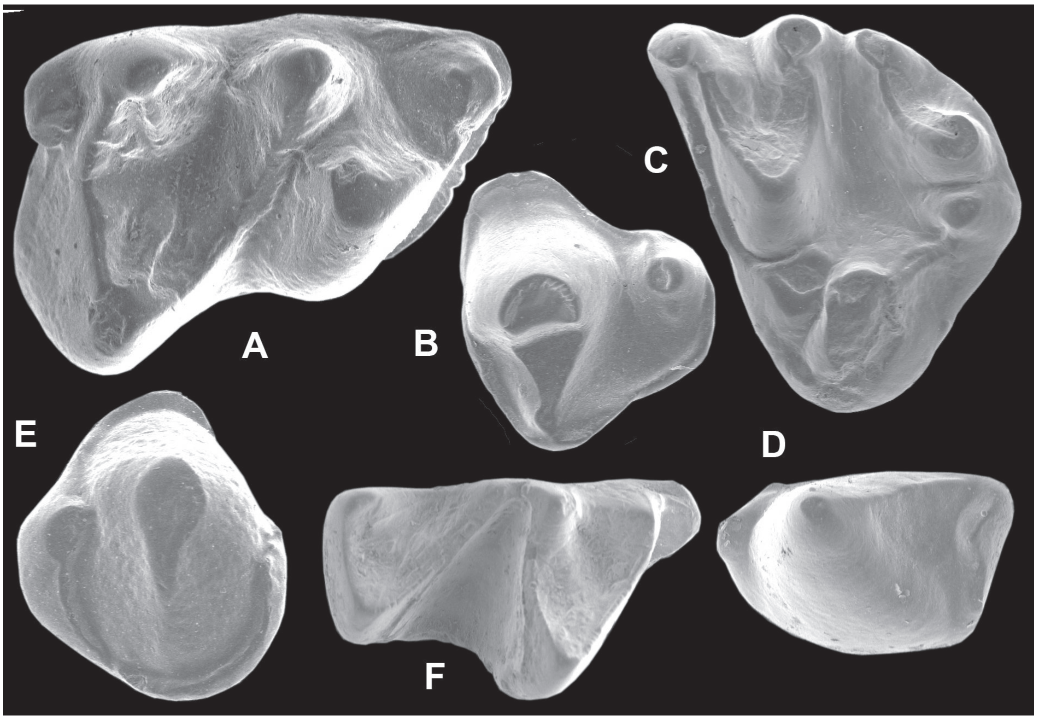

Fig. 6. *Ruemkelia* sp. from Čobruči: A – right m2, TSU-Čobruči-1/1. *Ruemkelia* sp. from Čimišlija: B – right P3, TSU-Čimišlija-1/1; C – left M3, TSU-Čimišlija-1/1; D – left p4, TSU-Čimišlija-1/1. *Desmanella* sp. from Bužor I: E – left P4, TSU- Bužor-1/1; F – right m3, TSU- Bužor-1/2. All occlusal view, (× 35).

part of the crown, at the anterior side ending further lingually than buccaly. The cingulum is slightly higher at the base of the posterocrista. The strong root is flattened antero-posteriorly and has an elliptical cross-section. The p4 is stout and sub-rectangular in occlusal view. Its antero- and posterocristids are not sharp. The buccal side of the tooth is convex, the lingual side is straight and the posterior side is slightly concave. In two of three teeth the paraconid is well developed. The shallow talonid basin is close posteriorly to the high cingulum, but it is open at the buccal and lingual sides. A small cingular cusp (? entoconid) is present in the posterolingual part of the posterior cingulum. The remaining cingula are absent. The tooth has two separate roots. The m2 has massive cusps. Its oblique cristid ends high, against the top of the metaconid. The parastylid is a mere widening of the anterior cingulum. The entostylid is large. From the parastylid runs a short lingual cingulum, and from the entostylid a short posterior cingulum. The buccal cingulum is present below the protoconid and the hypoflexid..

Measurements. See Table V.

Systematic position. The structure of the upper M3 described above, characterized by a divided mesostyle and a strongly developed lingual part (the presence of the protoconule, the protocone and the metaconule) indicates its affiliation to the subfamily Desmaninae, while its small size suggests the genus *Ruemkelia*. The remaining small mole teeth (P3, lower i or c, p4 and m2) included here certainly represent the same form. In comparison to specimens from Čobruči and Čimišlija, other genera of Desmaninae such as *Asthenoscapter* HUTCHISON, 1974 and *Mygatalpa* SCHREUDER, 1940 (both included by some authors, e.g., ENGESSER 1980, and RÜMKE 1985 to Uropsilinae) are too small, while *Mygalea magna* ZIEGLER, 1990, *Galemys* KAUP, 1829 and *Desmana* GUELDENSTAEDT, 1777 too large. Other species of the genus *Mygalea* SCHREUDER, 1940 although similar in size to the Moldova specimens, differ in some morphological characters, e.g. they have a well developed parastyle and weak protoconule in the upper molars. More or less similar in size are the teeth of *Storchia* DAHLMANN, 2001, however, they differ from the Moldovan teeth by very low paraconids in the lower molars and by very narrow molars and premolars. *Mygalinia hungarica* (KORMOS, 1913) also possessed teeth similar in size, although the morphology of p4, characterized by a very well developed parastyle, is different from the P_4 from Čimišlija which lacks a parastyle. The teeth of *Desmanodon* ENGESSER, 1980 (Talpidae incertae sedis), similar in size and structure to Desmaninae, can also be excluded from comparisons because they are much more robust and characterized by a low oblique cristid in the lower molars and a lack of the protoconule in the upper molars. Additionally, all of the above mentioned forms, with the exception of *Ruemkelia*, were found in much older localities, dated to MN3-MN7+8.

In the recent classification of the Desmaninea given by RÜMKE (1985), confirmed by numerical taxonomy methods by VAN DEN HOEK OSTENDE et al. (1989) and used by many authors, genera are distinguished on the basis of the overall size and the morphology of the first upper and lower incisor (I1 and i1) and species by the absolute and particularly by the relative length of six selected antemolars: upper C, P2 and P3 (P2/P3 ratio) and lower p2, p3 (p2/p3 ratio) and p4. The morphological characters of particular teeth are used rarely. In this situation whole jaws or their fragments with the above mentioned teeth are necessary for correct specific identification. Species identification is not possible with only five isolated teeth.

The size of the teeth described above is comparable with the size of some *Ruemkelia* species described from Europe and Turkey (see Table V). However the morphology of particular teeth is different. One or more characters differentiate the Čimišlija and Čobruči teeth from species of *Ruemkelia* similar in size cited in Table V. The teeth from Čobruči and Čimišlija represent the same size category but it is impossible to compare their morphology because there are no teeth of the same category in both localities (e.g. there is no m2 in the material from Čimišlija). It is also quite probable that the Čimišlija and Čobruči material represent one or two new species of *Ruemkelia*. More material is needed to support this supposition.

Subfamily **Uropsilinae** DOBSON, 1883

Genus ***Desmanella*** ENGESSER, 1972

Desmanella sp.

Fig. 6 E-F

Material. One P4, one M1 with metacone and metastyle broken, one m2 with parastyle and paraconid broken and one m3. Minimum number of individuals = 1. Bužor I, MN9 (coll. TSU-Bužor-1).

Description. The P4 is characterized by a large paracone and the small protocone. They are separated by a narrow groove. The anterocrista is absent. On the other hand, the sharp posterocrista joins the top of the paracone with the postero-buccal angle of the tooth crown. The cingulum runs around the base of the crown except for the lingual side of the protocone. In general, it is large and only narrow in its buccal side. The upper molar is considered to be the M1 because it has a square lingual side (the protocone is only slightly shifted lingually in comparison with the protoconule and metaconule), not triangular as the M2 (protocone considerably shifted lingually in comparison with the protoconule and metaconule). It is worn and its metacone and metastyle are broken. The small parastyle is connected with the paracone. The mesostyle was probably only slightly divided because the fissure is not visible on the worn tooth. The protoconule, protocone and metaconule are well individualized. A very small cusp is also present between the protoconule and protocone. The protoconule crista is continuous with the anterior cingulum (paracingulum). A weak buccal cingulum is present below the parastyle. The anterior cingulum (except below the protoconule) and posterior cingulum are well developed, the lingual cingulum is also present, but hardly visible between the paracone and the metaconule.

The large lower tooth with broken parastyle and paraconid most probably represents the second molar (m2). Although its anterior part is damaged and the presence of the parastylid, characteristic for m2, cannot be confirmed, its trigonid and talonid are more or less of the same size, while in m1 the talonid is wider, and its oblique cristid terminates at the posterior wall of the trigonid, not very high and lingually to the protocristid notch, while in m1 it rather ends half way down the protoconid-metaconid crest. The entostylid, the narrow, flat posterior cingulum (postcingulid) and a hardly visible lingual cingulum are present. The ectocingulid, which can be seen on the preserved parts of the tooth, has the shape of a small denticle between the protoconid and the hypoconid. It is absent below the hypoconid. The m3 has a much narrower talonid than trigonid, but the hypoconid and entoconid are well developed. The oblique cristid ends low, lingually to the protoconid/metaconid notch. The anterior cingulum (precingulid) is wide and the parastylid is present. The lingual (entocingulid), posterior (postcingulid) and buccal (below the hypoconid) (entocingulid) cingula as well as the entostylid are absent.

Measurements. Unfortunately only the width (W) of m2 can be measured. See Tables VI and VII.

Systematic position and distribution. The teeth of the mole from Bužor I described above and characterized by well individualized lingual cusps, only slightly or undivided mesostyle in upper M1 and by the wide, low-crowned lower molars (m2 and m3) with cusps pointing lingually represent the genus *Desmanella*. Similar, at first sight, species of *Desmanodon* ENGESSER, 1980 (Talpidae incertae sedis) and Desmaninae (apart from morphological differences) are larger and more robust.

So far, a dozen or so *Desmanella* species have been described from Eurasian localities. The oldest unnamed forms (*Desmanella* sp.) were found in Europe and dated to the Late Oligocene (MP28, Herrlingen 8, Germany, ZIEGLER 1998). The oldest named species are cited from the Early Miocene.

Table VI

Measurements of lower teeth (in mm) of different *Desmanella* species in Europe. *Somewhat damaged, **Taken from scatter-diagram

	D. engesseri Petersbuch 2 Germany MN4 Ziegler 1985	*D. stehlini* Anwil Switzerland MN7+8 Engesser 1972	*D.* cf. *stehlini* Bełchatów A Poland MN7+8 or MN7+8/9 Rzebik--Kowalska 2005	*Desmanella* sp. Bužor I Moldova MN9	*D. rietscheli* Dorn-Dürkheim Germany MN11 Storch and Dahlmann 2000	*D. crusafonti* Concud 3 Spain MN12 Rümke 1974	*D. dubia* Pikermi Greece MN12 Rümke 1976	*D. dubia* Maramena Greece MN13 Doukas et al. 1995, Doukas 2005	*D. woelfersheimensis* Wölfersheim Germany MN15 Dahlmann 2001	*D. gardiolensis* Balaruc 2 France MN16 Crochet 1986
L P4	1.15-1.37 n=4**	–	1.25*	1.51	1.20-1.28 n=3	1.68	1.26	1.26	1.30-1.42 n=8	–
W	0.99-1.11	–	1.17	1.26	1.12-1.16 n=4	1.51	1.19	1.10	1.08-1.32 n=7	–
m2 W	0.87-1.18 n=10	1.32	0.98-1.07 n=4	1.06	1.20	1.22	1.11-1.11 n=2	0.97-1.16 n=50	1.00-1.32 n=28	1.11-1.42 n=10
L m3	1.08-1.25 n=9	–	1.32-1.33 n=2	1.27	1.20-1.26 n=3	–	1.28-1.37 n=2	1.16-1.29 n=30	1.08-1.24 n=14	1.37-1.43 n=4
W	0.63-0.79 n=9	–	0.82-0.85 n=2	0.79	0.88-1.00 n=3	–	0.68-0.70 n=2	0.58-0.71 n=30	0.72-1.00 n=14	0.85-0.94 n=4

Table VII

Measurements of lower teeth (in mm) of different *Desmanella* species in Moldova. * – taken from scatter-diagram

	Desmanella sp. Bužor I (Moldova) MN9	*D. sickenbergi* Sari Çay (Turkey) MN7+8 Engesser 1980 *	*D. cingulata* Eskihisar (Turkey) MN7+8 Engesser 1980 *	*D. storchi* Moergen (China) MN7+8 Qiu 1996	*D. amasyae* Amasya (Turkey) MN13 Engesser 1980 *
L P4	1.51	1.60-1.62 n=2	1.44-1.48 n=2	–	1.68
W	1.26	1.36-1.36	1.26-1.28	–	1.30
m2 W	1.06	1.02-1.20 n=13	1.04-1.12 n=5	1.25	–
L m3	1.27	–	–	1.25	1.44
W	0.79	–	–	1.15	1.00

D. engesseri was described by ZIEGLER (1985) from Early Miocene Petersbuch 2 in Germany. It was later found in other MN3 or MN4 German, Swiss, Austrian and (MN4-MN5/6) Polish localities (ZIEGLER & FAHLBUSCH 1986; ZIEGLER 1990, 1998; BOLLIGER 1992; RZEBIK-KOWALSKA 2005).

D. stehlini ENGESSER, 1972 was found for the first time in Anwil (Switzerland), the locality was dated to MN7+8. Later on it was cited from other Swiss (MN7+8, KÄLIN 1993), as well as German (MN7+8, ZIEGLER 2003b), French (MN10, CROCHET & GREEN 1982), and Polish (MN7+8 or MN7+8/9, RZEBIK-KOWALSKA 2005) localities.

D. rietscheli STORCH & DAHLMANN, 2000 was described from the German Dorn-Dürkheim (Late Miocene, MN11), so far it is only known from its type locality.

D. crusafonti RÜMKE, 1974 was found in Concud 3 (Spain) dated to the Late Miocene, MN12. It was later cited from another Spanish locality (Early Vallesian, DE JONG 1988) and from Austria (MN11) by BACHMAYER and WILSON (1985).

D. dubia RÜMKE, 1976 was described from the Greek locality Pikermi, dated to the Late Miocene, MN12. It was also found in a second Greek locality, Maramena (MN13, DOUKAS et al. 1995, DOUKAS 2005), as well as in France and Poland (MN14, CROCHET 1986, Harrison & RZEBIK-KOWALSKA 1994).

D. woelfersheimensis DAHLMANN, 2001 known from Wölfersheim in Germany (late Early Pliocene, MN15) was also cited from Romanian Dranic-0, locality dated to the middle of the zone MN15 (RZEBIK-KOWALSKA 2002).

D. gardiolensis CROCHET, 1986 described from Balaruc 2 (France) and dated to the early Late Pliocene, MN16 is known only from its type locality.

Three Asiatic species of *Desmanella* were found in Turkey, while a single species was recorded from China. *D. sickenbergi* ENGESSER, 1980 was described from Sari Çay (MN7+8), but it is known also from other Turkish localities Sofça and Koçgazi. *D. cingulata* ENGESSER, 1980 is known only from Eskihisar (MN7+8) and *D. amasyae* ENGESSER, 1980 was found at Amasya (MN13) and cited also from Kavurca. The Chinese *D. storchi* was described by QIU (1996) from Moergen II (MN7+8, STORCH & DAHLMANN 2000) and is so far known only from its type locality.

D. fejfari GIBERT, 1974 described from the Early Miocene (MN4) of Rubielos de Mora in Spain, was considered by ENGESSER (1980) a synonym of *Asthenoscaptor meini* HUTCHISON, 1974. On the other hand, ZIEGLER (1999) cited them separately, the first one in Talpinae incertae sedis, and the last one in Desmaninae. *D. quinquecuspidata* MAYR & FAHLBUSCH, 1975 from Hammerschmiede in Germany (MN9) was questioned by RÜMKE (1985) and ENGESSER and ZIEGLER (1996) as belonging to the genus *Desmanella*.

A comparison of teeth from Bužor I (two damaged, and only two, P4 and m3, in a good shape) with teeth of all described species cited above, is very difficult. A review of lower molars of the *Desmanella* species known so far indicates that almost in all species the number of known (described) teeth is limited. The m2 is unknown in *D. amasyae* and little known in other species (in 8 out of 12 species only 1-5 specimens have been described). The m3 was not found in two species, and its measurements in others are not cited in the literature. Besides, the description of m3 in 6 of 9 species is very limited (1-4 specimens only).

A comparison of measurements of m2 and m3 from Bužor I with the same tooth category of the known *Desmanella* species shows that in localities where these teeth are numerous the size of Bužor I second and third molars lies in the range of variation of other species. Only *D. gardiolensis* seems to be larger. For the remaining forms, the sizes of lower molars seem not to be diagnostic.

As concerns morphology, with such limited material it is also difficult to say what species we are dealing with. In this situation the specimens from Bužor I have been tentatively described as *Desmanella* sp.

Subfamily **Talpinae** FISCHER VON WALDHEIM, 1814

Tribe **Scalopini** GILL, 1875

Genus ***Proscapanus*** GAILLARD, 1899

Proscapanus metastylidus n. sp.

Figs 7 A, 13 A

Etymology. The new species has by far the largest metastylids of all *Proscapanus* and talpids in general.

Holotype. Right mandible fragment with four alveoli of premolars and m1-m3, without processes, TSU-Bužor-1/1.

Type locality. Bužor I.

Age. Early Late Miocene (MN9).

Referred material. Only one mandible fragment described as the holotype. Minimum number of individuals = 1.

Diagnosis. Large species of *Proscapanus* with wide molars (especially m2 and m3) characterized by large, very well developed metastylids, especially in m2 and m3.

Differential diagnosis. *P. metastylidus* n. sp. differs from *P. intercedens* ZIEGLER, 1985, *P. austriacus* ZIEGLER, 2006 and *P. minor* ZIEGLER, 2006 mainly in its larger size. It differs from *P. sansaniensis* (LARTET, 1851) by wider molars (m2 and m3), and large, well developed metastylids.

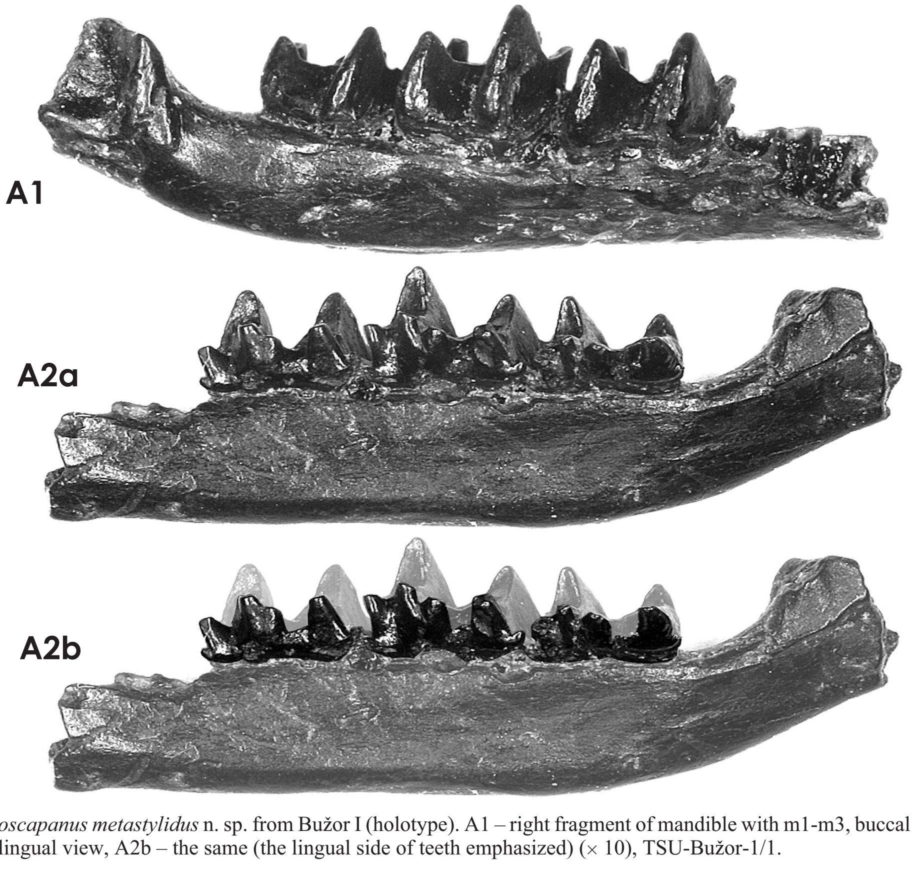

Fig. 7. *Proscapanus metastylidus* n. sp. from Bužor I (holotype). A1 – right fragment of mandible with m1-m3, buccal view; A2a – lingual view, A2b – the same (the lingual side of teeth emphasized) (× 10), TSU-Bužor-1/1.

It is differentiated from *P. lehmani* (GIBERT, 1975) by the size relation of the lower molars, which in *P. metastylidus* n. sp. equals m2>m1>m3 while in *P. lehmani* m1>m2>m3. Besides, in *P. metastylidus* n. sp. the buccal cingulum (ectocingulid) is absent, the posterior mental foramen is situated more anteriorly, below the p4/m1 boundary, the buccal re-entrant valley (hypoflexid) is wide, the metastylid of m1 is less developed than in m2 and m3 and the oblique cristid joins the metastylid in m1. On the other hand, in *P. lehmani* the buccal cingulum is present, the posterior mental foramen is situated more posteriorly below the first root of m1, its re-entrant valley is narrow, the metastylid is better developed in m1 than in m3, and the oblique cristid fails to reach the metastylid in m1.

Description of the holotype. The horizontal ramus of the mandible is massive but not very high. It narrows slightly in the anterior direction and its lower margin is almost straight (slightly concave under m1). The posterior mental foramen present in the mandible is situated below the p4/m1 boundary.

The sizes of the molars are ranked in the following order: m2>m1>m3. The m1 has a distinctly wider talonid than trigonid but they are more or less of the same lenght. Its hypoflexid is wide. The oblique cristid joins the large metastylid, which is very well developed (large). The entoconid has a shape of a cone, the entocristid and metacristid are absent. On the other hand, the precingulid, parastylid and entostylid are present. The m2 has a narrower and much longer talonid than trigonid. Additionally, in comparison with the m1 its precingulid is wider, the metastylid larger and more isolated from the metaconid and a trace of the entocristid is visible. The proportions and morphology (the trigonid wider and shorter than the talonid) of the m3 are similar to m2. It differs by a very wide buccal hypoflexid, and a very small entostylid.

Measurements. See Table VIII.

Systematic position and distribution. The large size, larger than the size of other Miocene moles (with the exception of the Early Miocene *Geotrypus*) and tooth mor-

Table VIII

Measurements of lower teeth of *Proscapanus* species from Europe

		P. metastylidus Bužor I Moldova MN9	*P. intercedens* Petersbuch 2 Germany MN4 (ZIEGLER 1985)	*P. sansaniensis* Sandelzhausen Germany MN5 (ZIEGLER 2000)	*P. sansaniensis* Sansan France MN6 (BAUDELOT 1972)	*P. sansaniensis* Petersbuch 31, 35 and 48 Germany MN7+8 (ZIEGLER 2003b)	*P. lehmani* Castell de Barbera Spain MN9 (GIBERT 1975)	*P. austriacus* Schernham Austria MN10 (ZIEGLER 2006)
m1	L	2.40	2.05	2.19-2.45 n=15	2.17-2.38 n=8	2.42-2.60 n=5	2.56-2.56 n=2	2.02-2.10 n=3
	W	1.58	1.32	1.43-1.64 n=21	1.37-1.50 n=8	1.40-1.49 n=5	1.68-1.80 n=2	1.22-1.30 n=3
m2	L	2.52	2.12	2.36-2.64, n=12	2.30-2.43 n=12	2.58-2.67 n=6	2.40	2.22-2.39 n=5
	W	1.69	1.25	1.48-1.65 n=17	1.35-1.45 n=12	1.42-1.51 n=6	1.60	1.23-1.38 n=5
m3	L	2.35	–	1.96-2.26 n=13	1.86-2.10 n=8	2.11-2.17 n=4	2.24	1.86-2.09 n=3
	W	1.41	–	1.21-1.36 n=17	0.87-1.06 n=8	1.16-1.30 n=4	1.68	1.11-1.25 n=4

phology include the mandible fragment from Bužor I to the genus *Proscapanus.* As mentioned above, all three mole molars (m1-m3) in Bužor I are characterized by very distinct metastylids. The presence of metastylids is not common among talpids. Apart from *Proscapanus*, residual metastylids are present in "*Scaptonyx*", and are best developed in some American genera e.g. *Scalopoides* WILSON, 1960, *Condylura* DOBSON, 1883 and others (HUTCHISON 1968, 1974; SKOCZEŃ 1976). However, the presence of the American genus in southeastern Europe is rather little probable. Instead of an explanation involving dispersal, a more probable hypothesis is the parallel evolution of European and American forms. In addition, the size of "*Scaptonyx*", *Scalopoides* and *Condylura* species is much smaller than the size of the specimen from Bužor I. On the other hand, the size is in accordance with the species of *Proscapanus*.

So far, five species of *Proscapanus* have been described: *P. intercedens* ZIEGLER, 1985 from Rembach in Germany, locality dated to the Early Miocene (MN4), *P. sansaniensis* (LARTET, 1851) from Sansan in France dated to the Middle Miocene (MN6), *P. lehmani* (GIBERT, 1975) from Castell de Barbera in Spain dated to the early Late Miocene (MN9), *P. austriacus* ZIEGLER, 2006 from Schernham in Austria dated to the Late Miocene (MN10), and *P. minor* ZIEGLER, 2006 from the same locality in Austria. The most common and widespread is *P. sansaniensis* found in France, Switzerland and Germany and dated from MN4 to MN9. *P. intercedens* is known from several Early Miocene localities in Germany, and the remaining species exclusively from their type localities.

Taking into consideration the general large size of the molars (particularly their large width), as well as the very large metastylids, the specimen from Bužor I resembles the Spanish *P. lehmani*. However, a more detailed comparison shows several differences which are cited in the differential diagnosis.

Some of the characters (size relation of lower molars, presence of precingulids, some measurements) of the Bužor I mandible can be also found in *P. sansaniensis,* characterized by large variability in size (ZIEGLER 2000). However, the width of the lower molars (m2 and m3) as well as the size of metastylids in the Bužor I mandible are much larger than in *P. sansaniensis*.

As the Bužor I specimen clearly differs from *P. lehmanni*, *P. sansaniensis* and the remaining (much smaller) three species, in spite of the limited material, it is described as a new *Proscapanus* species, *P. metastylidus*.

Proscapanus cf. ***austriacus*** ZIEGLER, 2006

Fig. 8 A-B

Material. One single m3 and two fragments of the right humeri. Minimum number of individuals = 2. Bužor I, MN9 (coll. TSU-Bužor-1).

Description. The m3 has the trigonid wider and slightly shorter than the talonid, a very wide precingulid and buccal hypoflexid, a vestigial metastylid and the entostylid absent.

Humeri are rather slender. The better preserved specimen has a broken the ecte-and entepicondyles, and damaged head and greater tuberosity. However, three characters typical of Scalopini are visible: the comparatively small supratrochlear fossa, the shallow notch for the muscle flexor digitorum ligament between the trochlea and the fossa, as well as a fragment of the "scalopine ridge" in the shape of a shelf. Besides, the teres tubercle is long and the olecranon fossa is short. The second humerus is slightly smaller. Its proximal part is broken, but the distal one is similar to the first specimen.

Measurements. See Table IX.

Systematic position and distribution. The size of the m3 described above is smaller than the size of this tooth described from the same locality as *P. metastylidus* n. sp. Also, both humeri are too small to represent the new *Proscapanus* species. On the other hand, the size of the m3 mole from Bužor I lies in the range of variation of this tooth in *P. sansaniensis* and *P. austriacus*. Also, its morphology does not differ much from the morphology of the m3 of these two species. At first glance, because of its small metastylid and large precingulid, it resembles the

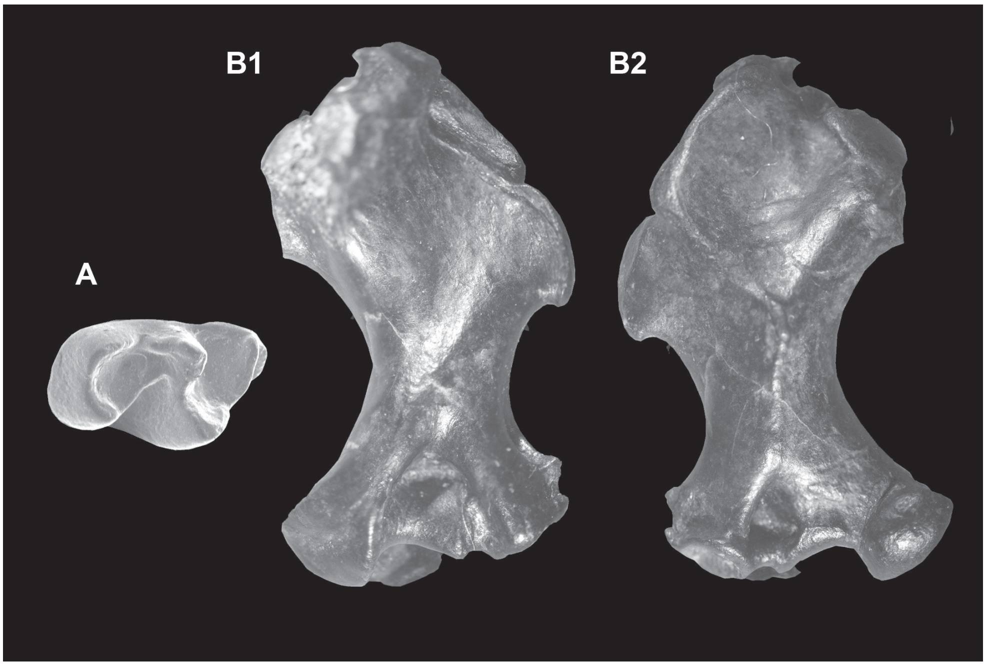

Fig. 8. *Proscapanus* cf. *austriacus* ZIEGLER, 2006 from Bužor I: A – right m3, occlusal view (× 15), TSU-Bužor –1/1; B1 – left humerus, dorsal view; B2 – ventral view (× 3), TSU-Bužor –1/1.

Table IX

Measurements of m3 and humeri (in mm) of *Proscapanus* species from Europe

	P. cf. *austriacus* Bužor I Moldova MN9	*P.* *intercedens* Petersbuch 2 Germany MN4 (ZIEGLER 1985)	*P.* *sansaniensis* Sandelzhausen Germany MN5 (ZIEGLER 2000)	*P.* *sansaniensis* Sansan France MN6 (BAUDELOT 1972)	*P.* *sansaniensis* Petersbuch 31, 35 and 48 Germany MN7+8 (ZIEGLER 2003b)	*P.* *lehmani* C. de Barbera Spain MN9 (GIBERT 1975)	*P.* *austriacus* Schernham Austria MN10 (ZIEGLER 2006)
L m3	1.99	–	1.96-2.26 n=13	1.86-2.10 n=8	2.11-2.17 n=4	2.24	1.86-2.09 n=3
W	1.23	–	1.21-1.36 n=17	0.87-1.06 n=8	1.16-1.30 n=4	1.68	1.11-1.25 n=4
Humerus							
L	12.83	–	12.70-13.5 n=3	13.0-14.0 n=11	14.4-16.5 n=3	15.5-7.0 n=2	–
DS	3.10-3.30 n=2	2.50-3.00 n=15	3.30-3.65 n=22	–	3.90-4.75 n=12	–	2.90-3.25 n=2

m3 of *P. sansaniensis*, but taking into account the small number of specimens in the Austrian material (n = 3), not enough information is available on the morphological variation of this tooth in the second species, *P. austriacus*. As concerns humeri, they are closer in size to the oldest (from MN4-MN5) than to the youngest (MN7+8) *P. sansaniensis*, but fit well *P. austriacus* described by ZIEGLER (2006) from Schernham in Austria (MN10). As the material is very limited and damaged, it has been tentatively described as *P.* cf. *austriacus*. If the identification is correct, this species probably appeared earlier (MN9) in the Eastern than in Central Europe. Taking into consideration the question of competition, the presence of two species of moles of the same genus in one locality may seem doubtful. However, such a situation is common not only for insectivore mammals but also for rodents. The co-occurrence of two species of the same genus has been confirmed by many authors, e.g. by STORCH 1978, DAHLMANN 2001, ZIEGLER, 2000, 2003b, 2006 and others. The most important criterion of this co-occurrence in Moldavian Bužor I seems to be the difference in size, as in the case of large *P. metastylidus* n. sp. and small *P. austriacus*.

Talpinae gen. et sp. indet.

Material. Two fragments of talonids (m1 or?and m2) and one m3 with paraconid and protoconid broken. Minimum number of individuals = 1. Leordoaja, MN13 (coll. TSU-Leordoaja-1).

Description. The talonids of lower molars are narrow. They have distinct entostylids and are deprived of a cingulum. The m3 is similar to those described above (p. 34), but smaller.

Systematic position. These small and delicate teeth are typical for the „true" moles but they are too fragmentary for precise identification.

Family **Soricidae** FISCHER VON WALDHEIM, 1814

Subfamily **Crocidosoricinae** REUMER, 1987

Genus ***Miosorex*** KRETZOI, 1959

?***Miosorex*** sp.

Fig. 9 A

Material. One I1. Minimum number of individuals = 1. Čobruči, MN11 (coll. TSU-Čobruči-1).

Description. The *Crocidura*-like I1 is not fissident. Its dorsal (upper) edge is convex and the posterior one as well as the posterior buccal cingulum are somewhat undulate. The protruded cingulum runs along 2/3 of the posterior edge and in the upper part of the crown fades away. The talon is wide, slightly concave in its lower side.

Measurements. I1: L = 1.55 mm, L of talon = 0.62 mm, H = 1.14 mm.

Systematic position and distribution. The small size and morphology allow to identify this tooth as one of the small representatives of the genus *Crocidura* WAGLER, 1832 or as one of the members of a genus of the subfamily Crocidosoricinae REUMER, 1987.

As concerns the *Crocidura*, the size and morphology of the *Crocidura*-like I1 from Čobruči lie in the range of variation of e.g. fossil European *C. kornfeldi* KORMOS, 1934 or extant Eurasian and African *C. suaveolens* (PALLAS, 1811). However, a *Crocidura* specification seems less probable because the first records of this genus in Europe are dated to the beginning of the Pliocene (RZEBIK-KOWALSKA 1998). All older data are badly in need of revision and should be treated with caution.

On the other hand, the Crocidosoricinae shrews appeared in Europe in the Early Oligocene and they lived here to the Late Miocene. Although most of them did not survive the beginning of the Vallesian (MN10 zone), several forms of uncertain genus identification (?*Miosorex* indet., France, MN10, GUERIN & MEIN 1971; *Limnoecus*? sp., Austria, MN11, RABEDER 1970; *Myosorex* sp. Spain, MN13 and MN14, MEIN et al. 1989-1990; *Sorex dehmi* [now *Lartetium dehmi* (VIRET & ZAPFE, 1951)], Gargano Peninsula, Italy, ?Early Pliocene, DE GIULI et al. 1987) were mentioned in

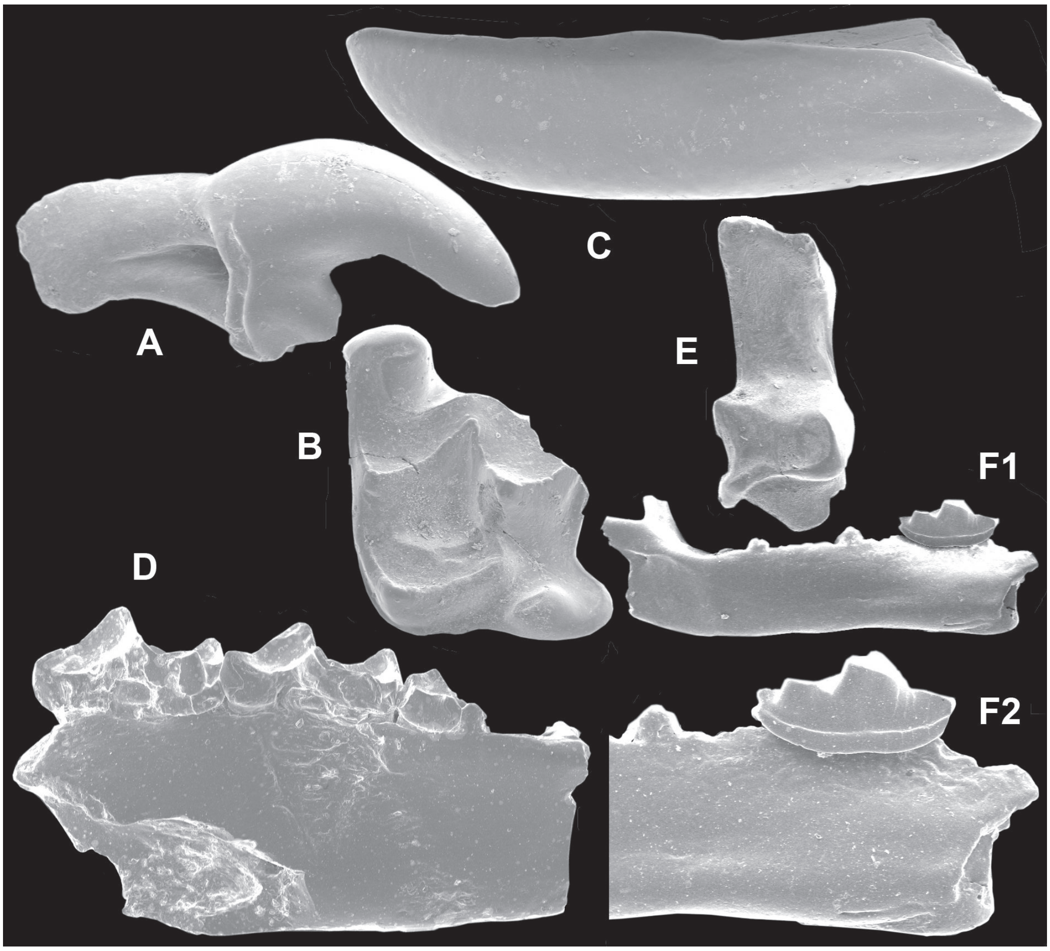

Fig. 9. ?*Miosorex* sp. from Čobruči: A – right I1, buccal view (× 35), TSU-Čobruči-1/1. ?*Amblycoptus* sp. from Bužor I: B – left fragment of M1, occlusal view, TSU-Bužor-1/1. Anourosoricini gen. et sp. indet. from Kejnar I: C – left i1, buccal view (× 20), TSU-Kejnar-1/1. *Petenyia* cf. *dubia* BACHMAYER and WILSON, 1970 from Čobruči: D – right fragment of mandible with m1-m3, lingual view (x 10), TSU-Čobruči-1/1. ? *Asoriculus* sp. from Kejnar: E – left I1, anterior view (× 35), TSU-Kejnar-1/1. "*Paenelimnoecus*" cf. *repenningi* (BACHMAYER and WILSON, 1970) from Čobruči: F1 – left fragment of mandible with m1, lingual view (× 15); F2 – the same (× 35), TSU-Čobruči-1/1.

the literature. These forms are cited only in the lists of species of particular localities without any morphological description, illustrations and measurements and unfortunately without mention of the presence of I1. However, they show that although rare, the Crocidosoricinae were still present in Europe during the end of the Miocene. Recently, studies of FURIÓ et al. 2007 showed that one of the Recent African genus, *Myosorex* GRAY, 1838, appeared in European continent in the Late Pliocene localities of France and Spain.

The I1 from Čobruči is most similar to the I1 of *Miosorex*, namely to *Miosorex* aff. *grivensis* found in the Spanish locality Villafeliche 9 (MN7+8) and illustrated by DE JONG (1988) in the Plete 5 (figs 8-9). Also its measurements (I1: L = 1.60 mm, L of talon = 0.75 mm, H = 1.00 mm), calculated from DE JONG fig. 8, by the authors of the present paper show that they are almost identical in size with the I1 from Čobruči. On the basis of these data we identified the tooth described above as ?*Miosorex* sp.

Subfamily **Soricinae** FISCHER VON WALDHEIM, 1814

Tribe **Anourosoricini** ANDERSON, 1879

Genus ***Crusafontina*** GIBERT, 1974

Crusafrontina cf. ***endemica*** GIBERT (1974)

Fig. 10 A

Material. One extremely damaged fragment of maxilla with talon of I1, and A1-M2. Minimum number of individuals = 1. Kalfa, MN9 (coll. TSU-Kalfa-1).

One mandible (broken in two between p4 and m1) with the proximal part of i1, a1-m2, the coronoid process and the lower facet of the condyloid process, two isolated m1 and m2. The minimum number of individuals = 2. Bužor I, MN9 (coll. TSU-Bužor-1).

One mandible (broken in two pieces between m1 and m2) with all teeth, without processes. The minimum number of individuals = 1. Girova, MN9 (coll. TSU-Girova-1).

One m2. Minimum number of individuals = 1. Kejnar, MN10 (coll. TSU-Kejnar-1).

Description. The talon of I1 is almost straight on its lower side, and the buccal cingulum is narrow and protruded but it does not continue in the upper part of the tooth. There are three antemolars in the upper jaw. The A1 is large and elongated, triangular in occlusal view. Its main cusp is situated rather buccaly. The buccal side is slightly convex, the lingual one concave. The large cingulum which surrounds the tooth on the buccal, posterior and lingual sides narrows in the anterior direction. It is absent in the front of the tooth. There are two cingular cusps. A smaller

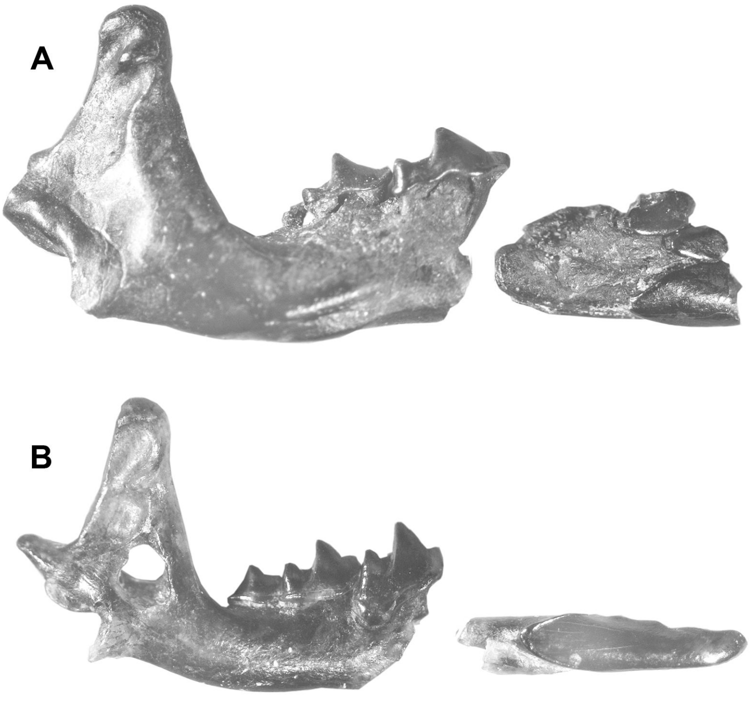

Fig. 10. *Crusafontina* cf. *endemica* GIBERT, 1975 from Bužor I: A – right mandible with fragment of i1, a1-p4, m1-m2 and coronoid process (broken between p4 and m1), buccal view, TSU-Bužor-1/1. *Hemisorex suchovi* LUNGU, 1981 from Kalfa: B – right mandible with i1, m1-m3 and coronoid and condyloid processes, broken (× 10), TSU-Kalfa-1/1.

cusp is situated in the postero-lingual corner, while a larger cusp is nearby, on the lingual side of the tooth. The A2 is similar but much smaller. The only difference is the lack of the lingual cusp on the postero-lingual corner of the tooth. The A3 is also similar but very small. It is slightly damaged so it is not clear if the cingular cusps were present. The P4 is large. Its distinct parastyle has the shape of a cusp. The distinct protocone is situated in the antero-lingual corner of the tooth. The hypocone is as heavy as the protocone. The hypoconal flange is narrow. The posterior cingulum is present. The M1 is also large, almost square in occlusal view. Its parastyle and protocone are very large. The metaloph is not very high and the hypocone is small but distinct. The only present posterior cingulum is narrow. The M2 is much smaller. Its anterior side is much longer than the posterior one, so in occlusal view the tooth has a rhomboidal shape. Its parastyle is extremely large and the hypocone is small. The remaining characters are similar to those in M1. The emarginations of P4 and especially of M1 and M2 are moderate.

The horizontal ramus of the mandible is slightly concave under the m_1/m_2 junction. The anterior and posterior margins of the coronoid process are slightly concave and the apex is not very large. The coronoid spicule is distinct and situated high. The external temporal fossa is also distinct and it extends to below the upper sigmoid notch. The internal temporal fossa is narrow and high. It is provided with a horizontal bar separating the shallow upper from the deep lower part of the fossa. One large mandibular foramen is situated below the anterior half of the internal temporal fossa. Themental foramen is situated underneath the protoconid of m_1. The lower facet of the condyle is elongated.

The i1 is bicuspulate but its cusps are weakly developed. The apex is bent slightly upward. The cingulum is absent. The a1 is unicuspid. The cusp is large. The tooth is provided with a cingulum on both sides. The buccal cingulum is wide and flat, the lingual one wide and protruded. They narrow anteriorly. The p4 is also unicuspid and massive. Its postero-lingual basin is small. Strong buccal and lingual cingula do not reach the anterior corner of the tooth. The posterior cingulum is weak. The m1 is very long. Its trigonid is also long. It is about one and half times as long as the talonid. The oblique crest is almost parallel to the lingual border of the tooth. The hypoconid is very low, the entoconid and entostylid are separated by a narrow groove. The entoconid crest is not very high. The re-entrant valley is very shallow. The buccal and posterior cingula are weak, the lingual one is absent. The m2 is similar to m1, although the difference between trigonid and talonid length is less visible. The m3 is small and its talonid is slightly reduced. The talonid basin is surrounded by a continous crest. Because the tooth is worn, the hypoconid and entoconid are not visible. The re-entrant valley is wide.

There are no differences in the morphology of specimens from the four localities mentioned above.

Measurements. See Tables X and XI.

Systematic position and distribution. The remains of Anourosoricini described above belong to the genus *Crusafontina* GIBERT, 1974. It is smaller from other genera of this tribe and it also differs by the presence of A3, M3 and m3, by a strongly developed parastyle in P4 and M1, less bulbous teeth, distinct serrations of i1, etc. (MÉSZÁROS 1998; VAN DAM 2004).

Recently, six valid species have been included in this genus. The type species, *C. endemica* GIBERT, 1975, was described from Can Llobateres in Spain, a locality dated to the early Late Miocene (MN9). It was later cited also as *C.* aff. *endemica* and *C.* cf. *endemica* in other Spanish localities dated to MN9 and MN10 (GIBERT 1975, 1976; AGUSTÍ & GIBERT 1982; DE JONG 1988), as well as in Moldova (MN9, LUNGU 1981), Hungary (MN9, MÉSZÁROS 1998, ZIEGLER 2005, 2006), Germany (MN9, MAYR & FAHLBUSCH 1975), France (MN10, CROCHET & GREEN 1982), Greece (MN10, VAN DAM 2004), and Austria (MN11, BACHMAYER & WILSON 1970). *C. fastigata* VAN DAM, 2004 and *C. vandeweerdi* VAN DAM, 2004 are known, so far, only from their type localities in Spain, the first from Los Aguanaces 5A (MN10) and the second from Tortajada C (MN12). The remaining four species were described in other genera and then transferred to *Crusafontina*. These include *C. kormosi* (BACHMAYER & WILSON, 1970), described as *Anourosorex kormosi* from

Table X

Measurements of upper teeth (in mm) of different *Crusafontina* species

	C. cf. *endemica* Kalfa MN9	*C. endemica* 1-2 localities MN9 (GIBERT 1975; DE JONG 1988; VAN DAM 2004)	*C.* aff. or cf. *endemica* 6 localities MN9, MN10 (MAYR and FAHLBUSCH 1975; ZIEGLER 2006)	*C. kormosi* 5 localities MN10-MN13 (BACHMAYER and WILSON 1970; MÉSZÁROS 1998; ZIEGLER 2006)	*C. fastigata* Los Aguanaces 5A MN10 (VAN DAM 2004)	*C. vandeweerdi* Tortajada C MN12 (VAN DAM 2004)
L A1 W	1.50 1.07	1.74-1.84 n=5 0.99-1.12	1.45-1.83 n=12 1.06-1.21 n=11	1.50-2.12 n=71 1.00-1.70 n=69	2.11-2.11 n=2 0.97-1.14	– –
L A2 W	0.85 0.88	1.07 0.93	0.93-1.28 n=19 0.82-0.99 n=20	0.94-1.22 n=42 0.90-1.20 n=40	1.49 –	– –
L A3 W	0.58 0.67	– –	– –	– –	– –	– –
P4 L	2.09	1.84-2.00 n=3	2.14-2.52 n=15	2.05-2.80 n=81	–	2.72
L M1 W	2.09 2.28	1.84-2.16 n=7 2.00-2.50	1.70-2.07 n=17 1.95-2.22 n=15	1.88-2.56 n=75 1.90-2.58 n=79	1.82 1.93	2.48 2.58
L M2 W	1.30 2.06	1.36-1.44 n=2 2.08	1.19-1.45 n=21 1.85-2.05 n=12	1.15-2.06 n=35 1.32-2.35 n=33	1.20 1.92	1.50-1.55 n=2 2.26

Kohfidisch in Austria, dated to MN11. Later (1991) it was included in the genus *Crusafontina* by STORCH and QIU. *C. exculta* (MAYR & FAHLBUSCH, 1975) was first described as *Angustidens excultus* from Hammerschmiede in Germany (MN9) and transferred in 1982 by ADROVER et al. (not by RZEBIK-KOWALSKA 1998 as cited in ZIEGLER 2006) to *Crusafontina*. VAN DAM (2004) considers this species as the synonym of *C. endemica* but ZIEGLER (2006), taking into account its small size, preferred to name it *C.* aff. *endemica*. Two American species, *C. magna* (HUTCHISON & BOWN, 1980) from Nebraska and *C. minima* (HUTCHISON & BOWN, 1980) from Oregon, were described in the genus *Anouroneomys* HUTCHISON & BOWN, 1980 (in BOWN 1980). In 1991 STORCH and QIU included this American genus into *Crusafontina*.

The size of the remains from Moldova lie in the range of variation of the sizes of two European species, *C. endemica* and *C. kormosi*. The latter two species are very similar in morphology. *C. endemica* only differs from *C. kormosi* by a slightly more anterior position of the mental foramen (below the trigonid of m1, while in *C. kormosi* it is situated between the roots of this tooth), a slightly shallower re-entrant valley in m1, and a different ratio of the length of m2/m1 and m3/m1 (VAN

Table XI

Measurements of mandible and lower teeth (in mm) of different *Crusafontina* species

	C. cf. *endemica* Bužor I MN9	*C*. cf. *endemica* Girova MN9	*C*. cf. *endemica* Kejnar MN10	*C. endemica* 10 localities MN9-MN10 (GIBERT 1975; CROCHET and GREEN 1982; VAN DAM 2004)	*C*. aff. and cf. *endemica* 8 localities MN9-MN10 (MAYR and FAHLBUSCH 1975; ZIEGLER 2006)	*C. kormosi* 5 localities MN10-MN13 (BACHMAYER and WILSON 1970; MÉSZÁROS 1998; ZIEGLER 2006)	*C. fastigata* Los Aguanaces 5A MN10 (VAN DAM 2004)	*C. vandewerdi* Tortajada C MN12 (VAN DAM 2004)
L i1	–	4.15	–	4.40-4.48 n=7	4.00-4.42 n=6	4.25-4.56 n=32	–	–
W	1.11	1.04	–	1.04-1.12	1.04-1.28 n=20	0.90-1.52	–	–
a1 L	0.94	1.28	–	1.04-1.40 n=7	1.05-1.11 n=5	0.90-1.55 n=18	–	1.46-1.55 n=3
L p4	1.32	1.23	–	1.15-1.61 n=11	1.15	1.35-1.61 n=10	1.43-1.43 n=2	2.24
W	1.01	1.06	–	0.91-1.08	0.85	1.1 2- 1.25	0.87-0.89	1.29
L m1	2.00	2.18	–	1.90-2.25 n=25	1.85-2.35 n=22	2.38-3.20 n=147	–	–
W	1.09	1.20	–	1.03-1.52 n=27	1.05-1.25 n=31	1.16-1.64	–	–
L m2	1.55	1.66	1.68	1.60-1.90 n=32	1.55-1.91 n=30	1.20-2.28 n=121	–	–
W	0.90	0.98	0.90	0.80-1.15 n=17	0.90-1.11	0.88-1.66 n=116	0.97	–
L m3	–	1.00	–	0.88-1.22 n=17	1.02-1.44 n=9	0.55-1.34 n=58	–	1.10
W	–	0.61	–	0.56-0.98	0.60-1.05	0.30-0.84	–	0.65
H of ascending ramus	5.29	–	–	–	5.71-6.58 n=3	5.71-6.58 n=10	–	–

DAM 2004; ZIEGLER 2006). In *C. endemica*, the m2 is less reduced than in *C. kormosi*. Its length is about 80% of the length of m1, while in *C. kormosi* this value comes to ca. 70%. The ratio of m3/m1 in *C. endemica* should not be less than 0.40, but for *C. kormosi* the ratio should be below this value. As in the Girova specimen, m2/m1 ratio = 0.77 and m3/m1 ratio = 0.46, indicating that they belong to *C. endemica* rather than *C. kormosi*. The same is true for the specimen from Bužor I, where the m2/m1 ratio = 0.775. In addition, the mental foramen in the Bužor I specimen is situated under the trigonid of m1, and the re-entrant valley of this tooth is rather shallow. Unfortunately the mandible from Girova has a damaged mental foramen but its re-entrant valley is also shallow, even more so than in the specimen from Bužor I. The upper teeth from Kalfa do not differ in size and morphology from those of *C. endemica* with the exception of the length of A2 which is extremely small. It equals 0.85 mm while in *C. endemica* from different localities it is 0.93-1.28 mm, n = 62 (see Table X). On the basis of this difference, as well as the limited number of specimens in all localities mentioned above, we opted for a placement of this specimen as *C.* cf. *endemica*.

?***Crusafontina*** cf. ***kormosi*** (BACHMAYER and WILSON, 1970)

Material. One fragment of mandible with alveoli of m1-m2 without teeth and processes. Minimum number of individuals = 1. Leordoaja, MN13 (coll. TSU-Leordoaja-1).

Description. The lower margin of the horizontal ramus is slightly concave between m1/m2 and the mental foramen is situated below the re-entrant valley of the m1.

Measurements. H of mandible below m2 = 2.7 mm.

Systematic position and distribution. As mentioned above, six species of this genus are currently recognized. The size of the specimen from Leordoaja agrees with the size of *C. endemica* and *C. kormosi.* The morphology, however, is more similar to *C. kormosi* because its mental foramen has a more posterior position. The age of the locality, the late Late Miocene (MN13), also supports this identification. As the material is very poor and badly preserved the mandibular fragment from Leordoaja is tentatively identified as ?*C.* cf. *kormosi*.

Genus ***Amblycoptus*** KORMOS, 1926

?***Amblycoptus*** sp.

Fig. 9 B

Material. One M1 damaged in its postero-buccal side (the metastyle is broken). Minimum number of individuals = 1. Bužor I, MN9 (coll. TSU-Bužor-1).

Description. The M1 is very large and massive. Its parastyle is extremely wide (with subparallel anterior and posterior border) and protruding. The mesostyle is subdued. The metacone and protocone are the highest cusps, the hypocone is very well developed. The trigon basin is deep. The cingulum is present round the protocone, between the protocone/hypocone valley and round the hypoconal flange. The postero-buccal part of the tooth is broken.

Measurements. M1: W = 2.49 mm.

Systematic position and distribution. Because of its extremely large parastyle, the tooth described above represents the first upper molar, M1, belonging to the representatives of the tribe Anourosoricini and most probably to the genus *Amblycoptus*. It is certainly not the M2 because in the generally accepted six genera of Anourosoricini (one Recent *Anourosorex* MILNE EDWARDS 1872, and five fossil taxa: *Amblycoptus*, *Anourosoricodon* TOPACHEVSKY, 1966, *Crusafontina*, *Kordosia* MÉSZÁROS, 1997 and *Paranourosorex* RZEBIK-KOWALSKA, 1975) the M2 of *Crusafontina* and *Paranourosorex* is smaller than M1, much shorter and its parastyle is pointed (its anterior and posterior borders are tapering). In *Amblycoptus*, *Anourosorex* and *Kordosia* this tooth is also small and of a different shape (triangular, not rectangular). The upper teeth of the sixth form, *Anourosoricodon*, are unknown.

The oldest remains of Anourosoricini are known from the beginning of the Late Miocene (MN9), but they belong to *Crusafontina*. However, the parastyle in its M1 is much smaller. The oldest representatives of *Amblycoptus* come only from MN12 (Széchenyi Hill in Hungary, MÉSZÁROS 1997). In this situation there is a large temporal gap between the finding from Bužor I and that cited from Hungary. As additionally the material is very poor and badly preserved and the tooth seems to be slightly smaller than the *Amblycoptus* specimens known so far (although among shrews older forms are generally smaller than younger ones) it has been tentatively described as ? *Amblycoptus* sp.

Anourosoricini gen. et sp. indet.

Fig. 9 C

Material. One i1. Minimum number of individuals = 1. Kejnar, MN10 (coll. TSU-Kejnar-1).

Description. The i1 is large, massive and acuspulate. Its wide apex is slightly bent upwards. The buccal cingulum is absent.

Measurements. See Table XII.

Systematic position. Such a massive, large and acuspulate i1 is known only among the representatives of the Heterosoricidae VIRET & ZAPFE, 1951 and the Anourosoricini. However, the shape of the i1 of the Heterosoricidae is quite different. Its apex is narrower than in the Anourosoricini and its buccal surface is wrinkled.

Among the Anourosoricini, *Anourosorex*, *Anourosoricodon* and *Crusafontina* have their i1 more or less cuspulate. The remaining forms, *Kordosia*, a single species of *Amblycoptus* (*A. jessiae* DOUKAS, 1995 in DOUKAS et al. 1995), and especially *Paranourosorex* have an acuspulate i1, but these taxa are much larger (see Table XII). More material is needed for the identification, in this case, of a probable new Miocene taxon of Anourosoricini.

Table XII

Measurements of i1 (in mm) in *Amblycoptus*, *Kordosia* and *Paranourosorex*

	?Amblycoptus sp. Kejnar MN10	*Amblycoptus jessiae* Teruel Basin MN13 (VAN DAM 2004)	*Amblycoptus jessiae* Maramena MN13-MN14 (DOUKAS et al. 1995)	*Kordosia topali* Osztramos 1 MN14 (REUMER 1984)	*Paranourosorex gigas* Podlesice MN14 (RZEBIK-KOWALSKA 1975)
L	5.35	6.74	6.32-7.10	6.89-7.43	7.20-7.65
i1			n=3	n=4	n=3
W	1.22	–	–	–	1.67-1.75

Tribe **Blarinellini** REUMER, 1998

Genus ***Hemisorex*** BAUDELOT, 1967

Hemisorex suchovi LUNGU, 1981

Figs 10 B, 13 B

Material. One fragment of mandible with m1-m3 and processes, except the angular process, and one isolated i1 from the same mandible. This specimen was first described by LUNGU in 1981, but has since been damaged (because its i1 and p4 dropped out and the p4 disappeared). Minimum number of individuals = 1. Kalfa, MN9 (coll. TSU-Kalfa-1).

Description. (The missing p4 has been described here on the ground of drawings and a description in LUNGU 1981). The horizontal ramus of the mandible is short and massive, most probably largest under the m1. The ascending ramus is high and rather narrow. The coronoid process is also narrow and its tip is rounded. The external temporal fossa is deep and it extends to the upper sigmoid notch. It is divided in two by the coronoid spicule which is strongly pronounced. In its lower part the internal temporal fossa is deep and almost round. It is separated by a bar from its upper part which is triangular, short and very shallow. The condyloid process is low. Its upper facet is cylindrical and small but the lower facet is very large and slightly concave in its lower and lingual sides. The interarticular area is broad. One large mandibular foramen is situated under the anterior corner of the internal temporal fossa, the mental foramen lies below the trigonid of m1, on the border with the re-entrant valley of this tooth.

The i1 is massive and tricuspulate. The cusps are very low. The first one is long, the second short and slightly higher than the remaining two, the third cusp is the smallest and the lowest. The apex is slightly curved upwards. The buccal cingulum is protruded. It narrows in the direction of the apex at the upper and lower sides of the tooth. The a1 is very small because its alveolus is also very small and hidden under the p4. The p4 is high and has one cusp. The cusp is bent posteriorly. The posterior basin is large but rather shallow. The buccal and lingual cingula are well developed. A small (cingular?) cusp is present in the anterior side of the tooth. The m1 is large, much larger than m2. Its trigonid is higher and longer than the talonid. A considerable buccal overhang of the talonid over the posterior root of this tooth is present. The highest cusp is the protoconid. The metaconid is slightly lower and the remaining cusps are much lower. The entoconid is situated close to the metaconid, so the entoconid crest is short and high. The re-entrant valley is not very deep and opens high above the cingulum. The buccal and posterior cingula are large and protruded, the lingual cingulum is hardly visible and the anterior one is absent. The m2 is smaller than the m1. It is similar to m1 although its re-entrant valley opens near the buccal cingulum and it is deprived of the talonid overhang over the posterior root. The m3 is the smallest and its talonid is reduced to the talonid basin. The cusps (hypoconid and entoconid) are not visible. Only the buccal cingulum is present. In the lingual side the lower border of the molars shows a strong convexity.

Measurements. See Table XIII.

Systematic position. The combination of such characters as a short and high horizontal ramus of the mandible, large mandibular condyle with a broad interarticular area, well developed coronoid spicule, a short and high entoconid crest in the lower molars and a reduced talonid in m3 indicate that the specimen described above belongs to the tribe Blarinellini REUMER, 1998 and to the genus *Hemisorex* BAUDELOT, 1967. The tribe contains eight fossil genera described from

Table XIII

Measurements of mandible and lower teeth (in mm) of *Hemisorex* BAUDELOT, 1967

	H. suchovi Kalfa, Moldova MN9	*H. robustus* Sansan, France MN6 (BAUDELOT, 1967)
i1 L	3.82	–
i1 W	0.97	–
m1 L	1.45	1.40
m1 W	0.93	0.90
m2 L	1.32	1.30
m2 W	0.88	0.80
m3 L	1.13	1.00
m3 W	0.70	0.80
m1-m3L	3.78	–
H of mandible below m2	1.39	–
H of ascending ramus	4.38	–
W of coronoid process	0.94	–
H of condyloid process	1.88	–
W of interarticular area	0.63	–

North America, Asia and Europe and one Recent, *Blarinella* THOMAS, 1911, from South-Eastern Asia. In Europe the tribe is represented by four named genera. These include: *Petenyia* KORMOS, 1934, *Hemisorex*, *Alloblarinella* STORCH, 1995, and *Cokia* STORCH, 1995. Except for *Cokia* which is smaller, the remaining genera are more or less of the same size.

Hemisorex differs from *Petenyia* by a lower mandible below m2, a different shape of the coronoid process which is straight (not concave) in the anterior side, narrower top of the coronoid process, deeper and longer external temporal fossa, almost round internal temporal fossa, i1 with less convex cusps, m1 with talonid overhanging over the posterior root of the tooth, shorter entoconid crests and a navicular lower margin in the lingual side of lower molars.

Hemisorex differs from *Alloblarinella* by a less navicular lower margin of the mandible, a and narrower coronoid process in its anterior side, a coronoid spicule situated low (in the middle of the external temporal fossa), internal temporal fossa round (not triangular), i1 with very small cusps, small m3, short entoconid crests and a "boat-shaped" lingual lower margin in the lower molars.

Besides its slightly larger size, *Hemisorex* differs from *Cokia* by a less massive and less convex mandible in its lower side, less massive i1, much larger teeth in relation to the size of the mandible and much higher crowns of the lower molars.

So far two species of *Hemisorex* are known. *H. robustus* was described by BAUDELOT in 1967 from Sansan (France), a locality dated to the Middle Miocene (MN6). Subsequently it was cited by GUERIN and MEIN (1971) as *H.* cf. *robustus* from the younger (MN7+8) La Grive. In the same paper GUERIN and MEIN listed also *Hemisorex* sp. from the Late Miocene (MN13) Lissieu (both in France). Besides France, ZIEGLER (1989) mentioned ?*Hemisorex* sp. from the Early Miocene (MN3-MN4) locality Stubersheim 3.

The second species, *H. suchovi*, has been described by LUNGU (1981) from the early Late Miocene (MN9) Kalfa in Moldova. It differs from *H. robustus* by a smaller and round in shape (not triangular) internal temporal fossa, a much lower position of the coronoid spicule (in the middle and not at the top of the external temporal fossa), a more anterior position of the mandibular foramen (below the anterior corner of the internal temporal fossa and not in the middle of its lower margin) and by a weakly visible lingual cingulum in the lower molars. So far *H. suchovi* is known only from its type locality. The genus *Hemisores* is the oldest Soricinae shrew known so far.

Genus ***Petenyia*** KORMOS, 1934

Petenyia cf. ***dubia*** BACHMAYER & WILSON, 1970

Fig. 9 D

Material. One mandibular fragment with alveoli of p4-p3 without teeth and processes and one isolated m1. Minimum number of individuals = 1. Kejnar, MN10 (coll. TSU-Kejnar-1).

One fragment of mandible with m1-m2 and a small anterior fragment of m3, without processes. Minimum number of individuals = 1. Čobruči, MN11 (coll. TSU-Čobruči-1).

Description. The horizontal ramus of the mandible is short and high and its lower margin is convex. The mental foramen is situated between the roots of m1.

The m1 is massive. The lower margin of its crown on the buccal side is almost square. The re-entrant valley opens directly above the cingulum. The entoconid crest is very high. The buccal cingulum is broad and protruded, the lingual one narrower and flat. The m2 is similar to m1, but smaller.

Measurements. See Table XIV.

Systematic position and distribution. The relatively short and high horizontal ramus of the mandible with a convex lower margin, the posterior position of the mental foramen, lower molars compressed anteroposteriorly with high entoconid crests indicate that the specimens described here represent the tribe Blarinellini. As mentioned above (see *Hemisorex*) in Europe four representatives of this tribe are currently accepted. These include *Petenyia*, *Hemisorex*,

Table XIV

Measurements of mandible and lower teeth (in mm) of *Petenyia.*

	P. cf. *dubia* Kejnar MN10	*P.* cf. *dubia* Čobruči MN11	*P. dubia* Kohfidisch Austria MN11 (BACHMAYER and WILSON 1970*)	*P. hungaricaa* 9 localities Poland MN15-Q_1** (RZEBIK-KOWALSKA 1989)
L m1	1.40	1.43	1.50-1.60	1.25-153 n=96
W m1	0.86	–	1.00	0.80-1.07 n=85
L m2	–	1.36	1.40-1.50	1.15-1.40 n=110
W m2	–	0.85	0.90-1.00	0.49-0.78
H of mandible below m2	1.56	1.58	–	1.44-1.80 n=115

*The authors did not give the number of specimens, ** Q_1 = Early Pleistocene

Alloblarella and *Cokia*. The remains from Kejnar and Čobruči resemble representatives of *Petenyia*. The mandible of *Hemisorex* is not so high and convex in its lower margin, its lower molars stand more loosely in the mandible and the m1 is distinctly larger than m2. The mandible of *Alloblarinella* is also lower, and its lower margin is a slightly concave below m1/m2. Additionally, the entoconid crests of the lower molars are the highest and the longest of all genera described in this analysis. On the other hand, *Cokia* has a high, short and convex mandible, but it is generally smaller and its teeth are extremely compressed and very small in relation to the massive lower jaw.

So far, two species of *Petenyia* are known from Europe. *P. dubia* was described by BACHMAYER and WILSON in 1970 from Kohfidisch in Austria, a locality dated to MN11. It is also cited from several localities in Spain, Italy, France, Hungary and Greece dated from the Late Miocene to the early Early Pliocene (MN9-MN14) (Farjanel & MEIN 1984; REUMER 1984; MEIN et al. 1989-1990; KORDOS 1991; ENGESSER & ZIEGLER 1996). The oldest *P. dubia* known so far is listed by KORDOS (1991) from Rudabánya in Hungary (MN9).

The second species, *P. hungarica* KORMOS, 1934, was described from Hungary at Villany 3, dated to the Late Pliocene, MN17. Its oldest remains come from Maramena (Greece), a locality dated to the late Late Miocene (MN13), the youngest specimens from many localities of the Early Pleistocene of Europe. During the Early Pleistocene this species was very common and widely distributed in the all of Europe (RZEBIK-KOWALSKA 1998).

Table XIV shows that there is no size difference between *P. dubia* and *P. hungarica*. Also morphological differences between these two species are not substantial and in the accessible material (m1, m2, horizontal fragment of mandible) are not visible at all. The only clue that can help in species identification of the *Petenyia* individuals from Kejnar and Čobruči is the old age of the specimens. Accordingly, it is more probably *P. dubia* than *P. hungarica*, i.e. the latter appeared only in MN13. As age cannot be decisive in this question (it may be a new species) the remains from Kejnar and Čobruči are tentatively described as *P.* cf. *dubia*.

Some unnamed forms of *Petenyia* (*Petenyia* sp.) are also cited from the Late Miocene of Asia (STORCH at al. 1998; RZEBIK-KOWALSKA 2007).

Tribe **Neomyini** MATSCHIE, 1909

Genus ***Asoriculus*** KRETZOI, 1959

*?*Asoriculus *sp.*

Fig. 9 E

Material. One I1 (the cingulum slightly damaged). The minimum number of individuals = 1. Kejnar, MN10 (coll. TSU-Kejnar-1).

Description. The I1 is fissident, the dorsal (upper) margin and the buccal posterior margin are perpendicular. The posterior margin is provided with a cingulum along its border. This cingulum increases in width from lower to upper sides of the tooth. The talon is wide, convex in lower anterior side and concave in lower posterior side. The tooth is devoid of pigmentation.

Measurements. See Table XV.

Systematic position and distribution. Among shrews of Eurasia a bifid or fissident I1 is present in representatives of tribes Beremendiini REUMER, 1984, Neomyini MATSCHIE, 1909 and in some species of Soricini [in *Sorex minutus* LINNAEUS, 1766, *S. pseudoalpinus* RZEBIK-KOWALSKA, 1991, *S. minutoides* STORCH, 1995, *S. ertemtensis* STORCH, 1995 and in several species of *Sorex* (*Drepanosorex*) sp.].

Table XV

Measurements of I1 (in mm) of the genus *Asoriculus*

	?*Asoriculus* sp. Kejnar MN10	*A. gibberodon* Maramena Greece MN13 (DOUKAS et al. 1995)	*A. gibberodon* Podlesice Poland MN14 (RZEBIK-KOWALSKA 1981)	*A. gibberodon* Osztramos 9 Hungary MN14 (REUMER 1984)
L	1.61	1.53-1.74, n=6	1.50-1.71, n=10	1.31-1.56, n=16
I1L of talon	0.64	0.70-0.83, n=6	0.57-0.69, n=10	0.59-0.74, n=15
H	1.09	1.02-1.18, n=5	1.12-1.22, n=10	1.04-1.28, n=16

Considering the size as well as the presence of pigmented teeth in the Beremendiini, most of the Neomyini and all of the Sorex species mentioned above, the I1 from Kejnar cannot be included in any of these taxa. On the other hand, it is most similar to the I1 of fossil *Asoriculus.* As can be seen from Table XV, its size lies in the range of variation of *Asoriculus gibberodon* (PETÉNYI, 1864) and its morphology also does not differ much from the morphology of I1 of the latter species. It is conceivably slightly more massive and has a wider and more protruded cingulum in its upper part.

However, the oldest representatives of the genus listed as *A.* aff. *gibberodon* and *Asoriculus* sp. are known from the late Late Miocene (MN13), from Italy, Greece, Portugal and Spain (RZEBIK-KOWALSKA 1998). Unfortunately the authors cited these forms without any measurements. Taking into consideration the temporal gap between the findings known so far and the specimen from Kejnar, more material is needed to support this identification. If it is correct the specimen from Kejnar would be the oldest record of this genus.

Soricinae incertae sedis

"*Paenelimnoecus*" Baudelot, 1972

"*Paenelimnoecus*" *repenningi* (Bachmayer & Wilson, 1970)

Figs 9 F, 13 C

Material. A fragment of mandible with m1 (slightly broken in its antero-buccal part) without processes. Minimum number of individuals = 1. Čobruči, MN11 (coll. TSU-Čobruči-1).

Description. The horizontal ramus of the mandible is small and slender. Its lower margin is slightly concave between m1 and m2. The mental foramen is situated in a shallow depression below the anterior border of the re-entrant valley of m1. The m1 is very worn. It is characterized by the presence of a small but clear entoconid and entostylid and a lack of the entoconid crest. Its re-entrant valley opens at a distance above the buccal cingulum. The lower lingual border of its crown is navicular. The buccal and lingual cingula are wide but not very protruded.

Measurements. See Table XVI.

Systematic position and distribution. The very small size indicates that the mandible from Čobruči represents a shrew of the subfamily Crocidosoricinae or of the genus *Paenelimnoecus* Baudelot, 1972 (Soricinae incertae sedis).

As mentioned above (see p. 36), the Crocidosoricinae lived from the Early Oligocene to the Late Miocene but abundantly persisted until the beginning of this period (MN9). Subsequently they are very rare and their identification is uncertain.

A comparison of the mandible from Čobruči with the Late Miocene representatives of Crocidosoricinae excluded their similarity. E.g. one of the youngest *Miosorex* forms, *M.* aff. *grivensis* (Depéret, 1892) described by De Jong (1988) from six Spanish localities dated for the Late Astracian and Early Vallesian (n = 11), showed that it is identical in size with the mandible from Čobruči, but its morphology is quite different. Its mental foramen must have been situated below p4, because it is not visible in the mandible fragment with m1-m3. The m1 has an entoconid crest, its re-entrant velley opens above the buccal cingulum and the lower lingual margin of its crown is not navicular.

In the original description of *L. dehmi* from La Grive in France (Viret & Zapfe 1951), cited later from the ?Early Pliocene of Italy (de Giuli et al. 1987), the authors did not give specific measurements (with the exception of the L of m1-m3), but the morphology of the specimen from La Grive is different from the morphology of the mandible from Čobruči. In *L. dehmi* the mental foramen is situated below the p4 and its m1 is robust and has a very wide talonid.

Table XVI

Measurements of mandible and lower dentition (in mm) of *P. repenningi.* The authors did not give the number of specimens

	"P". repenningi Čobruči MN11	*P. repenningi* Montredon France MN10 (Crochet and Green 1982)	*P. repenningi* Kohfidisch Austria MN11 (Bachmayer and Wilson 1970)
L	1.08	1.03	1.20-1.30
m1			n=?*
W	0.76	0.62	0.70-0.80
H of mandible below m2	0.92	–	–

The mandible from Čobruči is most similar to the mandible of *Petenyiella repenningi* BACHMAYER & WILSON, 1970 described by these authors from Kohfidish in Austria and to "*Petenyiella ? repenningi*" mentioned by CROCHET and GREEN (1982) from Montredon in France. Both forms were later included by REUMER (1984) to the genus *Paenelimnoecus* BAUDELOT, 1972. *P. repenningi* has similar dimensions and morphology as the mandible from Čobruči because the horizontal ramus of the mandible is slightly concave below the m1/m2 boundary, its mental foramen is situated near the re-entrant valley of m1 and the entoconid is present in the m1.

However, the affiliation of the species *P. repenningi* to the genus *Paenelimnoecus* seems doubtful. According to BAUDELOT (1972), besides its very small size, *Paenelimnoecus* is characterized by the lack of an entoconid in the lower molars which is evident in *P. crouzeli* BAUDELOT, 1972, *P. micromorphus* (DOBEN-FLORIN, 1964) and *P. pannonicus* (KORMOS, 1934). In this situation *P. repenningi* most probably represents another (new?) genus of very small shrews. Unfortunately, the genus *Petenyiella* KRETZOI, 1956 is excluded because it is considered to be a synonym of *Sorex* LINNAEUS, 1758 (REUMER 1984).

Besides the localities mentioned above, "*Paenelimnoecus repenningi*" or "*P.* cf. *repenningi*" were also found in several Spanish localities (MN12 and MN13), but the oldest remains come from Hungary (MN9) (RZEBIK-KOWALSKA 1998). In all these papers the remains were listed as *Petenyilla*. A revision of the genus *Paenelimnoecus* is urgently needed.

Family **Heterosoricidae** VIRET & ZAPFE, 1951

Genus ***Dinosorex*** ENGESSER, 1972

Dinosorex grycivensis RZEBIK-KOWALSKA & TOPACHEVSKY, 1997

Fig. 11 A-B

Material. Three I1, two mandible fragments – one with i1 and m1, and the second with m2, and isolated m3. Minimum number of individuals = 2. Bužor I, MN9 (coll. TSU-Bužor-1).

Description. The I1 is large and bifid. Its buccal surface is more or less wrinkled. The upper margin of the crown is straight and the apex is curved downwards. If present, the buccal cingulum is visible only at the posterior part of the talon.

The horizontal ramus of the mandible is high and its lower margin convex. The i1 is long, very wide in its proximal part and narrow in its distal part. Its lower margin is convex and its apex is narrow and bent upwards. The buccal surface of the proximal part of the tooth is wrinkled. The buccal cingulum is very well visible in the upper part of the crown. It dissapears in the lower part. The m1 is large and massive and only slightly longer than m2. The m1/m2 ratio equals 1.16 (most probably the teeth belong to two different specimens). The talonid is much wider than the trigonid. The hypolophid is closely connected with the entoconid (modus "A"). The entoconid crest is absent. The wide re-entrant valley reaches the buccal cingulum, which is wide and protruded. The posterior cingulum is also very wide and protruded and it mounts to the end of the hypolophid on the postero-lingual corner of the tooth. The anterior cingulum is flat and the lingual one absent. The m2 is also large. It is only slightly smaller than the m1 but its talonid is more of less of the same size as its trigonid. The remaining characters are identical with those of m1. The m3 is much smaller. Its talonid is reduced but a small enoconid and hypoconid are present.

Measurements. See Table XVII.

Systematic position and distribution. The presence of a strong and acuspulate i1 refers the remains of the Bužor I Heterosoricidae to the genus *Dinosorex* ENGESSER, 1972. The representatives of *Dinosorex* lived in Europe and Asia Minor from the Late Oligocene to the Late Miocene (MP27-MN11) (RZEBIK-KOWALSKA 1998).

So far, five species of *Dinosorex* are generally accepted.

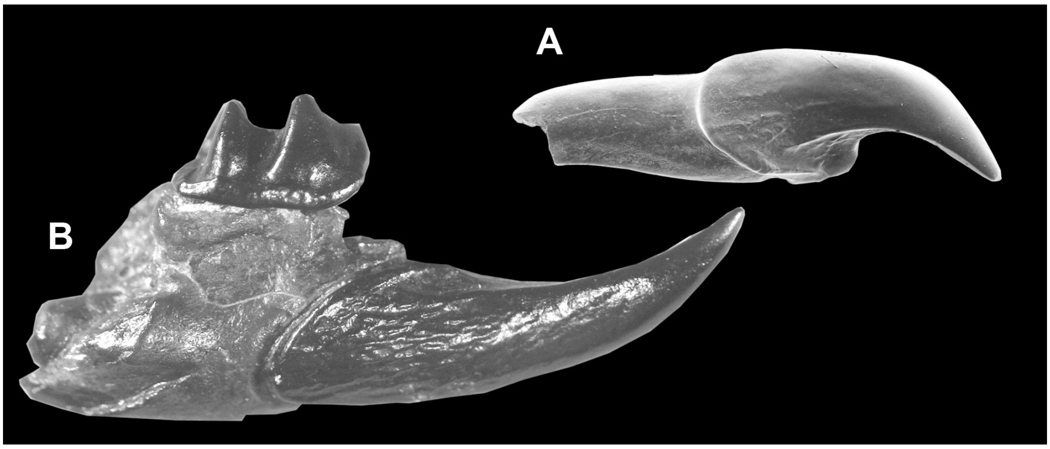

Fig. 11. *Dinosorex grycivensis* RZEBIK-KOWALSKA and TOPACHEVSKY, 1997 from Bužor I: A – right I1, buccal view, TSU-Bužor-1/2; B – right fragment of mandible with i1 and m1, buccal view, TSU-Bužor-1/1 (×10).

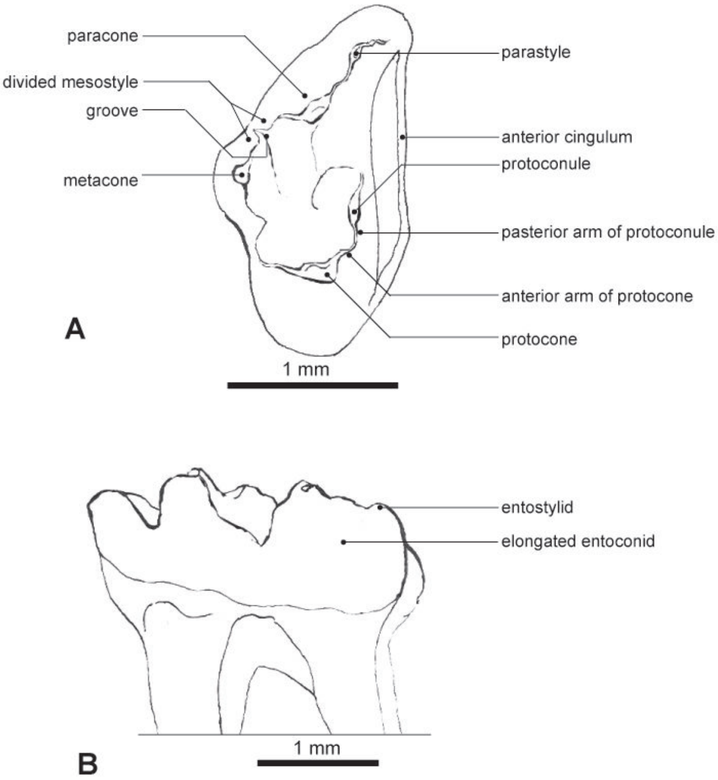

Fig. 12. The most characteristic features of *Schizogalerix sarmaticum* LUNGU, 1981: A – right M3, occlusal view; B – right m1, lingual view (explanatory drawings).

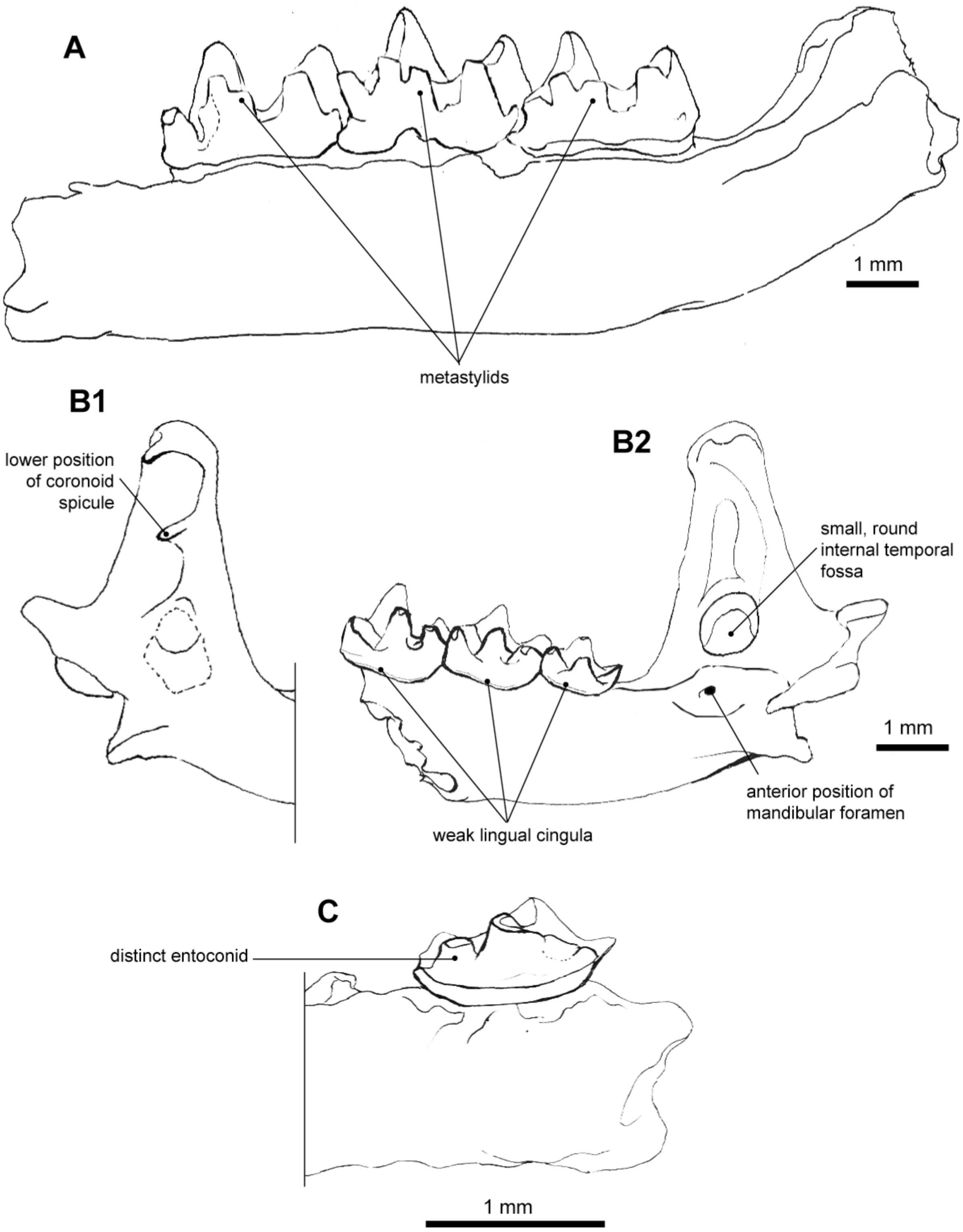

Fig. 13. The most characteristic features of: A – *Proscapanus metastylidus* n. sp., right mandible, lingual view; B – *Hemisorex suchovi* LUNGU, 1981, right mandible; B1 – buccal view, B2 lingual view; C – "*Paenelimnoecus*" *repenningi* (BACHMAYER and WILSON, 1970), left mandible, lingual view (explanatory drawings).

Table XVII

Measurements of upper and lower teeth (in mm) of *Dinosorex*

		D. grycivensis Bužor I MN9	*D. grycivensis* Grytsiv Ukraine MN9 (RZEBIK-KOWALSKA and TOPACHEVSKY, 1997)	*D. grycivensis* Bełchatów A Poland MN7+8/MN9 (RZEBIK-KOWALSKA 1994)	*D. zapfei* Devínska Nová Ves (Neudorf) Slovakia MN6 (ENGESSER 1975) HOLOTYPE	*D. zapfei* Vermes 1 Switzerland MN5 (ENGESSER et al. 1981)	*D. huerzeleri* Rickenbach Switzerland MP29 (ENGESSER 1975) HOLOTYPE	*D. pachygnathus* Anwil Switzerland MN7+8 (ENGESSER 1972) HOLOTYPE	*D. sansaniensis* Sansan France MN6 (ENGESSER 1975*)
I1	L	4.54-4.74 n=3	4.45-4.96 n=4	4.85-5.30 n=2	–	–	–	–	–
	H	1.99-2.13	1.87-2.14 n=6	1.98-2.06 n=5	–	–	–	–	–
i1	L	7.20	7.51-7.94 n=4	8.16	–	–	–	–	–
	H	2.26	2.08-2.29 n=5	2.10	–	–	–	–	–
m1	L	2.75	2.45-2.91 n=17	2.55-2.76 n=4	2.80	2.50-2.92 n=2	1.96	2.72	2.80-3.10, n=11
	W	1.72	1.57-1.77	1.59-1.69	1..58	1.40-1.66	1.26	1.80	1.86-2.20, n=11
m2	L	2.36	2.13-2.48 n=20	2.18-2.32 n=6	2.16	2.48	1.80	2.32	2.22-2.45, n=11
	W	1.45	1.32-1.65 n=18	1.31-1.50	1.38	1.64	1.24	1.74	1.72-1.95, n=11
m3	L	1.70	1.63-1.84 n=5	1.63-1.78 n=5	1.46	1.60	1.32	–	1.72-1.90, n=5
	W	1.08	1.03-1.25	1.10-1.20	1.16	1.12	0.98	–	1.25-1.42, n=5

*Taken from the scatter-diagram (ENGESSER 1975, p. 666, fig. 4).

D. huerzeleri ENGESSER, 1975 comes from the Late Oligocene (MP29) of Rickenbach in Switzerland and is known only from its type locality.

D. zapfei ENGESSER, 1975 was described by ZAPFE [1951, as *Heterosorex sansaniensis* (LARTET, 1851) from the Middle Miocene (MN6) of Devínska Nová Ves (Neudorf) in Slovakia. It was also present in Germany, Switzerland and Poland in the Early to early Late Miocene localities (MN4-MN9).

D. sansaniensis (LARTET, 1851) was described from Sansan in France, a locality dated to MN6. Subsequently it was found in many European countries (Spain, France, Germany, Austria, Switzerland and ?Serbia), in localities dated from MN5 to MN10.

D. pachygnathus ENGESSER, 1972 was found in the Middle Miocene (MN7+8) of Anwil in Switzerland and it was later cited from the late Middle to the early Late Miocene localities (MN7+8 and MN9) of Spain and Germany.

The fifth species of *Dinosorex*, *D. grycivensis* RZEBIK-KOWALSKA & TOPACHEVSKY 1997 was described from the Late Miocene (MN9) of Grytsiv in the Ukraine. It is also known from the slightly older Polish locality Bełchatów A, dated to MN7+8 or MN7+8/MN9 (RZEBIK-KOWALSKA 2005). Previously, it was described as *Dinosorex* sp. (RZEBIK-KOWALSKA 1994).

With the exception of the oldest Oligocene *D. huerceleri*, which is smaller, and *D. sansaniensis*, which is larger, the remaining three species (*D. pachygnathus*, *D. zapfei* and *D. grycivensis*) seem to be of the same size. The measurements of remains from Bužor I (except the length of i1) lie in the range of their variation. As concerns morphology, the Bužor I specimens are identical with the morphology of *D. grycivensis.* In both forms the lower molars are characterized by "modus A" (they have a direct course of the hypolophid to entoconid, not separated by a groove), the absence of an entoconid crest, large and protruded buccal and posterior cingula and the presence of a vertical band on their postero/lingual corner (formed by the posterior cingulum mounting onto the end of the hypolophid), as well as by the absence of the lingual cingulum. On the other hand, *D. zapfei* also has a "modus A" and a lack of the entoconid crest in lower molars but contrary to *D. grycivensis* and specimens from Bužor I, their molars strongly diminish in size from m1-m3, while in *D. grycivensis* and the specimens from Bužor I the m2 is only slightly smaller than the m1. The length ratio of m1/m2 in the holotype of *D. zapfei* = 1.30, while in the nine specimens of *D. grycivensis* this ratio falls within 1.03-1.18, and in the Bužor I teeth = 1.16). Additionally, the buccal and posterior cingula of *D. zapfei* are narrow and there is no vertical band in the postero/lingual corners of these teeth. *D. pahygnathus* is characterized by a "modus B" in the lower molars, e.g. its hypolophid is separated from the entoconid by a distinct groove.

The specimens from Bužor I were already described by LUNGU in 1981 as *Trimylus sansaniensis* (LARTET, 1851). A revision of the systematics of this group of shrews allowed a correct identification.

IV. CONCLUSIONS

The insectivore mammals of the Late Miocene were studied in eight localities of the Moldova Republic. The number of individuals is low and their remains are fragmentary, however, the species composition is high. Three to six hedgehog taxa, four to five moles, and nine to ten shrew taxa have been described. The species composition in particular localities is presented in Table XVIII.

Both the abundance of insectivore remains and taxonomic diversity varied among the localities. The most numerous and diverse (three hedgehogs, three moles and three shrews) were found in the early Late Miocene (MN9) locality Bužor I. The younger (MN10-MN11) localities, Kejnar and Čiobruči, yielded respectively five (Erinaceidae and Soricidae) and four (Talpidae and Soricidae) species, and in the remaining late Late Miocene localities (MN12-MN13) only one to three species were present. Unfortunately, the small number of specimens and species in most localities do not allow for a reconstruction of the transformation of the insectivore fauna in the Late Miocene of Moldova.

On the other hand, the fossil assemblages found in the Miocene of the Republic of Moldova are similar to assemblages found in the other fossil localities of Europe at that time. The variety of Erinaceidae in Moldavian fossil localities confirms the opinion that the Miocene was the epoch of hedgehogs. They did not appear in Europe until the faunal turnover of the "Grande Coupure", probably in the Middle Oligocene (MP21). The first immigrants were members of Galericinae (spineless hedgehogs), present also in Moldova. During the Miocene more than 20 species (five genera) inhabited different areas of the continent. They disappeared almost completely from Europe in the end of the Miocene and so far only three to four taxa are known from the Early Pliocene of Spain and Greece. Most probably the climatic events (cooling and desiccation) around the Miocene/Pliocene boundary (in the marine record known as Messinian salinity crisis) were responsible for the extinction of the subfamily Galericinae in Europe. Today spineless hedgehogs comprising four genera live in relict forested area of Southeast Asia, often close to the water.

The representatives of the Erinaceinae (spiny hedgehogs) are also present in the Miocene Moldavian localities and had probably entered Europe in the Late Oligocene (MN28). So far, six genera with more than ten species were documented from the Miocene. However, erinaceines are

Table XVIII

Species composition in particular localities of the Moldova Republic

Localities	Girova	Bužor I	Kalfa	Kejnar	Pituška	Čobruči	Čimišlija	Leordoaja
Species/Age	MN9	MN9	MN9	MN10	MN10	MN11	MN12	MN13
Schizogalerix sarmaticum		+						
S. cf. *sarmaticum*					+			
Parasorex socialis				+				
?*P. socialis*							+	
Galericinae gen. et sp. indet.		+						
?*Erinaceus* sp.							+	
Erinaceinae gen. et sp. indet. 1		+						
Erinaceinae gen. et sp. indet. 2								+
Ruemkelia sp.						+	+	
Desmanella sp.		+						
Proscapanus matestylidus n.sp.		+						
P. cf. *austriacus*		+						
Talpinae gen. et sp. indet.								+
?*Miosorex* sp.						+		
Crusafontina cf. *endemica*	+	+	+	+				
?*C.* cf. *kormosi*								+
?*Amblycoptus* sp.		+						
Anourosoricini gen. et sp. indet.				+				
Hemisorex suchovi			+					
Petenyia cf. *dubia*				+		+		
?*Asoriculus* sp.				+				
"*Paenelimnoecus*" *repenningi*						+		
Dinosorex grycivensis		+						

characteristically scarce in the fossil record. Very often one taxon is restricted to its type locality or the holotype. Spiny hedgehogs are also very rare and fragmentary in the younger fossil material of the Pliocene and Pleistocene. As the fossil remains of small vertebrates, especially in cave localities, in general are derived from owl pellets, and spiny hedgehogs are well protected by their spines, more probably they only rarely fall prey to birds producing pellets. In this situation, the phylogenetic relationships, especially between Miocene Erinaceinae taxa, are obscure. Nevertheless, during the Miocene more than 30 species (14 genera) of both subfamilies lived in Europe, whereas only three species of two genera, all representatives of one subfamily (Erinaceinae) survived to Recent times in Europe.

In Miocene Europe, moles (family Talpidae) were also much more abundant in genera and species than today. They probably appeared in the course of the faunal turnover termed the "Grande Coupure", although some authors, based on scarce evidence from Eocene localities of Europe

(MP19, the Isle of Wight, England, MP21 Belgium – SIGÉ et al. 1977; SMITH 2007), have argued in favour of their European origin. A substantial diversification of moles took place in the Late Oligocene and in the Miocene. Representatives of desmans (subfamily Desmaninae) adapted to aquatic or semiaquatic habitats, shrew-moles (Uropsilinae) less adapted to fossorial habitats and "true" moles adapted to extensive burrowing were already present at the Moldavian localities. In general during the Miocene more than 45 species (?18-20 genera) inhabited Europe. Representatives of all subfamilies persisted to the present day, although in Europe only seven species of three genera (two subfamilies – Talpinae and Desmaninae) are now present. All but a single widely distributed species (*Talpa europaea*) inhabit small relict areas.

In Europe the Miocene shrews were comprised of two families – the extinct Heterosoricidae and the extant Soricidae. Both are present in the Moldavian material. Representatives of the Heterosoricidae lived in Eurasia and North America. They have been known since the Early Oligocene in Europe, and apparently became very common in the Early and Middle Miocene, i.e. about 10 species of two genera have been found so far. They had disappeared from Europe by the end of the Early Vallesian.

The Soricidae have been a part of the European mammal fauna since the Middle Oligocene, roughly 30 million years ago. Of the five Soricidae subfamilies listed by REUMER (1998), three (Crocidosoricinae, Soricinae and Allosoricinae) are represented in the Miocene fossil records of Europe and two (Crocidosoricinae and Soricinae) in the Republic of Moldova. The oldest true soricid yet known belongs to the subfamily Crocidosoricinae. Eight to ten genera with about 17 species are known from the Miocene. The subfamily did not survive beyond the Miocene/Pliocene boundary, although one species did survive into the Early Pliocene on the Italian peninsula Gargano (at that time an island, DE GIULI et al. 1987) and other appeared in the Late Pliocene localities of France and Spain (FURIÓ et al. 2007). As temperature and humidity play a crucial role in the ecology of shrews, it is very probable that the climatic events (cooling and desiccation) of the Miocene/Pliocene boundary were also responsible for the extinction of the family Heterosoricidae and subfamily Crocidosoricinae. According to REEUMER (1989), Crocidosoricinae gave rise to other subfamilies of shrews, particularly to the Soricinae which survived to Recent times. Rare in the Middle and the Late Miocene (?six genera and nine to ten species), Soricinae exploited the vacant (left open by Heterosoricidae and Crocidurinae) ecological niches. They strongly radiated during the Pliocene. In general, in comparison to the Miocene, the species composition of shrews in the following periods became entirely different.

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REFERENCES

ADROVER R., ALCALA L.,MEIN P., MOISSENET E., PARICIO J. 1982. Micromamiferos vallesienses del yacimiento La Salle enlas Arcillas Rojas de Teruel. *Acta Geológica Hispánica*, **17**: 89-93.

AGUSTÍ J., GIBERT J. 1982. Roedores e Insectivoros (Mammalia) del Mioceno Superior de Can Jotresa y Can Perellada (Vallès-Penedès, Cataluña). *Paleontologia i Evolució*, **17**: 29-41.

ANDERSON J. 1879. Anatomical and zoological researches: comprising an account of the zoological results of the two expedition to western Yunnan in 1868 and 1875. B. Quaritch, London, **1**: 984 pp.

AYMARD A. 1849. Concernant les restes de mammifères recueillis dans le calcaire miocène des envions du Puy. *Annales de la Societ d'Agriculture, Sciences, Arts et Commerce du Puy*, **14**: 14-114.

BACHMAYER F., WILSON R. 1970. Die Fauna der altpliozänen Höhlen- und Spalten-Füllungen bei Kohfidisch, Burgenland (Österreich). *Annalen des Naturhistorischen Museums*, **74**: 533-587.

BACHMAYER F., WILSON R. W. 1985. Environmental significance and stratigraphic position of some mammal faunas in the Neogene of eastern Austria. *Annalen des Naturhistorischen Museums*, Serie A, Wien, **87**: 101-114.

BARRETT-HAMILTON G. E. H. 1900. Note on the common hedgehog (*Erinaceus europaeus* LINNAEUS) and its subspecies or local variations. *The Annals and Magazine of Natural History*, Serie 7, **5**: 360- 368.

BAUDELOT, S. 1967. Sur quelques Soricidés (Insectivores) miocènes de Sansan (Gers). *Compte Rendu Sommaire des Séances de la Société Géologique de France*, **7**: 290-291.

BAUDELOT S. 1972. Ètude des Chiroptères, Insectivores et Rongeurs du Miocène de Sansan (Gers). Unpublished Ph. D. Thesis, Université de Toulouse.

BOLLIGER T. 1992. Kleinsäugerstratigraphie in der miozänen Hörnlischüttung (Ostschweiz). *Documenta naturae*, München, **75**: 1-296.

BOWN T. M. 1980. The fossil Insectivora of Lemoyne Quarry (Ash Hollow Formation, Hemphillian), Keith County, Nebraska. *Transactions of the Nebraska Academy of Sciences and Affiliated Societies*, **8**: 99-122.

BUTLER M. A. 1948. On the evolution of the skull and teeth in the Erinaceidae, with special reference to fossil material in the British Museum. *Proceedings of the Zoological Society of London*, **118**, part II: 446-499.

CROCHET J.-Y. 1986. Insectivores Pliocènes du sud de la France (Languedoc-Roussillon) et du nord-est de l'Esdpagne. *Palaeovertebrata*, **16**: 145-171.

CROCHET J.-Y., GREEN M. 1982. Contributions à l'étude des micromammifères du gisement miocène supérieur de Montredon (Hérault). 3 – Les insectivores. *Palaeovertebrata*, **12**: 119-131.

CRUSAFONT M., VILLATA J. F. 1947. Sur un nouveau *Palerinaceus* du Pontien d'Espagne. *Eclogae Geologicae Helvetiae*, **40**(2): 320-333.

DAHLMANN T. 2001. Die Kleinsäuger der unter-pliozänen Fundstelle Wölfesheim in der Wetterau (Mammalia: Lipotyphla, Chiroptera, Rodentia). *Courier Forschungsinstitut Senckenberg*, **227**: 1-129.

DE GIULI C., MASINI F., TORRE D., BODDI V. 1987. Endemism and bio-chronological reconstructions: the Gargano case history. *Bollettino della Societé Paleontologica Italiana*, **25**: 267-276.

DE JONG F. 1988. Insectivora from the Upper Aragonian and the Lower Vallesian of the Daroca-Villafeliche area in the Calatayud-Teruel Basin (Spain). *Scripta Geologica*, Special Issue 1, Leiden: 253-286.

DEPERET C. 1892. La faune de mammifères miocènes de La Grive Saint-Alban (Isère) et de quelques autres localités du Bassin du Rhône. *Documents nouveau et revision général.* Museum des Sciences naturals, Lyon Archives, **5**(2): 1-95.

DOBEN-FLORIN U. 1964. Die Spitzmäuse aus dem Alt-Burdigalium von Wintershof-West bei Eichstätt in Bayern. *Abhandlungen der Bayerischen Akademie der Wissenschaften, Mathematisch-Naturwissenschaftliche Klasse,* Neue Folge, **117**: 1-82.

DOBSON G. E. 1883. A monograph of the insectivora: systematic and anatomical: including the Erinaceidae, Centetidae, Solenodontidae, Potamogalidae, Chrysochloridae, Talpidae and Soricidae. John Van Voorst, London. 128 pp.

DOUKAS C. S. 1986. The mammals from the Lower Miocene of Aliveri (Island of Evia, Greece). *Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen*, Series B, **89**(1): 15-37.

DOUKAS C. S. 2005. Greece. [In:] L. W. VAN DEN HOEK OSTENDE, C. S. DOUKAS, J. W. F. REUMER (eds) – The fossil record of the Eurasian Neogene insectivores (Erinaceomorpha, Soricomorpha, Mammalia), Part I, *Scripta Geologica*, Special Issue, Leiden, **5**: 99-112

DOUKAS C. S., HOEK OSTENDE L. W. VAN DEN, THEOCHAROPOULOS C. D., REUMER J. W. F. 1995. The vertebrate locality Maramena (Macedonia, Greece) at the Turolian-Ruscinian boundary (Neogene). *Münchner Geowissenschaftliche Abhandlungen (A)*, **28**: 43-64.

ENGESSER B. 1972. Die obermiozäne Säugetierfauna von Anwil (Baselland). *Tätigkeitsberichte der Naturforschchenden Gesellschaft Baselland*, **28**: 35-363.

ENGESSER B. 1975. Revision der europäischen Heterosoricinae (Insectivora, Mammalia). *Eclogae Geologicae Helvetiae*, **68**: 649-671.

ENGESSER B. 1980. Insectivora und Chiroptera (Mammalia) aus dem Neogen der Türkei. *Schweizerische Paläontologische Abhandlungen*, **102**: 47-149.

ENGESSER B., MATTER A., WEIDMANN M. 1981. Stratigraphie und Säugetierfaunen des mittleren Miozäns von Vermes (Kt. Jura). *Eclogae Geologicae Helvetiae*, **74**(3): 893-952.

ENGESSER B., ZIEGLER R. 1996. Didelphids, Insectivores, and Chiropterans from the Later Miocene of France, Central Europe, Greece, and Turkey. [In:] R. L. BERNOR, V. FAHLBUSCH, and H.-W. MITTMANN (eds) – The evolution of Western Eurasian Neogene mammal faunas. Columbia University Press, New York. Pp. 157-167.

FARJANEL G., MEIN P. 1984. Une association de mammifères et de pollens dans la formation continentale des "Marnes de Bresse" d'âge Miocène supérieur, à Ambérieu (Ain). *Géologie de la France*, **1984**(1-2): 131-148.

FILHOL H. 1888. Description de quelques mammifères nouveaux trouves à Sansan (Gers.). *Bulletin de la Société Philomatique de Paris*, Serie 7, **12**: 24-32.

FISCHER VON WALDHEIM G. 1813. Zoognosia tabulis synopticis illustrata. Nicolai Sergeidis Vsevolozsky, Moscow, 3 volumes: 3-1814.

FREUDENTHAL M. 1972. *Dainogalerix koenigswaldi* nov. gen. nov. spec., a giant insectivore from the Neogene of Italy. *Scripta Geologica*, **14**: 1-19.

FURIÓ M., SANTOS-CUBEDO A., MINWER-BARAKAT R., AGUSTI J. 2007. Evolutionary history of the African soricid *Myosorex* (Insectivora, Mammalia) out of Africa. *Journal of Vertebrate Paleontology*, **27**(4): 1018-1032.

Gaillard, C. 1899. Mammifères miocènes nouveaux ou peu connus de La Grive St.-Alban. *Archives du Muséum d'Histoire Naturelle de Lyon*, **7**(2): 1-79.

Gibert, J. 1974. Etude des Inscectivores du Miocène de Vallès-Penedès, Calatayud-Daroca et Rubielos de Mora. Thèse. Sabadell 1974.

Gibert J. 1975. New Insectivores from the Miocene of Spain I and II. *Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen,* Section B, **78**: 108-133.

Gibert J. 1976. Nuevos datos sobre *Crusafontina endémica*. *Acta Geológica Hispánica*, **11**: 33-34.

Gill T. 1875. Synopsis of insectivorous mammals. *Bulletin of the United States Geological and Geographical Survey.* Territories 1, Second Series: 91-120.

Gray J. E. 1838. Revision of the genus *Sorex* Linn. *Proceedings of the Zoological Society of London*, **1837**: 123-126.

Gregory W. K. 1910. The orders of mammals. *Bulletin of the American Museum of Natural History*, **37**: 1-524.

Gueldenstaedt D. 1777. Beschreibung des Desmans. *Beschäftigungen der Berlinischen Gesellschaft Naturforschender Freunde*, **3**: 107-137.

Guerin C., Mein P. 1971. Les principaux gisements de mammifères Miocènes et Pliocènes du domaine rhodanien. *Documents du Laboratoire de Géologie de la Faculté des Sciences de Lyon*, **1**: 131-170.

Harrison D. L., Rzebik-Kowalska B. 1994. A note on the occurrence of *Desmanella* cf. *dubia* Rümke, 1976 (Insectivora: Talpidae: Uropsilinae) in the Lower Pliocene of Podlesice, Poland. *Cranium*, **11**(1): 3-6.

Hoek Ostende L. W. van den Furió M. 2005. Spain. [In:] L. W. Hoek Ostende van den, C. S. Doukas, J. W. F. Reumer (eds) – The fossil record of the Eurasian Neogene insectivores (Erinaceomorpha, Soricomorpha, Mammalia), Part I, *Scripta Geologica* Special Issue, **5**: 148-284.

Hoek Ostende L. W. van den, Rümke C. G., Hogeweg P. 1989. The use of time-constrained minimal spanning subtrees in the reconstruction of the phylogeny of the European desmanine moles (Desmaninae, Talpidae, Insectivora). *Proceedings of the Koninklijke Nederlandse van Wetenschappen,* Serie B, **92**(1): 47-60.

Holz H. von, Niethammer J. 1990. *Erinaceus concolor* Martin, 1838 – Weissbrustigel, Ostigel. [In:] J. Niethammer, F. Krapp (eds) – Handbuch der Säugetiere Europas, AULA – Werlag Wiesbaden. Pp. 50-64,

Hürzeler J. 1944. Über einen dimyloiden Erinaceiden (*Dimylechinus* nov. gen.) aus dem Aquitanien der Limagne. *Eclogae Geologicae Helvetiae*, **37**(2): 460-467.

Hutchison J. H. 1968. Fossil Talpidae (Insectivora, Mammalia) from the Late Tertiary of Oregon. *Bulletin of the Museum of Natural History University of Oregon*, **11**: 1-117.

Hutchison J. H. 1974. Notes on type specimens of European Miocene Talpidae and a tentative classification of Old World Tertiary Talpidae (Insectivora: Mammalia). *Géobios*, **7**(3): 211-256.

Hutterer R. 1995. *Archaeodesmana* Topachevski and Pashkov, the correct name for *Dibolia* Rümke, a genus of fossil water moles (Mammalia: Talpidae). *Bonner Zoologische Beitrage*, **45**(3-4): 171-172.

Hutterer R. 2005. Order Erinaceomorpha. [In:] D. E. Wilson, D. A. Reeder (eds) – Mammal species of the world: a taxonomical and geographical references, 3rd edition, Baltimore, Johns Hopkins University Press: 212-219.

Kälin D. 1993. Stratigraphie und Säugetierfaunen der Oberen Süsswassermolasse der Nordwestschweiz. *Unpublished Ph. D. Thesis*, Universität Zürich, 1-238 pp.

Kaup J. J. 1829. Skizzierte Entwicklungsgeschichte und Natürliches System der Europäischen Thierwelt. [In:] Commission bei Carl Wilhelm Leske, Darmstadt und Leipzig: 1- 203.

Kordikova E. G. 2000. Insectivora (Mammalia) from the Lower Miocene of the Aktau Mountains, South-Eastern Kazakhstan. *Senckenbergiana lethaea*, **80**(1): 67-79.

Kordos T. 1991. Le *Rudapithecus hungaricus* de Rudabánya (Hongrie). *L'Anthropologie*, **95**: 343-362.

Kormos T. 1913. Trois nouvelles espèces fossils des Desmans en Hongrie. *Annales Musei Nationalis Hungarici*, **11**: 135-145.

Kormos T. 1926. *Amblycoptus oligodon* n. g. & n. sp., eine neue Spitzmaus aus dem Ungarischen Pliozän. *Annales Musei Nationalis Hungarici*, **24**: 369-391.

Kormos T. 1934. Neue Insektenfresser, Fledermäuse und Nager aus dem Oberpliozän der Villanyer Gegend. *Földtani Közlöny*, **64**: 296-321.

Kretzoi M. 1956. Die Altpleistozänen Wirbeltierfaunen des Villányer Gebirges. *Geologica Hungarica, Series Palaeontologica*, **27**: 1-264.

Kretzoi M. 1959. New names for soricid and arvicolid homonyms. *Vertebrata Hungarica*, **1**: 247-249.

Lartet E. 1851. Notice sur la Colline de Sansan. *Annuaire du Département du Gers*, **1851**: 1-42.

Latreille P. A. 1829. Suite et fin des insectes. [In:] G. Cuvier (ed.) – Le règne animaldistribué d'après son organisation pour servir de base l'histoire naturelle des animaux et d'introduction l'anatomie comparée. Nouvelle edition, revue et augmente, Paris, **5**: 1-556.

Linnaeus C. 1758. Systema naturae pre regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Editio decima, reformata. 824 pp. Laurentius Salvus, Stockholm.

Linnaeus C. 1766. Systema naturae per regna tria nature, secundum classes, ordines, genera, species cum characteribus, differentiis, synonymis, locis. 12th edition, 532 pp. Laurenti Salvii, Stockholm.

Lungu A. N. 1981. Gipparionovaja fauna srednego sarmata Moldavii (nasekomojadnye, zajceobraznye i gryzuny) [The *Hipparion* fauna of the Middle Sarmatian from Moldavia (Insectivora, Lagomorpha, Rodentia)]. Izdatelstvo Štiinca, pp. 1-118. (In Russian).

Lungu A. 1990. Rannie etapy razvitija gipparionovoj fauny kontinentalnogo obramlenija Paratetisa [Early evolution stages of the *Hipparion* fauna in the continental frame of Paratethys]. Author's review of the dissertation, Geologičeskij Institut Akademii Nauk Gruzinskoj SSR, Tbilisi: 1-36. (In Russian).

Lungu A., Bilinkis G. 1979. O novom mestonachoždenii gipparionovoj fauny v baltskich otloženijach Centralnoj Moldavii [New locality of the *Hipparion* fauna in the "Baltsk" series of the Central Moldova]. *Izvestija Akademii Nauk Moldavskoj SSR*, *serija fiziko-techničeskich i matematičeskich nauk*, **3**: 70-75 (in Russian).

Lungu A., Čemyrtan G. 1986. K istorii razvitija gipparionovoj fauny pozdnogo sarmata severnych oblastej kontinentalnogo obramlenija Vostočnogo Paratetisa [Evolutionary history of the Late Sarmatian *Hipparion* Fauna in the north part of the continental frame of the Eastern Paratethis]. *Trudy Gosudarstvennogo Kraevebčeskogo muzeja Moldavskoj SSR*, Kišinev **3**: 48-66. (In Russian).

Lungu A., Rzebik-Kowalska B. Late Miocene localities of the Moldova Republic: stratigraphy, faunal assemblages and taphonomy (in press).

Matschie P. 1909. Mammalia. [In:] Brauer (ed.) – Die Süsswasserfauna Deutschlands. Eine Exkursionfauna, Gustav Fischer, Jena, **1**: 1-14.

Mayr H., Fahlbusch V. 1975. Eine unterpliozäne Kleinsäugerfauna aus der Oberen Süsswasser-Molasse Bayerns. *Mitteilungen der Bayerischen Staatssammlung für Paläontologie und Historische Geologie*, **15**: 91-111.

Mein P., Ginsburg L. 2002. Sur l'age relatif des différents dépôts karstiques miocénes de la Grive-Saint-Alban (Isére). *Cahiers scientifiques, Musèum d'histoire naturelle*, Lyon, **2**: 7-47.

Mein P., Martín Suárez E. 1994. *Galerix iberica* sp. nov. (Erinaceidae, Insectivora, Mammalia) from the Late Miocene and Early Pliocene of the Iberian Peninsula. *Géobios*, **26**(6): 723-730.

Mein P., Moissenet E., Adrover R. 1989-1990. Biostratigraphie du Néogène supérieur du bassin de Teruel. *Paleontologia i Evolució*, **23**: 121-139.

Mészáros L. 1997. *Kordosia*, a new genus for some Late Miocene Amblycoptini shrews (Mammalia, Insectivora). *Neues Jahrbuch für Geologie und Paläontologie,* Monatshefte 1997, **2**: 65-78.

Mészáros L. G. 1998. *Crusafontina* (Mammalia, Soricidae) from Late Miocene localities in Hungary. *Senckenbergiana lethaea*, **77**(1/2): 145-159.

Milne Edwards A. 1872. In David, A. Rapport adressé a MM. Les professeurs-administrateurs du Muséum d'Histoire Naturelle. *Nouvelles Archives du Muséum'histoire naturelle de Paris*, **7**(4): 92.

Novacek M. J. 1986. The skull of leptictid insectivorans and the higher-level classification of eutherian mammals. *Bulletin of the American Museum of Natural History*, **183**: 1-112.

Pallas P. S. 1811 [1831]. Zoographia Rosso-Asiatica, sistens omnium Animalium in extenso Imperio Rossico et adjacentibus maribus observatorum recensionem, domicillia, mores et descriptiones, anatomen atque icones plurimorum. [ICZN Opinion 212 – dates of volumes: 1&2: 1811, 3: 1814]. Petropoli, in officina Caes. acadamiae scientiarum, **1**: 133.

Petényi S. J. 1864. Hátragyott Munkai. Magyar Tudományos Akademia, **1**: 1-130.

Pomel N. A. 1848. Études sur les carnassierd insectivores. I. Insectivores fossils. II. Classification des insectivores. *Archives des sciences physiques et naturelles*, **9**: 244-257.

Qiu Zh. 1996. Middle Miocene micromammalian fauna from Tunggur, Nei Mongol. Institute of Vertebrate Paleontology and Paleoanthropology, Academia Sinica: 166-176. (In Chinese with English summary).

Rabeder G. 1970. Die Wirbeltierfauna aus dem Alt-Pliozän (O-Pannon) vom Eichkogel bei Mödling (NÖ). *Annalen des Naturhistorischen Museums*, **74**: 589-595.

Rabeder G. 1973. *Galerix* and *Lanthanotherium* (Erinaceidae, Insectivora) aus dem Pannon des Wiener Beckens. *Neues Jahrbuch für Geologie und Paläontologie*, **7**: 429-446.

Reumer J. W. F. 1984. Ruscinian and Early Pleistocene Soricidae (Insectivora, Mammalia) from Tegelen (The Netherlands) and Hungary. *Scripta Geologica*, **73**: 1-173.

Reumer J. W. F. 1987. Redefinition of the Soricidae and Heterosoricidae (Insectivora, Mammalia), with the description of the Crocidosoricinae, a new subfamily of Soricidae. *Revue de Paléobiologie*, **6**: 189-192.

Reumer J. W. F. 1989. Speciation and evolution in the Soricidae (Mammalia: Insectivora) in relation with the paleoclimate. *Revue Suisse de Zoologie*, **96**(1): 81-90.

Reumer J. W. F. 1998. A classification of the fossil and recent shrews. [In:] J. M. Wójcik, M. Wolsan (eds) – Evolution of shrews, Mammal Research Institute Polish Academy of Sciences, Białowieża: 5-22.

Rümke C. 1974. A new *Desmanella* species (Talpidae, Insectivora) from the Turolian of Concud and Los Mansuetos (prov. of Teruel, Spain). *Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen,* Serie B, **77**(4): 359-374.

Rümke C. 1976. Insectivora from Pikremi and Biodrak (Greece). *Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen*, Serie B, **79**(4): 256-270.

RÜMKE C. A. 1985. A review of fossil and recent Desmaninae (Talpidae, Insectivora). *Utrecht micropaleontological bulletins.* Special publication, **4**: 1-264.

RZEBIK-KOWALSKA B. 1975. The Pliocene and Pleistocene insectivores (Mammalia) of Poland. II. Soricidae: *Paranourosorex* and *Amblycoptus*. *Acta zoologica cracoviensia*, **20**: 167-182.

RZEBIK-KOWALSKA B. 1981. The Pliocene and Pleistocene Insectivora (Mammalia) of Poland. IV. Soricidae: *Neomysorex* n. g. and *Episoriculus* ELLERMAN et MORRISON-SCOTT, 1951. *Acta zoologica cracoviensia*, **25**: 227-250.

RZEBIK-KOWALSKA B. 1989. Pliocene and Pleistocene Insectivora (Mammalia) of Poland. V. Soricidae: *Petenyia* KORMOS, 1934 and *Blarinella* THOMAS, 1911. *Acta zoologica cracoviensia*, **32**: 521-546.

RZEBIK-KOWALSKA B. 1991. Pliocene and Pleistocene Insectivora (Mammalia) of Poland. VIII. Soricidae: *Sorex* LINNAEUS, 1758, *Neomys* KAUO, 1829, *Macroneomys* FEJFAR, 1966, *Paenelimnoecus* BAUDELOT, 1972 and Soricidae indeterminata. *Acta zoologica cracoviensia*, **34**: 323-424.

RZEBIK-KOWALSKA B. 1994. Insectivora (Mammalia) from the Miocene of Bełchatów in Poland. II. Soricidae FISCHER VON WALDHEIM, 1817. *Acta zoologica cracoviensia*, **37**: 137-155.

RZEBIK-KOWALSKA B. 1998. Fossil history of shrews in Europe. [In:] J. M. WÓJCIK, M. WOLSAN (eds) – Evolution of shrews, 23-92, Mammal Research Institute Polish Academy of Sciences, Białowieża.

RZEBIK-KOWALSKA B. 2002. The Pliocene and early Pleistocene Lipotyphla (Insectivora, Mammalia) from Romania. *Acta zoologica cracoviensia*, **45**(2): 251-281.

RZEBIK-KOWALSKA, B. 2005. Erinaceomorpha and Soricomorpha (Mammalia) from the Miocene of Bełchatów, Poland. IV. Erinaceidae FISCHER VON WALDHEIM, 1817 and Talpidae FISCHER VON WALDHEIM, 1817. *Acta zoologica cracoviensia*, **48**A(1-2): 71-91.

RZEBIK-KOWALSKA B. 2007. New data on Soricomorpha (Lipotyphla, Mammalia) from the Pliocene and Pleistocene of Transbaikalia and Irkutsk Region (Russia). *Acta zoologica cracoviensia*, **50**A(1-2): 15-48.

RZEBIK-KOWALSKA B., PAWŁOWSKI J. 1994. *Ruemkelia* (Mammalia, Insectivora, Talpidae) nom. nov. for *Dibolia* RÜMKE, 1985 (nec LATREILLE, 1829). *Acta zoologica cracoviensia*, **37** (1): 75-76.

RZEBIK-KOWALSKA B., TOPACHEVSKY V. O. 1997. Insectivora (Mammalia) from the Miocene of Grytsiv in Ukraine. I. Heterosoricidae VIRET and ZAPFE, 1951. *Acta zoologica cracoviensia*, **40**(2): 237-247.

SCHREUDER A. 1940. A revision of the fossil water-moles (Desmaninae). *Archives Néerlandaises de Zoologie*, **4**: 201-333.

SEN S. 1990. Stratigraphie, faunes de mammifères et magnétostratigraphie du Néogene de Sinap Tepe, Province d'Ankara, Turquie. *Bulletin du Muséum National d'Histoire Naturelle*, Série 4, Section C, Paris, **12**(3-4): 243-277.

SIGÉ B., CROCHET J.-Y., INSOLE A. 1977. Les plus vieilles taupes. *Geobios*, Lyon Mémoire spécial no.**1**: 141-157.

SKOCZEŃ S. 1976. Condylurini DOBSON, 1883 (Insectivora, Mammalia) in the Pliocene of Poland. *Acta zoologica cracoviensia*, **21**(8): 291-313.

SMITH R. 2007. Présence du genre *Eotalpa* (Mammalia, Talpida) dans l'Oligocène inférieur de Belgique (Formation de Borgloon, MP21). *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Sciences de la Terre*, **77**: 159-165.

ŞTIUCĂ E. 2003. Note préliminaire sur les mammifères du Miocénr de Reghiu (Dept. Vrancea, Roumanie). [In:] A. PETCULESCU, E. ŞTIUCĂ (eds) – Advances in Vertebrate Paleontology "Hen to Panta", A tribute to Constantine Răsulescu and Petre Mihail Samson: 113-116.

STORCH G. 1978. Die turolische Wirbeltierfauna von Dorn-Dürkheim, Rheinhessen (SW-Deutschland). 2. Mammalia: Insectivora. *Senckenbergiana lethaea*, **58**: 421-449.

STORCH G. 1995. The Neogene mammalian faunas of Ertemte and Harr Obo in Inner Mongolia (Nei Mongol), China. – 11. Soricidae (Insectivora). *Senckenbergiana lathaea*, **75**: 221-251.

STORCH G., DAHLMANN T. 2000. *Desmanella rietscheli*, ein neuer Talpide aus dem Obermiozän von Dorn-Dürkheim 1, Rheihessen (Mammalia, Lipotyphla). *Carolinea*, **58**: 65-69.

STORCH G., QIU Zh. 1991. Insectivores (Mammalia: Erinaceidae, Soricidae, Talpidae) from the Lufeng hominoid locality, Late Miocene of China. *Géobios*, **24**: 601-621.

STORCH G., QIU Zh., ZAZHIGIN V. S. 1998. Fossil history of shrews in Asia [In:] J. M. WÓJCIK, M. WOLSAN (eds) – Evolution of shrews, 92-117. Mammal Research Institute Polish Academy of Sciences, Białowieża.

THOMAS O. 1911. New mammals from Central and Western Asia, mostly collected by Mr. Douglas Carrthers. *The Annals and Magazine of Natural History*, London, Series 8, **8**: 758-762.

THOMAS O. 1912. On a collection of small mammals from the Tsin-ling Mountains, central China, presented by Mr. G. Fenwick Owen to the National Museum. *The Annals and Magazine of Natural History*, London **8/10**: 395-403.

TOPACHEVSKY V. O. 1966. A new genus of the big white-toothed shrew (Insectivora, Soricidae) from the Pliocene sediments of the southern Ukraine. [In:] Ekologija ta istorija chrebetnich fauni Ukraini, serija *"Problemi Zoologii"*, Naukova Dumka, Kiiv: 90-95. (In Ukrainian, with Russian summary).

TOPACHEVSKY V. O., PASHKOV A. V. 1983. A superspecific sistematics of the genus *Desmana* (Insectivora, Talpidae). *Vestnik Zoologii*, **3**: 39-45. (In Russian, with English summary).

VAN DAM J. 2004. Anourosoricini (Mammalia: Soricidae) from the Mediterranean region: a pre-Quaternary example of recurrent climate-controlled North-South range shifting. *Journal of Paleontology*, **78**(4): 741-764.

VIRET J., ZAPFE H. 1951. Sur quelques Soricidés miocènes. *Eclogae Geologicae Helvetiae*, **44**: 411-426.

VON MEYER H. 1865. Mittheilungen an Professor Bronn. *Neues Jahrbuch für Mineralogie, Geologie und Paläontologie,* Stuttgart: 215-221.

WAGLER J. G. 1832. Mittheilungen über einige merkwürdige Thiere. I. Säugethiere. *Isis von Oken* **1832**: 275 pp.

WILSON R. W. 1960. Early Miocene rodents and insectivores from northeastern Colorado. *The University of Kansas Paleontological Contributions*, Vertebrata, Article **7**: 1- 92

ZAPFE H. 1951. Die Fauna der miozänen Spaltenfüllung von Neudorf a. d. March (ČSR). Insectivora. *Sitzungsberichte der Österreichischen Akademie der Wissenschaften. Mathematisch-Naturwissenschaftliche Klasse*, **160**: 449-480.

ZIEGLER R. 1985. Talpiden (Mammalia, Insectivora) aus dem Orleanium und Astracium Bayerns. *Mitteilungen der Bayerischen Staatssammlung für Palaontologie und Historische Geologie*, **25**: 131-175.

ZIEGLER R. 1989. Heterosoricidae und Soricidae (Insectivora, Mammalia) aus dem Oberoligozän und Untermiozän Süddeutschlands. *Stuttgarter Beiträge zur Naturkunde aus dem Staatlichen Museum für Naturkunde,* Serie B, Stuttgart, **154**:1-73.

ZIEGLER R. 1990. Talpidae (Insectivora, Mammalia) aus dem Ober-oligozän und Untermiozän Süddeutschlands. *Stuttgarter Beiträge zur Naturkunde*, Serie B (*Geologie und Paläontologie*), **167**: 1-81.

ZIEGLER R. 1998. Wirbeltiere aus dem Unter-Miozän des Lignit-Tagebaues Oberdorf (Weststeirisches Becken, Österreich): 5. Marsupialia, Insectivora und Chiroptera (Mammalia). *Annalen des Naturhistorischen Museums*, **99A**: 43-97.

ZIEGLER R. 1999. Order Insectivora. [In:] E. ROSSNER, K. HEISSIG (eds) – The Miocene Land Mammals of Europe, 53-74. Verlag Dr Friedrich Pfeil, München.

ZIEGLER R. 2000. The Miocene Fossil-Lagerstätte Sandelzhausen, 17. Marsupialia, Lipotyphla and Chiroptera (Mammalia). *Senckenbergiana lethaea*, **80**(1): 81-127.

ZIEGLER R. 2003a. Insektenfresser (Lipotyphla) aus dem Mittel-Miozän von Mühlbach am Manhartsberg und Grund, Niederösterreich. *Annalen des Naturhistorischen Museums*, Wien, **104**A: 251-265.

ZIEGLER R. 2003b. Moles (Talpidae) from the late Middle Miocene of South Germany. *Acta Palaeontologica Polonica*, **48**(4): 617-648.

ZIEGLER R. 2005. Erinaceidae and Dimylidae (Lipotyphla) from the Upper Middle Miocene of South Germany. *Senckenberigiana lethaea*, **85**(1): 131-152.

ZIEGLER R. 2006. Insectivores (Lipotyphla) and bats (Chiroptera) from the Late Miocene of Austria. *Annalen des Naturhistorischen Museums, Wien,* **107**A: 93-196.

ZIEGLER R., DAXNER-HÖCK G. 2005. Austria. [In:] L. W. VAN DEN HOEK OSTENDE, C. S. DOUKAS, J. W. F. REUMER (eds) – The fossil record of the Eurasian Neogene insectivores (Erinaceomorpha, Soricomorpha, Mammalia). Part. I. *Scripta Geologica*, Special Issue, **5**: 11-29.

ZIEGLER R., FAHLBUSCH V. 1986. Kleinsäuger-Faunen aus der basalen Oberen Süsswasser-Molasse Niederbayerns. *Zitteliana*, **14**: 3-58.