Zorillas (Carnivora, Mustelidae, Ictonychini) from the Villafranchian of Bulgaria with a description of a new species of *Baranogale* Kormos, 1934

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ABSTRACT

Vormela petenyii Kretzoi, 1942 and *Baranogale balcanica* n. sp., the Ictonychini species from the Villafranchian locality of Varshets, Bulgaria (first half of the MNQ17 zone), which includes a total of 18 macromammalian species, are concerned. The fossils of *V. petenyii* (the earliest *Vormela* species), from Varshets, are among the very few known, and probably the oldest sure remains of this taxon. *B. balcanica* n. sp. differs from *B. helbingi* Kormos, 1934 mainly by its much smaller dimensions and by the combination of a reduced pm2 and the plesiomorphic condition of the pm4 and m2.

KEY WORDS
Carnivora,
Mustelidae,
Ictonychini,
Baranogale balcanica n. sp.,
Villafranchian,
Bulgaria,
new species.

RÉSUMÉ

Les zorilles (Carnivora, Mustelidae, Ictonychini) du Villafranchien de Bulgarie et description d'une espèce nouvelle de Baranogale *Kormos*, 1934.

Les restes de *Vormela petenyii* Kretzoi, 1942 et *Baranogale balcanica* n. sp. (Ictonychini) du site Villafranchien de Varshets (Bulgarie, première partie de la zone MNQ17), qui présente un total de 18 espèces, ont été décrits. Les vestiges de *V. petenyii* (le plus ancien représentant du genre) de Varshets sont parmi les très rares fossiles de l'espèce et, en même temps, sont probablement les plus anciens restes certains de ce taxon. *B. balcanica* n. sp. diffère de *B. helbingi* Kormos, 1934 surtout par ses dimensions beaucoup plus petites, ainsi que par la combinaison d'une pm2 réduite et des pm4 et m2 qui conservent une structure primitive.

MOTS CLÉS
Carnivora,
Mustelidae,
Ictonychini,
Baranogale balcanica n. sp.,
Villafranchien,
Bulgarie,
nouvelle espèce.

INTRODUCTION

Varshets, a very rich Villafranchian locality from Bulgaria, is recently studied. The faunal complex includes about 110 vertebrate taxa: amphibians, reptiles, birds, micro- and macromammals (Boev 1995; Popov & Delchev 1997; Spassov 1997a, b). The large mammals are represented by the families: Canidae Gray, 1821; Ursidae Gray, 1825; Mustelidae Swainson, 1835; Hyaenidae Gray, 1869; Felidae Gray, 1821; Cervidae Gray, 1821; Bovidae Gray, 1821 and Equidae Gray, 1821 (total of 18 species). The mammal megafauna of Varshets demonstrates an evident similarity with localities typical for the MNQ17 zone, such as Saint-Vallier and P. de Valverde. The finds of a primitive new *Gazellospira* sp. (the same taxon exists undescribed in Roccaneyra) (Spassov & Cregut-Bonnoure 1999), of *Nyctereutes* cf. *N. tingi* Tedford & Qiu, 1991, as well as the evolutionary stages of *Ursus* (between *U. minimus* D. de Chabriol & Bouillet, 1827 and *U. etruscus* Cuvier, 1823) and *Martes* (between *M. wenzensis* Stach, 1959 and *M. vetus* Kretzoi, 1942) put Varshets some earlier than Saint-Vallier, in the MNQ17 zone, most probably its first half. The Bulgarian locality seems to be approximately of the same age or most probably a little bit later than Roccaneyra, where the steppe faunistic element is better represented and where *Hipparion* De Christol, 1832 is still existing as a relict genus. The faunal composition suggests the existence of a landscape of mosaic character: open spaces and forests, or open forests (Spassov in press). The Ictonychini fossil remains are described below.

SYSTEMATICS

Subfamily MUSTELINAE Gill, 1872
Tribe ICTONYCHINI Pocock, 1921

Genus *Vormela* Blasius, 1884

DESCRIPTION

The genus *Vormela* has been regarded for a long time as closely connected with the polecats, *Mustela* (*Putorius*) Frisch, 1775, because of some common features in the general construction of the skull and the body (Heptner *et al.* 1967). Now *Vormela*'s close relationship to the recent African zorillas (*Ictonyx* Kaup, 1835, *Poecilictis* Thomas & Hinton, 1920 [considered by some authors as a synonym of *Ictonyx*, *cf.* Corbet 1978] and *Poecilogale* Thomas, 1883) could be considered firmly proved (Abelentsev 1968; Rabeder 1976). The genus *Vormela* (which probably also includes the fossil genus *Pliovormela* Kormos, 1934), together with the other above-mentioned genera and the fossil ones of *Baranogale* Kormos, 1934, *Oxyvormela* Rabeder, 1973 and *Propoecilogale* Petter, 1987, are united into a common tribe: the Ictonychini Pocock, 1921 (Rabeder 1976). The body features (in the recent forms) and the cranial and dental features of the forms included in the tribe are analyzed in details by Abelentsev (1968), Rabeder (1976) and Petter (1987). One of the typical features of the zorillas (tribe Ictonychini) is the existing bone connection between the bullae osseae and the hamuli pterygoidei. A similar connection exists also in *Lyncodon patagonicus* Blainville, 1942 from Argentina and Chile, whose systematic status is not quite clear, but can also occur in some central Asiatic-Siberian steppe polecats, *Mustela eversmanni* Lesson, 1827 (pers. obs.). However, it could turn out that this feature is not archaic, but a homoplasy.

Judging after the contemporary representatives, typical for the Ictonychini is a warning coloration, combined with scent glands and characteristic aggressive-threatening postures (Spassov & Spiridonov 1993). Those precautions seem to be directed mainly against other relatively small carnivores: rivals and enemies in conditions of more or less open habitats and an activity mostly in the night. The evolution of the color pattern of recent species and genera could be used for a reconstruction of the coloration of the fossil Pliocene forms living in conditions similar to those of the recent savanna representatives. In my opinion, the striped color pattern is the more primitive one for extant zorillas. In this case, it is accompanied by a bright band on the head (in the recent forms it is on the stage of disinte-

TABLE 1. — *Vormela* (*P.*) *petenyii* from Varshets. Comparative mandible and teeth dimensions (all measurements in this and the following tables, in mm, taken with ocular-micrometer technique).

Species	***V. petenyii***	***V. petenyii***	***V. peregusna***
Localities	Varshets	Villany	NMNH, Sofia
Measurements		(after Kormos 1934)	
Length of pm4	3.6	3.55-4.2 (n = 2)	-
Width of pm4	2	2.2-2.4 (n = 2)	2.0-2.4 (n = 7; ♂ + ♀)
Length of m1	6.9	6.3-6.85 (n = 3)	6.6-7.2 (n = 10; ♂ + ♀)
Talonid length of m1	2.3	-	-
Width of i1	2.9	2.7-3.0	2.9-3.1 (n = 4)
Metaconid length of m1 (to the bottom of the talonid valley)	2.1	-	-
Length of the paraconid (taken lingually)	2.3	(?) 2.4-2.5 (n = 3)	-
Length of c1-m1 (at the alveoli)	20.5	-	20.0-21.8 (n = 4 ♂ + 2 ♀)
Mandible height under i1 (taken lingually)	7	5.8-7.3 (n = 4)	6.6-7.5 (n = 6 ♂ + 2 ♀)
Transversal width of the mandible under m1 (taken lingually)	4	-	3.7-4.1 (n = 4 ♂ + 2 ♀)
Mesio-distal length of upper M1	2.4	-	2.3-2.6 (n = 5; ♂ + ♀)
Vestibulo-lingual width of the upper M1	5.2	-	5.2-5.7 (n = 5; ♂ + ♀)

gration in various degree). The most primitive coloration pattern is that of the South African *Ictonyx* (and of *Poecilogale*, if not considering its head coloration). *Ictonyx* also has, after the author's observations, the most primitive dental morphology and can occur in quite various biotopes. The disintegration of the strips on the back could be traced from *Ictonyx* through *Poecilictis* of North Africa to the Palearctic *Vormela* (Spassov & Spiridonov 1993). The relative primitivity of the *Ictonyx* skull and teeth, as well as the archaic coloration of the African forms suggest that Africa's savanna conditions are to a great extent relict for the group. Thus, the tribe is most possibly of African or African/Middle East origin.

The fossil remains and described forms of *Vormela* are rather scarce. Except for the several late Pleistocene remains of recent *V. peregusna* Guldenstaedt, 1884 (Spassov & Spiridonov 1993), the following fossil forms are also described: *Vormela* (? *Pliovormela*) *petenyii* Kretzoi, 1942, known from the end of the middle (the beginning of the late?) Villafranchian: Villany-Kalkberg-Nord, and Ostramos 3 (or, even from the Ruscinian?: Podlesice, *cf.* below). The species exists up to the end of the early Pleistocene of central Europe (Hungary, Poland) (Kormos 1934; Kretzoi 1942; Kowalski 1959; Janossy 1986; Wolsan 1993a). The single teeth from the Ruscinian locality Podlesice in Poland, referred by Kowalski (1959) to *V. petenyii* Kretzoi, 1942, cannot be considered belonging to that genus for certain (Wolsan 1989). Rabeder (1976) attributes some scarce remnants from the beginning of the Pleistocene of Deutsch-Altenburg-2 to *Vormela* sp., due to the several differences between both the fossil and the recent species. Outside Europe, Teilhard de Chardin & Leroy (1945) have described *Vormela prisca* from the middle/early Villafranchian of China (Yushe).

Kretzoi (1942) considers genus *Pliovormela* Kormos from Hungary (Villany) as synonymous with the recent *Vormela.* Until recently, almost all authors accepted this generic unification of the fossil European form with the recent one. Petter (1987) pointed out a number of plesiomorphies in the European fossil form described by Kormos (1934), thus arguing the restoration of its independent generic position. In fact, to those features mentioned by Petter we could add

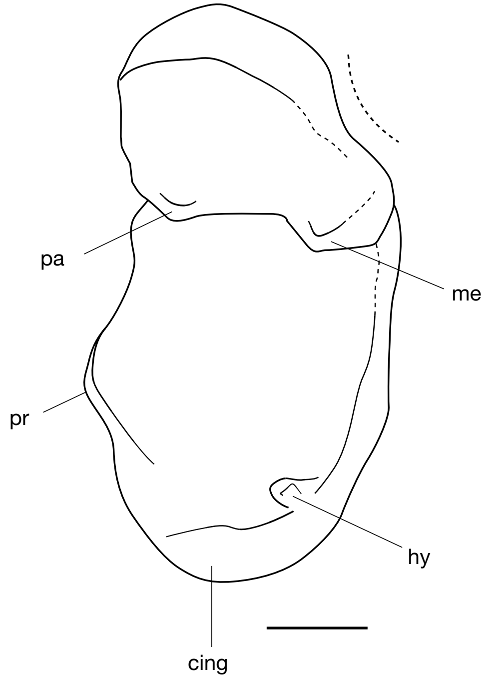

FIG. 1. — *Vormela petenyii* from Varshets, upper M1, occlusial view. Abbreviations: **cing**, cingulum; **hy**, hypocone; **me**, metacone; **pa**, paracone; **pr**, protocone. Scale bar: 1 mm.

other obvious differences announced by Kormos: two-rooted pm2, presence in most cases of an additional hind cuspid on the lower pm4, and a big metaconid on the lower carnassial. It should be noted, however, that in fact all these features represent a plesiomorphic stage of evolutionary tendencies typical for the zorillas (bicuspidity or birootness of premolars in process of reduction, strong metaconid on the lower m1, clear differentiation of meta- and paracone on the upper M2, etc.), or some kind of features are connected with ecological adaptations (dimension and degree of convexity of the bullae osseae, etc.). Some of the discussed diagnostic "generic" features are difficult to distinct. Also, there are individuals of the recent *V. peregusna* demonstrating an intermediate state of manifestation. Such, for instance, are: the position of the protocone on the upper PM4, the manifestation degree of the labial cingulum on the lower pm4, the presence of a paraconid on the lower m2. In many cases, such features have been classified as differences on a specific level in the evolution of a number of carnivores. Therefore the problem of the category of differences between "*V*". *petenyii* and *V. peregusna* is not easy and its final solving demands further investigations preferably using new fossil material. The numerous characters mentioned above are an indication for strong differences, specific at least. Until the final solution of this problem, the suggestion by Kretzoi that *Pliovormela* is congeneric with *Vormela* seems to be the most reasonable.

Vormela petenyii Kretzoi, 1942

Pliovormela beremendensis (Petenyi, 1864). — Kormos 1934.
Vormela petenyii Kretzoi, 1942.
Vormela beremendensis – Kurten 1968.
Pliovormela petenyii (Kretzoi, 1942). — Petter 1987.

LOCALITY AND BIOSTRATIGRAPHIC DISTRIBUTION. — Varshets, late Pliocene (middle Villafranchian, zone MNQ17, most probably its first half).

MATERIAL STUDIED. — Fragment of a right semimandible with pm4-m1 (FM 899); left M1 (coll. National Museum of Natural History, Sofia, Bulgaria) (Table 1; Figs 1-3).

DESCRIPTION AND COMPARISON

M1

The occlusial morphology of this tooth is well-presented due to the fact that it belongs to a young animal and its occlusial surface is practically not worn out. In its form – lacking a constriction in the middle –, it looks typical for the zorillas Ictonychini (Kowalski 1959). It differs morphologically from the corresponding *Baranogale* tooth in its much more reduced (far from the primitive tooth form) labial part: not so wide and with much weaker para- and metacone, but with a much more developed labial cingulum. In its shape and size (Table 1) it is within the limits of a small *V. peregusna*.

Unlike this species, the tooth morphology shows some plesiomorphic states (Fig. 1): while the para- and the metacone of *V. peregusna* are almost entirely merged in a common crest, here they are well-separated and somewhat better developed, especially the metacone which is apparently protruding although not with such a large surface as the paracone. Due to the distinct metacone, the labiodistal margin of the tooth is somewhat more concave than in the modern species. The big cusp near the mesial surface of the lingual part of the tooth must be considered a protocone. This protocone appears stronger than in *V. peregusna*. It is situated almost parallel to the mesial edge of this part of the tooth and in fact immediately upon it. The protocone is removed somewhat labially than in *V. peregusna*. The hypocone, though quite vestigial, could be observed (no trace of a hypocone could be found on all the four unworn teeth of young *V. peregusna* studied by me). The labial and the lingual cingulum are more distinct than those in the recent species. The labial portion of the tooth is less reduced compared to the recent form. That makes the tooth appear not so lingually broadening. Unlike the Varshets specimen, a slight broadening in lingual direction is usually observed in the recent species, where the mesial edge is also somewhat more concave in its middle part.

The development of the para- and metacone and of the cingula, as well as the position of the protocone, are analogous to those in *V. petenyii*, if judging after the characteristics in the cladogram of Petter (1987).

Mandible

In general, the mandible and the teeth do not differ in dimensions from those of the recent species *V. peregusna*, having at the same time the dimensions and proportions of *V.* (*P.*) *petenyii* (Table 1). Compared to those of the recent species, pm4 and m1 of the fossil one appear somewhat more slender; the first one maybe been adapted to breaking of bigger rodents' bones.

The alveoli of pm2 indicate that the tooth is positioned almost transversally against the tooth row in the jaw and has two roots which are fused towards the crown. Such is also the position of that tooth with the fossil *V. petenyii* from Europe and *V. prisca* from China. Such a position of the tooth (almost vertical) which is connected to the reduction tendencies of the front premolars in many of carnivores and especially the polecats, is possible in a number of recent individuals. The position of the tooth in such occasions is an individual feature. Nevertheless, this feature, seemingly occurring as a rule in the fossil remains of *Vormela* s.l. and combined with birootness, has some taxonomical value representing a certain stage of evolution (in 35 examined specimens of *V. peregusna* from Bulgaria the tooth is one-rooted and normally positioned).


FIG. 2. — *Vormela petenyii* from Varshets, stereophotography of mandible (FM 899), occlusial view. Scale bar: 5 mm.

The alveoli of pm3 demonstrate a strong reduction of the fore root, similar to that with the recent species. They are situated on the jaw not obliquely, as it is with the fossil Chinese species, in which this feature suggests a shortening of the mandible's rostral area (Fig. 2). The irregular growth of the tooth with the specimen from China (the feature is, possibly, variable in *V. prisca*) is probably related to the unfinished tendencies of reduction of pm2-3 with the shortening of the mandible (*V. peregusna* has these two teeth more shortened).

The pm4 appears in profile somewhat more conical than that of the recent species. It has a well-visible additional conid on its distal edge and an obvious mesolabial cingulum. After these features the tooth's morphology is similar to the pm4 of *V.* (*P.*) *petenyii*, where the additional conid is often developed (Kormos 1934). The specimen of *V. prisca* lacks that conid. That lack seems to be a rule in the recent species too. None of the 35 *Vormela peregusna* specimens (coll. of the National Museum of Natural History, Bulgarian Academy of Sciences) shows a similar conid. At the same time, the specimens I have compared, usually have the mesiolabial cingulum weakly developed or absent. Separate individuals only possess a more or less well-developed cingulum, but, anyway, somewhat weaker than that of the fossil mandible.

The overall morphology of m1 looks quite similar to that of the recent marbled polecat. It is a little more brachyodont. Its paraconid is somewhat lower and proportionally shorter, the metaconid is proportionally longer and the talonid longer than in the recent species (a plesiomorphic stage). The entoconid is, like the recent species, not pronounced. In conformity with the long talonid, the hypoconid, related to the long talonid, is elongated but more slender. Its apex is worn, i.e. uncomparable with the recent species, but its form at the base suggests that the hypoconid is (contrary to the opinion of Petter 1987) hardly less cutting than that of *V. peregusna*. Besides, Teilhard de Chardin & Leroy (1945) also note a less cutting (?) talonid in the China fossil form than that of the recent one. The position of the hypoconid in the recent specimens, however, can vary: more labial, or more towards the middle of the talonid.

The mandible bears the typical *Vormela* features: high and thick, with a robust and almost vertical symphysis (Fig. 3). Two mandibular foramens can be observed in the rostral area.

DISCUSSION

After its morphology, *V. petenyii* shows plesiomorphic stages of a number of features compared to the recent species. There is a good reason to suggest a direct origin for *V. peregusna* from *V. petenyii*. As to *V. prisca*, described after one mandible only, it shows a mosaic of the features of the two above-mentioned species. In general, this form which seems to be of the same age as *V. petenyii* (after the existing data) is morphologically an intermediate stage of evolution.

The mandible from Varshets differs from that of *V. prisca* Teilhard de Chardin & Leroy, 1945 and even more from that of *V. peregusna*. It is fully corresponding to the description of *V. petenyii* from Hungarian Pliocene. The same could be said about the M1, which is more plesiomorphic than the tooth of the recent species and has the features of the fossil Hungarian species.

The remains from Varshets seem to be the oldest certain ones of *Vormela petenyii*.

Genus *Baranogale* Kormos, 1934

DESCRIPTION

The genus is for the moment monospecific. It is described from the late Pliocene of Villany, Hungary (zone MNQ17/18) after a fragment of a mandible referred by Kormos (1934) to a new genus and species – *Baranogale helbingi* (= *B. beremendensis* [Petenyi, 1864] *sensu* Kretzoi 1942) (the synonymy and the problems of name priority are clarified by Kretzoi 1942 and above all by Kowalski 1959). Fossil remains from this species have also been found in another neighbouring Hungarian locality: Csarnota 2, MNQ15 (or MNQ16?; see the Villafranchian appearance of the bovids from the site) (Janossy 1986). *Zorilla fossilis* Bravard (? *Rabdogale antiqua* Pomel, 1853) from the early Villafranchian of Perrier (France) is also referred to that form by Schaub (1949) and Viret (1954) (see also Petter 1964). The species is also presented in France, in the well-known locality Saint-Vallier (MNQ17) (Viret 1954), as well as in three localities in Poland (Wolsan 1989). The earliest appearance of *B. helbingi* Kormos, 1934 is namely in one of them: Podlesice (early Ruscine). The belonging of *Baranogale adroveri* Petter, 1964 (Petter 1964) to the genus *Baranogale* is doubtful. This

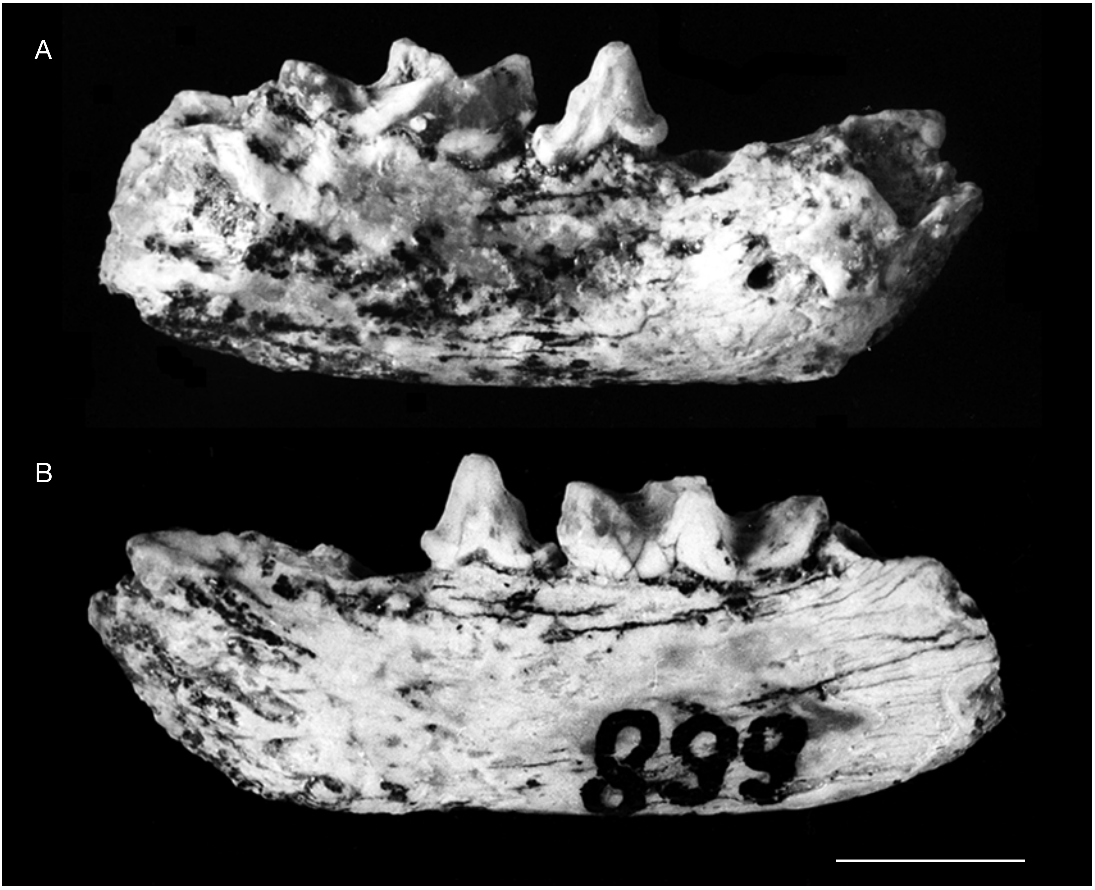

FIG. 3. — *Vormela petenyii* from Varshets, mandible (FM 899); **A**, labial view; **B**, lingual view. Scale bar: 5 mm.

"*Baranogale*" species is rather early (Turolian) and very large. It is known from two mandible fragments. The c1 lacks the strongly outlined distal edge (typical for *Baranogale*) of the vertical (longitudinal) crest visible on the lingual surface. The pm4 and m1 are also not quite typical: the pm4 is rather apomorphic, long and robust, with reduced additional distal cuspid compared to *Baranogale helbingi*. The talonid of m1 is also relatively reduced for a Turolian representative of the genus, reduced in comparison to *B. helbingi*. The m1 metaconid is robust compared to the known *Baranogale*.

Very recently a mandible from the middle Villafranchian of Greece-Dafnero was described as *B.* cf. *helbingi* (Koufos & Kostopoulos 1997). In central Europe, the species *B. helbingi* continues to exists also in the Eburonian with the latest certain fossils known (Wolsan 1993a).

Baranogale balcanica n. sp.
(Fig. 4)

HOLOTYPE. — Right semimandible with c1-m2 (FM 901), coll. National Museum of Natural History, Sofia, Bulgaria (the region of ramus ascendens lacking).

ETYMOLOGY. — From the name of the Balkan peninsula where the remains of the new species were found.

MATERIAL REFERRED. — Left semimandible with i2-m2 (FM 900), most probably belonging to the same

FIG. 4. — *Baranogale balcanica* n. sp., mandible (FM 901); **A**, labial view; **B**, lingual view. Scale bar: 5 mm.

individual as FM 901; palatum durum (FM 902) with the alveoli of C1-PM4 sin.; cranial rostrum (FM 903) with I1-2 sin. and C1 dex.

LOCALITY AND BIOCHRONOLOGIC POSITION. — Varshets, late Pliocene (middle Villafranchian, zone MNQ17, probably its first half).

DIAGNOSIS. — Dimensions very small (length of mandibular tooth row: c1-m2 of the type = 17.0 mm). Mandibular pm2 strongly reduced, much lower than pm3. pm4 with plesiomorphic features (short and high, with a well-formed, high positioned and pointed additional posterior conid). Metaconid of m1 very well-differentiated, its apex obliquely pointing, i.e. not only upward, but also in lingual-mesial direction. m2 elongated, with well-pronounced posterior and especially anterior cingula, and with a vestigial paraconid present. The longitudinal sulcus on the lingual surface of the upper canine, very strongly marked.

The new species, *B. balcanica* n. sp., differs from *B. helbingi* Kormos (and all the finds presently considered to be *Baranogale*) mainly by its much smaller dimensions and by the combination of a reduced pm2 and the noted plesiomorphic condition of pm4 and m2.

TABLE 2. — *Baranogale balcanica* n. sp.; comparative mandible dimensions.

Species	***B. balcanica* n. sp.**	***B. helbingi***	***B. helbingi***	***B. helbingi***	***B. helbingi***	***B.* aff. *helbingi***
Localities	Varshets	Villany Holotype (Kormos 1934)	Étouaires (Schaub 1959)	Saint-Vallier	Podlesice (Kowalski 1959)	Dafnero (Koufos & Kostopoulos 1997)
Measurements	FM 901; FM 900		(original measurements)	(original measurements)		
Length of m1	5.5; 5.5	7.4	7.7	8.7; 7.8	7	9.5
Length of m1	2.3; 2.3	2.75	3.1	3.8; -	2.4	4.1
Length of the talonid of m1 (lingually)	2.1; 2.1	2.45	-	-	-	-
Length of m2	2.0; 1.7 (broken)	1.5 (alv.)	2.1 (orig.) (alv.)	2.9; 2.6	-	3.7
Width of m2	1.3	-	-	2.7; 2.9	-	3.6
Length of pm4	3.1; 3.3	4.45	4.7 (orig.)	4.9	4.4	7.3
Width of pm4	1.8; 1.8	2	2.25	-	-	2.8
Length of pm3	2.5; 2.7	3.6	3.76	-	3.3	6.2
Width of pm3	1.6; 1.6	-	-	-	-	2.5
Length of pm2	1.6; 1.8	-	3.28	-	2.8 (alv.)	2.6
Mesio-distal diameter of c1	2.2; 2.2 (alv.)	-	3.8; 3.9 (orig.)	-	-	-
Height of c1	< 4.4; -	-	-	-	-	-
Teeth row length: c1-m2 (alv.)	17.1; 17.0	-	26.9	28.9; 29.8	-	-
Length pm2-m2	14.7	20	21.5	-	18.6	33.3
Transversal mandible width under m1	2.6; -	-	3.45 (orig.)	4.8	-	-
Mandible height under m1 (lingually)	4.8; -	-	6.9 (orig.)	8	-	-

DESCRIPTION

Mandible (FM 900; 901)

Very small (Table 2), at the upper limit of the variability, or a little bit bigger than in the recent stoat. It is relatively slender for a zorilla, narrow, with both the ventral shape of its body and the cranial shape of the symphysis slightly convex (Fig. 4). Two foramina mentale (one on the level of the mesial and the other on the level of the distal end of pm3) are present on the labial surface. Another foramen can also be observed immediately behind the anterior edge of the symphysis (below the incisors).

Incisors i2 and i3 with almost equally sized crowns (with a slight dimensional domination of i3). Radix of i2 distally slightly taken off from that of i3.

The canine (c1) is quite slender, strongly curved, its tip pointing slightly obliquely, upwards and backwards, with a strong bend on the anterior (mesial) edge. A strong lingual cingulum is situated in the base of the canine tooth; that cingulum continues up the lingual surface, thus forming a strong vertical (longitudinal) crest. This crest has a distinctly marked distal contour, thus being distally strongly separated from the tooth surface.

Premolars and molars, like the mandible, narrow. pm2 strongly reduced and, after the shape and degree of reduction, resembling that of recent *V. peregusna* (Fig. 5). The point of this tooth rather asymmetrical, situated on the mesial surface and obliquely pointing up- and forwards. The tooth point is at least twice lower than that of pm3. It is difficult to decide without destroying the

FIG. 5. — *Baranogale balcanica* n. sp., mandible (FM 900); **A**, labial view; **B**, lingual view. Scale bar: 5 mm.

mandible if pm2 has one or two roots: the labial view of the mandible FM 901 (holotype) and the place of the observable posterior radix (strongly displaced toward the distal portion of the tooth) suggests the existence of two radices. The first of them is rather strongly reduced resembling *Ictonyx*.

pm3 is conical, high and short, slightly asymmetrical, with a mesial margin somewhat longer than the distal one. Posterior cuspid (i.e. metaconid) lacking. Anterior and posterior talonids (cingula) are well-pronounced, especially the posterior one. Tooth apex (which is only slightly worn occlusially) is nearly at the same level as that of pm4 (Fig. 5).

pm4 relatively narrow, rather short and high, conical, with its anterior and posterior edges nearly symmetrical (the point of the tooth in mandible FM 901 is damaged). The additional posterior cuspid (= metaconid; = deuteroconid) well-developed, well-formed and high positioned. The tooth points strictly upward, in one of the mandibles (FM 901) slightly deviating backwards (Figs 4; 5). Anterior and posterior cingula are very strong, forming well-developed para- and metastylids. The cingulum is relatively well-pronounced on the lingual surface of the tooth too but not that strongly on the labial one. The occlusial view of the tooth shows a double pinch at the level between the parastyle and the protoconid (the main apex).

m1 narrow and elongated, its talonid moderately long. Anterior ridge of paraconid oblique. The length of the paraconid is nearly the same as that of the protoconid and its apex is situated considerably lower than the apices of both the protoconid and pm4. Metaconid well-developed, clearly separated from the protoconid. Its apex deviating from the latter in lingual direction, pointing slightly distally, thus projecting backwards behind the distal wall of the protoconid. Hypoconid on the mandible FM 901 rather destroyed; on mandible FM 900 the latter occupies almost the entire labial portion of the talonid. It is a high and well-shaped cuspid, although it has a cutting, crest-like occlusial surface. The entoconid is in both cases damaged. It is kind of a peripheral lingual edge of the talonid, much lower than the hypoconid, but shaped as an raised and cutting ridge. The surface of the talonid, closed between the hypo- and entoconid, resembles a deep valley.

m2 on the left semimandible (FM 900) partially destroyed, the cuspids of the tooth from the right semimandible (holotype FM 901) slightly damaged. The two teeth are not completely uniform and hint at a possible individual variability in this tooth. It seems that they were of different length and the left one was somewhat shorter, although proportionally large for a m2 of *Baranogale*. It is situated slightly obliquely against m1. Obviously it has well-developed proto- and metaconid. The preserved fragment of the anterior cingulum is rather strong suggesting that the cingulum was well-pronounced. Right m2 (holotype FM 901), which is almost wholly preserved, is elongate in shape, with large main cuspids, proto- and metaconid. Anterior and posterior cingula are very strong and elongated. The anterior cingulum could be considered a vestigial paraconid (Fig. 6).

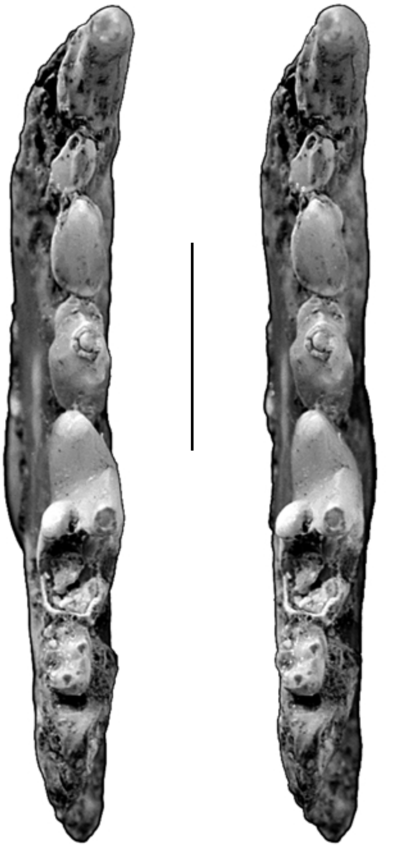

FIG. 6. — *Baranogale balcanica* n. sp., stereophotography of mandible (FM 901), occlusial view. Scale bar: 5 mm.

Rostrum (FM 903)

More gracile than that of *Vormela*, with relatively not so large intercanine distance. Nasal foramen relatively rounded, quite wide (a little more wide than high) (Table 3; Fig. 7).

The I2 and I3 preserved on the rostral fragment and the minute alveolus of the I1 demonstrate a considerable enlargement of the upper incisors from I1 to I3, the last one appearing asymmetrically lanceolate in profile.

The upper canine shows a longitudinal crest starting at the base of the tooth as a lingual cingulum. This crest is well-marked on the mesiolingual surface along the entire tooth. On the frontal surface of the tooth, parallel to the crest, there is a shallow longitudinal furrow. Another one is

FIG. 7. — *Baranogale balcanica* n. sp., rostral fragment (FM 903), frontal view. Scale bar: 5 mm.

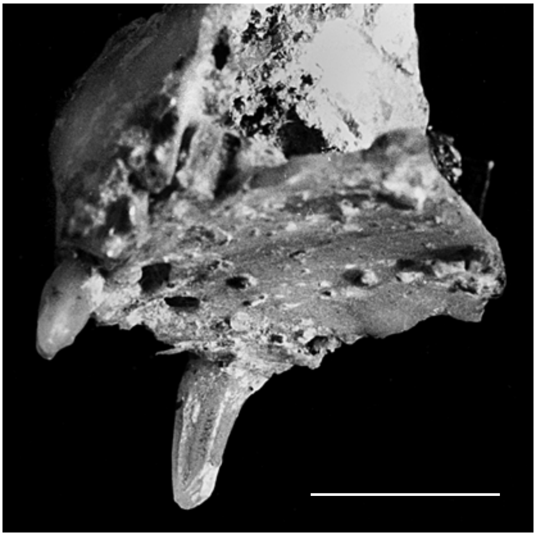

FIG. 8. — *Baranogale balcanica* n. sp., rostral fragment (FM 903), latero-ventral view. The lingual morphology of the right canine is shown. Scale bar: 5 mm.

present, immediately behind the crest, very well-pronounced and deep, along its whole length (Fig. 8).

Palatine fragment (FM 902) (Fig. 9)

Foramen infraorbitale very small. Its posterior edge is at the level of the alveolus's middle, below the paracone. The palatine fissures (as in fragment FM 903) have the characteristic shape of a drop, with their pointed caudal ends diverging latero-caudally, their inner margins well-formed, straight and parallel to each other.

There are two alveoli for the PM2. Alveoli of C1-PM4 situated without gaps between the teeth and show that the anterior premolars had a regular position (not obliquely or transversally against the cheek-teeth row). This suggests a relatively shortened muzzle. The alveolus for the root below the PM4's protocone does not reach mesially the alveolus for the anterior radix situated on the labial surface of the tooth. That indicates that most probably the protocone does not reach frontally the level of the parastyle.

COMPARISON

The morphology of the lower carnassial tooth is, as a whole, progressive, being specialized toward predation; para- and protoconid well-drawn apart (in occlusial view – the paraconid and protoconid cutting edges – at one line); the m1 talonid is relatively small, simplified and narrow with a strongly cutting hypoconid. The features just mentioned, the narrow premolars, and the strong reduction of the rostral area of the mandible in this Pliocene species, together with the peculiarities of the upper canine, are principally separating this species from the herpestids and the viverrids, allowing their comparison with some of the more advanced Mustelinae.

Comparison with the fossil Mustelini pigmies from the Ruscinian, Villafranchian and Biharian

Very small *Mustela* or *Mustela*-like forms dimensionally comparable to *B. balcanica* n. sp. have been described from the Pliocene and the beginning of Pleistocene of Europe. *Psalidogale altenburgensis* Rabeder, 1976 is known from the early Pleistocene (Biharian) of Deutsch-Altenburg 2

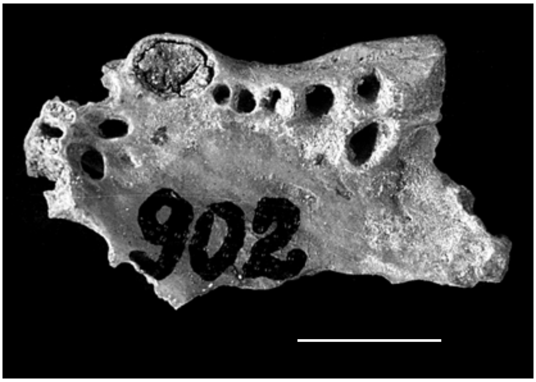

FIG. 9. — *Baranogale balcanica* n. sp., palatine fragment (FM 902), ventral view. Scale bar: 5 mm.

(Rabeder 1976). The taxonomic status of this form (mentioned also, though as doubtful, in the faunal list of Ostramos 7, MNQ17; Janossy 1986) is not clear enough. Probably this is a Mustelini representative. *Mustela pliocaenica* Stach, 1959, and *M. plioerminea* Stach, 1959 have been described from Weze (Poland) from the late Ruscinian (MNQ15) (Stach 1959). The earliest *M. palerminea* (Petenyi, 1864) and *M. praenivalis* Kormos, 1934, both typical for some later epochs (Wolsan 1993a), have probably been found as early as the early Villafranchian of Hungary (Janossy 1986).

B. balcanica n. sp. differs from *Psalidogale altenburgensis* in: its unreduced m2 bearing a complicated relief; the presence of a metaconid on m1; the plesiomorphic state of the talonid of this tooth, with a hypoconid positioned on the buccal talonid edge and with an inner concave talonid valley.

The new species differs from the Ruscinian *Mustela pliocaenica* in: its primitive, short and high pm3-pm4; the presence of an additional posterior cuspid on the pm4; the presence of a metaconid on m1.

Compared with both *Mustela palerminea* and *M. praenivalis*, the new species could be identified mostly after the following features: the metaconid on the lower carnassial tooth is present and strongly developed; the plesiomorphic state of the talonid (see the comparison with *Psalidogale*); the existence of an additional posterior cuspid on pm4; unreduced m2 with complicated relief.

The comparison with *Mustela plioerminea* is not easy because in the compared remains identical and taxonomically important morphological elements are almost lacking. After the photography in Stach's (1959) paper, the protocone of *M. plioerminea*'s PM4 is quite smaller. The bullae osseae in this species are typical for *Mustela*. The entire cranial morphology of *M. plioerminea*, according to Stach, is quite similar to *M. erminea* L., 1758 and *M. paleriminea*. *B. balcanica* n. sp. shows the following features: presence of a frontal furrow and a strong lingual furrow on the upper canine; combination of reduced premolars and a m1 with a developed metaconid (see the description and the comparison below); a feeble infraorbital foramen. Such features suggest that the new species belongs to an entirely different taxonomical group than *Mustela* and Mustelini as a whole.

The above-mentioned features indicated close relations with the zorillas-Ictonychini (Rabeder 1976), and the phyletic line of the Eurasian zorillas in particular (Petter 1987).

Comparison with the recent and fossil Ictonychini

From the highly specialized *Poecilogale* Thomas, *B. balcanica* n. sp. differs considerably in a series of features and most of all: the less reduced premolar number (presence of three and not two as in *Poecilogale*); the presence of a posterior additional cuspid on pm4; presence of a metaconid on m1 (lacking in *Poecilogale*); more plesiomorphic m2 (in *Poecilogale* the tooth is reduced and unicuspidate); the bigger talonid on m1; the relatively shorter diastema between maxillar C1-I3; the strong lingual furrow on the upper canine, and more pointed and laterally diverging caudal ends of palatine fissures; and the relatively smaller dimensions.

Compared to the fossil *Propoecilogale* Petter, *B. balcanica* n. sp. differs in: its less reduced talonid on m1, and the more archaic – labial – situation of its hypoconid; the presence of a metaconid on pm4 (as far as one can judge for its absence after one specimen only; see Petter

Table 3. — *Baranogale balcanica* n. sp.; comparative skull and upper teeth measurements. For *Baranogale* of Saint-Vallier, author's measurements (Muséum d'Histoire naturelle de Lyon).

	Nasal opening transversal diameter	**Nasal opening vertical diameter**	**C1-PM3 length**	**C1 mesio-distal Diameter**
B. balcanica FM 903	5.6	5	-	2.3 sin. (2.7 alv.) 2.2 dext.
B. balcanica FM 902	-	-	6.9	2.7 (alv.)
Baranogale Saint-Vallier				
161908	6.9	8.3	-	-
16195	7.7	-	-	-

1987); the not so mesially displaced protocone on the PM4 (as far as it could be judged after the corresponding alveolus); and the rostrum which appears more elongated and narrow.

B. balcanica n. sp. can easily be distinguished from the strongly evolved fossil genus *Oxyvormela* Rabeder (Rabeder 1973) by: its less massive rostrum; better developed and more mesially situated protocone of the upper canine; considerably longer, having a complicated relief, plesiomorphic m1; the unreduced metaconid of the m1 and its more archaic and elongated talonid; the lesser reduction of the anterior premolars of the mandible and the presence of a metaconid on pm4; the less massive mandible.

Main features which distinguish *B. balcanica* n. sp. from *Vormela petenyii* are: considerably more gracile mandible, obviously narrower and lower, the symphysis not so massive and more oblique; double pinched (buccally and lingually) pm4; more plesiomorphic m2, with strong lingual and buccal cuspids, somewhat lesser reduction of the rostral part of the mandible (pm2 normally and not obliquely positioned, pressed by the other teeth); the higher positioned metaconid of the pm4; the seemingly more concave talonid and more separate metaconid of m1; the very strong longitudinal furrow on the lingual surface of the upper canine; the more elongated and not so massive cranial rostrum; the smaller dimensions.

The differences between the new species on one hand, and *V. prisca* and the recent *V. peregusna*, on the other, are even greater. Besides those already mentioned, we could also add the lack of a metaconid on the pm4 in those two species. In the two *Vormela* species this tooth is longer and lower too.

B. balcanica n. sp. differs from *Ictonyx* Kaup in: the presence of an anterior and a lingual furrow on the upper canine; more plesiomorphic, short pm4, with a metaconid situated higher; the convex ventral surface of the mandibular corpus; the shorter rostral portion of the mandible (lacking gaps between c1 and pm2 and between pm2 and pm3); the considerably smaller dimensions; the protocone of the upper PM4 is not so protruding mesially in front of the tooth's parastyle. Besides, the pm3 of *Ictonyx* usually has a metaconid (vestigial at least), and fissura palatini, although similar in shape, has a caudal end that is some more prolonged and not so pointed.

The fossils from Varshets demonstrate a series of similarities with *Poecilictis* Thomas & Hinton, including the shape of the palatine fissures. The jaws from Varshets are somewhat smaller than those of the recent *Poecilictis*; only the teeth of the fossil *P. l. minor* from Morocco (about 2.5 My.) are also very small (Geraads 1997). *B. balcanica* n. sp. differs from that genus in the presence of an anterior and a lingual furrow on C1, which are lacking in *Poecilictis* (Petter 1987); the plesiomorphic, more elongated and bearing strong cuspids m2, as well as the absence of an additional posterior cuspid (metaconid) on the pm3. In general, the presence of such a cuspid on pm3 could be an individual and not a taxonomic feature. In *Poecilictis*, however, its presence is a typical character, while both mandibles from Varshets lack any trace of such a feature.

Comparison with Baranogale

Of all zorillas, the fossils from Varshets are most similar to the genus *Baranogale*. In fact, they possess all the main features of that genus (Schaub 1949; Viret 1954; Kowalski 1959; Petter 1987, and also author's own observations): mesiolingual ridge on upper canine, forming in front an behind the tooth very strong longitudinal furrows; protocone on PM4 not exceeding mesially the parastyle; PM2 with two well-developed roots; relatively elongated and not massive (compared to the specialized zorillas) rostrum; the infraorbital foramen has the as in *Baranogale*; the palatinal fissures same in shape, with their medial margins elongate and parallel; the mandible quite gracile and elongated, its ventral outline convex; lower canine elongated, with a strong bend; lower cheek-teeth narrow; pm4 with a well-developed additional posterior cuspid (metaconid); lower m1 with a strong metaconid, slightly displaced backward; the lingual margin of the talonid shaped as a cutting entoconidal edge; the masseter's fossa reaching the level of the anterior surface of m2; m2 with well-developed lingual and labial cuspids.

It is evident from the combination of features and dimensional comparisons that all the four fragments described here belong to the same species (two individuals at least). The above-mentioned statements constitute evidences to refer this species to the genus *Baranogale*.

Except for the dimensional differences, the presently known *Baranogale* specimens from Hungary, Poland and France do not contrast essentially in their morphology. All of them are referred in recent publications to *B. helbingi*. From *B. helbingi* Kormos, the Varshets fossils differ after the combination of plesiomorphic and apomorphic features:

1) plesiomorphic features: presence of a vestigial paraconid on m2; more conical, short and high pm3-4; highly positioned, distinctly separated posterior additional cuspid (metaconid) on pm4;

2) apomorphic feature: strongly reduced pm2. We could also add the reduction of the rostral part of the mandible (lack of gaps between c1-pm2-pm3), the very strongly developed longitudinal lingual furrow on the upper canine and the arrangement of the upper teeth alveoli, in a straight line, actually without gaps between the teeth. Besides the morphological differences, another obvious distinction are the rather small dimensions.

From *Baranogale* cf. *helbingi* from Dafnero (Greece) (Koufos & Kostopoulos 1997), the Varshets fossils can be clearly distinguished not only after their much smaller dimensions, but also after the archaic mandibular morphology: unreduced pm2, conical pm3-4, large metaconid on m1 and elongated m2.

DISCUSSION AND CONCLUSIONS

THE PROBLEM OF THE DIMENSIONAL DIFFERENCES AS A TAXONOMIC CRITERION

It is worth paying special attention to the taxonomic value of the dimensional differences. It is well-known that a strong sexual dimorphism is typical for most of the Mustelidae, which is expressed also in pronounced differences in size. This is especially true for some representatives of the genus *Mustela*. The length of the mandibular tooth row (c1-m2) of the smallest females of *M. putorius*, after data published in recent literature (Wolsan 1993b), is 68% of that length in largest males (n > 500 with samples from the whole European area). Concerning the length of c1-m2 from the same population of this species, the smallest females have dimensions of 73-74% of those of the largest males.

As for the c1-m2 length in *M. erminea* from the German population, the minimal size in females is 80% of that in males (n = 92); i.e. the females can be smaller with 20% (*cf.* metrical data in Reichstein 1993). An extreme sexual dimorphism is demonstrated by the weasel (*M. nivalis*). According to data from the whole Palearctic area, the minimal condylo-basal length of female *M. n. pygmea* equals 49% of the maximal length in males of the gigantic form *M. n. heptneri* (calculated after the data in Heptner *et al.* 1967).

After comparing the length of the tooth row of the Varshets mandibles with the known remains of *Baranogale helbingi* (Table 2), the following results were obtained: the length of *B. balcanica* n. sp. is 57% of that of the specimen from Saint-Vallier, *c.* 69% of that from Etouaire, *c.* 71-72% of the length of the type specimen from Villany, and *c.* 79% of that of the specimen from Podlesice (Poland) (the length of lower m1 is 78.6% of that of the latter specimen).

Following circumstances must be taken in account when comparing the ratio between the different *Baranogale* specimens with the maximal demonstration of sexual dimorphism (i.e. of individual and not specific differences) in Mustelidae:
1) in the noted recent species compared are the extreme differences, using moreover a very large sample;
2) these differences are related to (especially in the weasel) subspecific (and even specific, after some authors) features;
3) the extreme dimorphism in some recent *Mustela* (and especially the weasel) is a result from an adaptation to typically Late Quaternary climates, with their strongly contrasting in temperature favourable and unfavourable seasons, unlike the natural conditions during the middle Villafranchian. So, a demonstration of too great metric differences in Pliocene, Mustelidae (30-40%) should be regarded mostly as a taxonomic and not individual or sexual feature.

It is clear that even only the values of the dimensional variability in the known *Baranogale* remains (including those from Varshets) indicate the existence of more than one species.

On the systematics of Baranogale

Kowalski (1959) discussed the small dimensions of the specimen from Podlesice and supposed that these differences could be a result of taxonomical (i.e. subspecific) differences within time or space (i.e. an acceptance of an eastern and a western form of the species). Recent data show that the largest dimensions – Saint-Vallier, Dafnero (?) and the smallest ones, Varshets — in fact had coexisted in the same time (MNQ17) and the differences between them could hardly be regarded as a result of population variability in the same species in time, nor in space: the fossil from Podlesice, dimensionally closest to those from Varshets, is not only much older (the oldest one), but also different in morphology and in fact is similar to those known so far. The mandible from Poland could possibly represent a separate ancient subspecies, but it is closer to the remains known up till now from France and Hungary than all of them to the fossils from Varshets. The specimen from Saint-Vallier also strongly differs with its large size from all the rest, even more differs *B.* cf. *helbingi* from Dafnero. All those differences are probably not only a result of individual or sexual variance. Nevertheless, for the time being there is no reason, because of insufficient data, to suggest a specific status for any of the noted forms. All the finds except Varshets could preserve for the time being, their status of belonging to the same species. This also applies for the moment to *B.* cf. *helbingi* from Dafnero because of the still scarce material. Thus, the existence of two certain species in the genus could be accepted so far, *B. helbingi* (supposedly with subspecies) and *B. balcanica* n. sp., the differences between the two probably being a result of an adaptation to different ecological niches. It is also possible that the new Balkan species is exotic and local for the continent and will be found in the future in Asia.

The significant differences in size added to the other morphological differences give reason for the following question: do the fossils from Varshets differ on a generic level from *Baranogale*? The correspondence of most of the main features of these remains with the genus *Baranogale* and the strong fragmentariness of the cranial remains make me assume, following the principle of parsimony, that for the time being there are not enough reasons to set up a new genus for the finds from Varshets.

The nanism as an evolutionary adaptation with the Pliocene-Quaternary Mustelidae and the time of its appearance

The shortening of the limbs and the reduction of the body size is one of the main directions of specialization with the evolved Mustelidae, related to their adaptation towards the hunting of rodents and entering their holes. Such a specialization is stimulated by the aridification which started in the Pliocene and especially in the Pleistocene. It results in an enlargement of the areas of open spaces and grasslands (the Microtinae habitat) incites the evolution thus creating a new ecological niche for a number of small carnivores (King 1989).

The “attempts” of Mustelidae to create carnivores-“superdwarfs” seem to start as early as the late

Oligocene/early Miocene of Europe with "*Plesictis*" *julieni sicaulensis* Viret, 1929. The climax of this phenomenon, however, starts in the early Pliocene with Mustelini – *Mustela plioerminea* and *M. pliocenica* (Weze, MNQ15) –, and somewhat later with *M. palerminea* and *M. praenivalis*, known (Janossy 1986) as early as the early Villafranchian or the Ruscinian/Villafranchian boundary. A similar specialization evolves simultaneously in Ictonychini too with *Propoecilogale*, known from Laetoli, and *Poecilictis libyca minor* from Ahl Al Oughlam (Morocco). *Baranogale balcanica* n. sp. is also one of the early and smallest representatives of this evolutionary direction, and is the smallest of the Eurasian zorillas.

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