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Middle Pleistocene Small Mammals (*Mammalia: Insectivora, Lagomorpha, Rodentia*) from Varbeshnitsa (Bulgaria)

[With 21 text-figs.]

Środkowoplejstoceńskie drobne ssaki (*Mammalia: Insectivora, Lagomorpha, Rodentia*) z Varbešnicy (Bulgaria)

Abstract. A fauna of small mammals, including at least 21 species has been recovered from a karst fissure infilling at a limestone quarry near the village of Varbeshnitsa (Vratsa district). The paper comprises a description of small mammal remains. Special attention is given to the variability of M_1/M^3 dental pattern of *Prolagurus pannonicus, Microtus (Pitymys) arvalidens* and *Microtus* (s. str.) *arvalinus*. The former is considered to represent a very evolved chronopopulation, the second one is considered to be primitive member of *Pitymys* evolutionary lineage, the third one is thought as primitive, although specilized true *Microtus* (s. str.) The presence of these species and *Pliomys episcopalis, Cricetus* cf. *runtonensis, Sorex subaraneus* suggests correlation with the upper part of Nagyhársányhegy phase of Upper Biharian. The species composition indicates an European character of the fauna which is closely related to the localities in the Carpathian basin and the south part of the Russian plain. The occurrence of *Apodemus mystacinus*, in Varbeshnitsa, far northward beyond its recent distribution, indicates a warmer climate. The fauna is considered to correspond to a steppe environment with rocky areas and patches of bushes and trees.

CONTENTS

I. INTRODUCTION

The small mammals described below have been collected from reddish-brown clay deposits in a vertical karst fissure which is exposed in the western wall of the limestone quarry, situated at about 2 km NW of the village of Varbeshnitsa, Vratsa district. This locality lies in the foothills of Veslets-ridge (western part of of Pre-Balkan region) at about 500 m a.s.l. The fissure is about 0.7 m wide and 5 m high.

The fissure was found to be fossiliferous by the late Dr. I. NICOLOV and Mr. N. SPASSOV (National Museum of Natural History, Sofia) in 1979.

The author is grateful to Mr N. SPASSOV for his suggestion to prospect the locality for small mammals. We are deeply indebted to Prof. D. JÁNOSSY (Budapest), who revised part of the material at the initial stages of this study. Prof. K. KOWALSKI (Kraków) kindly offered the rich collections at his disposal freely available to me. Thanks are also due to Drs A. NADACHOWSKI and A. PRADEL (Kraków) for the fruitfull discussions on this material and for the possibility to use some unpublished data of theirs. We are gratefull to Dr A. I. MUNTIJANU (Kischinev) for the possibility to take measurements of materials of *Cricetulus migratorius* from Moldavia.

II. MATERIALS AND METHODS

During the summers of 1980 and 1981 a large sample (about 500 kg) of fossiliferous sediments was taken from the fissure, base part, which has the highest concentration of animal bones. The separation of the bones from the clay have been made by washing through screens (meshsize of 0.5—0.8 mm). More than 500 bones determinable at species level have been collected. The following is the list of small mammals identified from Varbeshnitsa:

Talpa sp.
Sorex subaraneus HELLER, 1958
S. cf. *minutus* LINNAEUS, 1776
Crocidura sp.
cf. *Hypolagus* sp.
Ochotona sp.
Citellus (s. str.) sp.
Glis cf. *sackdillingensis* HELLER, 1930
Spalax (s. l.) sp.
Apodemus (Petromys) mystacinus DANFORD & ALSTON, 1877
A. (Sylvaemus) ex gr. *sylvaticus* (LINNAEUS, 1758) — *flavicollis* (MELCHIOR, 1834)
cf. *Parapodemus* sp.
Allocricetus bursae SCHAUB, 1938
Cricetulus migratorius (PALLAS, 1773)

Cricetus cf. *runtonensis* NEWTON, 1909
Pliomys episcopalis MEHELY, 1914
Clethrionomys cf. *glareolus* (SCHREBER, 1780)
Prolagurus pannonicus (KORMOS, 1930)
Mimomys sp.
Microtus (Pitymys) arvalidens KRETZOI, 1958
M. (s. str.) *arvalinus* HINTON, 1923

The described material is stored in the collections of the Institute of Zoology, Bulg. Acad. of Sciences, Sofia.

All measurements of bone fragments and teeth have been made with a binocular microscope and ocular micrometer (ocular 8 × and objective 4 ×). The individual measuring error approximates 0.05 mm. The measurements taken and abbreviations used are specified below within the species descriptions. All measurements are given in milimeters; the ratios in percentages. For the all tabulated data the following sample statistics were calculated: ample size (N), mean (X), standard deviation (SD), coefficient of variation CV), sample observed range (OR), standard error of mean (SE).

III. SYSTEMATIC DESCRIPTIONS

1. Insectivores

Family *Talpidae* GRAY, 1825
Genus *Talpa* LINNAEUS, 1758

Talpa sp.

Material. One fragment of mandible without teeth, one humerus (Col. No: 13/Varb.-IZ).

Description. The remains available are largely the same as in the recent *T. europaea*.

Measurements

Height of mandible beneath M_2 (measured lingually) = 2.20
Length of the humerus = 13.6
Width of the humerus = 3.7

Discussion. It is impossible to give specific determination of this scarce *Talpa* material. The humerus is bigger than that of *T. minor* FREUDENBERG, 1914 from Hundscheim (RABEDER, 1972), from Hohensülzen (STORCH et al.,

1973) and the single measurement of mandible falls in the lower part of the range of variability of *T. europaea* LINNAEUS, 1758 (POPOV, 1985) and *T. fossilis* PETÉNYI, 1864 from Hohensülzen (STORCH et al. 1973).

Family *Soricidae* GRAY, 1821
Genus *Sorex* LINNAEUS, 1758

Sorex subaraneus HELLER, 1958
(Fig. 1 : 1—6; fig. 3 : 5)

Material. 22 fragments of mandible in different stage of preservation, 3 isolated lower incisors (Col. No: 1—5/Varb.-IZ).

Description. All lower teeth available are *Sorex*-like: dark-cherry pigmentation at the tips of the cusps; the I's inferior are with a tricuspulate cutting edge; the M_3 is with five cusps; A_1 is essentially single cusped and longer at the buccal side; the A_2 is two cusped, the anterior cusp is higher.

Mandible. The shape of *processus coronoideus* is variable — the upper part of the anterior edge often bends towards anterior or may be straight; the apex is usually pointed; the coronoid spicule always is presented. The mental foramen is situated below anterior part of the M_1. The upper facet of the condile is cylindrical, the lower one widens towards the median. The interarticular bridge is broad, notched lingually.

Measurements — see Table I.

Discussion. The characters of specimens described above show a great similarity with recent *S. araneus*, but they are distinctly smaller (Fig. 2). A large number of species of this group which is intermediate in size between *S. minutus* and *S. araneus* are described from the Pleistocene in Europe. The Varbeshnitsa material agrees well with the original description of *S. subaraneus* from Erpfingen (Middle Pleistocene) (HELLER, 1958).

Sorex cf. *minutus* LINNAEUS, 1776
(Fig. 3: 1—4)

Material. 4 fragments of mandible (Col. No: 6—8/Varb.-IZ)

Description. The I inf. is with three undulations; the A_1 is single cusped; the P_4 has two cusps as the posterior one is lower. The talonid is present on M_3. The foramen mentale is situated below the anterior part of the M_1. The apex of the coronoid process' anterior edge has an apparent anterior bending.

Measurements — see Table II.

Discussion. The poor material described from Varbeshnitsa is close to recent *S. minutus* (Fig. 4), but some measurements show somewhat lower values.

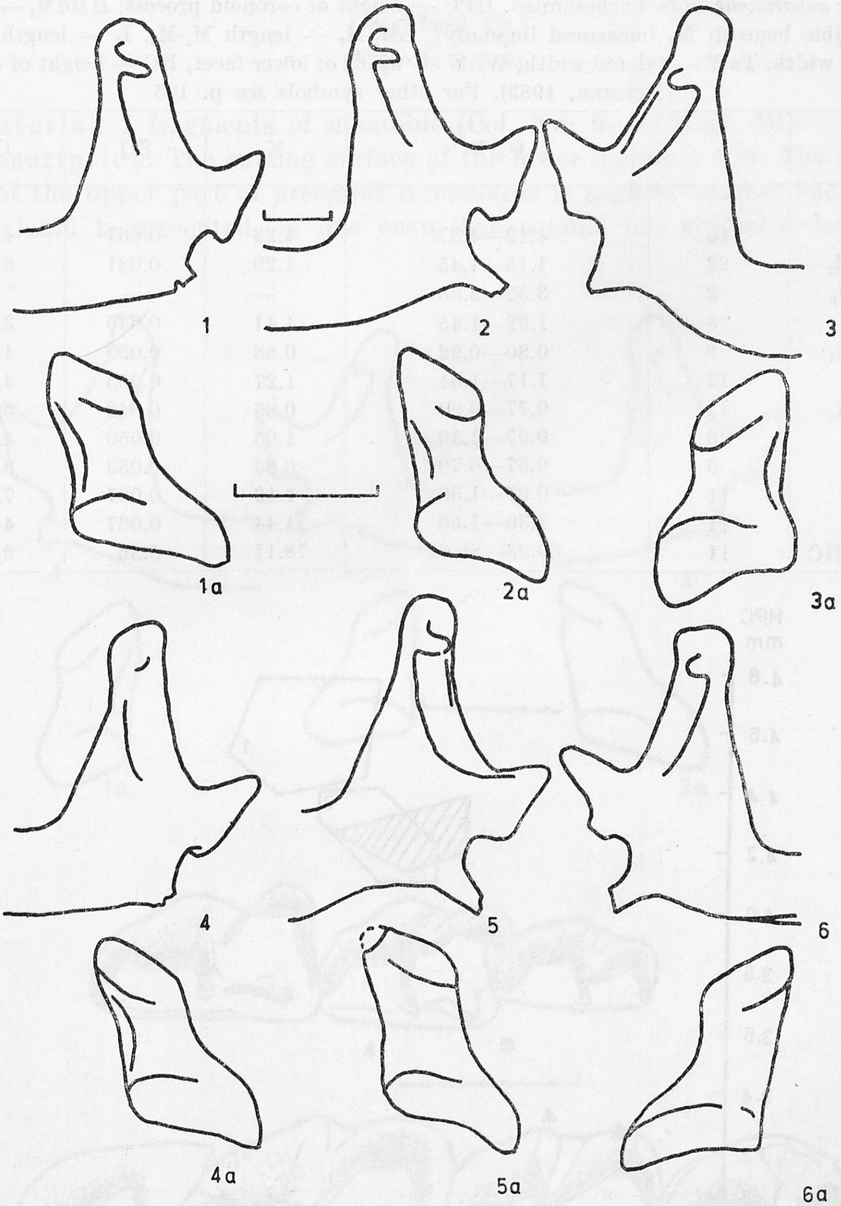

Fig. 1. *Sorex subaraneus* HELLER, 1958. Posterior part of mandibles (1—6) condilar process from behind (1a — 6a). 1. No: 4/Varb.-IZ, left; 2. No: 5/Varb. IZ, left; 3. No: 2/Varb.-IZ, right; 4. 1—1/Varb.-IZ, left; 5. 1—2/Varb.-IZ, left; 6. 3/Varb.-IZ, right. Scale represents 1 mm

Table I

Measurements (mm), ratios (%) and its univariate statistics of mandible and lower molars for *Sorex subaraneus* from Varbeshnitsa. HPC — height of coronoid process, $HMdM_2$ — height of mandible beneath M_2 (measured lingually), LM_1-M_3 — length M_1-M_3, L — length, W — maximal width, TaW — talonid width, WLW — width of lower facet, HC — height of condile, (Reumer, 1983). For other symbols see p. 195

	N	O. R.	$\bar{X}$	SD	CV
HPC	10	4.12—4.37	4.23	0.067	4.58
$HMdM_2$	22	1.15—1.45	1.29	0.081	6.30
LM_1-M_3	2	3.52—3.55	—	—	—
LM_1	8	1.32—1.45	1.41	0.045	3.26
$TaWM_1$	8	0.80—0.92	0.88	0.039	4.50
LM_2	12	1.17—1.34	1.27	0.053	4.17
$TaWM_2$	11	0.77—0.90	0.83	0.042	5.07
LM_3	6	0.97—1.10	1.05	0.050	4.80
WM_3	6	0.57—0.70	0.64	0.053	8.24
WLF	11	0.97—1.30	1.13	0.087	7.18
HC	11	1.30—1.50	1.44	0.067	4.64
WLF/HC	11	69.28—86.66	78.11	5.36	6,86

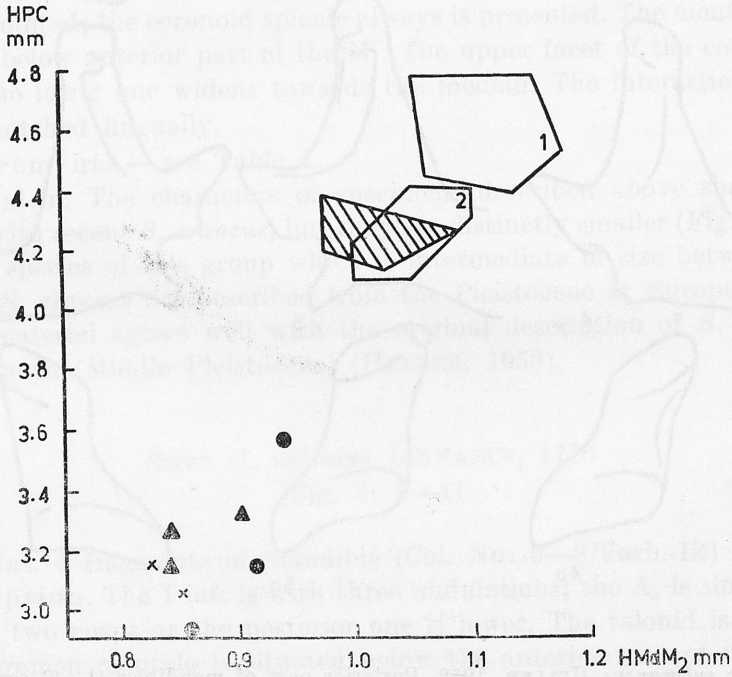

Fig. 2. Scatter diagram showing the hight of mandible below M_2 ($HMdM_2$) relative to the hight of coronoid process (HPC) of some *Sorex* species. Poligons represent distributions for: *S. subaraneus* from Varbeshnitsa (hatched poligon); subfossil *S. araneus* from the Rhodopes (N = 16), (1); *S. subaraneus* from Erpfingen (Heller, 1958), (2); solid circles-*S. cf. minutus* from Varbeshnitsa, solid triangles-subfossil *S. minutus* from the Rhodopes; cross-*S. minutus* from Württemberg, Elster glaciation (Koenigswald, 1973)

Genus *Crocidura* WALGER, 1832

Crocidura sp.
(Fig. 4: 1—3)

Material. 7 fragments of mandible (Col. No: 9—12/Varb.-IZ).

Description. The cutting surface of the lower incisor is flat. The anterior edge of the upper part of *processus coronoideus* is slightly bended backwards. The talonid is presented by one cusp. The condile has typical *Crocidurinae*

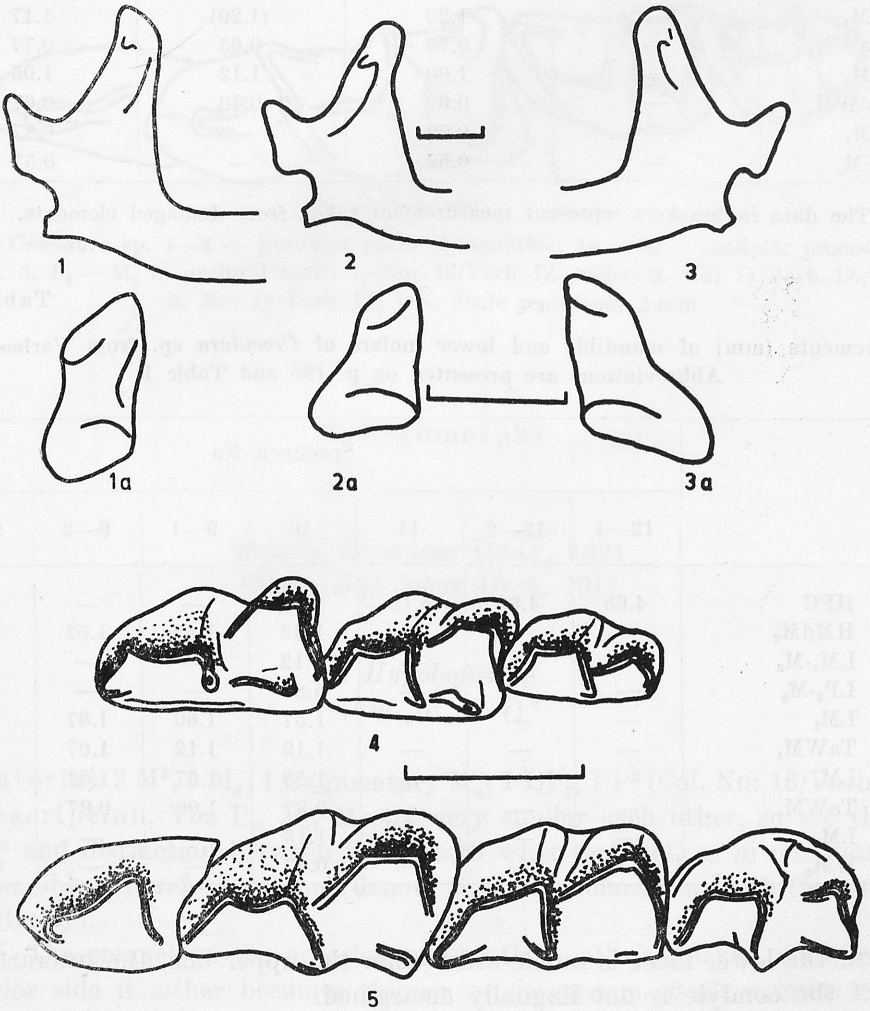

Fig. 3. 1—4. *Sorex* cf. *minutus* LINNAEUS. 1—3. Posterior parts of mandibles; 1a — 3a. Condilar process from behind. 1. No: 6—1/Varb.-IZ, right; 2. No: 6 —2/Varb.-IZ, right; 3. No: 8/Varb.-IZ, left; 4. M_1 — M_3 in occlusal view, No: 6/Varb.-IZ; 5. *Sorex subaraneus* HELLER, 1958, P_4 — M_3 in occlusal view. Scale represents 1 mm

Table II

Measurements (mm) of mandible and lower molars of *Sorex* cf. *minutus* from Varbeshnitsa. Abbreviations are presented on p. 195 and Table I

	Specimen No			
	6/Varb.	7/Varb.	8—1/Varb.	8—2/Varb.
HPC	3.57	2.92	3.15	—
$HMdM_2$	1.07	0.92	1.02	0.77
LM_1-M_3	—	3.15	(3.22) *	3.17
LM_1	—	1.20	(1.20)	1.17
$TaWM_1$	—	0.75	0.65	0.77
LM_2	—	1.00	1.12	1.05
$TaWM_2$	—	0.67	0.70	0.67
LM_3	—	0.90	—	0.87
WM_3	—	0.52	—	0.57

* The data in brackets represent measurement taken from damaged elements.

Table III

Measurements (mm) of mandible and lower molars of *Crocidura* sp. from Varbeshnitsa. Abbreviations are presented on p. 195 and Table I

	Specimen No						
	12—1	12—2	11	10	9—1	9—2	9—3
HPC	4.85	4.90	5.15	—	—	—	—
$HMdM_2$	—	—	—	1.35	1.45	1.52	—
LM_1-M_3	—	—	—	4.12	—	—	—
LP_3-M_3	—	—	—	5.80	—	—	—
LM_1	—	—	—	1.57	1.60	1.67	—
$TaWM_1$	—	—	—	1.12	1.12	1.07	—
LM_2	—	—	—	1.50	1.57	1.62	1.47
$TaWM_2$	—	—	—	0.97	1.00	0.97	1.05
LM_3	—	—	—	1.15	—	—	1.22
WM_3	—	—	—	0.67	—	—	0.70

pattern: the lower facet is much wider than the upper one, the interarticular area of the condyle is not lingually emargined.

Measurements — see Table III.

Discussion. It is difficult to give any full-proof species determination of this scarce and too fragmentary material. The Varbeshnitsa material is similar to recent *Crocidura russula* (HERMAN, 1870) both in the condyle's size and shape.

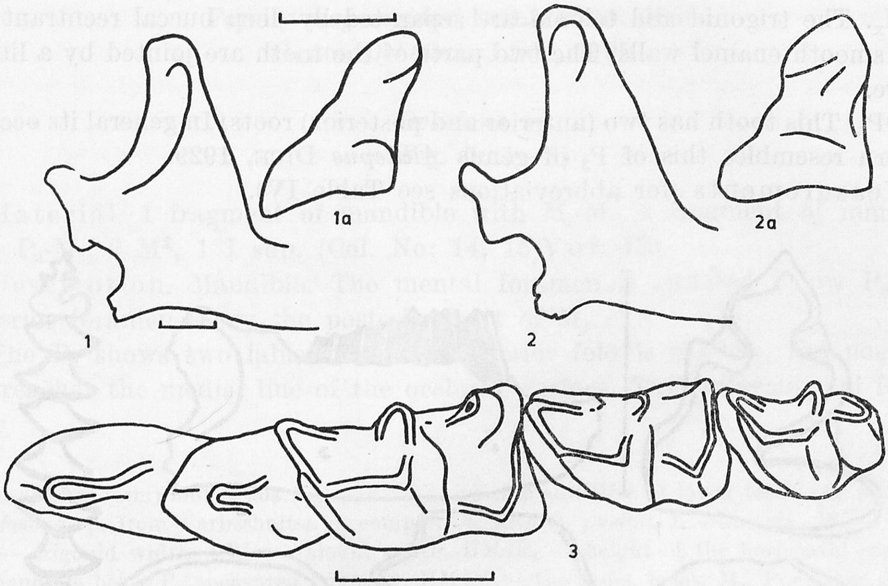

Fig. 4. *Crocidura* sp. 1—2 — posterior parts of mandible; 1a — 2a — condylar process from behind. 3. P_3 — M_3 in occlusal view. 1. No: 12/Varb.-IZ, right; 2. No: 11/Varb.-IZ, right; 3. No: 10/Varb.-IZ, left. Scale represents 1 mm

2. Lagomorphs

Family *Leporidae* Gray, 1821
Genus *Hypolagus* Dice, 1917

cf. *Hypolagus* sp.
(Fig. 5: 4—7)

Material. 2 M^x, 2 M_x, 1 fragmentary M_x, 1 DP_3, 1 P^2 (Col. No: 16/Varb.-IZ).

Description. The P_4, M_1, M_2 are very similar each other, so are the P^4, M^1, M^2 and distinction between these teeth when isolated, as in our material, is impossible. Therefore we shell denote them as molariform teeth (M_x and M^x respectively).

M^x. The enamel on the anterior wall of the tooth is thicker, while on the posterior side it either becomes thinner or disappears. Both margins of the hypostria are distinctly crenulated.

P^2. There is only one deep enamel fold at the anterior wall of the tooth. Lingually and buccally, to this fold there are two very shallow folds not filled with crowncementum. At the anterior wall the enamel is distinctly thicker.

M_x. The trigonid and talonid are separated by deep buccal reentrant fold with smooth enamel walls. The two parts of the tooth are jointed by a lingual bridge.

DP_3. This tooth has two (anterior and posterior) roots. In general its occlusal pattern resembles this of P_3 of genus *Allilepus* DICE, 1929.

Measurements (for abbreviations see Table IV).

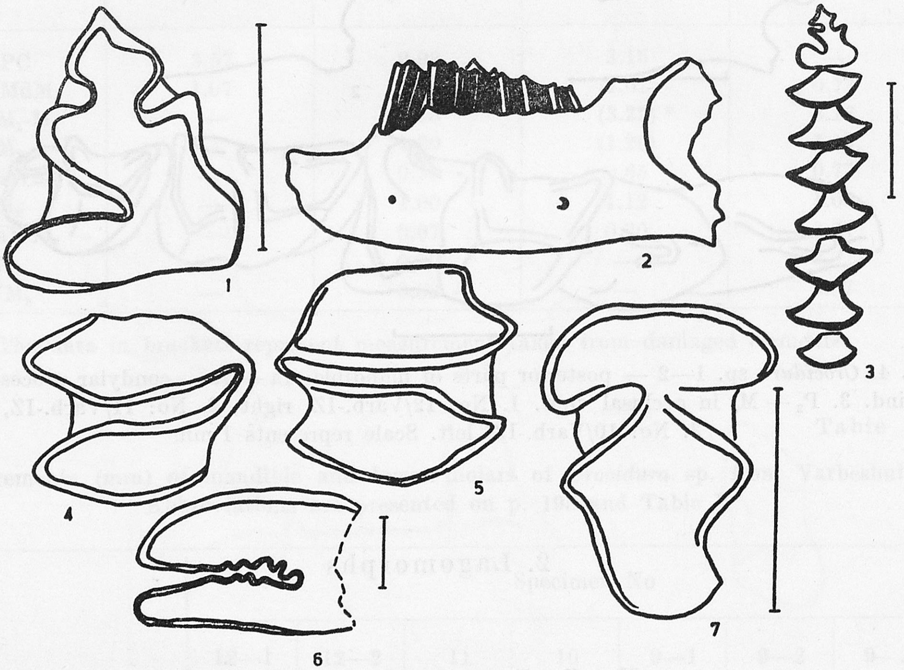

Fig. 5. 1—3. *Ochotona* sp. No: 14/Varb.-IZ, left. 1. P_3 on occlusal view; 2. fragment of mandible, 3. tooth row in occlusal view. 4—7. cf. *Hypolagus* sp. 4. M_x, No: 16—1/Varb.-IZ, left; 5. M_x, No: 16—2/Varb.-IZ, right; 6. M^x, No: 16—3 Varb.-IZ, right; 7. DP_3, No: 16—4/Varb.-IZ; left. Scale represents 1 mm

$LM_x = 3.32;\ 3.00$	$LM^x = 2.35;\ 3.00$
$trWM = 4.20;\ 3.55$	$alWM^x = 3.82$
$tlWM = 3.55;\ 2.95$	$plWM^x = 3.42$

Discussion. The upper and lower molariform teeth in the genera *Hypolagus* and *Lepus* LINNAEUS, 1758 are very similar. The absence of the diagnostic P_3 in the Varbeshnitsa material does not permit to classify it without doubt under one of these genera. On the other hand the presence of only one fold at the anterior wall of P^2 is a diagnostic feature of the genus *Hypolagus* (GUREEV, 1964). The pattern of available DP_3 is very similar to this of *Hypolagus brachignatus* KORMOS, 1934 as it is described by SYCH (1965). Judging from this evidence we may venture the assumption that the Varbeshnitsa material belongs to the genus *Hypolagus*.

Family *Lagomyidae* LILLJEBORG. 1866
Genus *Ochotona* LINK, 1795

Ochotona sp.
(Fig. 5: 1—3)

Material. 1 fragment of mandible with M_1-M_3, 1 fragment of mandible with P_3-M_3, 2 M^x, 1 I sup. (Col. No: 14, 15/Varb.-IZ).

Description. Mandible. The mental foramen is situated below P_3; the posterior foramen-below the posterior part of M_2.

The P_3 shows two labial folds-the anterior fold is shallow, the posterior one reaches the medial line of the occlusal surface. The anterolingual fold is

Table IV

Measurements (mm) and ratios (%) and its univariate statistics of lower teeth and mandible of *Ochotona* sp. from Varbeshnitsa in comparison with *O. pusilla*. L — length, W — width, trW — trigonid width, tlW — talonid width, $HMdP_4$ — height of the horizontal ramus of the mandible below P_4, measured lingually, $HMdM_2$ — the same, below M_2. For other simbols see p. 195

Parameter	*Ochotona* sp. Varbeshnitsa		*Ochotona pusilla* * Mamutowa Cave, Poland, Late Pleistocene			
	Specimen No:		N	O. R.	$\overline{X}$	SD
	14	15				
LP_3	1.17	—	3	0.97—1.08	1.02	—
WP_3	1.12	—	3	1.21—1.28	1.25	—
LP_4	1.37	—	8	1.28—1.43	1.36	0.060
$trWP_4$	1.27	—	6	1.21—1.43	1.31	0.083
$tlWP_4$	1.47	—	7	1.47—1.66	1.55	0.070
LM_1	1.50	1.45	11	1.46—1.68	1.55	0.060
$trWM_1$	1.65	1.55	11	1.43—1.71	1.60	0.090
$tlWM_1$	1.55	1.57	11	1.50—1.73	1.59	0.078
LM_2	1.57	1.45	11	1.43—1.64	1.54	0.061
$trWM_2$	1.57	1.50	11	1.43—1.74	1.57	0.096
$tlWM_2$	1.42	1.42	10	1.31—1.58	1.49	0.090
LM_3	0.60	0.57	10	0.51—0.64	0.58	0.030
WM_3	1.05	1.02	9	0.87—1.11	1.01	0.070
LP_3/WP_3	10 .46	—	3	78.12—85.70	81.32	—
LP_3/LP_4	85.40	—	3	70.80—78.12	74.81	—
P_3-M_3 (alv)	6.55	—	7	5.66—6.65	6.20	0.390
$HMdP_4$	5.50	—	9	7.66—5.33	5.06	0.270
$HMdM_2$	5.00	4.70	11	4.26—5.26	4.73	0.290

* Author's measurements of material stored in Institute of Experimental and Systematic Zoology, PAS Kraków.

not very deep. There is a wide connection between the anterior lobe and the remaining part of the occlusal surface. The posterolingual fold is very shallow and it is not filled with crowncementum. The enamel's thickness is not even.

Measurements — see Table IV.

Discussion. The material available is insufficient to support any species determination. However, both the measurements and the structure of P_3 suggest a rather small species, very similar to the recent *O. pusilla* PALLAS, 1786. On the other hand, the P_3-ratio is quite different and shows some affinity with *O. polonica* SYCH, 1980. However, this is the only feature that distinguishes this species from *O. pusilla*.

3. Rodents

Family *Sciuridae* GRAY, 1821
Genus *Citellus* OKEN, 1816

Citellus (s. str.) sp.
(Fig. 6: 1—7)

Material 3 P_4, 4 M_1, 3 M_2, 7 M^{1-2} (Col. No: 75—78/Varb.-IZ).

Description. The P_4's are two rooted; there are no traces of bifurcation of the posterior root. This tooth is wider posteriorly, when seen in occlusal view. The proto- and metaconid are equal in size. The protoconulid is presented by a distinct ridge that runs from the protoconid, but does not make contact with the base of the metaconid. The hypoconid is usually present. The mesostylid is present in two specimens alone.

M_{1-2}. The anterior cingulum and the metalophid are lower in their middle parts. The anterior cingulum always connects proto- and metaconid. In one specimen this cingulum forms a week protoconulid. The hypoconid is more pronounced than on P_4. The entoconide is not well individualized and is always little more than a minor expansion of the ridge of the posterolophid. The mesostylid is lacking.

M^{1-2}. The mesostyl is present on all specimens but two. The metaconule may be absent (two specimens), but usually is present. When present, it is connected with the protocone by the metastyle. The metastyle is interrupted between the metaconule and the metacone.

Measurements (length × width).

$P_4 = 2.12 \times 1.87$; 2.27×2.30; 2.12×2.10

$M_1 = 2.42 \times 2.75$; 2.15×2.60; 2.30×2.47; 2.65×2.77

$M_2 = 2.25 \times 9.00$; 2.40×3.02; 1.96×2.95

$M^2 = — \times 2.82$; $— \times 2.81$; 2.25×3.05; 2.30×2.77; 2.02×2.65; 2.15×2.85; 2.30×3.17.

Discussion. In the well developed metastyle shelf and the presence of weak protoconulid of one M_1, the Varbeshnitsa material shows some affinities to primitive representatives of subgenus *Urocitellus*, known from Lower Pleistocene of Central and East Europe (for example *C. primigenius* KORMOS, 1934).

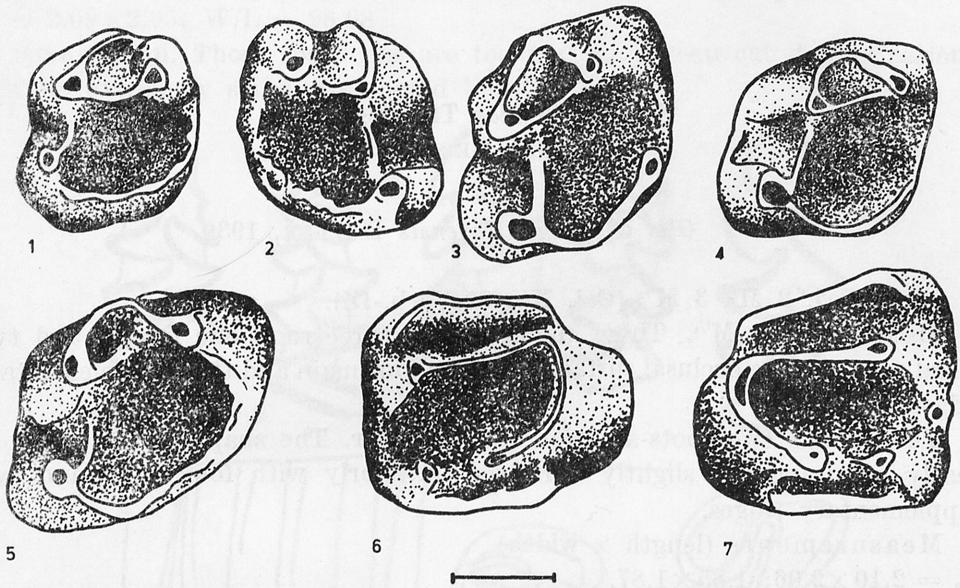

Fig. 6. *Citellus* sp. 1. P_4, No: 75—1/Varb.-IZ, left; 2. P_4, No: 75—2/Varb.-IZ, right; 3. M_2 No: 77—1/Varb.-IZ, left; 4. M_1, No: 76—1/Varb.-IZ, right; 5. M_2, No: 77—2/Varb.-IZ, left; 6. $M^{1/2}$, No: 78—1/Varb.-IZ, right; 7. $M^{1/2}$, No: 78—2/Varb.-IZ. All teeeth in occlusal view. Scale represents 1 mm

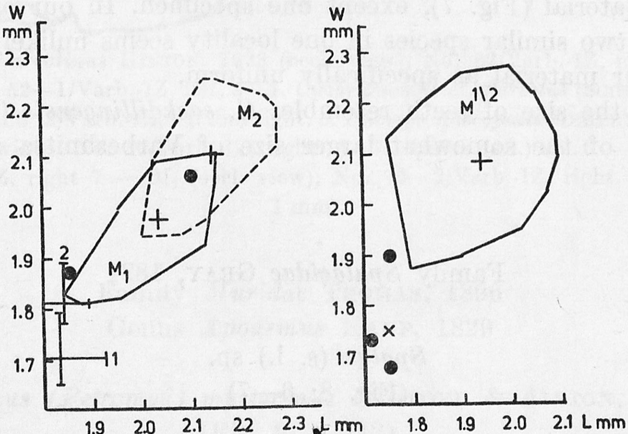

Fig. 7. Scatter diagrams showing length (L) and width (W) of M_1/M_2 and $M^{1/2}$ of *Glis* spp. The poligons define the range of variability of subfossil *G. glis* from the Rhodopes ($M_1 = 77$ specimens, $M_2 = 87$ specimens, $M^{1/2} = 118$ specimens); black circles — *G.* cf. *sackdillingensis* from Varbeshnitsa; the lines represents the observation ranges of *G. sackdillingensis* (HELLER, 1930, $M_1 = 6$ specimens, $M_2 = 5$ specimens); x — *G. antiqus* (KORMOS, 1930); with cross are noted mean values for each poligon

On the other hand, the specimens under study are smaller and very similar to recent *C. citellus* LINNAEUS, 1776 from Bulgaria. In our opinion, the Varbeshnitsa material represents an intermediate form between some primitive forms (noted usually as cf. *Urocitellus*) and earliest true *Citellus* (s. str.). Such forms are thought to be ancestors of recent *C. citellus* (GROMOV et al., 1965).

Family *Gliridae* THOMAS, 1867
Genus *Glis* BRISSON, 1762

Glis cf. *sackdillingensis* HELLER, 1930

Material. 2 M_2, 3 $M^{1/2}$ (Col. No: 80/Varb.-IZ).

Description. $M^{1/2}$. These molars have three roots-one lingual and two labial ones. On the occlusal surface there are four main and three supplementary ridges.

The M_2 has two roots-anterior and posterior. The shape of the crown is nearly quadrangular, slightly narrowed anteriorly with four main and two supplementary ridges.

Measurements (length × width).
$M_2 = 2.10 \times 2.06$; 1.85×1.87.
$M^{1/2} = 1.75 \times 1.90$; 1.70×1.76; 1.75×1.65.

Discussion. The structure of the teeth from Varbeshnitsa does not differ from that of recent *G. glis* LINNAEUS, 1776 from Bulgaria. The differences concerns only the size. All teeth available are of smaller size than subfossil comparative material (Fig. 7), except one specimen. In our opinion, the co-occurrence of two similar species in one locality seems unlikely. That is why we consider our material as specifically uniform.

In general, the size of teeth resembles *G. sackdillingensis* (HELLER, 1930, 1933), in spite of the somewhat larger size of Varbeshnitsa specimens.

Family *Spalacidae* GRAY, 1821

Spalax (s. l.) sp.
(Fig. 8: 6—7)

Material. 1 M^2, 1 M_2, 1 M_3 (Col. No: 79/Varb.-IZ).

Description. The nomenclature of the occlusal surface of the molar is after TOPAČEVSKIJ (1969).

M^2. The paracone is connected with the posterior cingulum, thus, the anterior reentrant fold is transformed in large islet. The tooth has three short roots.

M_2. It has one labial and one lingual fold. The accessory (posterior) lingual fold is presented as a small enamel islet. There are two small roots.

The M_3 has only one reentrant fold.

Measurements (length × width).

$M^2 = 1.85 \times 1.62$; W/L = 87.56

$M_2 = 2.09 \times 2.05$; W/L = 98.08

Discussion. These specimens are too few for a clear-cut determination. Only its extremely small size should be mentioned.

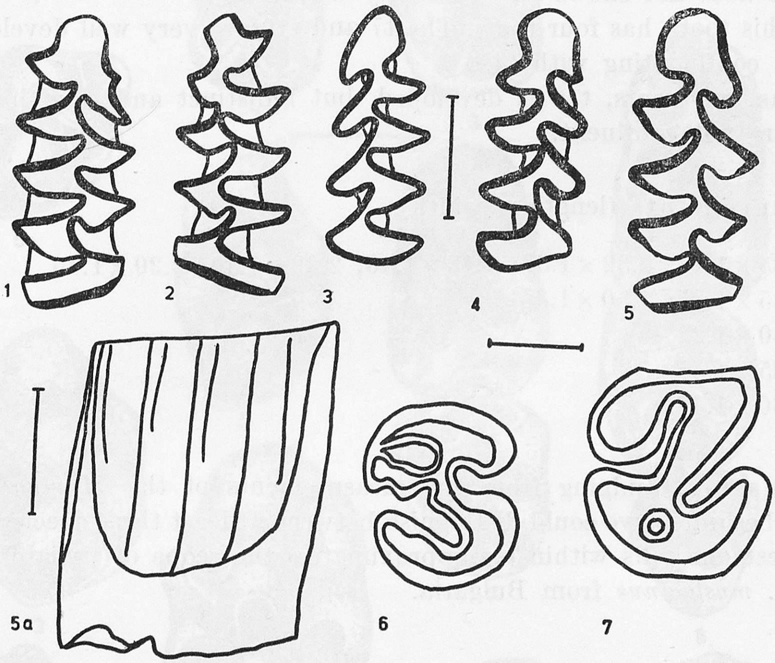

Fig. 8. 1. *Microtus arvalinus* HINTON, 1923 (occl. view), No: 62/Varb.-IZ, right; 2. *Microtus* sp. (occl. view), No: 52—1/Varb.-IZ, left. 3—4. *Clethrionomys* cf. *glareolus* (SCHREBER, 1780 occl. view), No: 41—1 and 2/Varb.-IZ, left and right. 5. *Pliomys episcopalis* MEHELY, 1914 (5 — occl. view, 5a — labial view), No: 40/Varb.-IZ, right. 6—7. *Spalax* (s.l.) sp. 6 — M^2 (occl. view), No: 79—1/Varb.-IZ, right 7 — M_2 (occl. view), No: 79—2/Varb.-IZ, right. Scale represents 1 mm

Family *Muridae* THOMAS, 1896
Genus *Apodemus* KAUP, 1829

Apodemus (Petromys) mystacinus DANFORD & ALSTON, 1877
(Fig. 9: 9—12)

Material. One fragment of mandible with M_1 and M_2, 4 M_1, 1 M_2, 1 M_3, 1 fragment of maxilae with M^1 and M^2, 1 M^1, 1 M^2 (Col. No: 22—27/Varb.-IZ).

Description. The nomenclature of parts of the occlusal surface is after various authors, summarized in TCHERNOV (1979).

The M_1 is two rooted; the anterior unpaired tubercle is well developed, it is not confluent with the next pair of cusps in unworn teeth only. The labial mesial cone is pushed strongly backwards; a very well developed sagital crest connects the lingual mesial cone with lingual central cone. The singular cones are well developed. The posterior cingular cone is linked with the labial distal cone in worn teeth only. The talonid is big.

M_2. The anterior mesial cone and labial crest are well developed.

M_3. It does not shows any accessory cusps.

M^1. This tooth has four roots. The t7 and t10 are very well developed, but t7 is not confluenting with t4.

M^2 has four roots, t10 is developed, but indistinct and ridge-like. The t4 and t7 are not confluent.

Measurements (length × width).

$M_1 = 2.25 \times 1.47$; 2.32×1.32; 2.12×1.40; 2.22×1.40; 2.20×1.45.
$M_2 = 1.45 \times 1.37$; 1.50×1.35
$M_3 = 1.30 \times 1.22$
$M^1 = 2.25 \times 1.55$
$M^2 = 1.60 \times 1.47$.

Discussion. Judging from the measurements of the *Murinae* material from Varbeshnitsa, we could distinguish between at least three species (Fig. 10). The largest one falls within (or approximates) the scope of variability of the recent *A. mystacinus* from Bulgaria.

Table V

Measurements (mm) and its univariate statistics of teeth of *Apodemus* ex gr. *syvaticus-flavicollis* from Varbeshnitsa. L and W — maximal length and width respectively, for other symbols see p. 195

	N	O. R.	$\overline{X}$	SD	CV
LM_1	10	1.65—1.95	1.76	0.094	5.33
WM_1	10	1.05—1.20	1.11	0.048	4.34
LM_2	7	1.15—1.30	1.24	0.051	4.10
WM_2	7	1.00—1.15	1.11	0.055	4.98
LM_3	3	0.92—1.10	1.02	—	—
WM_3	3	0.90—0.97	0.94	—	—
LM^1	2	1.87—2.02	—	—	—
WM^1	2	1.30—1.35	—	—	—

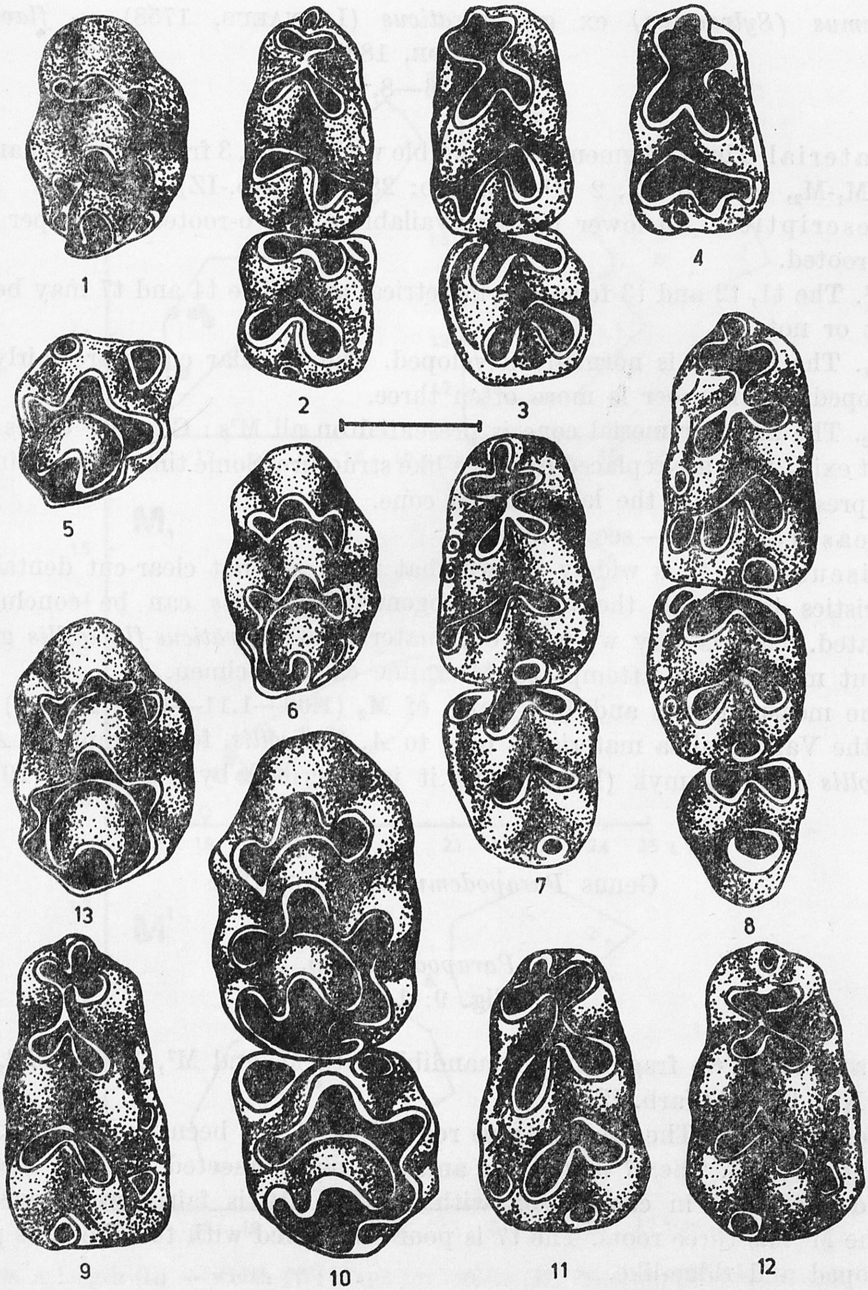

Fig. 9. 1—5. cf. *Parapodemus* sp. 1. M^1, right, No: 17/Varb.-IZ: 2. M_1 — M_2, right, No: 19/Varb.-IZ; 3. M_1 — M_2 left, No: 18/Varb.-IZ; 4. M_1, right, No: 20/Varb.-IZ; 5. M^2, right, No: 21/Varb.-IZ. 6—8 and 13. *Apodemus* ex gr. *sylvaticus* LINNAEUS, 1758 — *flavicollis* MELCHIOR, 1834. 6 — M^1, right, No: 30/Varb.-IZ; 7. M_1 — M_2, left, No: 32/Varb.-IZ; 8. M_1 — M_3, left, No: 31/Varb.-IZ; 13. M^1, right, No: 29/Varb.-IZ. 9—12. *Apodemus mystacinus* DANFORD & ALSTON, 1877. 9 — M_1, right, No: 26/Varb.-IZ; 10. M^1 — M^2, left, No: 27/Varb.-IZ; 11. M_1, left, No: 25/Varb.-IZ; 12. M_1, right, No: 24/Varb.-IZ. All teeth in occlusal view. Scale represents 1 mm

Apodemus (Sylvaemus) ex gr. *sylvaticus* (LINNAEUS, 1758) — *flavicollis* (MELCHIOR, 1837)
(Fig. 9: 6—8, 13)

Material. Three fragments of mandible with M_1-M_3, 3 fragments of mandible with M_1-M_2, 4 M_1, 1 M_2, 2 M^1 (Col. No: 28—32/Varb.-IZ).

Description. All lower molars available are two-rooted, all upper ones-four-rooted.

M^1. The t1, t2 and t3 form a symmetrical arch. The t4 and t7 may be confluent or not.

M_1. The talonid is normally developed. The cingular cones are fairly well developed. Its number is more often three.

M_2. The anterior mesial cone is presented on all M's . Cingular cones often do not exist, they are replaced by ridge-like structure. Some time a small cingular cone presetns beside the labial distal cone.

Measurements — see Table V.

Discussion. It is widely known that there are not clear-cut dental characteristics by which the species subgenus *Sylvaemus* can be conclusively separated. That is why we refer our material to "*sylvaticus-flavicollis* group" without making any attempt to determine each specimen.

The measurements and L/W ratio of M_2 (1.06—1.11—1.16, N = 7) show that the Varbeshnitsa material is near to *A. flavicollis*, for example to *A.* aff. *flavicollis* from Kamyk (Poland), as it is described by PASQUIER (1974).

Genus *Parapodemus* SCHAUB, 1938

cf. *Parapodemus* sp.
(Fig. 9: 1—5)

Material. Two fragments of mandible with M_1 and M^2, 1 M_1, 1 M^1, 1 M^2 (Col. No: 17—21/Varb.-IZ).

Description. The M^1 has three roots. The t1 has been pushed backwards in relation to t3. The t7 is wanting and it is not connected with t4. The t4 is shifted anteriorly in comparison with t6. The t10 is fairly well developed.

The M^2 has three roots. The t7 is poor but linked with t4. The t9 is poorly developed and ridge-like.

M_1. The antesomesial cone is well developed and situated symmetrically in relation to posterior pair of cusps. The cingular cones are rather poorly developed, sometimes they form a weak ridge. The posterior cingular cone is small and connected with the labial cone of the posterior lamina. The talonid is rather small.

M_2. The anterior mesial tubercle is small (one specimen) or ridge-like (two specimens). In all specimens there is labial crest. The talonid is very poor.

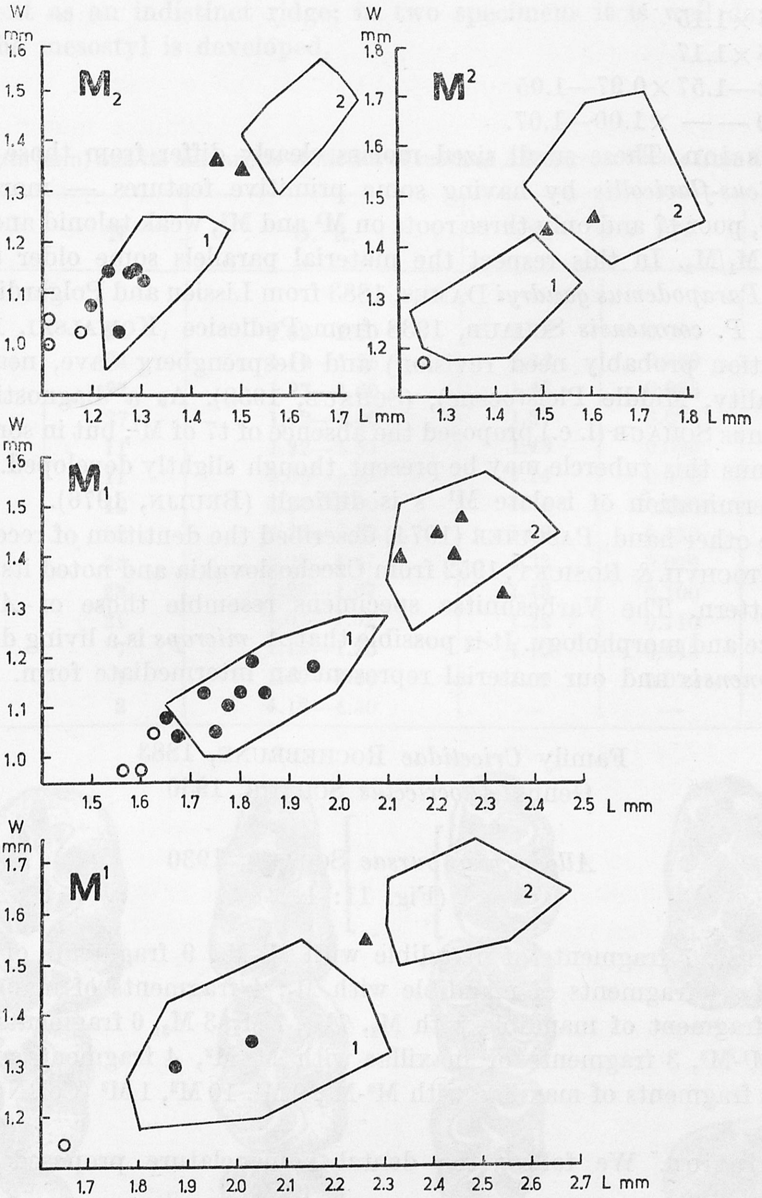

Fig. 10. A length (L) — width (W) graph for molars (M_1, M_2, M^1, M^2) of wood mice *(Apodemus*: *Sylvaemus, Petromys*; *cf. Parapodemus*). Polygons define distributions for subfossil *A.* ex gr. *sylvaticus-flavicollis* (1) from the Rhodopes (M^1 = 123 specimens, M_1 = 135 specimens, M^2 = 44 specimens, M_2 = 78 specimens); (the bulk of this material belong probably to *A. flavicollis*) and recent *A. mystacinus* (2) from SW Bulgaria (M^1 = 59 specimens, M_1 = 60 specimens, M^2, M_2 = 60 specimens); Solid circles represent *A.* ex gr. *sylvaticus-flavicollis*, white circles — cf. *Parapodemus* sp., black triangles — *A. mystacinus* from Varbeshnitsa

Measurements (length × width).
$M^1 = 1.65 \times 1.15$
$M^2 = 1.25 \times 1.17$
$M_1 = 1.62—1.57 \times 0.97—1.05$
$M_2 = 1.10 —— \times 1.00—1.07$.

Discussion. These small sized molars clearly differ from those of *A.* ex gr. *sylvaticus-flavicollis* by having some primitive features — more stephanodont M^1, poor t7 and only three roots on M^1 and M^2, weak talonid and cingular cones on M_1/M_2. In this respect the material parallels some older (Pliocene) species as *Parapodemus gaudryi* DAMES, 1883 from Lissieu and Polgardi (BRUJIN, 1976) and *P. coronensis* SCHAUB, 1938 from Podlesice (KOWALSKI, 1956, this determination probably need revision) and Gesprengberg Cave, near Braşov (type locality, Middle Pleistocene), (SCHAUB, 1938). As a diagnostic feature for this genus SCHAUB (l. c.) proposed the absence of t7 of M^1, but in some species of this genus this tubercle may be present, though slightly developed. Thus, the exact determination of isolate M^1 's is difficult (BRUIJN, 1976).

On the other hand, PASQUIER (1974) described the dentition of recent *A. microps* KRATOCHVIL & ROSICKÝ, 1952 from Czechoslovakia and noted its primitive dental pattern. The Varbeshnitsa specimens resemble those of *A. microps* both in size and morphology. It is possible that *A. microps* is a living descendant of *P. coronensis* and our material represent an intermediate form.

Family *Cricetidae* ROCHEBRUNE, 1883
Genus *Allocricetus* SCHAUB, 1930

Allocricetus bursae SCHAUB, 1930
(Fig. 11: 1, 2)

Material. 7 fragments of mandible with M_1-M_3, 9 fragments of mandible with M_1-M_2, 4 fragments of mandible with M_1, 4 fragments of mandible with M_2-M_3, 1 fragment of mandible with M_2, 7M_1, 7 M_2, 3 M_3, 6 fragments of maxillae with M^1-M^3, 3 fragments of maxillae with M^1-M^2, 4 fragments of maxillae with M^1, 2 fragments of maxillae with M^2-M^3, 9 M^1, 10 M^2, 1 M^3 (Col. No: 33—36/Varb.-IZ).

Description. We follow the dental nomenclature proposed by REIG (1977).

M_1. The posterolophid always present, but it is never termined with true posterostylid. The mesostylid is absent. The anterior cingulum sometimes is only poorly developed.

M_2. The mesostylid is not presented, only one tooth shows very small ridge.

M^3. The mesostylid is generally absent.

M^1. The posteroloph which passes from the hypocone is very well developed, reaching the metacone, sometimes it continues beyond the metacone as a weakly developed spur.

M^2. The lingual branch of the cingulum anterior often is absent, sometimes it is present as an indistinct ridge; in two specimens it is well developed.

M^3. The mesostyl is developed.

Table VI

Measurements (mm) and its univariate statistics of teeth of *Allocricetus bursae* from Varbeshnitsa

	N	O. R.	$\overline{X}$	SD	CV
LM_1	24	1.62—2.00	1.78	0.093	5.23
WM_1	24	1.10—1.25	1.13	0.060	5.35
LM_2	27	1.27—1.60	1.47	0.078	5.32
WM_2	27	1.12—1.40	1.27	0.075	5.95
LM_3	11	1.32—1.57	1.43	0.080	5.52
WM_3	11	1.00—1.25	1.14	0.070	6.16
LM_1-M_3	12	4.30—5.00	4.54	0.280	6.10
LM^1	22	1.70—2.12	1.93	0.130	6.70
WM^1	22	1.20—1.47	1.33	0.079	5.92
LM^2	23	1.25—1.67	1.43	0.100	7.13
WM^2	21	1.07—1.52	1.28	0.110	8.42
LM^3	7	1.15—1.25	1.19	0.042	3.60
WM^3	7	1.00—1.20	1.09	0.072	6.68
LM^1-M^3	2	4.12—4.50	—	—	—

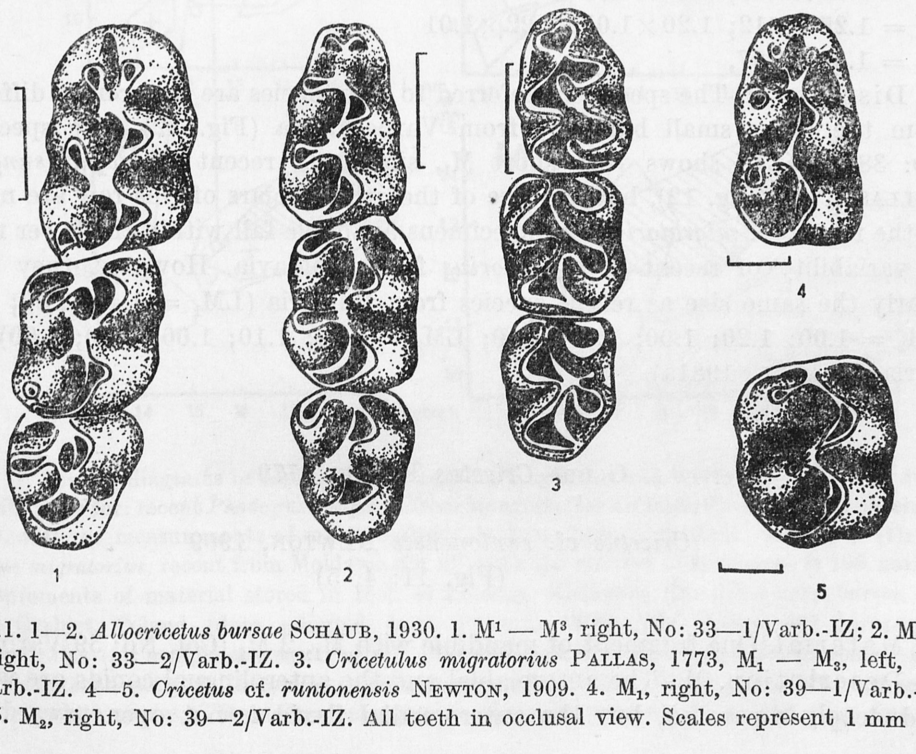

Fig. 11. 1—2. *Allocricetus bursae* SCHAUB, 1930. 1. M^1 — M^3, right, No: 33—1/Varb.-IZ; 2. M_1 — M_3, right, No: 33—2/Varb.-IZ. 3. *Cricetulus migratorius* PALLAS, 1773, M_1 — M_3, left, No: 38/Varb.-IZ. 4—5. *Cricetus* cf. *runtonensis* NEWTON, 1909. 4. M_1, right, No: 39—1/Varb.-IZ; 5. M_2, right, No: 39—2/Varb.-IZ. All teeth in occlusal view. Scales represent 1 mm

Mandible. It is more solid than in the recent *C. migratorius* (PALLAS, 1773). The foramen mentale is situated in front of the anterior root of M_1. The upper and lower masseteric crests form a rounded angle.

Measurements — see Table VI.

Discussion. The range of variability of Varbeshnitsa material coincide with the variability of *A. bursae* from Fortyogoberg (SCHAUB, 1930).

Although wider, the Varbeshnitsa molars are as long as the molars of *A. bursae* from Poland (Fig. 12), and are greater in size than the recent *C. migratorius* from Moldavia (Fig. 12).

Genus *Cricetulus* MILNE-EDWARDS, 1867

Cricetulus migratorius PALLAS, 1773
(Fig. 11: 3)

Material. One fragment of mandible with M_1-M_3, 1 fragment of mandible with M_1-M_2, 1 fragment of mandible with M_2 (Col. No: 37, 38/Varb.-IZ).

Description. M_1. The posterolophid is strong. The mesostylid is absent or poorly developed.

M_3. The mesostylid is well developed.

Measurements (length × width).

$M_1 = 1.55 \times 1.05;\ 1.40 \times 0.97$
$M_2 = 1.25 \times 1.12;\ 1.20 \times 1.07;\ 1.22 \times 1.01$
$M_3 = 1.30 \times 1.07.$

Discussion. The specimens referred to this species are apparently different from the other small hamsters from Varbeshnitsa (Fig. 12). The specimen No: 38/Varb.-IZ shows very short M_1, similar to recent *Phodopus sungorus* PALLAS, 1770 (Fig. 12), but the size of the other molars of this row are nearer to the recent *C. migratorius*. All specimens available fall within the lower range of variability of recent *C. migratorius* from Moldavia. However, they show nearly the same size as recent species from Bulgaria ($LM_1 = 1.40$; 1.60; 1.50; $LM_2 = 1.00$; 1.20; 1.00; 1.20; 1.40; $LM_3 = 0.90$; 1.10; 1.00; 1.30; 1.00) and Syria (PRADEL, 1981a).

Genus *Cricetus* LESKE, 1779

Cricetus cf. *runtonensis* NEWTON, 1909
(Fig. 11: 4, 5)

Material. One fragment of mandible with M_1, 2 M_2 (Col. No: 39/Varb.-IZ).

Description. M_1. The anterolabial and the anterolingual conids are widely and deeply separated, but the anteromedial flexid is not open towards anterior. The anteromurid is X-shaped and connects the protoconid, the metaconid, and the two lobes of the anteroconid. The mesolophid and the posterolophid are conspicuous. The anterolabial cingulum is indistinct. The dental pattern of M_2 is very similar to this of recent species.

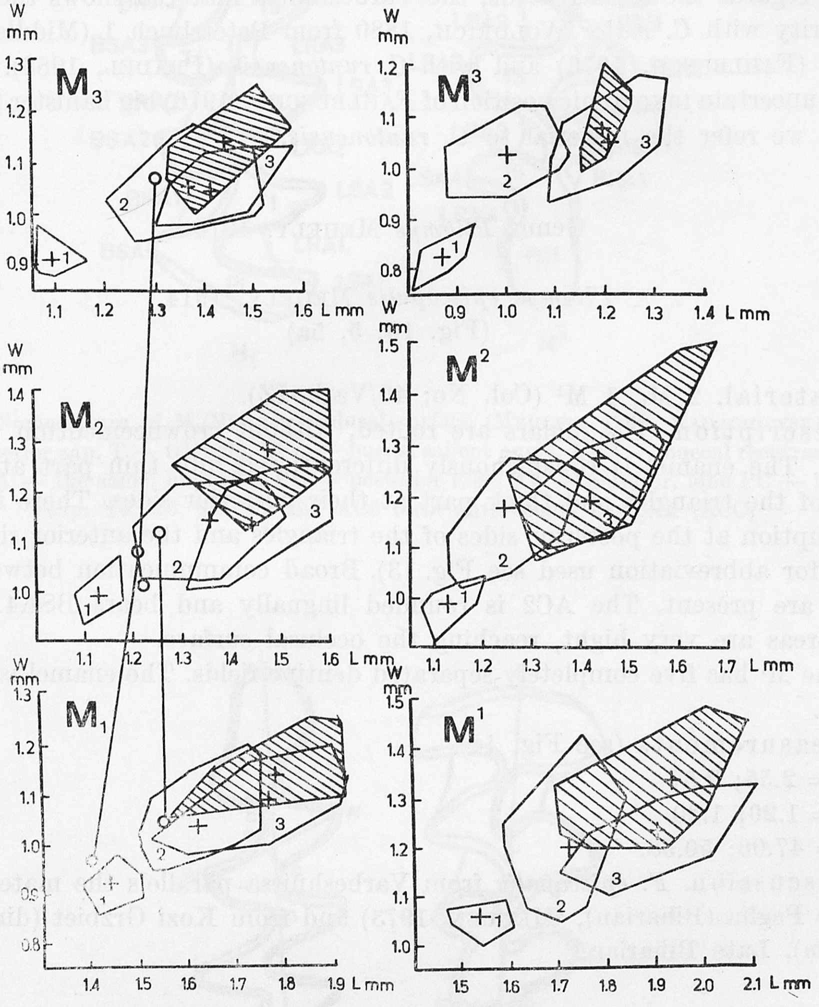

Fig. 12. Scatter diagrams of small hamster molars, length (L) and width (W). Poligons define distributions for: recent *Phodopus sungorus* from Mongolia (for all teeth the number of specimens is 12, author's measurements of material stored in Inst. Exp. Syst. Zool., Kraków), (1); *Cricetulus migratorius*, recent from Moldavia (for all teeth the number of specimens is 108, author's measurements of material stored in Inst. of Zoology, Kishinev), (2); *Allocricetus bursae* from Kozi Grzbiet, Poland (data adopted from PRADEL, 1988), (3); *Allocricetus bursae* from Varbeshnitsa (for sample size see Tabl. VI), (hatched poligon); with cross are presented mean values for each poligon; *Cricetulus migratorius* specimens from Varbeshnitsa are represented by white circles. The molars belonging to the same row are connected with line

Measurements (length × width).
$M_1 = 3.75 \times 2.30$
$M_2 = 2.70 \times 3.05—2.25 \times 2.60$.

Discussion. The specimens from Varbeshnitsa are distinctly larger than recent *Cricetus cricetus* (LINNAEUS, 1758) from Bulgaria (No: 5/26IZ, LM_1 = = 3.10; LM_2 = 2.20) and Poland (PRADEL, 1981b).

As regards the fossil records, the Varbeshnitsa material shows the greatest similarity with *C. major* WOLDŘICH, 1880 from Petersbuch 1 (Middle Pleistocene), (FAHLBUSCH, 1976) and with *C. runtonensis* (PRADEL, 1988). Because of the uncertain taxonomic position of FAHLBUSCH'S (1976) big hamster (PRADEL, 1985), we refer the material to *C. runtonensis*.

Genus *Pliomys* MEHELY, 1914

Pliomys episcopalis MEHELY, 1914
(Fig. 10: 5, 5a)

Material. 2 M_1, 1 M^1 (Col. No: 40/Varb.-IZ).

Description. The molars are rooted, without crowncementum.

M_1. The enamel is conspicuously differentiated into thin part at anterior sides of the triangles and thick part at their posterior sides. There is enamel interruption at the posterior sides of the triangles and the anterior side of the AC2 (for abbreviation used see Fig. 13). Broad communication between some parts are present. The AC2 is rounded lingually and bears BSA4. Enamel free areas are very hight, reaching the occlusal surface.

The M^1 has five completely separated dentine fields. The enamel is differentiated.

Measurements (see Fig. 14).
LM_1 = 2.55; 2.57
aM_1 = 1.20; 1.30
a/L = 47.06; 50.58.

Discussion. *P. episcopalis* from Varbeshnitsa parallels the material from Monte Peglia (Biharian), (MEULEN, 1973) and from Kozi Grzbiet (direct comparison), Late Biharian.

Genus *Clethrionomys* TILESIUS, 1850

Clethrionomys cf. *glareolus* (SCHREBER, 1780)
(Fig. 8: 4,3)

Material. 2 M_1, 1 M_2 (Col. No: 41/Varb.-IZ).

Description. The molars available have two roots and little crown-cementum in the reentrant folds.

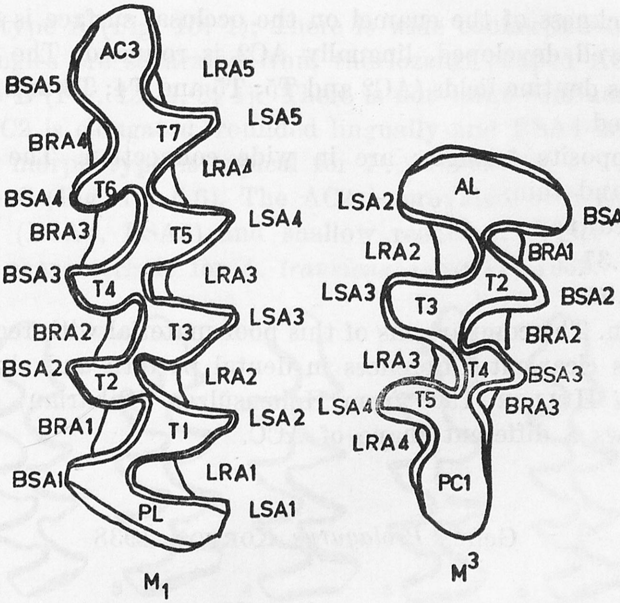

Fig. 13. Nomeclature of M_1/M^3 vole occlusal surface (MEULEN, 1973, NADACHOWSKI, 1982): AC — anterior cap. T — triangle, BSA — buccal salient angle, BRA — buccal reentrant angle, LSA, LRA — the same, lingually, PL — posterior lobe, AL — anterior, lobe PC — posterior cap. T4, T5, T6, T7 and AC3 form anteroconid complex (ACC)

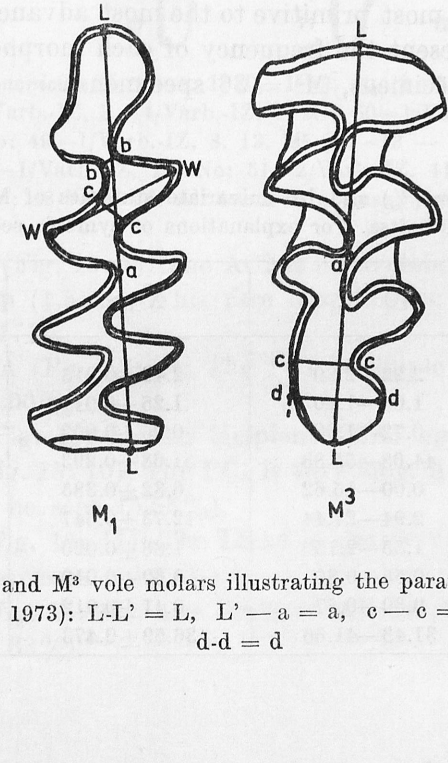

Fig. 14. Schemes of M_1 and M^3 vole molars illustrating the parameters that were measured (partly from MEULEN, 1973): L-L' = L, L' — a = a, c — c = cW — W = W, b-b = b, d-d = d

M_1. The thickness of the enamel on the occlusal surface is nearly uniform. The BSA4 is well developed, lingually AC2 is rounded. The communication between various dentine fields (AC2 and T5; T5 and T4; T3 and T4; T2 and T1) is well expressed.

M_2. The opposite triangles are in wide connection. The enamel is not differentiated and thin.

Measurements.

$LM_1 = 2.30; 2.37$

$aM_1 = 1.00; 1.00$

Discussion. The comparisons of this poor material with recent *C. glareolus* does not shows clear-cut differences in dental pattern and size. It is smaller than *C. sebaldi* HELLER, 1963 from Hohensülzen (Biharian) (STORCH et al., 1973) and shows a different shape of ACC.

Genus *Prolagurus* KORMOS, 1938

Prolagurus pannonicus (KORMOS, 1930)

(Fig. 15: 1—13)

Material. 46 isolated M_1, 1 fragment of mandible with M_1-M_3, 12 framents of mandible with M_1-M_2, 5 fragments of mandible with M_1, 1 fragment of maxillae with M^1-M^3, 34 isolated M^3 and 118 other molars (Col. Ño: 42—51/Varb.-IZ).

Description. The method of analysis of morphotypes of M_1/M^3 assemblages will be applied in the following section. The morphotypes are arranged in author's opinion from most primitive to the most advanced ones. The percentages in brackets represent the frequency of each morphotype in the material available (M_1 = 54 specimens, M^3 = 36 specimens).

Table VII

Measurements (mm), ratios (%) and its univariate statistics of M_1 and M^3 of *Prolagurus pannonicus* from Varbeshnitsa. For explanations of symbols see Fig. 14 and p. 195

	N	O. R.	$\bar{X} \pm SE$	SD	CV
LM_1	58	2.22—2.80	2.42±0.015	0.117	4.86
aM_1	61	1.05—1.40	1.25±0.011	0.085	6.84
WM_1	62	0.72—1.00	0.85±0.007	0.053	6.32
a/L	58	44.68—55.88	51.68±0.293	2.23	4.31
b/W	62	0.00—15.62	6.32±0.385	3.03	47.95
c/W	62	2.94—27.44	12.73±0.647	5.31	41.44
LM^3	37	1.55—2.15	1.88±0.020	0.12	6.41
aM^3	36	0.55—0.80	0.69±0.012	0.076	11.06
WM^3	37	0.30—0.57	0.41±0.012	0.071	17.30
a/L	36	31.43—41.66	36.59±0.473	2.84	7.78

M_1. Morphotype A (Fig. 15: 1): There is wide connection between T4 and T5. These triangles are separated from the lozenge-shaped AC2 (5.55%).

Morphotype B (Fig. 15: 2, 3, 4): There is not large confluence between T4 and T5. The AC2 is elongated, rounded lingually and BSA4 is well developed (77.77%). This morphotype is typical for *P. pannonicus*.

Morphotype C (Fig. 15: 5,6). The AC2 is provided with two more or less pointed salient (BSA4, LSA5) and shallow reentrant angles (14.81%). This morphotype is characteristic for *L. transiens* JANOSSY, 1962.

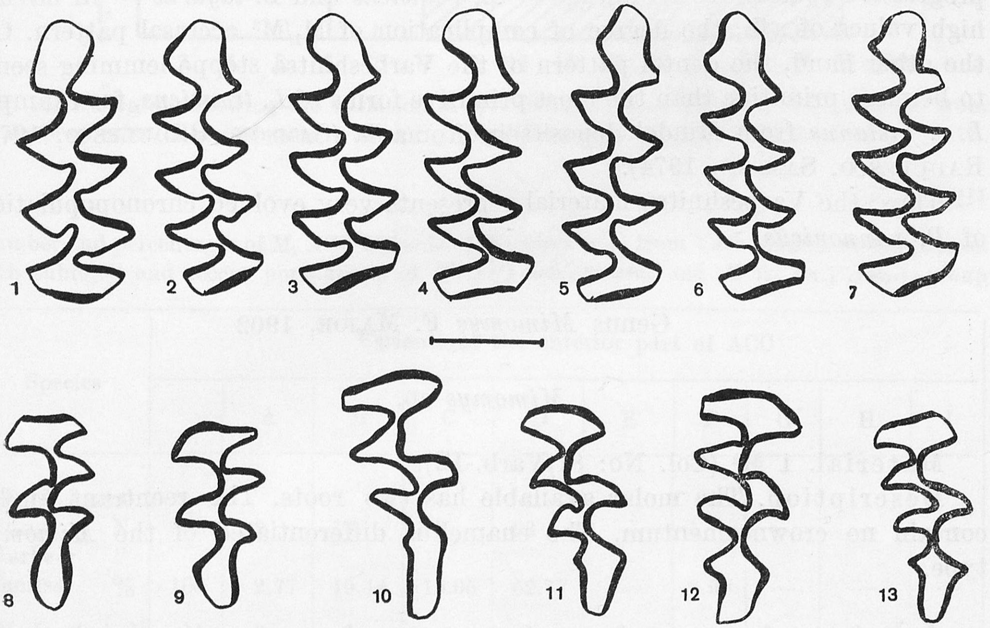

Fig. 15. *Prolagurus pannonicus* (KORMOS, 1930). 1—7. M_1 (2—7 — right, 1 — left) 1. No 42/Varb.-IZ, 2. No: 43/Varb.-IZ, 3. 44/Varb.-IZ, 4. No: 50—1/Varb.-IZ, 5. No: 45/Varb.-IZ: 6. 50—2/Varb.-IZ, 7. No: 49—1/Varb.-IZ, 8. 13. M^3 (10—13 — right, 8, 9 — left); 8. No: 46/Varb.-IZ, 9. No: 51—1/Varb.-IZ, 10. No: 51—2/Varb.-IZ, 11. No: 47/Varb.-IZ, 12. No 51—3/Varb.-IZ, 13. No: 48/Varb.-IZ. All teeth in occlusal view. Scale represents 1 mm

Morphotype D (Fig. 15: 7): The AC2 is more elaborated-BRA4 and sometimes LSA5 are deep (1.85%). This rare morphotype can be seen in recent *L. lagurus* PALLAS, 1773.

M^3. Morphotype A (Fig. 15: 8): The PC1 is simple and it is in wide connection with T4 (25.00%).

Morphotype B (Fig. 15: 9): An incipient LSA4 appears (38.88%).

Morphotype C (Fig. 15: 10): The PC1 is very long. A tendency to separation of T4 and PC1 can be seen (5.55%).

Morphotype D (Fig. 15: 11): The LSA4 is clearly visible. As a new feature an incipient BSA4 appears (13.88%).

Morphotype E (Fig. 15: 12): The BSA4 is well developed. The PC1 and the T4 are separated (8.33%).

Morphotype F (Fig. 15: 13): A characteristic feature is the distinct development of BSA4 and LSA4. A full separation between PC1 and T4 occurs (8.43 %).

Measurements — see Table VII.

Discussion. The M_1 material from Varbeshnitsa resembles the original material as described by KORMOS (1938). It differs only in the narrower connection between T4 and T5.

Some specimens from Varbeshnitsa show a great similarity to the more progressive species in this lineage — *L. transiens* and *L. lagurus* — in having high values of a/L, the degree of complication of M_1/M^3 occlusal pattern. On the other hand, the dental pattern of the Varbeshnitsa steppe lemming seems to be more primitive than the most primitive forms of *L. transiens*, for example *L. t. casianus* from Mindel deposits in Romania (SAMSON, RADULESCO, 1972, RADULESCO, SAMSON, 1974).

Thus, the Varbeshnitsa material represents very evolved chronopopulation of *P. pannonicus*.

Genus *Mimomys* F. MAJOR, 1902

Mimomys sp.

Material. 1 M^2 (Col. No: 81/Varb.-IZ).

Description. The molar available has two roots. The reentrant angles contain no crowncementum. The enamel is differentiated of the *Mimomys* type.

Investigations on the M_1/M^3 occlusal pattern in genus *Microtus* SCHRANK, 1798 (s. l.) from Varbeshnitsa

All medium sized vole molars which show absence of roots, abundant crowncementum in synclines, well differentiated enamel into thinner posterior and thicker anterior parts, well expressed dentine tracks reaching the occlusal surface in early stages of wear are assigned to the genus *Microtus* (s. l.).

In order to surmount the difficulties in separating species the method of analysis of morphotypes will be applied. In addition, biometrical data will be used in comparison with related fossil and living forms (see Fig. 14).

Analysis of M_1 *Microtus* assemblage

On the basis of the degree of separation of T4 and T5 M_1 *Microtus* assemblage from Varbeshnitsa may be divided into two main groups (Fig. 16).

Based on the shape of the anterior part of the anteroconid complex some nine variants are distinguished within the scope of these two groups:

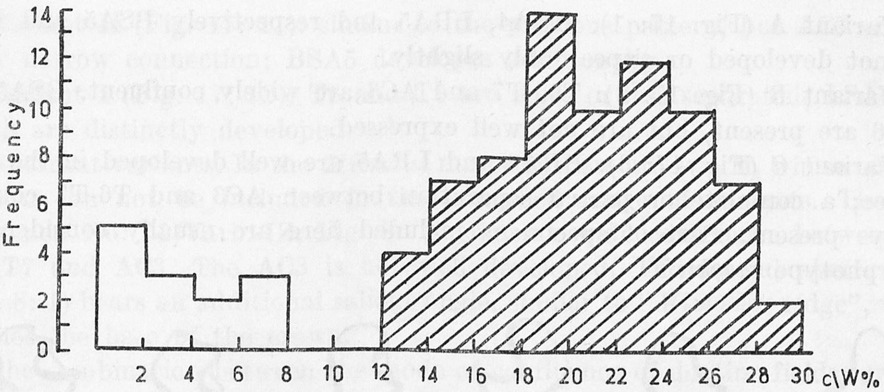

Fig. 16. Histogram showing the variation of c/W ratio of M_1 of *Microtus* (s.l.) material from Varbeschnitsa. Hatched area — *M. (P.) arvalidens* (= I group, for discussion see text)

Table VIII

Number and percentages of M_1 ACC variants of *Microtus* (s.l.) from Varbeshnitsa in comparison with subfossil and recent populations of *M. (P) subterraneus* and *M* (s. str.) *arvalis*-group

Species			Variants of the anterior part of ACC								
			A	B	C	D	E	F	G	H	I
M. (P.) arvalidens Varbeshnitsa	N	60	2	14	13	38	—	5	—	—	—
	%	100	2.77	19.44	18.05	52.77	—	6.90	—	—	—
M. (s. str.) arvalinus, Varbe shnitsa	N	11	3	1	—	1	2	—	1	2	1
	%	100	27.26	9.09	—	9.09	18.18	—	9.09	18.18	9.09
M. (P.) subterraneus, subfossil, the Rhodopes	N	43	—	1	33	7	—	2	—	—	—
	%	100	—	2.32	76.74	16.28	—	4.65	—	—	—
M. (P.) subterraneus recent, Bulgaria	N	18	—	—	13	5	—	—	—	—	—
	%	100	—	—	72.22	27.77	—	—	—	—	—
M. (s. str.) arvalis-group, SE Dobrudza, from owl pellets	N	102	3	5	11	68	3	1	1	10	—
	%	100	2.94	4.90	10.78	66.66	2.94	0.98	0.98	9.80	—

Variant A (Fig. 17: 1): BRA4, LRA5 and respectively BSA5 and LSA6 are not developed or appear only slightly.

Variant B (Fig. 17: 2): T6, T7 and AC3 are widely confluent. BSA5 and LSA6 are present, but are not well expressed.

Variant C (Fig. 17: 3): BRA4 and LRA5 are well developed in the same degree; a complete or partial separation between AC3 and T6-T7 complex always present. Part of specimens included here are usually considered as "morphotype *maskii*".

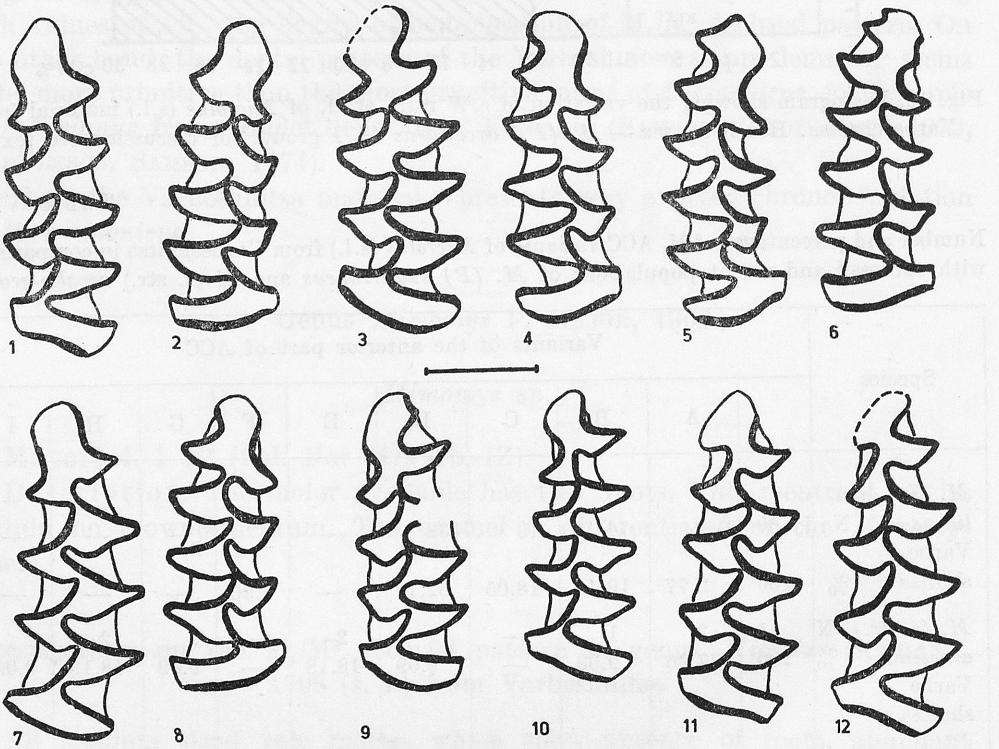

Fig. 17. 1—6. *Microtus (P.) arvalidens* Kretzoi, 1958, first lower molars (2, 4, 5, 6 — right 1, 3 — left). 1. No: 55/Varb.-IZ, 2. No: 54/Varb.-IZ, 3. 58/Varb.-IZ, 4. No: 56/Varb.-IZ, 5. No: 66/Varb.-IZ, 6. No: 57/Varb.-IZ. 7—12. *Microtus* (s. str.) *arvalinus* Hinton, 1923, first lower molars, (8 — right, the others — left); 7. No: 68/Varb.-IZ, 8. No: 67/Varb.-IZ, 9. No: 69/Varb.-IZ, 10. No: 70/Varb.-IZ

Variant D (Fig. 17: 4): AC3 is asymmetrical, because LSA6 or BSA5 is more distinctly developed. This variant is usually noted as "arvalid".

Variant E (Fig. 17: 5): LSA6 is distinctly developed; a shallow LRA6 is present.

Variant F (Fig. 17: 6): LSA6 and/or BSA5 are well developed; a shallow LRA6 and/or BRA5 appear.

Variant G (Fig. 17: 10): T6 and T7 are well separated, AC3 and T7 are largely confluent; AC3 is rounded.

Variant H (Fig. 17: 11): similar to the previous pattern, but AC3 and T7 show narrow connection; BSA5 developes additionally.

Variant I (Fig. 17: 12): T6 and T7 are more or less separated; LSA6 and BSA5 are distinctly developed.

Aberrant variants. In the *Microtus* material there are two M_1 whose occlusal pattern can not be included in the described range of variants. The first (specimen No: 52/Varb.-IZ, Fig 8: 2) shows a wide confluence between T5, T6, T7 and AC3. The AC3 is not well developed. The second aberrant M_1 (Fig. 8: 1) bears an additional salient angle, similar to "*Mimomys* ridge", which reaches the base of the crown.

The combination between the mode of confluence of dentine fields (groups) and the shape of ACC (variants) are considered as morphotypes (Tabl. VIII).

Discussion. The bulk of the available M_1 *Microtus* material belongs to the first group. The M_1 occlusal pattern of this group show some resemblance to those of the living members of the subgenus *Pitymys* — notably in the broad connection between T4 and T5, and to those of the sibling-species of *M. arvalis* group — in terms of the variability of the ACC. This combination allows of referring this part of M_1's to *M. (P.) arvalidens* KRETZOI, 1958 (= "*P.*" *arvaloides* HINTON, 1923).

The M_1 dental pattern of the second group is closely related to the recent members of subgenus *Microtus* (s. str.). It resembles the living members of *M. arvalis*-group. However, there are great differences. The fossil material shows wide variability of ACC (Tabl. 8), from some primitive variants (not well differentiated T6, T7 and AC3) to some more elaborated ones, characteristic for example, of the living *M. agrestis*. This type of differentiation resembles *Microtus arvalinus* HINTON, 1923. The aberrant morphotype with a "*Mimomys* ridge" is also referred to this species.

Analysis of M^3-*Microtus* assemblage

The analysis of the M_1 sample shows occurrence of two *Microtus* species of Varbeshnitsa, one of which is much more abundant than the other. These data suggest that such a ratio may be found in the M^3 sample. Thus, by analysing the variability of M^3 dental pattern one or another morphological group may be incorporated to either *M. arvalidens* or *M. arvalinus*. The significance of these investigations arises from the poor description in the literature of the M^3 dental pattern in these two species. In this way it will be possible to elucidate both their evolutionary stage and relationships.

We adopt the number of dentine fields as a criterion for classifying the M^3 available into groups. As isolated are accepted these dentine fields, between which the connection is no wider than two-fold enamel thickness. The first group includes the specimens that show three (Fig. 18: 1) or four (Fig. 18: 6) dentine fields; the second group — the M^3's with five dentine fields (Fig. 18: 3, 9, 10, 11).

On the basis of the variation of the shape of T5-PC-complex the following variants have been distinguished:

Variant A (= *simplex*, RÖRIG, BÖRNER, 1905): On the lingual side there are only two reentrant angles filled with crowncementum (LRA2 and LRA3) and three salient angles (LSA2, LSA3, LSA4). The PC may be poorly developed and short (Fig. 18: 1, 3) or more elongated (Fig. 18: 2, 4).

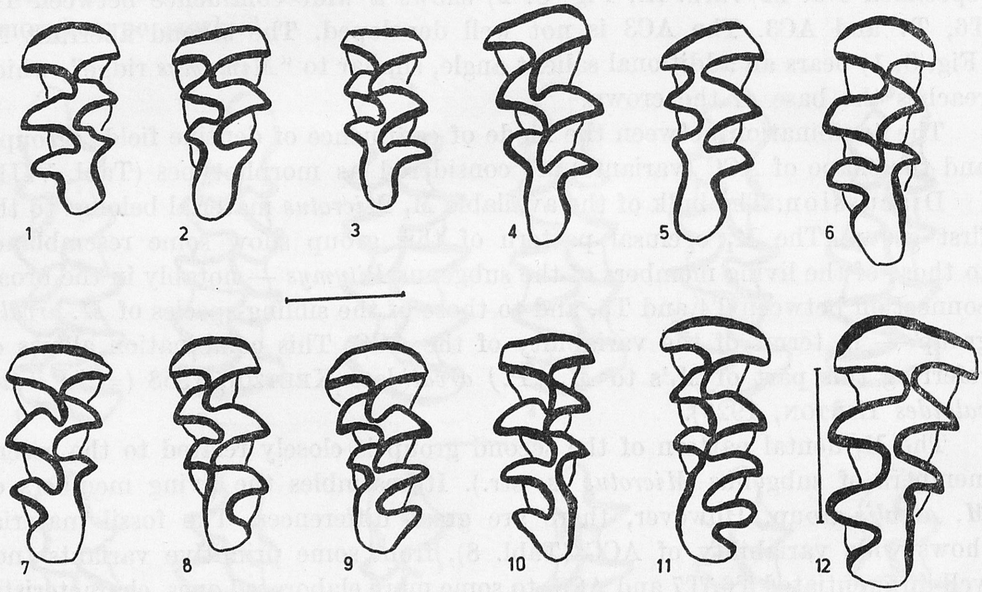

Fig. 18. 1—11. M^3 *Microtus* (s.l.) assemblage from Varbeshnitsa, (2, 3, 4, 6, 8, 11 — right, 1, 5, 7, 10 — left); 1. No: 60/Varb.-IZ, 2. No: 73—1/Varb.-IZ, 3. No: 61/Varb.-IZ, 7. No: 73—2/Varb.-IZ, 5. No: 59/Varb.-IZ, 6. No: 73—3/Varb.-IZ, 7. No: 74/Varb.-IZ, 8. No: 73—4/Varb.-IZ, 9. No: 71/Varb.-IZ, 10. No: 72/Varb.-IZ, 11. No: 73—5/Varb.-IZ. 12. *M. (P.) subterraneus* (DE SELYS-LONGSCHAMPS, 1836), recent, No: 87/77 Ogr. (left). All teeth in occlusal view. Scales represent 1 mm

Variant B (= *complex*, *sensu* RABEDER, 1981): as a new feature LRA4 filled with crowncementum appears. The LSA5 is incipient, rounded (Fig. 18: 5, 6, 7, 8).

Variant C (= *typica*, RÖRIG, BÖRNER, 1905): the LSA5 is very well expressed (Fig. 18: 9, 10).

Variant D (= var. 3/5, *sensu* ANGERMANN, 1974): the LSA6 appears, in some cases it is developed very distinctly (Fig. 18: 11).

Some specimens which show BSA4 (= *duplicata*) are not distinguished. They are very rare in the Varbeshnitsa M^3 sample.

The c/d ratio is used as a quantitative characteristics to show the degree of PC complication. Both the c/d and a/L ratios are considered to reflect to the main way of M^3 evolution of *Microtus* lineage. They have been used for biometrical separation of the fossil material as well as in addition to morphological analysis and in comparison with the recent forms.

Table IX

Number and percentages of M³ morphotypes of *Microtus* (s.l.) from Varbeshnitsa in comparison with recent *M. (P.) subterraneus* and *M. arvalis* group

M³ assemblage (species)	Group (mode of dentine field connection)	Sample size		Variants of T5-PC-complex			
				A	B	C	D
M³ assemblage from Varbeshnitsa	I	N	14	4	9	1	—
		%	36.84	10.52	23.68	2.63	
	II	N	24	7	15	1	1
		%	63.15	18.42	39.47	2.63	2.63
M. (s. str.) arvalis, recent, SE Dobrudza, fsom owl pellets	II	N	32	1	8	22	1
		%	100	3.12	25.00	68.75	3.12
M. (P.) subterraneus, recent, Bulgaria	I	N	15	—	2	13	—
		%	83.33		11.11	72.22	
	II	N	3	—	—	3	—
		%	16.16	—	—	16.16	—

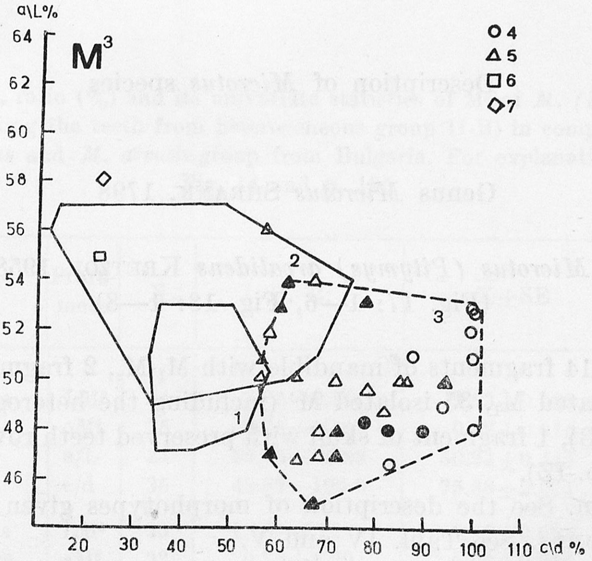

Fig. 19. Scatter diagram showing relation between c/d and a/L in some M³ assemblages of *Microtus* (s.l.). Poligons represent variability of: recent *M. (P.) subterraneus* from Bulgaria (N = 18), (1); recent *M. arvalis* — group from NE Bulagria (N = 33), (2) and *M. (P.) arvalidens* from Varbeshnitsa, including heterogenous morphotype II-B, (3); 4 — variant A, 5 — variant B, 6 — variant C, 7 — variant D; black figures represent specimens with three or four dentine fields (I group, see text), white ones-with five dentine fields (II group). The specimens outside polygon 3 are referred to *M.* (*s.* str.) *arvalinus*

Here the combination of mode of confluence of dentine fields and variants of T5-PC-complex are also considered as morphotypes. The frequency of M^3 morphotypes in both fossil and comparative recent materials is given on Table IX.

Discussion. The scatter diagram (Fig. 19) indicates two clusters in the fossil material. The bulk of M^3 sample from Varbeshnitsa belongs to the group which shows a low value of a/L ratio (short T5-T4-PC-complex) and a high value of c/d ratio (simple PC). Bearing in mind the evolutionary meaning of these characteristics, it can be supposed that the more abundant group may be associated with *M. (P.) arvalidens*; the poor material in second group may be assigned to *M. arvalinus.* Although the ratio between these two groups is similar to this in the M_1 sample, it is not the same (using chi-squer test). Only a few specimens of M^3 can be said without doubt to belong to *M. arvalinus.* This is probably due to the overlapping of the dental patterns in these two species, as it can be seen in the recent *M. arvalis* — group and *M. (P.) subterraneus* (Fig. 19). In our opinion the group belonging to the morphotype II-B is heterogeneous and contains both *M. arvalinus* and *M. arvalidens* M^3's. Thus, the material from Varbeshnitsa may be arranged as follow:

I-A, B, C, II-A — *M. arvalidens* = 21 M^3

II-B — *M. arvalidens* + *M. arvalinus* = 15 M^3

II-C, D — *M. arvalinus* = 2 M^3.

Description of *Microtus* species

Genus *Microtus* SHRANK, 1798

Microtus (Pitymys) arvalidens KRETZOI, 1958
(Fig. 17: 1—6, Fig. 18: 1—8)

Materials. 14 fragments of mandible with M_1-M_2, 2 fragments of mandible with M_1, 45 isolated M_1, 35 isolated M^3 (including the heterogeneous group of morphotype II-B), 1 fragment of skull with preserved teeth rows (Col. No: 53—61, 73—74/Varb.-IZ).

Description. See the description of morphotypes given above.

Measurements. See Tabl. IV and V.

Discussion. In the literature we find little agreement regarding the systematic position of this species. Some scholars (JÁNOSSY, 1969, GROMOV & POLJAKOV, 1977 and others) regards *M. (P.) arvalidens* as a member of *Microtus* (s. str.) evolutionary lineage, since they consider the broad connection between T4 and T5 as a primitive feature characteristic of *Pitymys* as well as for the earliest members of *Microtus* (s. str.) lineage.

Table X

Measurements (mm), ratio (%) and its univariate statistics of M_1 of *M. (P.) arvalidens* from Varbeshnitsa in comparison with recent *M. (P.) subterraneus* from Bulgaria. For explanation of symbols see Fig. 14 and p. 195

Species	Parameter	N	O. R.	$\overline{X} \pm SE$	SD	CV
M. (P.) arvalidens, Varbeshnitsa	LM_1	63	2.47—2.95	2.69±0.014	0.019	4.42
	aM_1	73	1.20—1.62	1.38±0.010	0.085	6.16
	WM_1	73	0.75—1.05	0.91±0.007	0.061	6.70
	c	74	0.12—0.25	0.19±0.004	0.035	18.42
	a/L	63	47.17—54.90	51.48±0.189	1.50	2.91
	c/W	73	12.50—29.41	20.73±0.484	4.10	19.78
M. (P.) subterraneus, recent, Bulgaria	LM_1	18	2.47—3.02	2.74±0.043	0.183	6.67
	aM_1	18	1.27—1.60	1.45±0.023	0.098	6.76
	WM_1	18	0.82—1.07	0.92±0.014	0.061	6.66
	c	18	0.07—0.22	0.17±0.010	0.042	24.61
	a/L	18	50.80—55.05	52.97±0.318	1.35	2.55
	c/W	18	8.62—27.44	18.32±1.180	5.03	27.47

Table XI

Measurements (mm), ratio (%) and its univariate statistics of M^3 of *M. (P.) arvalidens* from Varbeshnitsa (including the teeth from heterogeneous group II-B) in comparison with recent *M. (P.) subterraneus* and *M. arvalis*-group from Bulgaria. For explanation of symbols see Fig. 14 and p. 195

Species, locality	Parameter	N	O. R.	$\overline{X} \pm SE$	SD	CV
M. (P.) arvalidens Varbeshnitsa	LM^3	34	1.55—2.22	1.83±0.028	0.163	8.92
	aM^3	35	0.75—1.15	0.92±0.016	0.097	10.56
	a/L	34	45.05—55.88	50.24±0.451	2.63	5.24
	c/d	35	48.57—100.0	75.38±2.571	15.21	20.18
M. (s. str.) arvalis group, Dobrudza, recent (from owl pellets)	LM^3	33	1.50—2.12	1.83±0.023	0.134	7.35
	aM^3	33	0.75—1.20	0.99±0.016	0.094	9.47
	a/L	33	42.52—62.20	54.06±0.536	3.080	5.69
	c/d	33	10.71—77.14	42.65±2.839	16.31	38,23
M. (P.) subterraneus, recent, Bulgaria	LM^3	18	1.52—1.95	1.79±0.029	0.125	6.99
	aM^3	18	0.75—1.02	0.90±0.018	0.078	8.69
	a/L	18	47.18—53.48	50.41±0.471	2.00	3.91
	c/d	18	33.78—57.14	43.97±1.579	6.70	15.25

Other authors (HINTON, 1926, MEULEN, 1973, SUTCLIFFE & KOWALSKI, 1976) recognise it as a true *Pitymys*. RABEDER (1981) considers *M. arvalidens* as an ancestor of all recent European *Pitymys* species.

The material from Varbeshnitsa may contribute further information on this problem. Of primary importance here is the structure of M^3.

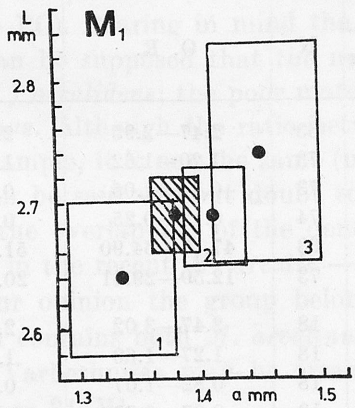

Fig. 20. Relation between mean values of LM_1 and aM_1 (black circles) of *M. arvalidens* from Nagyhársányhegy 4 (1), (MEULEN, 1973), Villany 6 (2), (MEULEN, 1973) and Varbeshnitsa (hatched rectangle) in comparison with recent *M. (P.) subterraneus* from Bulgaria (N = 18), (3). The rectangles represent 95% confidence intervals of the mean values

Table XII

Dominant M^3 morphotypes in recent *Pitymys* species in Europe (modified from data in the literature). Also see text for discussion

Dominant morphotype	Degree of complication	Species	Source
I-A, B	Most primitive	*M (P.) felteni* MALEC & STORCH, 1963	PETROV, ŽIVKOVIĆ, 1979
		M. (P.) thomasi Barret-Hamilton, 1903	ibidem
		M. (P.) duodecimcostatus (DE SELYS-LONGCHAMPS, 1839)	NIETHAMER, 1982a
		M. (P.) lusitanicus (GERBE, 1879)	NIETHAMER, 1982b
		M (P.) savi (DE SELYS-LONGCHAMPS. 1898)	CONTOLI, 1980
I-C	Intermediate	*M. (P.) subterraneus* (DE SELYS-LONGCHAMPS, 1839)	present author PETROV, ŽIVKOVIĆ 1979
II-C	Most derived	*M. (P.) tatricus* (KRATOCHVIL, 1952)	NIETHAMER, 1982c
		M. (P.) multiplex (FATIO, 1905)	STORCH, WINKING, 1977
		M. (P.) liechtensteini (WETTSTEIN, 1927)	ibidem
		M. (P.) majori THOMAS, 1906	STORCH, 1982

The variability of M^3 occlusal patterns of *M. (P.) arvalidens* from Varbeshnitsa covers only a part of that of the modern *Pitymys* species from Europe (Tabl. XII). It is clear that recent *M. (P.) subterraneus* and some other modern species have more complicated structure of M^3 than the fossil species. These observations lead to the assumption that *M. arvalidens* may be considered as a primitive form of the *Pitymys* lineage. The main trend of its evolution is towards recent *M. (P.) subterraneus* manifesting itself in complication of PC of M^3 (Fig. 19) and an increase of the relative length of ACC of M_1 (Fig. 20). Some isolated species from South Europe may be regarded as relict forms, near to primitive ancestor.

Microtus (s. str.) *arvalinus* HINTON, 1923
(Fig. 17: 7—12, Fig. 8: 1, Fig. 20: 9—11)

Material. 12 isolated M_1, 3 M^3 (Col. No: 62—72/Varb.-IZ).

Description. See above.

Measurements. For measurements of M_1 see Tabl. VII

LM^3 = 1.97; 1.80; 2.05
aM^3 = 1.10; 0.92; 1.20
a/L = 55.84; 51.11; 58.53
c/d = 24.00; 38.58; 26.31.

Discussion. CHALINE (1972) included *M. arvalinus* in the synonymy of *M. arvalis*. SUTCLIFFE & KOWALSKI (1976) consider this species as an ancestor of *M. agrestis*. The data available in the literature (NADACHOWSKI, 1982 etc.), concerning the relative length of ACC, and our data from Varbeshnitsa in comparison with recent *M. arvalis* group (Tabl. XIII) confirm the assumption that *M. arvalinus* is a more primitive species than either *M. arvalis* or *M. agrestis*. On the other hand, the variability of the ACC shape shows that we probably deal with an early specialized side branch of *Microtus* evolution.

IV. GENERAL REMARKS AND CONCLUSIONS

1. Age of the fauna

A biostratigraphic correlation of the Varbeshnitsa local fauna will be made with the Hungarian stratigraphical succession, based on small mammals (KRETZOI, 1941, 1953, 1956, JÁNOSSY, 1962, 1969, 1970, MEULEN, 1973, FEJFAR & HEINRICH, 1981). Species composition of Varbeshnitsa indicates an Upper Biharian age of the locality. Here we accept the subdivision of Upper Biharian into two phases — Nagyhársányhegy and Templomhegy and *Prologurus* late appearance date as a boundary between these phases. Thus, the locality under study may be correlated with the Nagyhársányhegy phase. Having in mind that in Varbeshnitsa we deal with a very progressive form of *P. pannonicus*, it seems reasonable to assume that the fauna may be referred to the uppermost part of Nagyhársányhegy phase.

On the basis of these correlations a tentative chronostsatigraphical correlation might be made. It seems reasonable to refer the locality of Varbeshnitsa to Cromerian (s. str.), usually considered as the end of Günz-Mindel interglacial, i.e. the lowermost part of Middle Pleistocene.

Table XIII

Measurements (mm), ratio (%) and its univariate statistics for M_1 of *M. (s. str. arvalinus)* from Varbeshnitsa in comparison with recent *M. arvalis*-group from Bulgaria

Species, locality	Parameter	N	O. R.	X±SE	SD	CV
M. arvalinus, Varbeshnitsa	LM_1	11	2.50—3.02	2.72±0.053	0.176	6.46
	aM_1	12	1.20—1.55	1.36±0.030	0.106	7.83
	WM_1	12	0.82—1.02	0.95±0.017	0.058	6.19
	a/L	11	46.43—53.91	50.74±0.660	2.20	4.23
M. arvalis-group SE Dobrudza (from owl pellets)	LM_1	81	2.40—2.97	2.65±0.014	0.127	4,81
	aM_1	81	1.25—1.62	1.42±0.010	0.091	6.40
	WM_1	81	0.80—1.05	0.93±0.005	0.048	5.15
	a/L	81	49.09—57.64	53.49±0.181	1.630	3.05

2. Ecological pecularities of the fauna and taphonomy

The species from Varbeshnitsa may be arranged in the following ecological groups:

1) species inhabiting open terrains: *M. (P.) arvalidens*, *P. pannonicus*, *A. bursae*, *Citellus* sp., *C. migratorius*, *C.* cf. *runtonensis*, *Spalax* sp., *Talpa* sp. The bulk of these species is characteristic of dry, steppe environments.

2) "buch" dwellers: *Crocidura* sp., *A. mystacinus*, *Ochotona* sp., cf. *Hypolagus* sp., *S. subaraneus*, cf. *Parapodemus* sp., *Apodemus* cf. *sylvaticus*.

3) woodland species: *S. minutus*, *G.* cf. *sackdillingensis*, *Clethrionomys* cf. *glareolus*, *P. episcopalis*, *A.* cf. *flavicollis*.

The structure of the fossil community from Varbeshnitsa (Fig. 21) shows the predominance of steppe species, since we tend to interpret the Varbeshnitsa past landscape as an open (grassland and shrub) not heavily forested area.

Under the present-day climatic conditions the occurrence of *A. mystacinus* is restricted to the south-west part of the country, where the influence of the mediterranean type of climate is most impressive. Thus, *A. mystacinus* presence in Varbeshnitśa, about 100 km northwards indicates a climate warmer and drier than at present.

Taphonomy. The fissure found in the Varbeshnitsa quarry is part of old vertical shaft, which acted as a natural trap for many small animals. This assumption agrees with the large number of snake's vertebres and snails found here, as well as with the complete absence of bird's and bat's remains and the scarceness of underground animals as the moles and the mole rats. In this case, the small mammal remains reflect the past community which occurred in the nearest surroundings of the shaft opening.

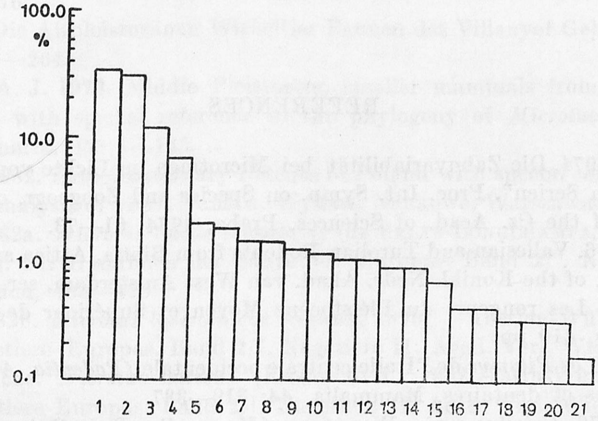

Fig. 21. Structure of fossil small mammal community from Varbeshnitsa (semi log-scale). The relative abundance of the species has been estimated by counting the number of molars of each species, regardless of state of preservation (on mandible/maxillae or isolated). Total number of teeth is 672. The $M_{2\ 3}$ and $M^{1\ 2}$ of *Microtus* (s.l.), indeterminable at species level, are also taken into account, using the assumption that the ratio found between M_1 of *M. arvalidens* and *M. arvalinus* is the same in the sample of other molars. Thus, the respective numbers of indeterminable molars was added to M_1 samples of each of these two species. 1. *M. (P.) arvalidens*, 2. *P. pannonicus*, 3. *A. bursae*, 4. *M.* (s. str.) *arvalinus*, 7. *Crocidura* sp., 6. *A. (P.) mystacinus*, 7. *A.* ex gr. *sylvaticus — flavicollis*, 8. *S. subaraneus*, 9. *Citellus* sp., 10. *Ochotona* sp., 11. cf. *Hypolagus* sp., 12. · *Parapodemus* sp., 13. *C. migratorius*, 17. *S. minutus*, 15. *G.* cf. *sackdillingensis*, 16. *C.* cf. *glareolus*, 17. *P. episcopalis*, 18. *Spalax* (s.l.) sp., 19. *Talpa* sp., 20. *C. cf. runtonensis*, 21. *Mimomys* sp.

9. Zoogeographic considerations

The distinctly European elements in Varbeshnitsa local fauna are: *A. bursae*, *Talpa* sp., *Crocidura* sp., *A. sylvaticus-flavicollis*, cf. *Parapodemus* sp., *S. subaraneus*, *S. minutus*, *G. sackdillingensis*, *C.* cf. *glareolus*, *P. episcopalis*, *C.* cf. *runtonensis*. The East European elements are *P. pannonicus* (its distribution reaches West Siberia), *Citellus* sp., *Spalax* sp. Wide distributed species (from West Europe to West Siberia) are *M. (P.) arvalidens*, *M.* (s. str.) *arvalinus*, *Ochotona* sp., cf. *Hypolagus* sp. The southern (Mediterranean and Near

East) influence is presented by *A. (P.) mysticinus* and *C. migratorius*. Thus, the zoogeographic structure of the Varbeshnitsa local fauna agrees with its geographical position and shows greatest similarity with the Upper Biharian localities of Carpathian basin and south part of Russian Plain.

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STRESZCZENIE

W pracy opisano 21 kopalnych taksonów drobnych ssaków (owadożernych, zającokształtnych i gryzoni), których szczątki uzyskano przez przemywanie osadów pionowej szczeliny krasowej koło miejscowości Varbešnica (Vraca, Bułgaria). Szczególną uwagę zwrócono na zmienność M_1/M^3 *Prolagurus pannonicus*, *Microtus (Pitymys) arvalidens* i *Microtus* (s. str.) *arvalinus*, gatunków mających znaczenie stratygraficzne. Pierwszy z wymienionych taksonów jest reprezentowany przez silnie zaawansowaną ewolucyjnie chronopopulację, drugi gatunek reprezentuje początkowy etap ewolucji podziemnych nornikowatych z podrodzaju *Pitymys*, a trzeci takson to prymitywny, lecz równocześnie wyspecjalizowany przedstawiciel *Microtus* (s. str.). Obecność tych trzech gatunków, a także *Pliomys episcopalis*, *Cricetus* cf. *runtonensis*, *Sorex subaraneus* pozwala określić wiek fauny na górny Biharian. Opisywany zespół ssaków ma europejski charakter i swoim składem odpowiada górnobiharskim faunom Basenu Karpackiego i południowej części Równiny Rosyjskiej. Obecność *Apodemus mystacinus*, około 100 km na północ od obecnej granicy zasięgu tego gatunku, świadczy o cieplejszym klimacie. Skład fauny wskazuje na rozwój głównie środowisk otwartych, stepowych.

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