ACTA ZOOL. CRACOV.	29	2	13-28	KRAKÓW, 15. XII. 1985

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Biharian voles *(Arvicolidae, Rodentia, Mammalia)* from Kozi Grzbiet (Central Poland)

(With 49 text-figs.)

Biharskie nornikowate *(Arvicolidae, Rodentia, Mammalia)* z Koziego Grzbietu

Abstract. A morphotypic analysis of dentition of the following voles: *Mimomys savini*, *Microtus* ex gr. *agrestis*, *M.* ex gr. *oeconomus*, *M.* ex gr. *nivalis*, *M. (Pitymys) arvalidens*, *M.* (? *Stenocranius*) *gregaloides*, *Clethrionomys glareolus* and *Pliomys episcopalis* has been carried out and a new morphotype in the morphological row of *Microtus* ex gr. *agrestis* ("*extratriangulatus*" nov.) has been described. The biostratigraphic position of Kozi Grzbiet has been discussed and established as the Templomhegyian phase of the Biharian.

I. INTRODUCTION

The locality of a Pleistocene fauna at Kozi Grzbiet is situated in the Świętokrzyskie Mts. (Holy Cross Mts.) in Central Poland (50°51'N, 20°21'E). GŁAZEK et al. (1976, 1977a, b) presented the geological profile of the cave and its interpretation and discussed the stratigraphic position of the deposits. The rich fauna of snails and vertebrates has partly been described in detail, but some systematic groups are still being studied. So far, comprehensive studies have been given to snails (STWORZEWICZ, 1981), amphibians and reptiles (MŁYNARSKI, 1977; SANCHIZ and SZYNDLAR, 1984; SZYNDLAR, 1981, 1984), birds (BOCHEŃSKI, 1984), lagomorphs (SYCH, 1980) and some rodent species (BLACK and KOWALSKI, 1974; KOWALSKI, 1975a, 1977, 1979). Studies of insectivores, bats, several families of rodents, carnivores and ungulates are under way. The fossil fauna was found only in Unit 2, which consisted of three layers: 2a, 2b, and 2c. A part of the material comes from deposites of uncertain stratigraphic position (layers 2b + c and 2a + b + c).

Among the voles of Kozi Grzbiet KOWALSKI (1975b) mentions *Mimomys* cf. *savini*, *Clethrionomys* cf. *glareolus*, *Pliomys* cf. *episcopalis*, *Pliomys* cf. *lenki*, *Pitymys gregaloides*, *Pitymys arvaloides*, *Microtus* ex gr. *oeconomus*, *Microtus*

ex gr. *arvalis*, *Lemmus* and *Dicrostonyx*. Both lemming species and *Pliomys lenki* were described earlier (KOWALSKI, 1975a, 1977) and so only the teeth of the remaining species have been analysed in the present work.

All the materials described are in the possession of the Institute of Systematic and Experimental Zoology, Polish Acad. Sci., Kraków.

II. METHOD

The teeth (chiefly M_1) were examined for morphological variation. The population approach was applied; it consists in treating rare morphological types as extreme variants of one form and not as often done, as separate species. Different series of morphotypes were established for each species, terms known from literature being most frequently used as specific names. The frequency of occurrence of particular morphotypes was also calculated. Terminology used in the descriptions of the morphological structure of teeth was adopted after VAN DER MEULEN (1973) and the length of M_1 (L) was also measured in the manner proposed by that author. The drawings of teeth were made directly from the specimens on the same scale.

III. SYSTEMATIC PART

Family *Arvicolidae* GRAY 1821
Genus *Mimomys* MAJOR 1902
Mimomys savini HINTON 1910

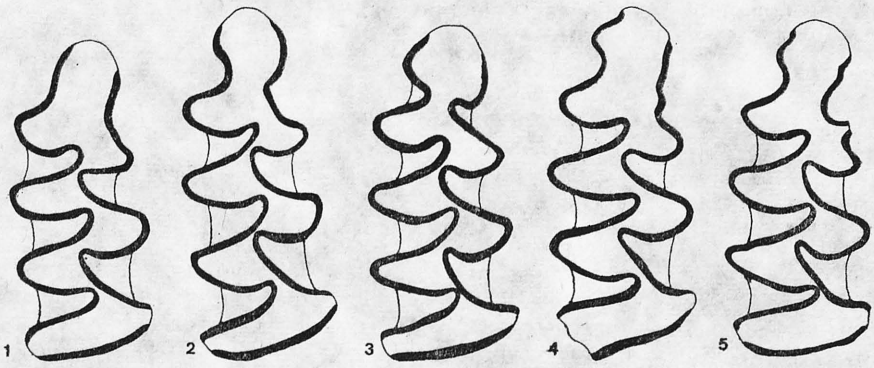
Material: MF/1763, layer 2a — 19 M_1, 11 M_2, 16 M_3, 14 M^1, 25 M^2, 18 M^3; layer 2b — 13 M_1, 8 M_2, 13 M_3, 21 M^1, 7 M^2, 7 M^3; layer 2c — 27 M_1, 22 M_2, 34 M_3, 28 M^1, 24 M^2, 17 M^3; layer 2a+b — 2 M_1, 4 M_2, 6 M_3, 10 M^1, 9 M^2, 11 M^3; layer 2a+b+c — 11 M_1, 14 M_2, 14 M_3, 8 M^1, 17 M^2, 21 M^3.

Measurements of M_1	Range	x	SD	CV	N
L (2a)	3.22—3.71	3.45	0.13	3.9	15
L (2b)	3.23—3.76	3.43	0.14	3.4	11
L (2c)	3.14—3.66	3.38	0.13	3.4	22

Morphology of M_1

Three morphotypes occur in the population of Kozi Grzbiet (cf. KRETZOI, 1965). The "*milleri*" (= "*intermedius*") morphotype with poorly developed BRA3 and LRA4 has been distinguished in 20% of specimens (Fig. 1). The "*majori*" type is the most frequent (nearly 50% of specimens) and splits up into two variants. The variant with AC2 distinctly separated (Fig. 3) was found in

only four specimens (5.6%). The "*savini*" morphotype is also represented by two variants. One of them is marked by a very poor development of the *Mimomys*-ridge and the presence of LRA5 at an initial stage of development

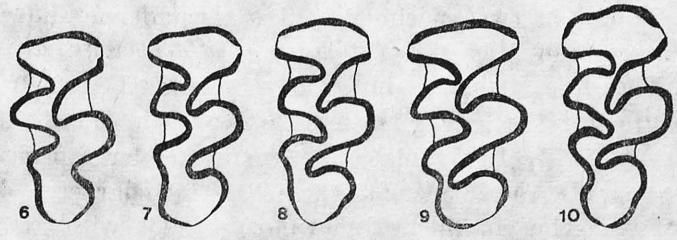


Figs 1—5. *Mimomys savini*, morphotypes of M_1 (MF/1763/1—5). 1: "*milleri*" — layer 2c, L = 3.39, 2: "*majori*" — layer 2b, L = 3.71, 3: "*majori*" — layer 2c, L = 3.57, 4: "*savini*" — layer 2a, L = 3.60, 5: "*savini*" — layer 2a, L = 3.56

(18.3%). The other variant with a distinct *Mimomys*-ridge characterizes 9 specimens (12.7%).

Morphology of M^3

Five morphotypes can be distinguished as regards the structure of tooth (Figs 6—10). Morphotype shown on Fig. 6, found only in one specimen, has T3 joined with T4 and PCl. The next morphotype, very much resembling the previous one but with a better developed LSA4, occurs in 37% of specimens. Morphotype with fields T3 and T4 separated but T4 fused with PCl, is the most frequently encountered form in the Kozi Grzbiet population. Morphotype (Fig. 9) present only in two specimens (2.7%), has its PCl separated from the



Figs 6—10. *Mimomys savini*, morphotypes of M^3 (MF/1763/6—10). 6: layer 2a+b+c, L = 2.03, 7: layer 2b, L = 2.14, 8: layer 2a, L = 2.13, 9: layer 2b+c, L = 2.24, 10: layer 2a, L = 2.40

rest of the tooth (T3 joined with T4). The most complex structure characterizes morphotype shown on Fig. 10 in which five entirely isolated enamel fields can be distinguished. It is represented by about 12% of these teeth.

Notes

The population of Kozi Grzbiet shows great variation. The morphological types described as *Mimomys milleri* KRETZOI 1958 (= *M. intermedius* (NEWTON 1881)), *M. majori* HINTON 1910 and *M. savini* HINTON 1910 can be distinguished in it. They form one fairly variable species.

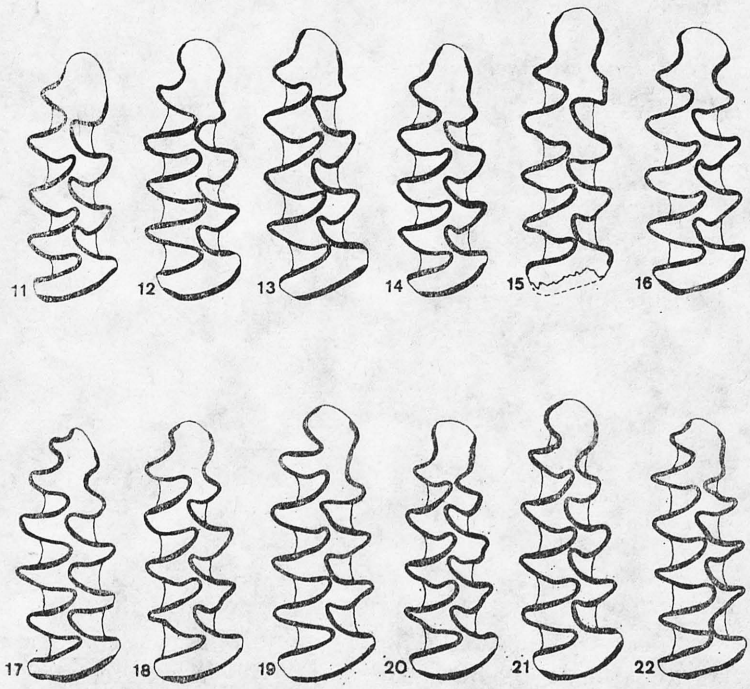
Genus *Microtus* SCHRANK 1798
Microtus ex gr. *agrestis*

Material: MF/1764, layer 2a — 74 M_1; layer 2b — 47 M_1; layer 2c — 152 M_1; layer 2b+c — 13 M_1; layer 2a+b+c — 54 M_1

Measurements of M_1	Range	x	SD	CV	N
L (2a)	2.60—3.20	2.82	0.14	4.9	47
L (2b)	2.58—3.12	2.87	0.13	2.9	27
L (2c)	2.54—3.37	2.91	0.18	6.1	94
LT4/LT5 index (2a)	44.9—73.3	59.9	6.2	10.3	47
LT4/LT5 index (2b)	54.9—70.2	61.6	4.8	7.8	27
LT4/LT5 index (2c)	44.4—80.0	60.3	6.9	11.4	94

Morphology of M_1

The morphological series numbered in this group consists of nine morphotypes (Figs 11—22). The "*fortis*" morphotype, characteristic of the modern East-Asiatic vole species *Microtus fortis* BÜCHNER 1889 (cf. MEYER, 1978) is the simplest. It lacks BRA4 and poorly developed AC. It occurs in only three specimens. The next morphotype, has intermediate characters between the "*gregalis*" and "*arvalis*" types (poorly developed BRA4). It has been found in nearly 10% of specimens and the name "*assimilis*" may be used, after RÖRIG and BÖRNER (1905), for this pattern. The next morphotype, which is represented by two variants (Figs 13 and 14), in its structure resembles the teeth most frequently described as "*nivalinus-nivaloides*", but in the Kozi Grzbiet population the respective characters are weakly marked and that is why these specimens are included in the morphological *agrestis-arvalis* series. Its frequency is scarely 3.5%. Found in two specimens only, morphotype shown on Fig. 15 has typical characters of *Microtus (Pitymus) arvalidens* KRETZOI 1958 (T4 and T5 confluent). These specimens are however very large (L = 3.20), their length considerably exceeding the length normally observed in M_1 of this species (cf. VAN DER MEULEN, 1973). In populations of many modern species of *Microtus* s. str. there are sporadic specimens with the "*Pitymys*" character, which justifies the decision above. The commonest morphotype met with at Kozi Grzbiet (60% of the population) is "*arvalinus*", almost identical in its structure with the typical specimens of modern *Microtus arvalis*. Another pattern, here called "*agrestis*", is marked by its distinctly developed LRA6. As has been shown by the author's study on abundant contemporary material, it is a typical morphotype of *Microtus agrestis* (NADACHOWSKI, in prep.). Its frequency in the study material is very low (1.8%). Morphotype shown on Figs 18 and 19 is distinguished

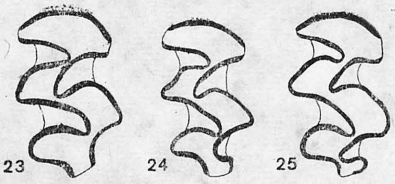


Figs 11—22. *Microtus* ex gr. *agrestis*, morphotypes of M_1 (MF/1764/1—12): 11: "*fortis*" — layer 2a, L = 2.75 (inverted), 12: "*assimilis*" — layer 2a, L = 2.86, 13: "*nivalinus-nivaloides*"? — layer 2c, L = 2.91, 14: "*nivalinus-nivaloides*"? — layer 2c, L = 2.82, 15: "*arvalidens*" — layer 2a, L = 3.20 (inverted), 16: "*arvalinus*" — layer 2a, L = 2.86, 17: "*agrestis*" — layer 2c, L = 2.82 (inverted), 18: "*coronensis*" — layer 2b, L = 2.82, 19: "*coronensis*" — layer 2a+b+c, L = 3.05, 20: "*extratriangulatus*" nov. — layer 2b, L = 2.87, 21: "*extratriangulatus*" nov. (type) — layer 2c, L = 3.04, 22: "*problematicus-agrestis*" — layer 2c, L = 2.86

by a strong narrowing between the fields T6 and T7 and, in some cases, a lingual bend of the tooth top. This morphological pattern is characteristic of *Microtus coronensis* KORMOS 1933, described from Brasso. A comparison of the specimens from Kozi Grzbiet with the type material stored in Budapest shows the unquestionable identity of these two forms. This morphotype comes in second as regards its frequency in the material studied (14.7%). The existence of an additional closed triangle of enamel (T6) is a conspicuous distinctive character of the next morphotype. For this pattern the author proposes the name "*extratriangulatus*" nov. (Type: right M_1 from Kozi Grzbiet, layer 2c, MF/1764/11, L = 3.04). Two variants distinguished in it differ in the built of the tooth top. This morphotype was found in 30 specimens (8.8% of the whole of material). A distinct increase is however observed in its frequency in consecutive layers (2a — 4.0%, 2b — 8.5%, 2c — 11.8%). Morphotype shown on Fig. 22 is present in only one specimen. Characters of two patterns are combined in it, namely, those of the "*problematicus*" morphotype, described by HELLER (1958) from Erpfingen, but with a weakly marked *Mimomys*-ridge, and the "*agrestis*" morphotype with well-developed LRA6.

Morphology of M^2

In the *Microtus agrestis-arvalis* group the structure of the second upper molar is of great diagnostic importance. In the material under study most M^2 teeth belonging to *Microtus* s. l. (N = 427) are the "*arvalis*" type as regards structure (93.5%), about 6% of specimens have the last loop strongly elongated and only 2 are characterized by the presence of an additional enamel loop (= "*agrestis*" morphotype) (Fig. 25).



Figs 23—25. *Microtus* sp. (s. l.), morphotypes of M^2. 23: "*arvalis*" — layer 2c L = 1.86, 24: intermediate form — layer 2a, L = 1.68, 25: "*agrestis*" — layer 2a, L = 1.78

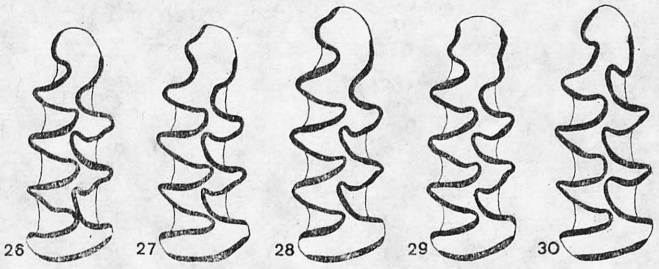
Notes

The Biharian voles of this group are most freqiently described under the name *Microtus arvalinus* HINTON 1923. The population of Kozi Grzbiet however shows very great morphological variation. To be sure, most teeth show the "*arvalinus*" or "*coronensis*" structure but at the same time a relatively high proportion of specimens have a complicated structure ("*extratriangulatus*") and it seems more accurate to number them in the *agrestis-arvalis* group. Which of these two species does the population under study resemble more closely? The simple structure of M^2 suggests that this form stands close to *M. arvalis*. On the other hand, the pattern of M_1 and the large size of this tooth prompt us to accept the statement on the resemblance to *M. agrestis*. Especially the fairly great frequency of the "*extratriangulatus*" morphotype, typical for the field vole and the lack of the "*maskii*" pattern, which occurs in nearly all modern populations of the common vole support this opinion. The values of LT4/LT5 index are also characteristic for *Microtus agrestis*. In the whole material 77% of the population show LT4/LT5 values lower than 65.0 (cf. NADACHOWSKI, 1984a). In this case we observe as if an "ununiform" rate in the evolution of M_1 and M^2. The morphological structure of the first lower molar is advanced in evolution and much resembles that of *M. agrestis*, whereas the structure of M^2 "lags behind" in respect of the development of the additional agrestid loop. This phenomenon is fairly common in the biharian faunas of Europe. The lack of the fifth loop on M^2 in *M. agrestis* occurs in some regions (e. g. in Bacho Kiro Cave) still in the Late Pleistocene (NADACHOWSKI, 1984b). The appearance of this diagnostic character on M^2 may have happened rapidly (mutation ?) in the populations of this species and was fixed a relatively short time ago (Steinheimian ?) The population from Kozi Grzbiet seems therefore to be closely related to the species *M. agrestis* but has little in common with *M. arvalis*, in spite of the arvalid structure of its M^2.

Microtus ex gr. *oeconomus*

Material: MF/1765, layer 2a — 12 M_1, layer 2b — 6 M_1, layer 2c — 36 M_1, layer 2b+c — 2 M_1 layer 2a+b+c — 15 M_1

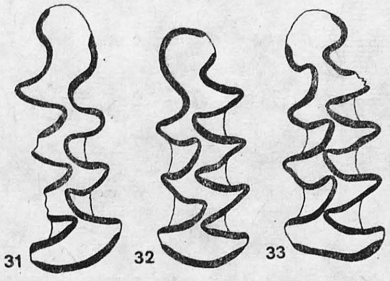
Measurements of M_1	Range	x	SD	CV	N
L (2a)	2.52—2.73	2.60	0.07	2.8	7
L (2b)	2.54—2.70	2.63	0.07	2.7	4
L (2c)	2.55—2.96	2.72	0.11	3.9	23



Figs 26—30. *Microtus* ex gr. *oeconomus*, morphotypes of M_1 (MF/1765/1—5). 26: "*ratticepoides*" — layer 2b, L = 2.54, 27: "*ratticepoides*" — variant with poorly developed LSA5, layer 2a, L = 2.55, 28: "*ratticeps*" — layer 2c, L = 2.74, 29: "*epiratticeps*" — layer 2a, L = 2.65, 30: "*gud*" — layer 2b, L = 2.70

Morphology of M_1

The morphological series consists of four morphotypes (Figs 26—30). The most numerously represented morphotype, shown in Figs 26 and 27, characteristic of *Microtus ratticepoides* HINTON 1923, has two variants, its frequency being 34.3%. The typical variant (lack of LSA5) has been found in 20 specimens. Another morphotype, the "*ratticeps*" one (= "*oeconomus*" acc. to ANGERMANN, 1974), which is the main pattern of the modern species *Microtus oeconomus*, is less frequent (28.5%). Than comes the morphotype for which the name "*epiratticeps*" may be used (after RABEDER, 1981 from KOWALSKI and HASEGAWA, 1976), with a still lower frequency (23%) The last of morphotypes has the most complex structure — "*gud*" (cf. ANGERMANN, 1984) and occurs only



Figs 31—33. *Microtus* ex gr. *oeconomus*, rare morphotypes of M_1 (MF/1765/7—9). 31 — tooth with confluent T3 and T4, layer 2c, L = 2.96, 32 — tooth with T1 and T2 confluent, layer 2c, L = 2.63, 33: tooth with confluent T4 and T5 (morphotype "*eonivalis*"), layer 2c, L = 2.85

in ten specimens (14.2%). Moreover, T1 and T2 are confluent in two specimens from layer 2c and one specimen shows the fusion of T3 with T4 and T4 with T5 (Figs 31—33). This last tooth identified as *Microtus* ex gr. *oeconomus*, has the characters of the "*eonivalis*" morphotype (cf. RABEDER, 1981 Abb. 112, Fig. 5).

Notes

The teeth the morphology of which is presented in Figs 26—30 are described as *Microtus ratticepoides*, *M. nivaloides* MAJOR 1902, *M. nivalinus* HINTON 1923, or *M. subnivalis* PASA 1947. The first morphological type prevails in the population of Kozi Grzbiet and in spite of great variation, we seem to be concerned here with one species. As regards its morphology, it corresponds with *Microtus* ex gr. *oeconomus* from several localities of the Russian Plain (e. g. MARKOVA, 1982) and has little in common with the European *M. nivaloides* (sensu FEJFAR and HORÁČEK, 1983).

Microtus ex gr. *nivalis*

Material: MF/1770/83, layer 2a — 1 M_1

One specimen from layer 2a (Fig. 34) has the features corresponding to the characteristic tooth of *Microtus nivalis mirhanreini* SCHÄFER, 1935 from Tatra Mts. (cf. KRATOCHVIL, 1956). Such a pattern has not yet been found in the morphological seires of *M. oeconomus* (ANGERMANN, 1984) accordingly it is advisible to classify this specimen to the "*nivalis*" group.

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Fig 23. *Microtus* ex gr. *nivalis* left M_1 (MF/1765/6). Morphotype "*mirhanreini*" — layer 2a, L = 2.69

Microtus (Pitymys) arvalidens KRETZOI 1958

Material, MF/1766: layer 2a — 8 M_1, layer 2b — 2 M_1, layer 2c — 4 M_1, layer 2a+b+c — 7 M_1

Measurements of M_1	Range	$\bar{x}$	SD	CV	N
L (2a, 2b, 2c)	2.58—2.97	2.76	0.13	4.6	11

Morphology of M_1

All the teeth have a structure typical of this species with confluent T4 and T5. BSA4 and BRA4 are developed to nearly the same degree as are BSA5 and LRA5 (Fig. 35).

Notes

The population of Kozi Grzbiet is very homogeneous. Its specimens are big; they outsize the specimens of the populations from Nagyharsányhegy 4 and Villány 6 (VAN DER MEULEN, 1973).

Fig. 35. *Microtus (Pitymys) arvalidens*, M_1 (MF/1766/1), layer 2a, L = 2.88

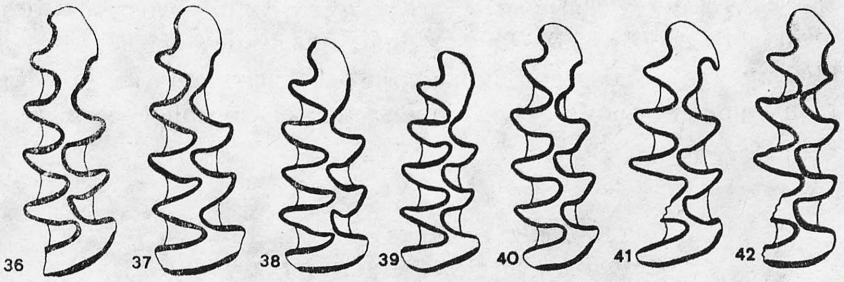
Microtus (? *Stenocranius*) *gregaloides* (HINTON 1923)

Material, MF/1767: layer 2a — 18 M_1, layer 2b — 7 M_1, layer 2c — 13 M_1, layer 2a+b+c — 6 M_1

Measurements of M_1	Range	$\bar{x}$	SD	CV	N
L (2a)	2.36—2.81	2.61	0.12	4.7	15
L (2b, 2c)	2.50—2.92	2.73	0.11	3.9	17

Morphology of M_1

Two specimens from layer 2c, numbered in this species, have their T5 confluent with the top portion of the tooth, which morphologically relates are included as the "*eoratticeps*" (cf. RABEDER, 1981) morphotype in *M. gregaloides*. Most specimens (77.3%) have a typical "*gregaloides*" structure, although several variants can be distinguished (Fig. 37—38). Three specimens from layers 2a and 2c (all of them young) with separated T4 and T5 and so having a structure characteristic of *Microtus gregalis* (PALLAS 1779). Three other spe-



Figs 36—42. *Microtus* (? *Stenocranius*) *gregaloides*, morphotypes of M_1 (MF/1767/1—7). 36: "*eoratticeps*" — layer 2c, L = 2.87, 37: "*gregaloides*" — layer 2b, L = 2.92, 38: "*gregaloides*" — layer 2c, L = 2.63, 39: "*gregalis*" juv. (inverted) — layer 2a, L = 2.46, 40: "*gregaloides-arvalidens*" — layer 2a+b+c, L = 2.74, 41: "*gregaloides-arvalidens*" (inverted) — variant with well-developed BSA5, layer 2c, L = 2.71, 42: "*arvalidens*" (inverted) — layer 2c, L = 2.85

cimens show an intermediate structure between the "*gregaloides*" and "*arvalidens*" patterns, with BSA4 in an early stage of development. Variant shown on Fig. 41 is besides marked by the presence of distinct BSA5. The morphological structure of two specimens resembles that of M_1 of *M. (Pitymys) arvalidens*, but their BSA4 is considerably less well-developed than LSA5. No teeth with a typical structure of *Pitymys hintoni* KRETZOI 1941 have been found in the population from Kozi Grzbiet.

Notes

Most authors include the material under study in several species of the subgenus (or genus) *Pitymys* MCMURTRIE 1831 on the basis of the presence of confluent T4 and T5. The teeth with the above-described morphology obtained from the Biharian localities of Europe are most frequently numbered in the species *Pitymys gregaloides* or *P. hintoni*. The other names, i. e. *P. schmidtgeni* HELLER 1933 and *P. dehmi* HELLER 1958 are generally regarded as synonyms. In the opinion of VAN DER MEULEN (1973) all the morphotypes mentioned ought rather to be treated as examples of variation inside one species. Recently, some authors have been including these forms in the subgenus *Neodon* HODGSON 1849 (FEJFAR and HEINRICH, 1981), related to *Pitymys*. Such a point of view has its disadvantages, for the subgeneric membership of the remains of *Microtus* s. l. should not be based exclusively on the confluence of T4 and T5, which character occurs with various frequency in all the subgenera. The lack of well-developed BSA4, characteristic of the subgenus *Stenocranius* KASTSCHENKO 1901 is also an important feature of "*Pitymys*" *gregaloides*. The hypothesis arises that this form belongs to the evolutionary line leading to *Microtus gregalis*. An indirect confirmation of this conception can be found in the material of *Microtus gregalis* from Late Pleistocene deposits and in the recent populations of this species, namely, in quantitatively larger samples one can always find specimens with "*Pitymys*" characters, their frequency reaching even 7—8% (BOLSHAKOV et al., 1980). Among the morphotypes of this species there are besides the "*gregaloides*", "*hintoni*", "*schmidtgeni*" and "*dehmi*" patterns (cf. NADACHOWSKI, 1982, Fig. 23). The gradual appearance of *Microtus gregalis* in the Biharian is also characteristic; at first it occurs only as an admixture and next, in younger deposits, the frequency of this morphotype increases by degrees.

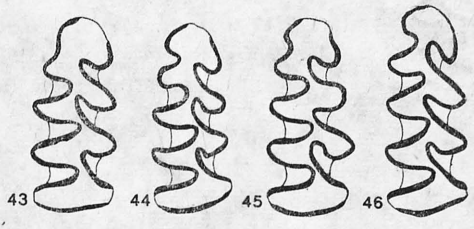
Genus *Clethrionomys* TILESIUS 1850
Clethrionomys glareolus (SCHREBER 1780)

Material, MF/1768: layer 2a — 87 M_1, 87 M_2, 79 M_3, 104 M^1, 84 M^2, 75 M^3, layer 2b — 43 M_1, 54 M_2, 32 M_3, 71 M^1, 58 M^2, 39 M^3, layer 2c — 66 M_1, 68 M_2, 66 M_3, 61 M^1, 78 M^2, 68 M^3, layer 2b+c — 14 M_1, 12 M_2, 13 M_3, 9 M^1, 12 M^2, 9 M^3, layer 2a+b+c — 56 M_1, 47 M_2, 32 M_3, 79 M^1, 53 M^2, 32 M^3

Measurements of M_1	Range	x	SD	CV	N
L (2a)	1.82—2.37	2.10	0.12	5.7	76
L (2b)	1.82—2.31	2.14	0.11	5.0	39
L (2c)	1.84—3.44	2.15	0.13	6.2	54

Morphology of M_1

The structure of this tooth is variable and particular patterns differ in the shape of the anterior cap and in the manner in which the enamel triangles are connected (Fig. 43—46). More than a half of the teeth (52.2%) have T4 confluent



Figs 43—46. *Clethrionomys glareolus*, morphotypes of M_1 (MF/1768/1—4). 43: layer 2a, L = 2.11, 44: layer 2c, L = 2.06, 45: layer 2b, L = 2.14, 46: layer 2a, L = 2.19

with T5 and AC. Morphotype shown on Fig. 44, which is fairly frequent (22%) and similar to the previous one, is marked by the distinct development of LSA5. The next morphotype, with separated T4 and T5 occurs in 12% of specimens. The most complex structure (Fig. 46) has been found in 13.5% of specimens.

Notes

The population from Kozi Grzbiet does not differ from the modern population of this species, there being conspicuous morphological variation in it (both individual variation and that connected with the age of specimens).

Genus *Pliomys* MÉHELY 1914
Pliomys episcopalis MÉHELY 1914

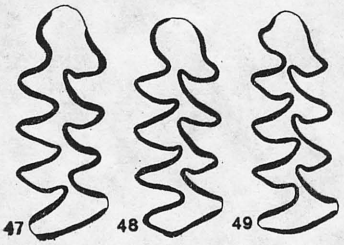
Material, MF/1769: layer 2a — 23 M_1, 11 M_2, 7 M_3, 10 M^1, 16 M^2, 12 M^3, layer 2b — 7 M_1, 9 M_2, 5 M_3, 4 M^1, 5 M_2, 5 M^3, layer 2c — 10 M_1, 8 M_2, 6 M_3, 14 M^1, 15 M^2, 13 M^3, layer 2b+c — 6 M_2, 2 M_3, 1 M^1, 2 M^2, 1 M^3, layer 2a+b+c — 9 M_1, 7 M_2, 3 M_3, 21 M^1, 2 M^2, 1 M^3

Measurements of M_1	Range	$\bar{x}$	SD	CV	N
L (2a)	2.26—2.70	2.45	0.13	5.3	14
L (2b)	2.36—2.84	2.51	0.22	8.9	4
L (2c)	2.12—2.54	2.42	0.12	4.9	7

Morphology of M_1

Three morphotypes can be distinguished in the structure of this tooth (Figs. 47—49). The most primitive, "*simplicior*" morphotype is marked by the

fusion of T5 with the anterior loop and occurs in 8.1% of specimens. The "*episcopalis*" pattern, typical of this species, is distinctly dominant (78.4%). Some of the specimens (13.5%) have a more complex structure with conspicuously developed LRA5 ("*chalinei*" morphotype).



Figs 47—49. *Pliomys episcopalis*, morphotypes of M_1 (MF/1769/1—3). 47: "*simplicior*" — layer 2a, L = 2.70, 48: "*episcopalis*" — layer 2a, L = 2.38 49: " *chalinei*" — no stratigrafic data, L = 2.46

Notes

Several species of the group *Pliomys episcopalis* have been described in Europe. *Pliomys simplicior* KRETZOI 1956 constitutes the most primitive form, whereas *P. chalinei* JEANNET, 1974, described from Orgnac 3 (JEANNET, 1974), is evolutionarily the most advanced one. Although all the three morphotypes are encountered in the population from Kozi Grzbiet, we seem to be concerned here with one species *P. episcopalis* MÉHELY 1914.

IV. BIOSTRATIGRAPHIC POSITION OF KOZI GRZBIET

Stratigraphic studies of the locality, chemical analyses of the deposit samples and bony remains, and the quantitatively rich and differentiated fauna permit a fairly precise determination of the age of deposits, above all those of unit 2. The age of Kozi Grzbiet have been thus determined at the Mindel I/ Mindel II interglacial. Samples of bones from unit 2 were analysed by the complex fluoro--chloro-apatite and collagen method (cf. WYSOCZAŃSKI-MINKOWICZ, 1969), which dated them at 630 000—560 000 y. B. P. (GŁAZEK et al., 1977a). A palaeomagnetic examination refers unit 2 to the Brunhes normal magnetic epoch (GŁAZEK et al., 1977b). In his first paper dealing with this locality, KOWALSKI (1975b) determines the age of the deposits on the basis of the faunal association "at the final stage of a cold period antedating the Cromerian climatic optimum". Considerations on the biostratigraphy of terrestrial deposits of the Pleistocene are based chiefly on changes in the fauna of rodents of the family *Arvicolidae*. The association of these species at Kozi Grzbiet is marked by several features. The genus *Allophaiomys*, characteristic of the Lower Biharian is here missing. This fauna however lacks also the primitive *Arvicola* typical of the Steinheimian (HORÁČEK, 1981, FEJFAR and HEINRICH, 1983). Instead, *Mimomys savini*, in Central Europe regarded as the index species of the Upper Biharian (Templomhegyian phase) occurs at Kozi Grzbiet. The feature that differs this locality

from other Middle European localities of similar age is the presence of the evolutionarily far advanced population of the *Microtus agrestis-arvalis* group, whose characters very much resemble those of *Microtus agrestis*. This form generally occurs in younger faunal associations (with *Arvicola cantiana*), e. g. at Petersbuch (KOENIGSWALD, 1970) or Sudmer Berg-2 (KOENIGSWALD, 1972). The lack of *Lagurus (Prolagurus) pannonicus*, the species common in Hungarian localities, is a disadvantage of the fauna under study. The presence of not very numerous *Dicrostonyx simplicior* and *Lemmus lemmus* with the simultaneous quantitative predomination of sylvan species, like *Glis* cf. *sackdillingensis* and *Clethrionomys glareolus*, is also noteworthy. Out of the Central European localities, Villany 8 (KRETZOI, 1956; VAN DER MEULEN, 1973), where the interesting coexistence of *Mimomys savini* and *Arvicola* sp. is observed, is the nearest as regards its fauna and, out of the other Hungarian localities, Kövesvárad (JÁNOSSY, 1963) and probably also the Somssich-hegy 2 (JÁNOSSY, 1979). The German localities that most resemble Kozi Grzbiet are, among others, Voigtstedt (KRETZOI, 1965) and Süssenborn (FEJFAR, 1969). As for Czechoslovakia, the lower portion of the profile of Cave 718 at Koneprusy (H_7-H_8 — FEJFAR, 1961) seems to correspond closely to our locality. From among other similar faunas, Přezletice, Chlum 4 and 4k (upper interglacial) should be mentioned (HORÁČEK, 1981). A comparison of these data permints the reference of the fauna under study to the Templomhegyian phase of the Biharian corresponding to the interglacial of the glacial cicle H or I (cf. KUKLA, 1978).

Translated into English
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STRESZCZENIE

Praca zawiera analizę morfologii uzębienia następujących gatunków gryzoni z Koziego Grzbietu: *Mimomys savini*, *Microtus* ex gr. *agrestis*, *M.* ex gr. *oeconomus*, *M.* ex gr. *nivalis*, *M. (Pitymys) arvalidens*, *M* (? *Stenocranius*) *gregaloides*, *Clethrionomys glareolus*, *Pliomys episcopalis*. Został opisany nowy morfotyp M_1 w szeregu morfologicznym *Microtus* ex gr. *agrestis* ("*extratriangulatus*" nov.). Porównano faunę z Koziego Grzbietu z kilkoma stanowiskami ze środkowej Europy. Została również określona pozycja biostratygraficzna stanowiska (Biharium, faza Templomhegy).

Redaktor pracy: prof. dr K. Kowalski