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The Pliocene and Pleistocene *Gliridae* (Mammalia, Rodentia) from Poland
[15 text-figures]

Pliocénские i plejstocénские *Gliridae* (Mammalia, Rodentia) z Polski

Плиоценовые и плейстоценовые *Gliridae* (Mammalia, Rodentia) Польши

INTRODUCTION

The dormice (*Gliridae* THOMAS, 1897) constitute a distinct and specific family of rodents, which is divided into three subfamilies: the African *Graphiurinae* PALMER, 1899 known from several recent species, the primitive *Gliravinae* SCHaub, 1958 from the Eocene and Oligocene of Europe, and the *Glirinae* THOMAS, 1897 known in the fossil state from Europe from the Oligocene onwards and now living in Europe and Asia. In the present paper I shall deal with the members of the last of the above-mentioned subfamilies only.

The *Glirinae* occur in large numbers in the fossil faunae of the Oligocene and especially in those of the Miocene of Europe. In the early studies (e. g.. C. I. FORSYTH MAJOR, 1899) many of the Miocene forms were included in the recent genera; however, the particular authors often differed in opinions on the generic classification of the same form. Although R. DEHM (1950) took up a useful task of tidying up the systematics of the *Gliridae* of the European Tertiary, this problem still needs monographic elaboration. Unlike the abundance of the Miocene species, the Pliocene *Gliridae* have been hardly known as yet. Also the Pleistocene is represented by only single finds except for the Mediterranean region, where the remains of dormice are better known thanks to the works of D. BATE (1919, 1937). Some peculiar forms of *Glirinae*, probably taking rise in the Miocene, persisted here, isolated in islands, up to the Pleistocene.

The recent fauna comprises 6 genera of the *Gliridae*. Five of them dwell Europe, some ranging as far as North Africa and West Asia. The last genus, *Glirulus* THOMAS, 1906 is known from Japan. The recent detection of the occurrence of the genus *Myomimus* OGNEV, 1924 previously known from scarcely a few specimens from Turkmenistan, in Bulgaria proves that this group is not sufficiently well known even in the fauna of to-day.

The familiarity with the evolution of the *Glirinae* during the Pliocene and Pleistocene is very important to the knowledge of their systematics and especially for the elucidation of connexions existing between the genera of to-day and the rich Miocene fauna of this group. Therefore, the occurrence of fairly numerous remains of members of the group, which make the subject of this paper, in the Polish localities of the fossil fauna of land vertebrates is a fact of great significance. The chronological order of these localities, the general characteristics of which will be given below, is as follows: Podlesice, Weże and Rebielice Królewskie refer to the Pliocene, while Kadzielnia and Kamyk represent the early Pleistocene. Besides, I had some remains to work out, which came from the Jaskinia w Dziadowej Skale and belonged to the genus *Glis* BRISSON, 1762, from the late Pleistocene, most likely from the Eemian (Riss-Würm) interglacial. For comparison I used recent specimens of the genera *Glis* BRISSON, 1762, *Muscardinus* KAUP, 1829, *Eliomys* WAGNER, 1840 and *Dryomys* THOMAS, 1906, from Poland. I am much indebted to Docent Z. PESHEV, Sofia, for a specimen of *Myomimus personatus* OGNEV, 1924, from Bulgaria, to Dr Y. IMAIZUMI, Tokyo, for that of *Glirulus japonicus* (SCHINZ, 1845) from Japan, and to Dr M. KRETZOI, Budapest, for the teeth of *Dryomimus eliomyoides* KRETZOI, 1959, from the Pliocene of Csarnota in Hungary. I wish to thank them all heartily for the valuable material for comparison. My gratitude is also due to Dr W. CHMIELEWSKI, Łódź, for sending me the specimens of *Glis* from the Jaskinia w Dziadowej Skale, to Dr O. FEJFAR, Prague, for drawing illustrations, and to Mr J. ZAWADZKI for translating the paper into English.

All the fossil materials from Poland described in this paper, as well as the above-mentioned recent and fossil comparative materials, are kept in the collection of the Institute of Systematic Zoology, Polish Academy of Sciences, Kraków.

The localities from which the remains of *Gliridae* described here come are all in Central Poland.

Podlesice. It is a deep cave with deposits containing for the most part remains of bats. In addition, scanty fossils of reptiles, insectivorous and carnivorous mammals, and rodents were occasionally found. Originally, I determined the age of this locality as the early Pleistocene (K. KOWALSKI, 1956). The further study of the very rich new material made it possible to point out that the locality is older than the other fossil-bearing localities in Poland and probably dates from the middle Pliocene. The fauna suggests the presence of both forest environment and open areas as well as a fairly mild climate, perhaps of the Mediterranean type.

Węże. Abundant Pliocene fauna of large numbers of reptiles, amphibians, and mammals, both small and large. The literature referring to this locality has been given in the latest studies of K. KOWALSKI (1962a, 1962b), M. MLYNARSKI (1962), and J. SULIMSKI (1962a). The cave with a vertical opening in the vault was probably a trap, in which remains of animals accumulated. The fauna points to a climate of the Mediterranean type and the presence of open areas and forests in the vicinity.

Rębielice Królewskie. Rich fauna of the Pliocene or perhaps the lower Villafranchian, at any rate younger than the faunae of Podlesice and Węże. It contains a large number of small and middle-sized vertebrates, which lived under climatic and vegetational conditions similar to those prevailing at Węże. The fauna of mammals collected during early excavations has been discussed by K. KOWALSKI (1960a). The exploration carried out at this locality in 1962 provided new rich materials.

Kadzielnia in Kielce. Remains of small vertebrates were found here in the fillings of karst pits. They dated from the Pleistocene, probably from the Tegelen interglacial. The climate at the time of formation of the deposits was fairly mild, as will be seen from the make-up of the fauna and the type of the deposits. However, such animals as, e. g., tortoises, common at the Pliocene localities, are lacking here. The fauna includes mostly species inhabiting open areas (K. KOWALSKI, 1958, 1962a).

Kamyk. This locality presents another filling of a karst pit, probably from the Günz-Mindel interglacial. The fauna of reptiles and small mammals found here suggests a rather cool climate and steppe vegetation. The earlier finds have been described by K. KOWALSKI (1960b). A considerably richer material was found during the excavation carried out in 1961.

The Jaskinia w Dziadowej Skale represents the formations of the late Pleistocene, mostly those of the last glaciation. Red clotty clay was found here in the bottom of a rock depression. In the opinion of W. CHMIELEWSKI (in litt.), who was in charge of the researches, the stratigraphic position indicates its dating from the Eemian interglacial. The only animal remains found in the clay were fairly numerous bones of the common dormouse *Glis glis* (LINNAEUS, 1766).

SYSTEMATIC PART

Family *Gliridae* THOMAS, 1897

Subfamily *Glirinae* THOMAS, 1897

Genus *Glirulus* THOMAS, 1906

Glirulus (Amphidyromys) pusillus (HELLER, 1936)

1936 *Amphidyromys pusillus* n. g. n. sp.; F. HELLER, Eine oberpliozäne..., 125—126, Taf. X, Fig. 1.

1962 *Amphidyromys pusillus* HELLER; R. DEHM, Altpleistozäne..., 44—46, Abb. 3—6, Taf. 6, Fig. 10—13.

Material: Podlesice: 1 isolated right M_1 .

Description. The tooth belonged to a rather old individual, so there are apparent traces of wear on the enamel ridges of its crown. The tooth exhibits two roots, both preserved whole. They are flattened anteroposteriorly, and have distinct furrows, reaching from the base to the end of either of them, on the posterior wall of the anterior root and on the anterior wall of the posterior one.

The crown is low, its surface evidently concave. Viewed from above it is subsquare in shape, the anterior margin being slightly bent inward. The inner margin of the crown is formed by a high uniform enamel ridge, while three low cusps, ending three main transverse ridges, are poorly marked on the outer

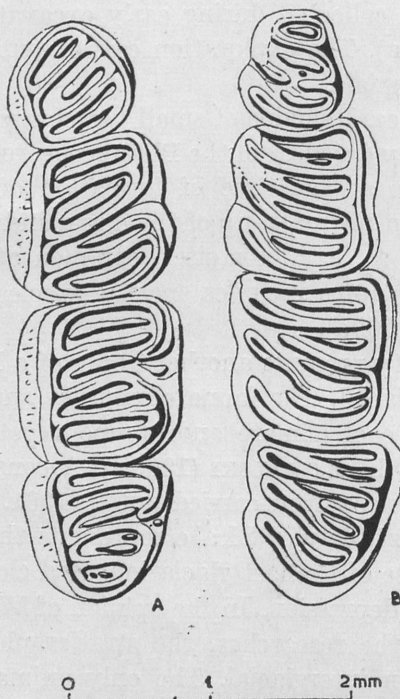


Fig. 1. *Glirulus japonicus* (SCHINZ, 1845), recent, from Japan. Left — maxillary tooth-row, right — mandibular tooth-row

margin. On the surface of the crown there are 9 transverse enamel ridges in all, of which the second, counting from the front, ramifies in the medial half of its length.

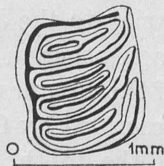
Dimensions: The length of the tooth, measured in its mid-line, amounts to 0.84 mm, the width to 0.81 mm.

Systematic position. The tooth found at Podlesice differs obviously from all the other remains of the *Gliridae* from the same locality in its fine dimensions and structure. It shows a close likeness to the loose tooth (M_2) from Gunderheim described by F. HELLER (1936). They are both characterized by the

concavity in the crown, the distinct ridge on the inner side, the apparent development of cusps on the outer margin, and the large number of enamel ridges. The size of the tooth from Gundersheim is somewhat larger (length 1.0 mm, width 1.1 mm); however, it is worth while mentioning that in the recent *Glirulus japonicus* (SCHINZ, 1845) the second lower molar is also larger than the first (in my specimen M_1 is 0.91 mm long and 0.97 mm wide, M_2 being 1.15 mm long and wide).

R. DEHM (1962) has recently described 7 loose teeth of *Amphidyromys pusillus* HELLER from Schernfeld, but there is not a specimen of M_1 among

Fig. 2. *Glirulus* (*Amphidyromys*) *pusillus* (HELLER, 1936) from Podlesice. M_1



them. M. KRETZOI (in litt.) has stated the occurrence of this species also in the Pliocene of Csarnota in Hungary.

My specimen shows a very close resemblance to the recent *Glirulus japonicus* (SCHINZ). The fossil species is distinguished by its slightly smaller size; in addition, my specimen exhibits a partial ramification of the anterior secondary ridge (in M_2 from Gunderheim it is complete), which brings about an increase in the number of enamel ridges from 9, in the species of to-day, to 10. Evolutionarily, *Glirulus* (*Amphidyromys*) *pusillus* (HELLER) would thus rank above the species that has persisted in Japan up to now, and it might be of use to maintain the name *Amphidyromys* HELLER, 1936 for it as a subgeneric denomination.

The question of relations between the genera *Amphidyromys* HELLER, 1936, and *Glirulus* THOMAS, 1906, has already been discussed several times. In the description of his specimen F. HELLER (1936) did not compare it with the Japanese species at all. In 1950 R. DEHM described the remains of 3 species of *Gliridae* from the Burdigal of Wintershof-West, which he included in the genus *Glirulus*: *G. gracilis* DEHM, *G. modestus* DEHM and „*Glirulus?* n. sp.“. In this genus he also placed the species „*Muscadinus*“ *sansaniensis* (LARTET, 1851) known for a long time from Sansan, La Grive-St. Alban, and Göriach. He seems to have based his conclusions mainly upon the figures of *Glirulus japonicus* (SCHINZ) in the work of C. L. REUVENS (1890), where the teeth of this species are shown very inaccurately. R. DEHM (1950) discussed also the systematic position of *Amphidyromys* HELLER, but in his opinion it differs from the Japanese species among other things in having the crown of M_2 concave, whereas the Japanese form was supposed to have the crown flat. As a matter of fact, in accordance with what I found in my specimen of *Glirulus japonicus* (SCHINZ) the crowns of the molars of this species are evidently concave, which suggests that the remains from the Burdigal of Wintershof-West described by

R. DEHM (1950) represent a distinct genus of the *Gliridae*, which probably did not live out the Miocene.

Having examined the original specimen of *Glirulus japonicus* (SCHINZ) described by C. L. REUVENS (1890) and having compared „*Muscardinus*“ *sansaniensis* (LARTET, 1851) from Nova Ves (Neudorf) with it, S. SCHAUB and H. ZAPFE (1953) point rightly out that this fossil form is not very closely related to the recent species, either.

Describing M_3 and M^1-M^3 in his latest work, R. DEHM (1962) contributes much to the knowledge of *Amphidyromys pusillus* HELLER. The appearance of these teeth and especially the relatively large size of M_3 and M^3 point to a similarity to the Japanese species. In DEHM's opinion these two species differ from each other in the presence of a cingulum in front of the anterior ridge on M_1 of the Japanese form, noticed by S. SCHAUB and H. ZAPFE (1953) in the specimen described by C. L. REUVENS. This characteristic may be attributed to the wear of the tooth, causing the ramification of the enamel ridge. In my specimen of the Japanese species there is no such distinctive cingulum visible, and in this respect it does not show any difference in relation to the tooth from Podlesice.

The finding of a species belonging to the genus that has survived in East Asia up to now in the Pliocene of Europe is an interesting fact for palaeozoogeography. The scarcity of remains of the *Gliridae* in general and the uncommonly small size of the genus *Glirulus* THOMAS, very frequently rendering its teeth unnoticed, in particular, may be responsible for the extremely rare finds of the teeth of this species and its only occasional occurrence in the fossil faunae of Europe.

Genus *Muscardinus* KAUP, 1829

Muscardinus pliocaenicus sp. n.

†1962 — *Muscardinus avellanarioides* SULIMSKI; A. SULIMSKI, O nowym znalezisku... 221 (nomen nudum).

Holotype: damaged lower jaw with M_1-M_2 (Inst. of Syst. Zoology, Pol. Acad. Sc., Kraków, No. MF (636) 63.

Type stratum: Upper Pliocene.

Type locality: Węże, Poland.

Derivation of name: *pliocaenicus* — found in Pliocene strata.

Material:

Podlesice. Loose teeth: 4 M_1 , 1 M_2 , 1 M_3 , 1 P^4 , 4 M^1 , 1 M^3 .

Węże. Mandibular fragment with M_1-M_2 (holotype), mandibular fragment with P^4 , M_2-M_3 , maxillary fragment with M^1 , loose teeth: 3 M_2 , 1 M^2 .

Rębiełice Królewskie. Maxillary fragment with P^4-M^2 , maxillary fragment with M^1 , loose teeth: 3 M_1 , 1 M_2 .

Description of holotype. The holotype is an incomplete lower jaw with M_1-M_2 and the alveoli of P_4 and M_3 . The incisor is broken and in the

section exhibits a band of enamel overlapping the sides of the tooth at the lower margin. The structure of the lower jaw is like that in *Muscardinus avellanarius* (LINNAEUS, 1758) except that it is finer. M_1 and M_2 have 6 enamel ridges each. In M_1 the ridges are almost parallel, in M_2 they are slightly arched anteriorly. The alveoli of M_3 indicate that the tooth had 4 roots or at least that the posterior root was evidently bifurcated. The teeth are distinguished from those of *M. avellanarius* not only by their smaller size but also by somewhat different shape; they are almost the same breadth all over their length, whereas in the species of to-day M_1 apparently narrows anteriorly and M_2 posteriorly.

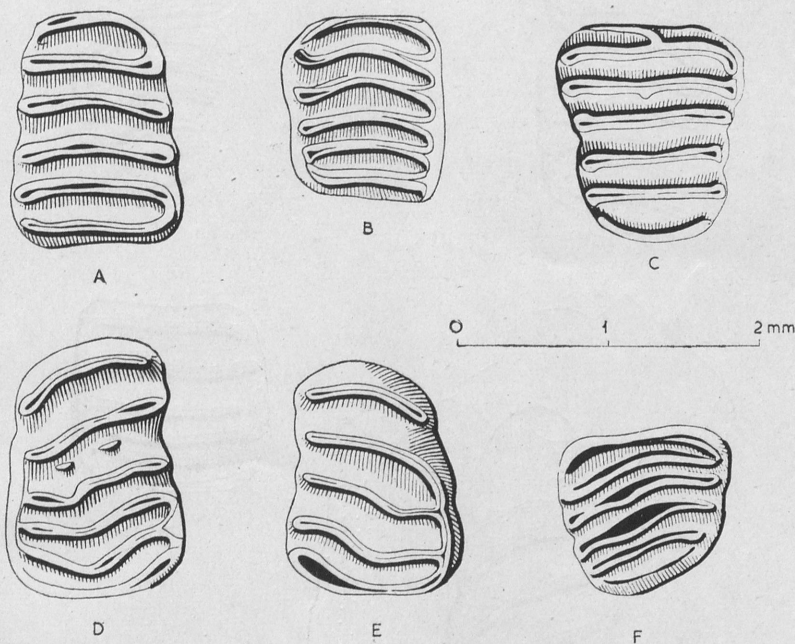


Fig. 3. *Muscardinus phliocaenicus* sp. n. from Podlesice. A — M_1 (No. 1), B — M_2 , C — M^2 , D — M^1 (No. 1), E — M^1 (No. 3), F — M^3

Description of other specimens. The remaining specimens from Weže render it possible to complete the knowledge of the species under description. P_1 seems to be more reduced than in most specimens of *M. avellanarius*. It is very short, with 2 enamel ridges forming a horseshoe and a rudiment of the third ridge on the anterior margin. M_1 has 3 roots, a larger anterior root and two smaller posterior ones. M_2 has 4 roots of almost the same size. M_3 in the other of the lower jaws preserved has 3 roots, but only the posterior one has a longitudinal furrow all over its length and bifurcates at the end. There are 6 enamel ridges on the surface of M_3 .

M^1 has 5 widely spaced enamel ridges. M^2 has 4 roots of almost the same size each and a square crown with 6 enamel ridges scarcely arched, the 3 anterior ridges being crowded together and the 3 posterior ones at wider intervals. On the inner margin of the crown there is a longitudinal ridge, which makes

this tooth distinct from M_2 , otherwise similar to it. The whole material from Weże described above, although composed of loose teeth, seems to be uniform and most likely belongs to one species.

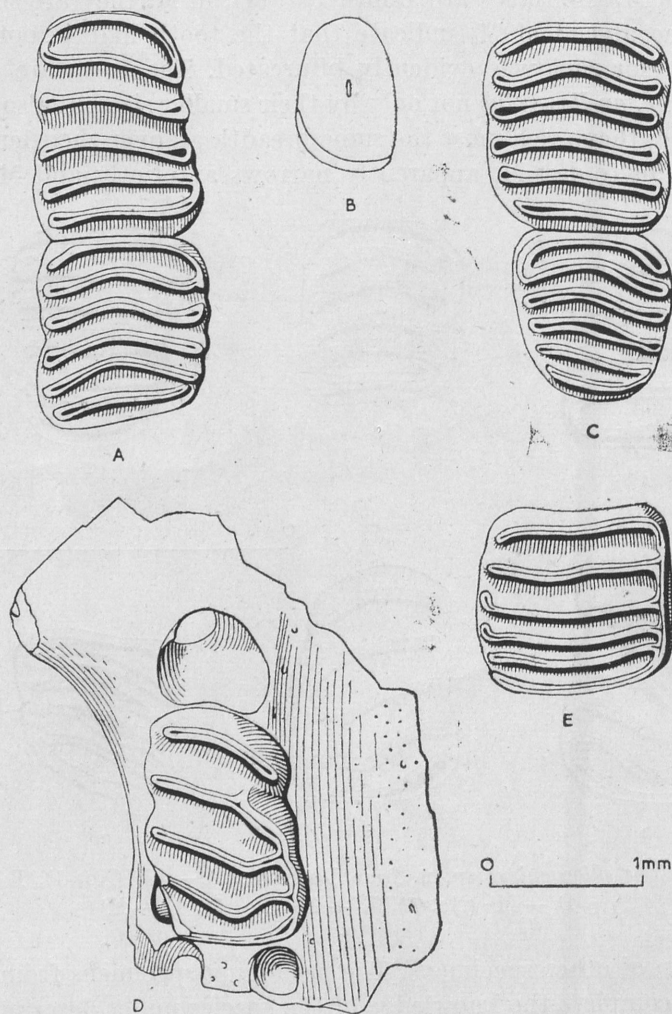


Fig. 4. *Muscardinus pliocaenicus* sp. n. from Weże. A—B — holotype (A — M_1 — M_3 , B — cross-section of the incisor), C — M_2 — M_3 (No. 2), D — M^1 preserved with a part of maxilla, E — M^2

The material from Podlesice, reckoned in the same species, shows greater diversity. However, there being only a small number of specimens, it is hard to judge whether one has to do with individual varieties or with mixed specimens of two distinct forms.

Out of the 4 specimens of M_1 from Podlesice one is badly damaged. The remaining ones differ between them in shape and size; especially one of them (spec. No.3) has its crown narrowed anteriorly more than the others. After all, they all have

3 roots and 6 enamel ridges and they all fall short of the size of the corresponding tooth in *M. avellanarius*.

M_2 from Podlesice resembles the specimens from Weże, though it is a bit smaller. M_3 has 3 roots: a broad but single posterior root and 2 small ones at the front. Compared with the corresponding tooth of *M. avellanarius* it has a broader posterior margin, and so it is less narrowed posteriorly.

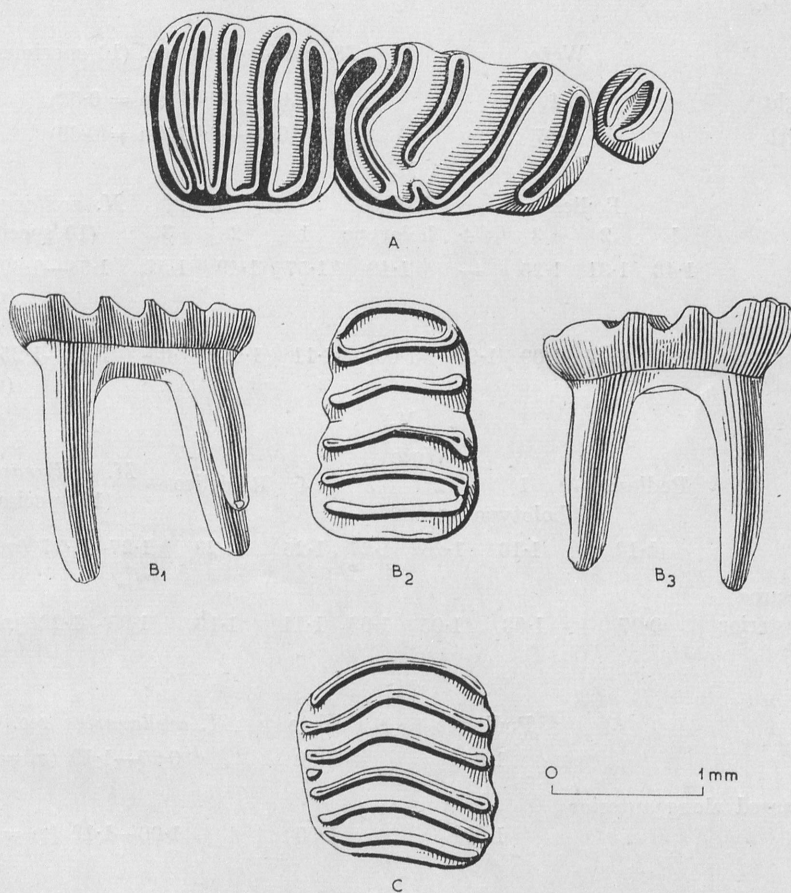


Fig. 5. *Muscardinus pliocaenicus* sp. n. from Rebielice Królewskie. A — P^4 — M^2 (No. 1), B — M^1 (No. 1): crown view and seen from both sides, C — M^2

As for the teeth of the upper jaw from Podlesice, P^4 is oval, with 2 enamel ridges arranged in the form of an elongated horseshoe. The size of M^1 is very variable, but it has always 4 roots, which are nearly the same size, and a fifth supplementary small root situated at the mid-length of the crown on the inner side. On the surface of the crown are 5 complete enamel ridges and a sixth ridge developed to a various degree and situated at various places. Thus, the pattern of the crown shows great variety. In comparison with *M. avellanarius* the ridges seem to be more crowded. M^3 from Podlesice is quadrangular, narrowed and rounded posteriorly. It has 4 roots of almost the same length.

As far as size is concerned, the specimens from Rębielice Królewskie stand half-way between the material from Podlesice and Weże and *Muscardinus avellanarius*. M¹ has 5 enamel ridges at wide intervals. In one specimen of M₁ the anterior root has a longitudinal furrow. In other morphological details it agrees with the specimens from Podlesice and Weże.

Dimensions (in mm):

	P ₄									
	Weże				<i>M. avellanarius</i> rec. (10 specimens)					
length	0.49				0.46—0.54 (m = 0.52)					
width	0.67				0.65—0.73 (m = 0.69)					
	M ₁									
	Podlesice				Weże	Rębielice		<i>M. avellanarius</i> rec. (10 specimens)		
	1	2	3	4	holotype	1	2	3		
length	1.43	1.31	1.25	—	1.40	1.57	1.49	1.57	1.54—1.60 (m = 1.58)	
width measured along posterior margin	1.11	0.97	1.09	1.09	1.03	1.11	1.03	1.05	1.14—1.25 (m = 1.21)	
	M ₂									
	Podlesice		1	Weże		4	Rębielice	<i>M. avellanarius</i> rec. (10 specimens)		
			holotype	2	3					
length	1.12		1.16	1.26*	1.27	1.25	1.29	1.27—1.37 (m = 1.33)		
width measured along posterior margin	0.97		1.03	1.05	1.03	1.11	1.19	1.05—1.22 (m = 1.15)		
	M ₃									
	Podlesice				Weże	<i>M. avellanarius</i> rec. (10 spec.)				
length	1.05				1.00	0.97—1.19 (m = 1.12)				
width measured along anterior margin	1.09				1.00	1.00—1.19 (m = 1.12)				
	P ⁴									
	Podlesice				<i>M. avellanarius</i> rec. (4 spec.)					
length					0.81 0.56—0.67 (m = 0.62)					
width					1.00 0.73—0.81 (m = 0.76)					
	M ¹									
	Podlesice				Weże	Rębielice		<i>M. avellanarius</i> rec. (8 specimens)		
	1	2	3	4		1	2			
length	1.57	1.59	1.49	1.54	1.62	1.73	1.62	1.73—1.81 (m = 1.76)		
width measured along posterior margin	1.14	1.11	1.14	1.00	1.00	1.11	1.14	1.19—1.29 (m = 1.25)		

* found in a lower jaw together with M₃

	M ²		
	Weże	Rębielice	<i>M. avellanarius</i> rec. (7 spec.)
length	1.19	1.17	1.24—1.37 (m = 1.31)
width measured along posterior margin	1.22	1.22	1.24—1.35 (m = 1.28)
	M ³		
	Podlesice		<i>M. avellanarius</i> rec. (1 spec.)
length	1.04		0.94
width measured along anterior margin	1.14		1.22

The systematic position of this species will be discussed below together with the systematics of the other forms of the genus *Muscardinus* KAUP.

Muscardinus aff. *dacicus* KORMOS, 1930

?1930. *Muscardinus dacicus* n. sp.; T. KORMOS, Diagnosen... 243—244.

Material. Podlesice: maxillary fragment with M¹, loose teeth: 1 M¹, 3 M₂, 1 M² or M₂ badly worn.

Description. M¹ has 6 roots: 4 large, 1 at the mid-length of the tooth on the inner side, a bit smaller than the previous ones but normally developed, and one minute at the mid-length on the outer side. There are 6 complete enamel ridges on the surface of the crown in one specimen, while in the other the sixth ridge is not completely developed. M₂ has 4 roots and, on the surface, 6 enamel ridges very slightly bent anteriorly.

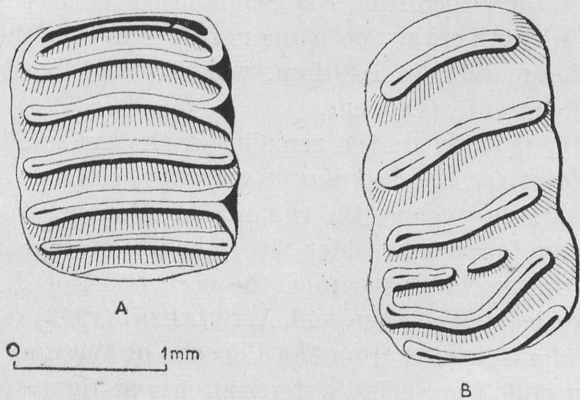


Fig. 6. *Muscardinus* aff. *dacicus* KORMOS, 1930 from Podlesice. A — M₂, B — M¹

Dimension (in mm):

	M ₂			M ¹	
	1	2	3	1	2
length	1.57	1.52	1.62	2.16	2.11
width measured along posterior margin	1.37	1.32	1.35	1.37	1.40

Muscardinus sp.

Two loose teeth, undoubtedly belonging to *Muscardinus* KAUP on account of the flatness of their crowns and the distinctive form of the enamel ridges, vary from the rest so much that they cannot be counted in any of the forms described above.

M_1 (?) from Podlesice has 3 roots and 7 parallel enamel ridges. It resembles M_1 of the species *M. pliocaenicus* n. sp. in dimensions, the length of its crown being 1.37 mm, and the width, measured along the posterior margin, 1.16 mm, but differs from it in shape, narrowing considerably more anteriorly.

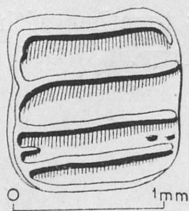


Fig. 7. *Muscardinus* sp. from Weze, probably M^2

M^2 (?) from Weze has 4 roots and only 5 widely spaced enamel ridges. An enamel ridge is also marked on the inner margin. The length and width of the tooth are 1.14 mm.

Muscardinus cf. *avellanarius* (LINNAEUS, 1758)

1958. — *Muscardinus* sp.; K. KOWALSKI, An Early Pleistocene... 39—40, Fig. 24.

It seems that M_1 described from Kadzielnia in Kielce may be included in the recent species. The length of this tooth amounts to 1.46 mm, the width, measured along the posterior margin, to 1.19 mm, which is slightly less than the mean dimensions of the recent specimens.

The systematic position of the remains of the genus *Muscardinus* KAUP from Poland. Except for „*Muscardinus*“ *sansaniensis* LARTET, which undoubtedly belongs to another genus, the remains of *Muscardinus* KAUP had been unknown from any formations older than the Pleistocene up to the recent time, when H. TOBIEN (1952) recorded the occurrence of *Muscardinus* in the Pliocene of Wölfersheim-Wetterau, and A. SULIMSKI (1962) recognized *Muscardinus avellanarioides* SULIMSKI from the Pliocene of Weze as a nomen nudum. Finally, R. DEHM (1962) presented a description and figures of „*Muscardinus*“ nov. spec.“ from a fauna, which perhaps dated from the Pliocene, though was described by him as a Pleistocene fauna from Schernfeld. The last form, represented by a fragment of an upper jaw and large numbers of loose molar teeth, is characterized by its dimensions being generally somewhat smaller than those in the recent species, though larger than in my specimens of *M. pliocaenicus* n. sp. M_3 of the species from Schernfeld, being 1.30 mm long, reaches a size

unencountered in the modern material of *M. avellanarius* examined by me. It points to the primitiveness of the form under description, that is to say, the less advanced differentiation of the size of teeth than in the modern form.

From the Lower Pleistocene we know a specimen identified as *Muscardinis* sp. from Moggaster Höhle (F. HELLER, 1930). It is a loose M^3 , comparatively large (width — 1.50 mm), with 8 enamel ridges. G. BRUNNER (1934) mentions *Muscardinus* sp. (aff. *avellanarius* L.) from Sackdillinger Höhle, this being a mandibular fragment with M_1 , 1.67 mm long, and M_2 , 1.2 mm long. Lastly, O. FEJFAR (1956) records the occurrence of *Muscardinus avellanarius* L. in the early Pleistocene of Koneprusy in Czechoslovakia.

T. KORMOS (1930) described a new species, *Muscardinus dacicus* KORMOS, 1930 from an assemblage of the early Pleistocene fauna from Episcopia (Püspökfürdő) in Rumania. Its dimensions are somewhat larger than those of *M. avellanarius*, and the presence of 6 enamel ridges on the surface of M^1 is its characteristic feature.

The material described above from the Polish localities allows the statement that the genus *Muscardinus* was completely developed as early as the Pliocene, and showed as high a degree of specialization as that found in the species of today. At least two obviously distinct species of this genus have been met with at Podlesice: *M. pliocaenicus* n. sp. and *M. aff. dacicus* KORMOS. The first of them is distinguished from *M. avellanarius* by smaller dimensions of the teeth and by their being less distinctly differentiated in size: P^4 and M^3 are proportionally larger. It is still more different from the only fossil form which was given a specific name, i. e., from *M. dacicus* KORMOS, the species larger than the modern one.

The other species from Podlesice is here referred to as *M. aff. dacicus* KORMOS on account of the characters it shares with this form: large size and presence of 6 enamel ridges on M^1 . The presence of 6 roots on this tooth indicates that this is a form more specialized than the modern species, its M^1 being particularly strongly developed.

As early as the late Pliocene of Poland, in the faunae of Weże and Rebielice there occurred only one species of the genus *Muscardinus* KAUP. An increase in size of *M. pliocaenicus* n. sp., which likens it to *M. avellanarius*, may be noticed at Rebielice. *M. pliocaenicus* n. sp. may have been the direct ancestor of the modern species, which appeared probably no later than the early Pleistocene (Kadzielnia).

Genus *Glis* BRISSON, 1762

Glis minor KOWALSKI, 1956

1956. *Glis sackdillinaensis minor* n. subsp.; K. KOWALSKI, Insectivores..., 384—386, Pl. IV, Fig. 8; Text-fig. 2f.

1959. *Glis minor* KOWALSKI; M. KRETZOI, Insectivoren..., 240, 245.

Material. Podlesice: mandibular fragment (holotype) and a loose M^1 described in the paper of K. KOWALSKI (1956); besides, loose teeth from the new material from this locality: 1 P_4 , 9 M_1 , 5 M_2 , 4 M_3 , 3 P^4 , 8 M^1 , 2 M^2 , 1 M^3 .

Weże: mandibular fragment with M_3 and alveoli of P_4 — M_2 , mandibular fragment with M_1 and alveoli of M_2 — M_3 , loose teeth: 1 P_4 , 20 M_1 , 12 M_2 , 5 M_3 , 1 P^4 , 16 M^1 , 18 M^2 , 1 M^3 .

Rębielice Królewskie: loose teeth: 1 D_1 , 4 P_4 , 7 M_1 , 7 M_2 , 1 M_3 , 2 P^4 , 3 M^1 , 2 M^2 .

Description. D_1 (found at Rębielice) has 2 roots, approximately the same size, of which one is directed slantingly to the front and the other to the back. The pattern of the crown is like that in P_4 , there being 4 main and 2 minor enamel ridges.

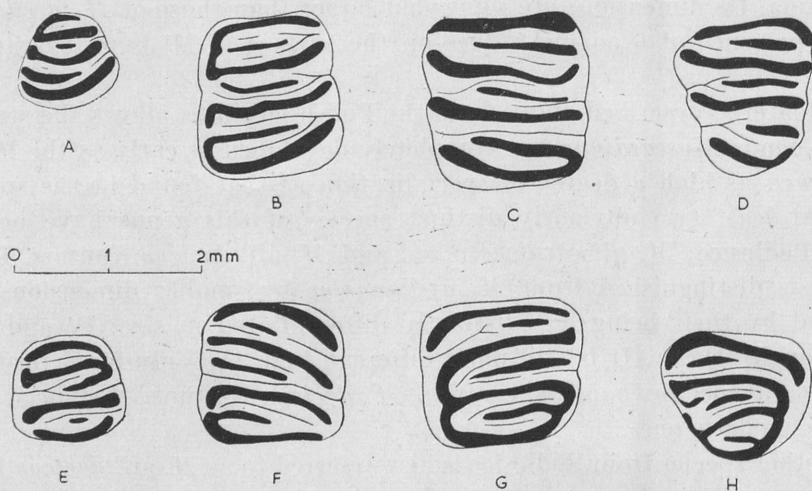


Fig. 8. *Glis minor* KOWALSKI, 1956 from Podlesice. A — P_4 , B — M_1 (No. 2), C — M_2 (No. 1), D — M_3 (No. 3), E — P^4 (No. 1), F — M^1 , G — M^2 , H — M^3

P_4 is one-rooted. The crown has the shape of a triangle with rounded vertices. There are 4 main and 1—2 supplementary ridges on its surface. The anterior of the supplementary ridges is sometimes poorly marked or missing.

M_1 has 2 anteroposteriorly flattened roots of nearly the same length or the posterior one may be somewhat shorter. The crown is quadrangular, a little narrowed anteriorly, with 4 main and 3 supplementary enamel ridges.

M_2 resembles M_1 , but its crown narrows slightly posteriorly. It has 4 main and 3 supplementary ridges and anteroposteriorly flattened roots of almost the same length, otherwise the posterior root is somewhat longer and more robust.

M_3 is rather varying. It has the shape of a quadrangle strongly narrowed posteriorly and with the posterior vertices rounded. Two roots are situated in the long axis of the tooth. The anterior root is more slender, shorter, and flattened anteroposteriorly, while the posterior one is longer, sturdier and di-

rected obliquely backwards. On the surface of the crown there are 4 main and 3 supplementary enamel ridges. In one of the specimens from Węże the middle supplementary ridge is lacking.

P⁴ has 2 roots: one very large, semilunar in section as if of 2 coalesced roots, its base embracing the posterior and inner margins of the crown. The other root, directed to the front and outside, is round, considerably shorter and more slender, sometimes arcuate. The crown is oval, with 4 main and 1—2 minor ridges.

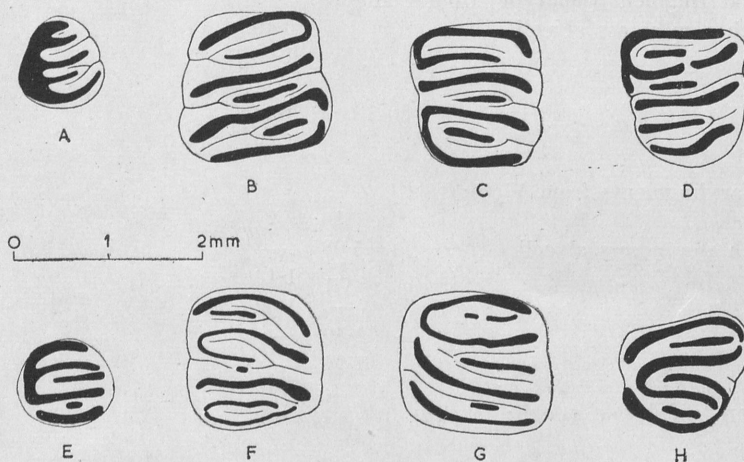


Fig. 9. *Glis minor* KOWALSKI, 1956 from Węże, A — P₄, B — M₁, C — M₂, D — M₃, E — P⁴, F — M¹, G — M², H — M³

M¹ has 3 roots: a large long laterally flattened internal root and 2 short round external ones. The crown is quadrangular, somewhat narrowed on the inner side. It has 4 main and 3 supplementary ridges. On the inner side the main ridges are strongly bent backwards.

The arrangement of the roots in M² is the same as in M¹. Generally speaking, the tooth is very similar to M¹, its crown being, however, somewhat broader,

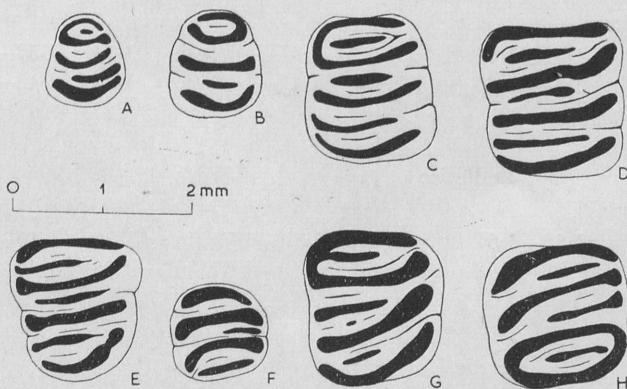


Fig. 10. *Glis minor* KOWALSKI, 1956 from Rebielice Królewskie. A — D₁, B — P₄, C — M₁, D — M₂, E — M₃, F — P⁴, G — M¹, H — M²

nearly rectangular. On the inner side, the main enamel ridges are less bent backwards. The ridge on the outer margin is more distinctly marked than in M^1 .

M^3 has 3 roots: one in the front on the inner side, longer and thicker, the other two, slender and short. All of them are round. The crown is triangular, with its corners rounded. There are 4 main and 3 supplementary enamel ridges on it.

Dimensions (in mm):

The mandibular fragment (holotype) from Podlesice:

length of tooth row across alveoli	5.40
P_4 length	1.05
width	1.11
M_1 length	1.54
width	1.49

The mandibular fragments from Weże:

specimen No.	1	2
length of tooth row across alveoli	5.08	—
M_1 length	—	1.43
width	—	1.52
M_3 length	1.40	—
width	1.24	—

Dimensions of loose teeth:

D_1

One specimen from Rębielice. Length — 1.00, width — 0.89.

P_4

locality	Podlesice	Weże	Rębielice
number of specimens	2	1	4
length	1.05—1.08 (m = 1.07)	1.03	0.94—1.14 (m = 1.04)
width	1.11—1.16 (m = 1.14)	0.94	0.94—1.16 (m = 1.04)

M_1

locality	Podlesice	Weże	Rębielice
number of specimens	9	23	7
length	1.54—1.76 (m = 1.65)	1.27—1.70 (m = 1.54)	1.52—1.67 (m = 1.58)
width	1.43—1.65 (m = 1.57)	1.27—1.70 (m = 1.49)	1.43—1.54 (m = 1.48)

M_2

locality	Podlesice	Weże	Rębielice
number of specimens	5	12	7
length	1.62—1.81 (m = 1.68)	1.49—1.73 (m = 1.58)	1.46—1.63 (m = 1.55)
width	1.59—1.73 (m = 1.65)	1.49—1.67 (m = 1.58)	1.46—1.59 (m = 1.53)

M_3

locality	Podlesice	Weże	Rębielice
number of specimens	4	6	1
length	1.46—1.68 (m = 1.57)	1.35—1.54 (m = 1.44)	1.57
width	1.46—1.57 (m = 1.51)	1.24—1.37 (m = 1.33)	1.46

P⁴

locality	Podlesice	Weże	Rębielice
number of specimens	2	1	2
length	1.16	0.93	1.00—1.03 (m = 1.01)
width	1.30	1.08	1.03—1.14 (m = 1.08)

M¹

locality	Podlesice	Weże	Rębielice
number of specimens	7	16	3
length	1.43—1.59 (m = 1.54)	1.25—1.62 (m = 1.47)	1.52—1.62 (m = 1.55)
width	1.51—1.65 (m = 1.59)	1.35—1.52 (m = 1.49)	1.46—1.54 (m = 1.49)

M²

locality	Podlesice	Weże	Rębielice
number of specimens	3	18	2
length	1.49—1.57 (m = 1.52)	1.40—1.64 (m = 1.52)	1.52—1.54 (m = 1.53)
width	1.70—1.84 (m = 1.75)	1.40—1.77 (m = 1.58)	1.52—1.67 (m = 1.59)

M³

locality	Podlesice	Weże
number of specimens	1	1
length	1.38	1.19
width	1.62	1.40

Systematic position. The form under study was first described as a new subspecies from Podlesice (K. KOWALSKI, 1956). M. KRETZOI (1959) recorded it from the Pliocene of Csarnota in Hungary and raised it — rightly, as I think now — to the rank of a distinct species.

The material described above from Podlesice renders it possible to widen the knowledge of the morphology of this species considerably. Its remains occur also at Weże and Rębielice Królewskie. The structure of the teeth derived from these two localities does not differ from that of the specimens from Podlesice, nevertheless there are some divergencies in their dimensions: the specimens from Weże and Rębielice are evidently smaller. If we take into account the fact that the population of the common dormouse dwelling the South of Europe at present, distinguished as *Glis glis italicus* BARRET-HAMILTON, 1898 is larger than the northern populations, we may suppose that that decrease in size imports a cooling of climate during the interval between the period represented by Podlesice and the late Pliocene represented by Weże and Rębielice. It might be also supposed that the decrease in size is here an evolutionary tendency and reflects only the variation of this species with time. I do not think it just to give utterance to the differences in size between the populations from different localities by using distinct systematic names for them, because they certainly represent stages of one evolutionary line.

If we recognize the gradual reduction of P₂ and M₃ in favour of the evolution of the remaining molariform teeth to be one of the evolutionary tendencies of the *Gliridae*, it ought to be stated that *Glis minor* presents itself more pro-

gressive in this respect than the recent species, and consequently it is out of question as its ancestor.

Ratio of the length of M_3 and P_4 to the length of M_1 :

locality	Podlesice	Weże	Rebielice	<i>Glis glis</i> rec. (3 spec.)
length of P_4 length of M_1	0.65	0.67	0.66	0.73
length of M_3 length of M_1	0.95	0.93	0.99	1.04

Glis sp.

Material. Kadzielnia: Two specimens with fragments of calcareous concretions: a lower jaw with all teeth and a rostral portion of a skull with P^4 — M^1 . In addition, 1 mandibular fragment with M_1 — M_2 , 1 mandibular fragment with P_4 — M_2 , 4 toothless mandibular fragments, 1 maxillary fragment with P^4 — M^2 , loose teeth: 1 D_1 , 1 P_4 , 6 M_1 , 7 M_2 , 2 M_3 , 3 P^4 , 6 M^1 , 3 M^2 , 1 M^3 .

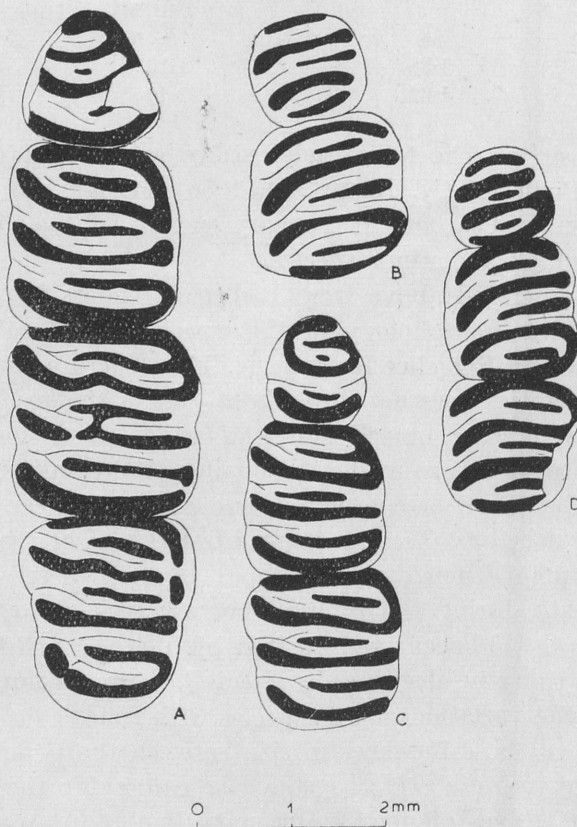


Fig. 11. *Glis* sp. from Kadzielnia. A—B: large form, probably *Glis glis* (LINNAEUS, 1766); A — mandibular tooth-row (No. 1), B — P^4 — M^1 (No. 1). C—D: small form, probably *Glis sackdillingensis* (HELLER, 1930); C — P_4 — M_2 (No. 2), D — P^4 — M^2 (No. 2)

Description. In the material under study there are two groups clearly distinguished from each other by size. The lower jaw and the skull fragment with remains of calcareous concretions (in the table of dimensions denoted by No 1) are larger, whereas the remaining upper and lower jaws are smaller. It is a little more difficult to distinguish these two groups of magnitude among the loose teeth, and for this reason the whole material is here described together and the dimensions are given separately for each specimen in the tables.

D₁ is two-rooted, as it is in the recent species *Glis glis*. The anterior root is larger, round, and directed a bit forwards, the posterior one is smaller, antero-posteriorly flattened, and directed downwards.

Two specimens (denoted by Nos. 1 and 2) of each, M₁ and M₂, are larger than the rest. P₄ and two specimens of M₃ are large and probably belong to the larger form. The morphology of all these teeth does not diverge from that of the recent *Glis glis*.

The specimens of P⁴ have 3 roots each; the anterior root is directed somewhat to the front, the 2 posterior ones are grown together at the base; further, however, they are apparently ramified, the outer ramification being considerably shorter. In two smaller specimens (Nos. 2 and 3) the two posterior roots are strongly severed, in the larger one (No. 1) only the very tip of the outer root is free. The crown is oval, in specimens Nos. 1 and 2 slightly narrowed anteriorly and inside and in specimen No. 3 almost quadrangular with rounded vertices.

The six specimens of M¹ form a uniform group as far as their size is concerned. The second main ridge, counting from the back, is always characteristically undulate, while in the specimens of *Glis glis* that I had at my disposal it is always straight. The other specimens of rectangular teeth with 3 roots are probably M². They do not show any major differences in size. In one of them there is a third-rate ridge by the side of the middle supplementary ridge.

The only specimen of M³ resembles the same tooth of *Glis glis*. The dimensions of the mandibular fragments are as follows:

mandible No.	1	2	3	4
length of tooth row				
across crowns	7.72	+5.67	—	—
P ₄ length	1.49	1.00	1.05	—
width	1.43	1.11	1.14	—
M ₁ length	1.89	1.57	1.59	1.62
width	1.84	1.52	1.57	1.52
M ₂ length	2.05	1.62	1.64	—
width	2.11	1.67	—	—
M ₃ length	2.16	—	—	—
width	1.93	—	—	—

Dimensions of maxillary fragments:

maxilla No.	1	2
P ₄ length	1.03	1.03
width	1.24	1.14

maxilla No.	1	2
M ¹ length	1.67	1.54
width	1.62	1.37
M ² length	—	1.40
width	—	1.46

Dimensions of loose teeth:

		D ₁					
length — 1.64, width — 1.43							
		P ₄					
length — 1.43, width — 1.54							
		M ₁					
specimen No.	1	2	3	4	5	6	
length	1.76	1.76	1.64	1.70	1.67	1.70	
width	1.67	1.81	1.57	1.62	1.57	1.73	
		M ₂					
specimen No.	1	2	3	4	5	6	7
length	2.09	1.95	1.73	1.64	1.76	1.64	1.76
width	1.99	1.99	1.73	1.67	1.84	1.60	1.76
		M ₃					
specimen No.	1	2					
length	1.95	1.99					
width	1.76	1.81					
		P ⁴					
specimen No.	1	2	3				
length	1.40	1.27	1.25				
width	1.70	1.52	1.40				
		M ¹					
specimen No.	1	2	3	4	5	6	
length	1.88	1.81	1.84	1.95	1.81	1.78	
width	2.09	2.02	2.11	1.99	1.84	1.95	
		M ²					
specimen No.	1	2	3				
length	1.62	1.64	1.67				
width	1.76	1.67	1.67				
		M ³					
length — 1.67, width — 1.78							

Systematic position. There was no evidence for the occurrence of the genus *Glis* in the collection made by me at Kadzielnia, instead fairly numerous remains of this genus were found in the material I received by courtesy of Mgr B. W. WOŁOSZYN, who collected it at this locality later. One fragment of a lower jaw was examined by the fluorine method in the Department of Quaternary Geology of the Warsaw University, for which I am indebted to Prof. Z. RÓŻYCKI. The

result obtained is not altogether reliable because of the small amount of material; however, it shows that the age of the specimen is unquestionably older than that of the Upper Pleistocene bones from the same locality. Also the morphology and dimensions of specimens point to the fact that at least the smaller of the forms represented in my material is from the early Pleistocene and so it is most likely contemporary with the rest of the material described from Kadzielnia.

The length of the tooth row of lower jaw No. 1 is not smaller than that in the recent species and even exceeds it. P^4 in upper jaw No. 1 is strikingly short but M_1 is not much smaller than in *Glis glis*. The same is true of the dimensions of the larger specimens of loose teeth: D_1 , M_3 , part of M_1 and M_2 , and upper teeth.

At Kadzielnia the smaller form is represented by fragments of lower jaws Nos. 2—4, fragment of an upper jaw No. 2, and small specimens of M_1 and M_2 . This form differs decidedly from *Glis glis* in dimensions: the length of tooth row across the crowns amounts in it to ± 5.67 mm, while in *Glis glis glis* it is 6.8—7.2 mm, and in *G. g. italicus* 7.6—8.2 mm (G. S. MILLER, 1912). The length of tooth row given above makes my form similar to *Glis sackdillingensis* (HELLER) from Kamyk. The $P_4 : M_1$ ratio in length (calculated from 3 specimens) is 0.65, in which this form also resembles *G. sackdillingensis* and differs from *Glis glis*.

It may be supposed that in the material from Kadzielnia we have to do with specimens of two species mixed up together: *Glis sackdillingensis* (HELLER), contemporary with the rest of the early Pleistocene fauna from this locality, and *Glis glis* (LINNAEUS), probably of the last interglacial or the Holocene.

Glis sackdillingensis (HELLER, 1930)

Synonymy given in the paper of K. KOWALSKI, 1960b, pp. 20—21. Besides: 1962. *Glis sackdillingensis* (HELLER); R. DEHM, *Altpleistozäne...*, 46—47.

Material. In addition to the material worked out previously (K. KOWALSKI, 1960b) the following fossils were found during the exploration of 1961: 3 toothless maxillary fragments, 1 maxillary fragment with M^2 , 5 incomplete mandibular fragments, of which 2 were toothless, 1 with M_1 — M_2 , 1 with P_4 — M_2 , and 1 with P_4 — M_3 , as well as loose teeth: 29 P_4 , 71 M_1 , 63 M_2 , 23 M_3 , 6 D^1 , 7 P^4 , 66 M^1 , 56 M^2 , and 9 M^3 .

Description. P_1 has a single very robust root and its crown is small, in the shape of a triangle with rounded vertices. Four main and 1 (at the back of the tooth) or 2 supplementary furrows are marked on the crown surface.

M_1 has two almost vertical roots. The crown is somewhat narrowed anteriorly and it exhibits 4 main and 3 supplementary ridges. The anterior margin of the crown forms a slight archlike indentation at the place where it is touched by the margin of the crown of P_4 .

M_2 is usually broader than M_1 , and its crown narrows slightly posteriorly. It has 2 roots, of which the posterior one is strongly curved backwards. On the surface of the crown it has also 4 main and 3 supplementary enamel ridges.

M_3 has 2 roots, the anterior root flattened anteroposteriorly and the posterior one round, directed slantingly backwards. The crown of the tooth narrows evidently posteriorly and the anterior margin is somewhat oblique to the long axis of the tooth. There are 4 main and 3 supplementary ridges on the crown. A group of 5 specimens is fairly clearly distinguished from the others by that they are nearly rectangular, only slightly narrowed posteriorly (Fig. 12G).

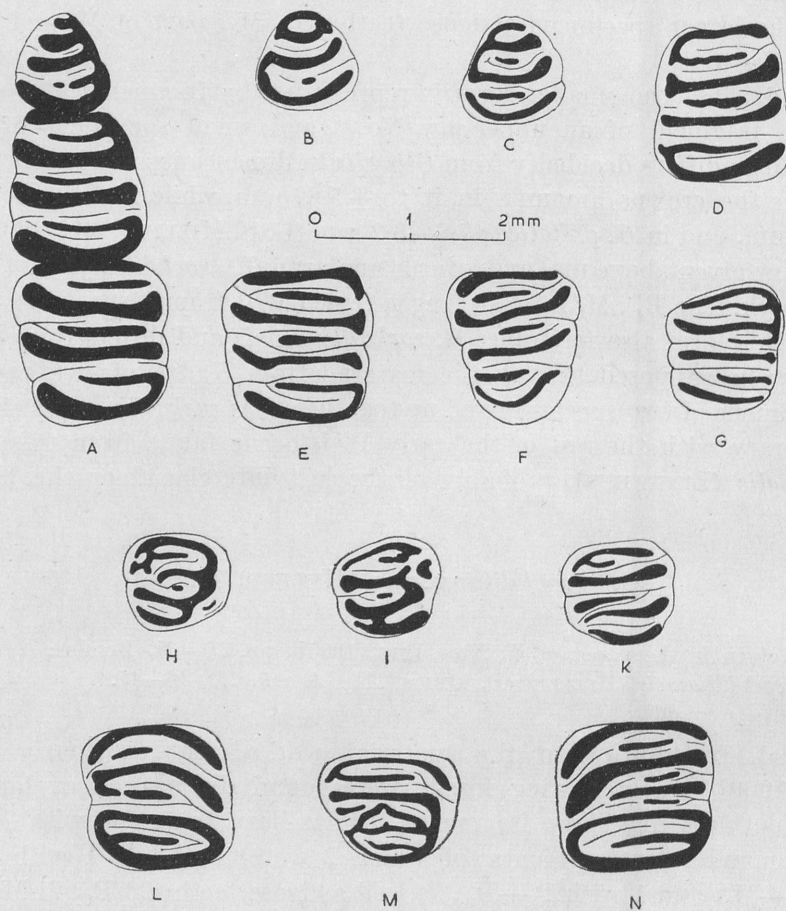


Fig. 12. *Glis sackdillingensis* (HELLER, 1930) from Kamyk. A — mandibular tooth-row, B—C: P^4 (two different forms), D — M_1 , E — M_2 , F—G: M_3 (two different forms), H—J: D^1 , K — P^4 , L — M^1 , M — M^3 , N — M^2

Seeing that the whole remaining material of the *Gliridae* from Kamyk is completely uniform, it may be supposed that these specimens are individual variations.

D¹. Six specimens probably represent the upper milk-teeth. Their roots are like those in P¹, but remarkably more slender and shorter. The crown surface exhibits 4 main enamel ridges, which do not run all across the crown but join each other by means of supplementary ridges in various ways.

P⁴ has 2 roots: one thick and robust, slightly curved, the other considerably shorter and more slender, but also curved. The shape of the oval surface of the crown is rather varying; however, the crown has usually 4 main and 1—2 supplementary enamel ridges, extending from the inner margin up to the half-width of the tooth.

M¹ has 3 roots: one big on the inner side and 2 small ones on the outer side. The crown surface is rectangular and has 4 main and 3 supplementary enamel ridges.

M² has the same arrangement of roots as M¹ and their crowns are also similar in shape. The constant presence of two lower but always clearly visible third-rate ridges on both sides of the middle supplementary ridge on the surface of the crown is a very distinctive character of this tooth.

M³ has the shape of a triangle with strongly rounded vertices. It has 3 roots: one thick on the inner side and two others on the outside. The crown surface has 4 main and 3 differently developed supplementary enamel ridges.

Dimensions of mandibular fragments:

specimen No.	1	2	3	4
length of tooth row				
across crowns	+5.73	—	—	—
length of tooth row				
across alveoli	—	—	—	5.81
length of P ₄	—	1.03	—	—
length of M ₁	1.62	1.57	1.54	—
length of M ₂	1.67	1.64	1.57	—
length of M ₃	1.59	—	—	—

The dimensions of the loose teeth are given below. The dimensions of the teeth of *Glis sackdillingensis* from Sackdillinger Höhle (after F. HELLER, 1930) and from Schernfeld (after R. DEHM, 1962) as well as those of *Glis antiquus* from Episcopia (after T. KORMOS, 1930) are presented for comparison.

P₄

locality	Kamyk	Sackdilling	Schernfeld	Episcopia
number of specimens	28	4	—	—
length	1.03—1.28 (m = 1.13)	1.20—1.26 (m = 1.22)	1.17—1.24	1.15
width	1.05—1.24 (m = 1.12)	—	—	—

M₁

locality	Kamyk	Sackdilling	Schernfeld	Episcopia
number of specimens	68	6	—	—
length	1.43—1.67 (m = 1.58)	1.80—1.95 (m = 1.83)	1.63—1.75	1.70
width	1.29—1.67 (m = 1.50)	1.65—1.80 (m = 1.70)	—	1.80

M ₂				
locality	Kamyk	Sackdilling	Schernfeld	Episcopia
number of specimens	59	5	—	—
length	1.49—1.76 (m = 1.72)	1.80—1.89 (m = 1.84)	1.82—1.89	1.70
width	1.52—1.76 (m = 1.64)	1.77—1.89 (m = 1.81)	—	1.75

M ₃				
locality	Kamyk	Sackdilling	Schernfeld	Episcopia
number of specimens	23	5	—	—
length	1.43—1.64 (m = 1.58)	1.62—1.86 (m = 1.79)	1.66—1.83	1.40
width	1.28—1.54 (m = 1.43)	1.53—1.77 (m = 1.62)	—	1.40

D ¹		
locality	Kamyk	Schernfeld
number of specimens	6	2
length	1.03—1.08 (m = 1.05)	0.91—0.97 (m = 0.94)
width	1.16—1.22 (m = 1.20)	1.17

P ¹			
locality	Kamyk	Schernfeld	Episcopia
number of specimens	7	—	—
length	1.05—1.29 (m = 1.12)	1.04—1.17	1.3
width	1.14—1.29 (m = 1.23)	—	1.3

M ¹			
locality	Kamyk	Schernfeld	Episcopia
number of specimens	66	(M ¹ or M ²)	—
length	1.43—1.67 (m = 1.56)	1.57—1.70	1.75
width	1.46—1.76 (m = 1.58)	—	1.75

M ²		
locality	Kamyk	Episcopia
number of specimens	56	—
length	1.52—1.76 (m = 1.63)	1.75
width	1.57—1.84 (m = 1.70)	1.75

M ³		
locality	Kamyk	Schernfeld
number of specimens	9	—
length	1.11—1.24 (m = 1.18)	1.37—1.43
width	1.43—1.57 (m = 1.52)	—

Systematic position. The remains described from Kamyk, doubtless forming a specifically uniform material, differ markedly from the recent *Glis glis* in their having considerably smaller dimensions. They are also distinguished from *Glis minor* of the Pliocene of Poland by their somewhat larger dimensions and in particular by the larger size of P₄ and the presence of very distinctive third-rate enamel ridges on the crown of M². Ratio of the length of P₄ and M₃ to the length of M₁:

locality	Kamyk	Sackdilling	Episcopia
length of P ₄			
length of M ₁	0.72	0.67	0.68
length of M ₃			
length of M ₁	1.00	0.93	0.82

Length of tooth row on the lower jaw in several forms of *Glis*:

	Kamyk	Sackdilling	Episcopia	<i>Glis g. glis</i> (after MILLER, 1912)	<i>G. g. italicus</i>
length across crowns	± 5.73	—	—	6.8—7.2	7.6—8.2
length across alveoli	5.81	5.9—6.4	6.2—7.0	—	—

Three forms of the genus *Glis* have been described from the Lower Pleistocene of Europe. „*Myoxus glis* mut. *süssenbornensis*“ (SOERGEL, 1919), represented by only one lower jaw with M₁—M₂, has the same dimensions as the modern species, from which it is distinguished by its somewhat elongated teeth, the partial resorption of the anterior ridge on M₁ and M₂, and the poor development of the anterior supplementary ridges of these teeth. The specimens from Süssenborn differ from the Polish material in the considerably larger size of their teeth, and consequently they are not taken into account at its identification. Moreover, it is very likely that the only specimen from Süssenborn W. SOERGEL (1919) had at his disposal during his otherwise very elaborate study had some pathological characters, for this form has not been found in any other collections ever since.

F. HELLER (1930) described „*Myoxus glis* var. *sackdillingensis*“ from the early Pleistocene of Sackdillinger Höhle and subsequently (F. HELLER, 1933) raised it to the rank of a distinct species. His description is based only on lower jaws and a few limb bones. Later on, a skull was found at the same locality (G. BRUNNER, 1934), but no data about it have been published except for the length of the upper tooth row. The dimensions of the form from Sackdilling, being smaller than those in the recent species, are its only distinctive character.

Glis antiquus KORMOS was described by T. KORMOS (1930) from Episcopia (Püspökfördő) in Rumania. According to this author it differs from the recent *Glis glis* in having smaller dimensions and small strongly reduced M₃ (length and width 1.40 mm), as well as in the presence of only 2 roots on P⁴. *G. antiquus* is distinguished from *Glis sackdillingensis* by the reduction of M₃.

In 1960 I described the specimens from Kamyk as *Glis sackdillingensis* (HELLER, 1930). Next, a far richer material was found, allowing the statement that, as regards size, these specimens differ a little from *G. sackdillingensis* and *G. antiquus*, being smaller than either of them, but appearing to approach nearer the species from Episcopia (unfortunately T. KORMOS (1930), presenting

the dimensions of teeth, does not explain whether they are mean values or dimensions of one specimen). The $M_3 : M_1$ ratio in length in the specimens from Kamyk also shows differences in relation to both these forms, more resembling the species from Sackdilling. Generally speaking, the specific distinction of *G. antiquus* is very doubtful and for this reason I hold it good to keep up the name of *G. sackdillingensis* for my specimens inasmuch as it was introduced earlier.

Glis sackdillingensis (HELLER, 1930) was recorded from several localities of the Pleistocene in Germany and recently from the fauna of Schernfeld (R. DEHM, 1962), which perhaps dates from the Pliocene or contains some Pliocene elements, and from which a large number of isolated teeth have been described. The dimensions of these teeth generally fall within the limits of the extreme variations represented by the specimens from Sackdilling.

Specifically undetermined remains of *Glis* were reported from many faunae of the early Pleistocene, among other localities from Wojcieszów („Kitzelberghöhle“; F. HELLER, 1937), Podumci (T. KORMOS, 1931), and Split (M. MALEZ, 1961). M. KRETZOI (1956) mentions *Glis antiquus* from Ostramos in Hungary, without giving a description that would make it possible to check this specific identification.

Glis glis (LINNAEUS, 1766)

Material: Jaskinia w Dziadowej Skale: 1 lower jaw with P_4-M_2 , 4 toothless lower jaws, 2 upper incisors, 5 femora, 3 tibiae, 2 pelvic fragments, 2 humeri, 1 clavicle.

Description. The remains preserved do not show any differences in relation to the corresponding bones of the species of today.

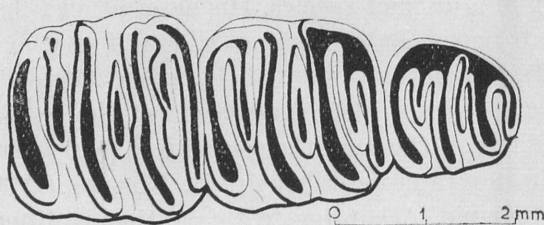


Fig. 13. *Glis glis* (LINNAEUS, 1766) from Jaskinia w Dziadowej Skale. Mandibular tooth-row

Dimensions. The lengths of the lower tooth rows, measured across the alveoli, in four specimens are 7.03, 7.16, 7.22, and 7.22 mm.

Dimensions of teeth of the only mandibular fragment with dentition preserved in comparison with the dimensions of the recent specimens of *Glis glis* from South Poland:

locality and No. of specimen	Dziadowa Skala	<i>Glis. glis</i> rec.			
		1173	1448	1447	1446
length of lower tooth					
row across crowns	—	7.41	6.99	6.73	—
length of upper tooth					
row across crowns	—	6.80	6.35	6.11	—
P ₄ length	1.46	1.46	1.31	1.33	D ₁ : 1.32
width	1.43	1.42	1.27	1.29	D ₁ : 1.15
M ₁ length	2.00	1.95	1.83	1.76	1.79
width	2.00	1.88	1.95	1.91	1.95
M ₂ length	2.05	1.98	1.98	1.82	1.89
width	2.16	2.06	2.06	2.03	2.07
M ₃ length	—	2.04	1.89	1.86	—
width	—	1.89	1.78	1.74	—
P ⁴ length	—	1.48	1.25	1.27	D ¹ : 1.09
width	—	1.67	1.46	1.44	D ¹ : 1.28
M ¹ length	—	1.79	1.79	1.76	1.70
width	—	2.02	1.99	2.06	1.95
M ² length	—	1.81	1.77	1.70	1.79
width	—	2.22	2.35	2.11	2.09
M ³ length	—	1.65	1.63	1.47	—
width	—	1.90	1.92	1.77	—

Systematic position. The remains described, derived from the last interglacial (Eem), belong undoubtedly to the same species as the recent specimens. The occurrence of this species was ascertained in many localities of the late Pleistocene of Europe (A. DUBOIS & H. G. STEHLIN, 1933) associated with both the forest and the steppe fauna, or even with the tundra fauna. It should however, be stated that the stratigraphic value of the majority of these finds is very questionable, and consequently, even though they have been taken together with the tundra or the steppe fauna, this may be due to the confusion of deposits of various age.

Gliridae, gen. et sp. indet.

Material: Weze: 2 loose teeth, M¹ and M².

Description. The two teeth, each with 3 roots, a large root and 2 small ones, are certainly M¹ or M². Their crowns are rectangular, with strongly rounded



Fig. 14. *Gliridae*, gen. et sp. indet., from Weze. A — probably M¹ (No. 2), B — probably M² (No. 1)

corners, slightly concave, and have 4 main and 3 supplementary enamel ridges on the surface. Tooth No 1 is somewhat broader.

Dimensions:

No. of specimen	1	2
length	1.27	1.27
width	1.49	1.38

Systematic position. These teeth differ from the corresponding teeth of *Glis minor* from Weže too apparently to reckon them in this species. However, the general pattern of the crown approaches most closely to the genus *Glis*, though, on the other hand, it is essentially distinct from that in all other recent genera of the *Gliridae* as well as from the teeth of the genus *Dryomimus* KRETZOI, 1959, with which I was able to compare my material directly. Its scarcity renders it impossible to make far-reaching conclusions, but it may be supposed that beside the species described there lived another member of the *Gliridae*, perhaps a fairly peculiar species of the genus *Glis*, at Weže.

GENERAL REMARKS

The striking character of all the faunae of *Gliridae* described from the Pliocene and Pleistocene of Poland is the lack of any members of the genera *Eliomys* WAGNER, 1840, *Dryomys* THOMAS, 1906 and *Myomimus* OGNEV, 1924. It seems that,

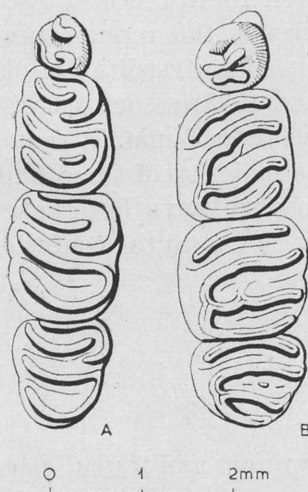


Fig. 15. *Myomimus personatus* OGNEV, 1924, recent, from Bulgaria. On the left mandibular tooth-row, on the right — maxillary tooth-row

if these genera had been present in the fauna of those times, their remains would certainly be preserved in such an abundant material. The genera mentioned above represent more primitive lines of the *Gliridae* than the *Muscardinus*, *Glis*, and *Glirulus* found in my material, and no doubt they were completely developed in the Pliocene. As far as I know, the genus *Dryomys* has not been found in the Pliocene and early Pleistocene localities, instead the genus *Eliomys* has been recorded from the Pliocene of Sète in France (M. FRIANT, 1953) and the early Pleistocene of Hungary (T. KORMOS, 1937) and Germany (W. WEILER, 1952; F. HELLER, 1958).

The lack of the species described as *Dryomimus eliomyoides* KRETZOI, 1959, on the basis of a very rich material from the Pliocene of Csarnota in Hungary in our localities is also distinctive. This species, isolated without a satisfactory justification by M. KRETZOI (1959) into a separate genus, seems to belong to the recent genus *Myomimus*. It should be mentioned here that *Philiostomys roachi* BATE, 1937, described by D. BATE (1937a, 1937b) from the late Pleistocene of Palestine, also belongs to this genus. Thus, the genus *Myomimus* constitutes an old Pliocene element of the fauna of the eastern Mediterranean region preserved up to the present.

The fauna of *Gliridae* described in the present paper suggests that Podlesice, Weże, and Rębielice Królewskie have a similar Pliocene fauna of mammals, obviously distinct from the early Pleistocene fauna of Kadzielnia and Kamyk. It may also be seen that the fauna of Podlesice is the oldest of those represented in my material: the abundance of the *Gliridae* still characteristic of the Miocene, persisted here represented by at least 4 species. Comparatively large dimensions of *Glis minor* from Podlesice may indicate a milder climate than that suggested by the subsequent Pliocene faunae of this country.

The *Gliridae* are regarded as an indication of the presence of forest, because the recent European genera *Eliomys*, *Dryomys*, *Glis*, and *Muscardinus* are closely associated with forest environment.

One must, however, be cautious when extending this conclusion over older geological periods. The *Muridae* and *Microtidae*, which in the Upper Pliocene dominated above all in open environments, perhaps having driven other rodents out of them, were lacking in the Miocene. The recent forms of *Gliridae* are only relics of the old rich fauna of this group, which may have had a markedly wider ecologic distribution. *Myomimus personatus* OGNEV, 1924 lives in the open land at the present time (T. PESHEV, T. DINEV & V. ANGELOVA, 1960). It is why the abundance of the *Gliridae* at Podlesice need not be an evidence of the forest character of the fauna of that time, but it may express the old geological age of this locality.

The question of environment in which the early Pleistocene species of *Gliridae*, particularly *Glis sackdillingensis*, lived is more disputable. F. HELLER (1930b) considered it to be a steppe species. Its abundant occurrence in the pure steppe community of the fauna of Kamyk confirms his opinion.

On the other hand, the late Pleistocene finds of *Glis glis* certainly indicate a forest environment, with which this species is associated now.

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STRESZCZENIE

W stanowiskach kopalnych faun kręgowców z okresu pliocenu i plejstocenu w Polsce znaleziono dość liczne szczątki *Gliridae*. Autor podaje krótką charakterystykę tych stanowisk. Leżą one na terenie Polski środkowej i przedstawiają resztki osadów jaskiń lub zagłębień krasowych. Podlesice zawierają faunę prawdopodobnie środkowego pliocenu. Weże dostarczyły bardzo bogatych szczątków z późnego pliocenu, podobnie jak nieco jeszcze młodsze od nich Rębiełice Królewskie. Wszystkie te trzy stanowiska plioceniczne wskazują na klimat ciepły, typu śródziemnomorskiego, i na obecność zarówno lasów, jak i terenów otwartych, stepowych.

Kadzielnia w Kielcach dostarczyła fauny pochodzącej prawdopodobnie z interglacjału Tegelen. Klimat był wówczas stosunkowo ciepły, ale chłodniejszy niż w pliocenie. Kamyk zawiera faunę z okresu interglacjału Günz-Mindel; wskazuje ona na środowisko stepowe i klimat dość chłodny.

Opracowano również szczątki popielicy z warstw interglacjału eemskiego (Riss-Würm) z Jaskini w Dziadowej Skale.

W części szczegółowej pracy podano opis szczątków *Gliridae*, ich wymiary oraz dyskusję nad ich stanowiskiem systematycznym.

Glirulus (Amphidyromys) pusillus (HELLER, 1936) stwierdzony został w Podlesicach, gdzie znaleziono jeden ząb tego gatunku. Opisany jako *Amphi-*

dyromys pusillus HELLER, 1936 z pliocenu Gundersheim w zachodnich Niemczech, został on później stwierdzony także w Schernfeld w Bawarii i w Csarnota na Węgrzech. Autor stwierdza, że należy on do rodzaju *Glirulus* THOMAS, 1906 występującego dziś w Japonii.

Muscardinus pliocaenicus n. sp. stwierdzony został w Podlesicach, Wężach i Rębielicach. Jest on mniejszy od dzisiejszego gatunku *Muscardinus avellanarius* (LINNAEUS, 1758) i różni się od niego bardziej prymitywną budową, a mianowicie zróżnicowanie wielkości zębów nie jest jeszcze u niego tak silne jak u formy dzisiejszej. Od Podlesic do Rębielic widzimy stopniowy wzrost rozmiarów tego gatunku, który jest być może bezpośrednim przodkiem *Muscardinus avellanarius*.

W Podlesicach występuje jeszcze drugi gatunek rodzaju *Muscardinus* KAUP, 1829, oznaczony jako *M. aff. dacicus* KORMOS, 1930. Jest on większy od *Muscardinus avellanarius* i bardziej od niego wyspecjalizowany, M¹ bowiem jest u niego szczególnie duży i opatrzone 6 korzeniami (u dzisiejszej formy — 4). Okazy z Podlesic zbliżają się do *Muscardinus dacicus* opisanego z wczesnego plejstocenu Episcopia w Rumunii.

W Kadzielni stwierdzono obecność formy bliskiej, a najprawdopodobniej nawet identycznej z gatunkiem dzisiejszym *Muscardinus avellanarius*.

W Podlesicach, Wężach i Rębielicach liczny jest *Glis minor* KOWALSKI, 1956. Został on opisany z Podlesic, a obecne materiały pozwalają znacznie rozszerzyć znajomość jego morfologii i wskazują jego obecność także i w dwu pozostałych naszych faunach plioceńskich. Rozmiary okazów tego gatunku z Podlesic są największe, z Wężów mniejsze, a najmniejsze z Rębielic. Ponieważ u dzisiejszego *Glis glis* (LINNAEUS, 1766) populacje występujące na południu zasięgu są większe niż na północy, autor przypuszcza, że to zmniejszanie się rozmiarów może być wynikiem ochłodzenia się klimatu w ciągu pliocenu.

Materiał rodzaju *Glis* BRISSON, 1762 z Kadzielni przedstawia prawdopodobnie mieszaninę okazów dwu form: jednej staroplejstocenińskiej, identycznej z *Glis sackdillingensis* (HELLER, 1930) i równowiekowej z resztą fauny kopalnej z tej miejscowości i drugiej, większej, bliskiej *Glis glis*, która dostała się do osadu z warstwy z okresu ostatniego interglacjału lub nawet holocenu.

Z Kamyka opisano bardzo liczny materiał oznaczony jako *Glis sackdillingensis*. Autor porównuje go z okazami tego gatunku z Sackdilling i Schernfeld, a także z okazami z Episcopia opisanymi bez dostatecznego uzasadnienia jako odrębny gatunek *Glis antiquus* KORMOS, 1930.

W eemskiej warstwie Jaskini w Dziadowej Skale stwierdzono obecność *Glis glis* nie odbiegającej od okazów współczesnych.

W materiale z Wężów stwierdzono obecność 2 górnych zębów trzonowych zbliżonych do zębów w rodzaju *Glis*, ale różniących się od *Glis minor*. Autor opisuje je jako *Gliridae*, gen. et sp. indet., uważając, że mogą wskazywać na obecność jeszcze jednej formy z tej grupy gryzoni w faunie z Wężów.

W uwagach ogólnych na końcu pracy autor zwraca uwagę na uderzający brak w polskich faunach pliocenu i wczesnego plejstocenu przedstawicieli bar-

dziej прymитивных родов *Gliridae*: *Dromys* THOMAS, 1706, *Eliomys* WAGNER, 1840 i *Myomimus* OGNEV, 1924. Stwierdza również, że opisany z pliocenu Węgier rodzaj *Dryomimus* KRETZOI, 1959 i z plejstocenu Palestyny rodzaj *Philistomys*, BATE 1937 są synonimami *Myomimus* OGNEV, 1924.

Opisana fauna *Gliridae* potwierdza dotychczasowe poglądy na wiek geologiczny omawianych faun kopalnych Polski. Podlesice, Węże i Rębielice mają w zasadzie jednolitą, plioceńską faunę, odrębną od staroplejstocenijskiej fauny Kadzielni i Kamyka. Bogactwo *Gliridae* w Podlesicach (3 rodzaje z 4 gatunkami) jest dowodem przetrwania do tego czasu charakterystycznej dla miocenu obfitości tej rodziny gryzoni.

Gliridae uchodzą za wskaźnik obecności lasu, gdyż europejskie rodzaje tej rodziny: *Eliomys*, *Dryomys*, *Muscardinus* i *Glis* żyją w środowisku leśnym. Nie jest jednak wykluczone, że w miocenie rodzina ta miała szerszy zasięg ekologiczny, została jednak w pliocenie stopniowo wyparta z terenów otwartych przez zjawiające się wówczas w Europie *Muridae* i *Microtidae*. Jest interesujące, że *Myomimus personatus* OGNEV, 1924 żyje wyłącznie w terenie otwartym. Również co do *Glis sackdillingensis* wysuwane było przypuszczenie, że był to gatunek stepowy. Obecność bardzo licznych okazów tego gatunku w stepowej faunie Kamyka potwierdza takie przypuszczenie.

Późnoplejstocenijskie znaleziska współczesnego gatunku *Glis glis* wskazują niewątpliwie na obecność środowiska leśnego.

РЕЗЮМЕ

В составе ископаемой фауны позвоночных из плиоцена и плейстоцена Польши найдены довольно многочисленные остатки *Gliridae*. Автором дается краткая характеристика их местонахождений. Они расположены на территории центральной Польши и представляют собой остатки пещерных осадков, либо осадков карстовых впадин. В Подлесицах (Podlesice) найдена фауна, очевидно, средне-плиоценового возраста. В Венжах (Węże) собрано очень много остатков времени позднего плиоцена, подобно тому как и в более молодых Рембелицах Крулевских (Rębielice Królewskie). Фауна всех этих трех местонахождений свидетельствует о теплом климате среднеземноморского типа и наличии как леса, так и ландшафта открытой степи.

В Кадзельни (Kadzielnia) в Кельцах возраст ископаемых остатков определяется, очевидно, временем интергляциала Tegelen. Климат того времени также был сравнительно теплый, хотя и менее теплый чем в плиоцене. Камык (Kamyk) содержит фауну интергляциала Günz-Mindel; ее состав указывает на степную обстановку и довольно холодный климат.

Автором также обработаны остатки сонь из отложений еемского интергляциала (Riss-Würm), собранные в Пещере Дзядовой Скалы (Jaskinia w Dziadowej Skale).

Описательная часть работы содержит морфологическую характеристику остатков *Gliridae*, их промеры и обсуждение систематической принадлежности.

Glirulus (Amphidyromys) pusillus (HELLER, 1936) отмечен в Подлесьях, где был найден один зуб этого вида. Описанный первоначально как *Amphidyromys pusillus* HELLER, 1936, из плиоцена Гундерсхейм (Gundersheim) в Западной Германии, он позже был отмечен также в Шернфельде (Schernfeld) в Баварии и в Чарноте (Csarnota) в Венгрии. Автор констатирует, что он относится к роду *Glirulus* THOMAS, 1906, в настоящее время распространенному в Японии.

Muscardinus pliocaenicus n. sp. определен в Подлесьях, Венжах и Рембелицах. Он мельче современного вида *Muscardinus avellanarius* (LINNAEUS, 1758) и отличается от него более примитивным строением; в частности у него нет еще столь большой разницы в величине коренных, как у современного вида. От Подлесья к Рембелицам отмечено постепенное возрастание размеров этого вида, который, возможно, является непосредственным предком *Muscardinus avellanarius*.

В Подлесьях встречен еще один из рода *Muscardinus* KAUP, 1929, определенный как *M. aff. dacicus* KORMOS, 1930. Он крупнее *Muscardinus avellanarius* и несколько более специализирован: M^1 развит особенно сильно и имеет 6 корней (у современного вида — 4). Остатки из Подлесья близки к *Muscardinus dacicus*, который описан из раннего плейстоцена Эпископии (Episcopia) в Румынии.

Из Кадзельни отмечен уже вид близкий (по всей вероятности тождественный) к современному *Muscardinus avellanarius*.

В Подлесьях, Венжах и Рембелицах многочислен *Glis minor* KOWALSKI, 1956. Он описан из Подлесья; новые дополнительные материалы из состава обеих других плиоценовых фаун позволяют значительно расширить сведения о его морфологии. Наибольшими размерами характеризуется экземпляры из Подлесья, меньшими из Венже и наименьшими из Рембелиц. Так как особи южных популяций современного *Glis glis* (LINNAEUS, 1766) больше северных, автор предполагает, что уменьшение размеров *G. minor* является вероятным следствием охлаждения климата на протяжении плиоцена.

Род *Glis* BRISSON, 1762 из Кадзельни представлен, очевидно, смесью остатков двух форм: 1) раннеплейстоценовой, идентичной с *Glis sackdillingensis* (HELLER, 1930) и одновозрастной остальной ископаемой фауной этого местонахождения и 2) более крупной, близкой к *Glis glis*, которая попала сюда из отложений относящихся либо к периоду последнего интергляциала, либо даже к голоцену.

Из Камыка описывается очень богатый материал по *Glis sackdillingensis*. Автор сравнивает его с особями того вида из Сакдиллингена (Sackdilling), Шернфельда и Эпископии, которые были без достаточных оснований описаны в качестве самостоятельного вида — *Glis antiquus* (KORMOS, 1930).

В еемских отложениях Пещеры в Дзядовой Скале установлено наличие *Glis glis* не отличающегося от современного вида.

В материале из Венже найдены 2 верхнекоренных зуба, сходные с зубами представителей рода *Glis*, отличающиеся от *Glis minor*. Автор относит их к *Gliridae*, gen. et sp. indet., считая, что они могут указывать на наличие еще одной формы этого рода в составе фауны Венже.

В заключительных замечаниях автор указывает на явное отсутствие, в польской плиоценовой и раннеплейстоценовой фауне, представителей примитивных родов семейства *Gliridae*: *Dryomys*, THOMAS, 1706, *Eliomys* WAGNER, 1840, *Myomimus* OGNEV, 1924. Констатируется также, что описанный из плиоцена Венгрии род *Dryomimus* KRETZOI, 1959, равно как и род *Philistomys* BATE, 1937 из плейстоцена Палестины являются синонимами рода *Myomimus* OGNEV, 1924.

Описанная фауна *Gliridae* подтверждает существование до сих пор взгляды на геологический возраст рассматриваемых ископаемых фаун Польши. Подлесье, Венже и Рембелице имеют, в основном, сходную фауну плиоценового возраста, отличную от ранее плейстоценовой фауны Кадзельни и Камька. Обилие форм *Gliridae* в Подлесьях (3 рода с 4 видами) является своеобразным наследием миоценовых фаун, характеризующихся многообразием видов этого семейства.

Считается, что наличие остатков *Gliridae* является показателем лесной обстановки, так как современные европейские роды этого семейства — *Eliomys*, *Dryomys*, *Muscardinus* и *Glis* входят в состав лесной фауны. Однако не исключено, что в миоцене его представители обитали в более разнообразных экологических условиях и лишь в плиоцене были вытеснены из открытой местности появляющимися в это время в Европе представителями *Muridae* и *Microtidae*. Интересно, что *Myomimus personatus* OGNEV, 1924 живет исключительно в условиях открытого ландшафта. Высказывались предположения, что и *Glis sacdillingensis* был степным видом. Это подтверждается и присутствием его многочисленных остатков в составе степной фауны Камька. В то же время позднеплейстоценовые находки современного вида *Glis glis* несомненно указывают на наличие лесного ландшафта.

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