

## THE MALACOFUNA OF THE YOUNGER AND OLDER LOESS OF THE PRZEMYŚL REGION, SE POLAND

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**ABSTRACT:** Differences between molluscan assemblages occurring in loess series of the Younger Pleistocene bear no distinct relation to the age of the sediments. The assemblages recorded from the last two cold periods (Saalian, Vistulian) comprise the same species, differences in the species composition among the faunae of various localities being controlled by environmental factors. This conclusion stems from the studies carried out by V. Ložek in Czechoslovakia, J. J. Puissegur in France, M. Wagner in Hungary, as well as from those carried out in Roland, a.o. in the profiles at Odonów and in the Przemyśl region.

**KEY WORDS:** molluscan assemblages, Pleistocene fauna, geological profiles

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### INTRODUCTION

The occurrence of subfossil molluscs in loess series distributed in the region lying between Przemyśl, Jarosław and Rzeszów was recorded as early as in the beginning of this century (Łomnicki 1900, Friedberg 1903). Seventy years later, in an outcrop of loess and loess-like clay near Radymno, as well as on some other localities of these sediments in the discussed region, mollusc shells were found by Łaskowska-Wysoczańska (1971), Malicki (1972), and Maruszczak (1980). The latter author had initiated the detailed stratigraphic studies that were carried out in 1983 on several localities by the present authors. H. Maruszczak worked out the lithostratigraphic profiles, while S. W. Alexandrowicz described the molluscan assemblages. In 1984 J. Butrym estimated the age of the sediments by means of the thermoluminescence dating (TL) whose detailed characteristics he gave elsewhere (Butrym 1985).

The outcrops under consideration are situated near the outer margin of the Carpathians, in the Rzeszów Foot-Hills which is the southern periphery of the Sandomierz Basin (Fig. 1). The loess and accompanying formations of the area occur in the form of a tight and considerably thick cover. East of Przemyśl, within the East Carpathian Foot-Hills, the cover is poorly developed. In the West Carpathian Foot-Hills loess occurs in separate lobes and is partly substituted with loess-like loam and loamy slope formations.

In the area lying between Jarosław and Przemyśl one can distinguish between the loess series of the last two glaciations. The Vistulian loess is called "Younger Loess", whereas the Saalian loess is named "Older Loess". The stratigraphy of both the loess series is presented according to the scheme drawn by Maruszczak (1985), using the signs and symbols proposed by that author.

#### RADYMNO PROFILE

The outcrop is situated at a brickyard on the north-eastern outskirts of the town of Radymno. The loess series covers the San River middle terrace which is the main macromorphologic unit of the eastern part of the Rzeszów Foot-Hills (Fig. 1). The north-eastern margin of the terrace, situated at about 203 m a.s.l., is outcropped for exploitation. The accessible profile in the outcrop wall comprises over 14 m of the loess series (0 - 14.5 m). Older sediments (14.5 - 28.8 m) were outcropped in the profile of a well situated in the southern part of the town, about 2.5 km SSE of the brickyard. The upper part of the profile was previously described by Maruszczak (1980). The layer numbers used in the present paper are the same as in the cited one. They are given according to the sequence of the layers, beginning at the uppermost ones (Fig. 2).

a-c	0 - 0.90 m	recent soil - genetic levels A-(B),
d <sub>1-2</sub>	0.90 - 2.15 m	calcareous subaeral loess (Upper Younger Loess),
d <sub>3-10</sub>	2.15 - 8.10 m	calcareous subaeral loess showing macromorphologic traces of pedogenetic processes in its upper, middle and lower parts (Middle Younger Loess),
e <sub>1-8</sub>	8.10 - 12.30 m	distinctly stratified loess showing traces of gleying; calcareous in its upper part, while lacking CaCO <sub>3</sub> in the lower one; its characters indicate its sedimentation in the water environment of flood waters and marshes (Lower Younger Loess),
f-g-h	12.30 - 13.95 m	three-level gley soil,

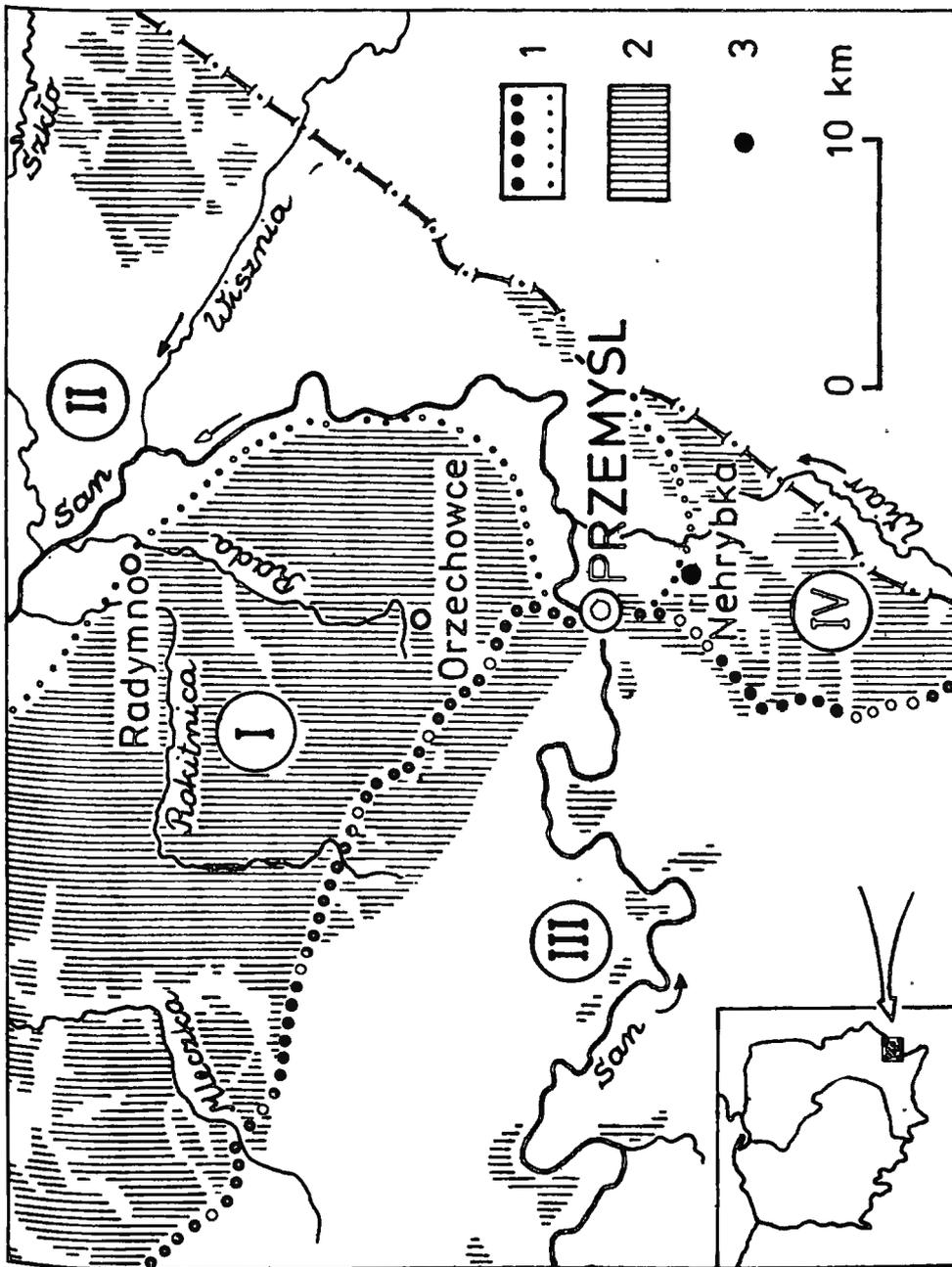


Fig. 1. Localities of the mollusc fauna against a background of the loess distribution in the vicinity of Przemysł. 1 - borders of physico-geographic regions of low and high level; I - Rzeszów Foot-Hills, II - San River Valley with Lubaczów Plain, III - Dynów Foot-Hills, IV - Chyrdw Foot-Hills; 2 - distribution range of loess (after the Reconnaissance Geologic Map of Poland, supplemented according to data of Assistant Prof. Dr. K. Pekala), 3 - the localities of loess containing Malaco fauna, described in the text

- i            13.95 - 16.50 m coarse- and fine-grained sand with an admixture of a silt fraction; a fluvial sediment, in its upper part represented by a channel facies, while in the lower one by a flood facies (probably the Earliest Vistulian),
- j            16.50 - 17.40 m brown, silty clay,
- k            17.40 - 20.30 m grey, coarse-grained riverine sand,
- l            20.30 - 28.80 m riverine sand and gravel (probably the maximum stadial of the Saalian I Glaciation),
- m            below 28.80 m Krakowiek clay - the Miocene.

The TL dating of samples from the Radymno Profile was carried out at the laboratory of the Geological Institute of the Academy of Sciences of the Ukrainian SSR in Kiev, in 1980, and at the laboratory of the Department of Physical Geography of the M. Skłodowska-Curie University of Lublin, in 1984. The results obtained at both the laboratories are convergent (Butrym 1985, Shelkopylas et al. 1985). They are used for a stratigraphic interpretation of the profile (Fig. 2). The described loess series is remarkable for the small thickness of the Upper Younger Loess (LMg). The fossil gley soil (f-g-h) was previously determined as an interglacial, Eemian soil (Maruszczak 1980). However, numerous loess datings of recent years show that about 80 ka BP in the area of Poland the levels of interstadial soil were formed to separate the Lower Younger Loess (LMd) from the Lowest Younger Loess (LMn). According to this observation the soil occurring at a depth of 12.30 - 13.95 m in the discussed profile is defined herein as an interstadial soil of the Early Vistulian.

Gastropod shells were found in the upper part of the layer  $e_1$  (8.10 - 8.40 m) representing interstadial soil, as well as in the layer  $e_3$  (9.05 - 9.45 m) representing the Lower Younger Loess. The gastropod assemblage of the former layer comprised four taxa, out of which Succinea oblonga elongata occurred in mass, while of the other three (Columella columella, Pupilla loessica and Lymnaea truncatula) only single shells were found. In the layer  $e_3$  two distinct molluscan assemblages were found. The assemblage of the upper part of the layer comprised numerous specimens of Gyraulus laevis, less numerous ones of Succinea oblonga elongata, and single specimens of Vertigo parcedentata. The assemblage of the lower part of this layer consisted of Succinea oblonga elongata, Pupilla loessica and Vertigo parcedentata, represented by rather small numbers of specimens. The distinctness of the particular layers of the loess series of Radymno points out altering conditions of the sedimentation of formations regarded as belonging to the Lower Younger Loess (Fig. 2). The altering circumstances were due to the alternate creation and vanishing of temporary water reservoirs.

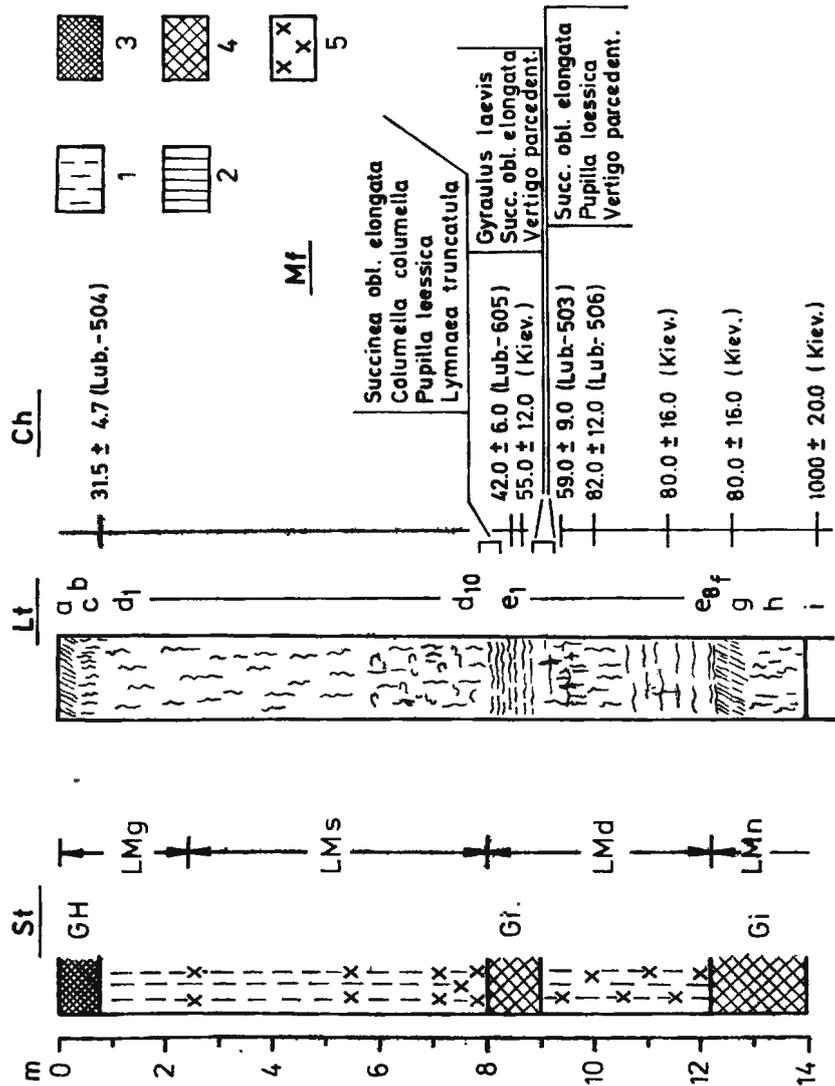


Fig. 2. Loess series profile at Radymno. St - stratigraphy (symbols of stratigraphic units after Maruszczak 1985, concerning Figs 2 - 4) GH - Holocene soil, GI - interstadial soil, G1 - interglacial soil, LMg - Upper Younger Loess, LMs - Middle Younger Loess, LMD - Lower Younger Loess, LMn - Lowest Younger Loess, LSg1 - Late Upper Older Loess, LSg2+3 - Middle-Early Older Loess, LSg4 - Earliest Upper Older Loess, LS-fluv - Upper Older Loess in valley facies, LN - Oldest Loess; Lt - lithology, a-s - lithologic symbols of layers after H. Maruszczak (1980), Ch - TL Chronology in ka BP, Mf - molluscan assemblages, 1 - non-weathered loess, 2 - weathered non-calcareous loess, 3 - Holocene and interglacial soil, 4 - interstadial soil, 5 - soil sediments and poorly developed interstadial soil

## ORZECHOWCE PROFILE

The outcrop of a brickyard is situated in an area of a quite diversified relief, lying in the eastern part of the Rzeszów Foot-Hills. The relative relief is there much higher than at Radymno, and reaches 50 m. Loess does not occur continuously, but forms vast patches. Depending on the character of the relief it is represented either by eolic or by slope-wash or slope-wash-eolic facies. The brickyard is situated at the village of Orzechowce about 7.5 km north of Przemyśl, on the slope of the valley of a small river (the River Rada), exposed north-westward, at an altitude of 247 m a.s.l. The upper part of the profile (0.0 - 16.1 m) is accessible in the wall of the outcrop, whereas the lower part (16.1 - 21.4 m) is described basing on boring data. A detailed description of the profile is given according to Maruszczak (1980), using the same symbols and signs (Fig. 3).

a-b-c	0.00 - 1.50m	recent soil - genetic levels A <sub>1</sub> -AB-B,
d	1.50 - 3.20m	calcareous subaeral loess (Upper Younger Loess, in the bottom part Middle Younger Loess),
e	3.20 - 3.55m	light grey, silty formation with brown laminae; a result of the denudation of the underlying interglacial soil, interlaid with laminae of the levels A and B,
f	3.55 - 4.60m	brown, silty -clayey formation; the illuvial level of a partly denuded interglacial soil (soil of the Eemian Interglacial),
g <sub>1</sub> -h <sub>3</sub>	4.60 - 8.65m	decalcified subaeral loess with an intercalation of loess showing a trace of pedogeny (Upper Older Loess),
i <sub>1</sub> -4	8.65 - 10.75m	carbonate subaeral loess (Upper Older Loess),
j-k-1	10.75 - 11.75m	non-carbonate subaeral loess with a poorly developed interstadial soil (Upper Older Loess),
l-m-n	11.75 - 13.45m	three-level interglacial soil, well developed, probably corresponding to the interglacial dividing the Oder (Saalian I) and Warta (Saalian II) Glaciations,
o <sub>1</sub> -2	13.40 - 13.89m	variegated, strongly weathered loess (Middle or Lower Older Loess),
p-r <sub>1</sub> -2	13.89 - 15.60m	highly developed poligenous soil, secondarily gleyed (Mazovian = Holsteinian Interglacial),



s	15.50 - 17.20 m	strongly weathered and gleyed loess (Oldest Loess),
t	17.20 - 21.00 m	weathered till (Saanian = Elsterian II Glaciation),
u	21.00 - 21.40 m	sand with intercalations of boulders and gravel of Scandinavian rocks and Carpathian sandstones (fluvioglacial sediments of the Saanian = Elsterian II Glaciation).

TL dating results suggest that there are some stratigraphic hiatuses in the profile of the loess series of Orzechowce. The hiatuses are probably due to the degradation of the loess cover on the slope of the Rada Valley. The most conspicuous and largest stratigraphic hiatus occurs between the layers e and f, where the erosional surface cutting the interglacial soil (f) corresponds with a long period whose length is estimated at about 60 ka. The surface is hardly visible in the lithostratigraphic profile because the granulations of the over- and underlying sediments are not conspicuously different. This concerns also the other hiatuses that appear in the described profile, and makes its stratigraphic interpretation difficult owing to numerous datings being necessary. Owing to the lack of TL data, the previous interpretation was different (Maruszczak 1980).

Molluscan assemblages were found on three levels: d,  $i_1$  and  $i_3$  (Fig. 3). One of them occurred in the bottom part of the Upper Younger Loess (LMg), or just in the Middle Younger Loess (LMs), at a depth of 2.50 - 3.20 m. It comprised numerous taxa and specimens. The assemblage consisted of the following species: Succinea oblonga elongata, Pupilla loessica, Helicopsis striata, Clausilia dubia, Columella columella, Pupilla muscorum, Vertigo parcedentata, Trichia hispida, and Vallonia tenuilabris. The former two species were particularly numerous, while the next two were quite numerous.

In the upper part of the layer  $i_1$ , at a depth of 8.65 - 9.10 m, calcareous streaky loess determined as the Upper Older Loess (LSg) contained a gastropod assemblage of Succinea oblonga elongata, Pupilla muscorum, P. loessica, Vertigo parcedentata, and Columella columella. The number of specimens was there much lower than in the Younger Loess. Another assemblage of mollusc shells was observed in the layer  $i_3$ , at a depth of 9.75 - 10.15 m. This was a rich assemblage comprising 6 taxa: Pupilla muscorum, Succinea oblonga elongata, P. loessica, Vallonia tenuilabris, Columella columella, and Trichia hispida. The former two were numerous. It is worth of attention that the assemblages found in the Younger and Older Loess at Orzechowce were markedly similar in their species composition. This indicates environmental conditions being much stable in the successive glacial cycles of the loess sedimentation.

## NEHRYBKA PROFILE

The outcrop is situated about 4 km south of Przemyśl, on a slope exposed southward, at an altitude of 225 m a.s.l. The loess and accompanying formations that create vast patches in the vicinity of the villages of Pikulice and Nehrybka, were described by Malicki (1961, 1972) and Laskowska-Wysoczańska (1971). The present description of the upper part of the profile, accessible at an old brickyard (0 - 12 m), was completed basing on the authors' own observations, whereas the description of the lower part (12 - 19 m) was supplemented according to data published by Laskowska-Wysoczańska (1971).

a-b-c	0.00 - 1.30 m	recent soil - genetic levels A-AB-(B),
d <sub>1-4</sub>	1.30 - 4.70 m	calcareous subaeral loess showing weak traces of pedogeny in its middle and lower parts (Middle Younger Loess),
e-g	4.40 - 6.60 m	non-calcareous subaeral loess showing numerous traces of pedogeny; in the middle part interstadial soil distinct owing to traces of the gley formation; the soil morphology and structure little diversified (Lower and Lowest Younger Loess),
h-j	6.60 - 8.40 m	three-level, interglacial soil, very well developed (soil of the Eemian Interglacial),
k	8.40 - 17.80 m	distinctly stratified, non-calcareous clayey loess; the fluvial-alluvial facies of the loess series, probably associated with the valley of the River Wiar, coming from the Saalian Glaciation,
l	17.80 - 19.00 m	sand with an admixture of gravel (riverine sediments of a channel facies, connected with the valley of the River Wiar).

Results of the TL dating show that the Upper Younger Loess of the discussed profile is very thin, whereas the Middle Younger Loess is well developed. The soil, which is very distinct, corresponds with the last interglacial period. The underlying sediments were deposited in water environment and, as fluvial loess, may correspond approximately to the Saalian Glaciation (Fig. 4). Their top part, covered by the illuvial level of Eemian soil, is dated at 144 ka BP, which indicates sediments of the Saalian II (Wartianian) Glaciation.

The molluscan assemblage found in this profile within the layer d (2.20 - 2.80 m) was poor and comprised only two taxa. Its dominant species was Succinea oblonga elongata, while Pupilla loessica was represented by no more than several shells.

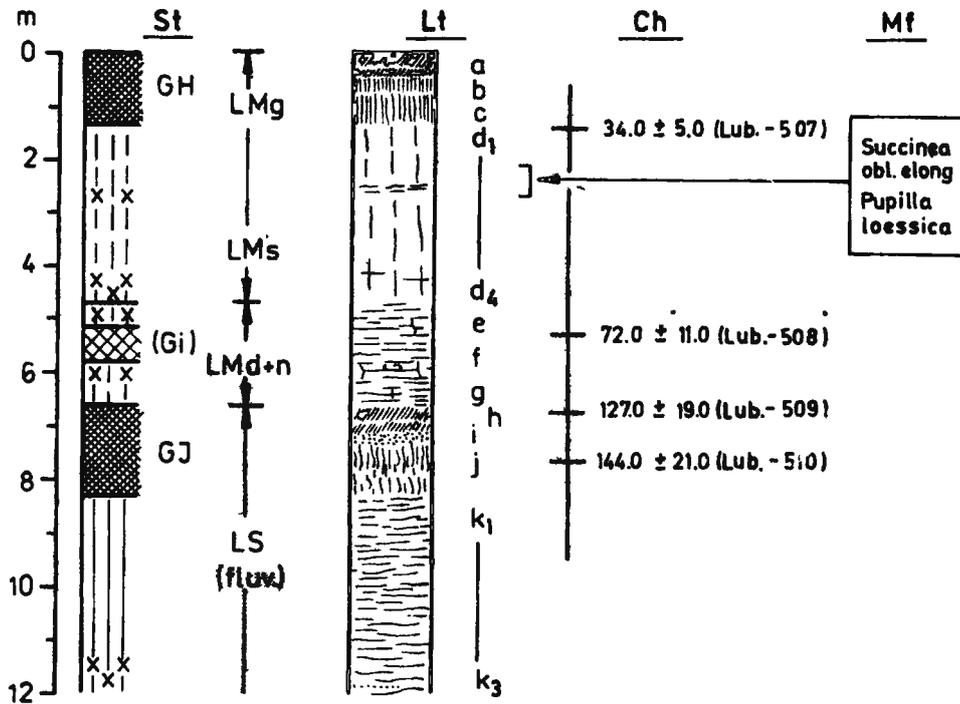


Fig. 4. Loess series profile at Nehrybka. Explanations as to Fig. 2

Table 1

The occurrence of snails in loess series of the Przemyśl Region  
 I-V: numbers of specimens in samples: I - 1-3, II - 4-9,  
 III - 10-31, IV - 32-99, V - 100-316

TAXON	Locality: Stratigraphy: Layer:	RADYMNO			ORZECOWCE			NEHRYBKA
		LMd e <sub>1</sub>	LMd e <sub>3</sub>	LMd e <sub>3</sub>	LMg d	LSg i <sub>1</sub>	LSg i <sub>3</sub>	LMs d
<i>Helicopsis striata</i> (Müller)					IV			
<i>Columella columella</i> (Martens)		I			II	I	III	
<i>Vertigo parcedentata</i> (Braun)			I	III		I		
<i>Pupilla muscorum</i> (Linnaeus)						II	V	
<i>Pupilla loessica</i> Ložek		II		I	V	I	IV	II
<i>Vallonia tenuilabris</i> (Braun)					I		IV	
<i>Succinea oblonga elongata</i> Sandberger		V	III	IV	V	IV	V	V
<i>Clausilia dubia</i> Draparnaud					IV			
<i>Trichia hispida</i> (Linnaeus)					II		II	
<i>Lymnaea truncatula</i> (Müller)		I						
<i>Gyraulus laevis</i> (Alder)				IV				

## MOLLUSCAN ASSEMBLAGES

In the studied loess series of the Przemyśl region assemblages of snails are distributed unevenly and occur only in several layers. The detailed lithostratigraphic studies and dating of numerous samples of the described three profiles made it possible to precise the stratigraphic position of the layers that contain the malacofauna. The layers are connected with the loess of the last two glaciations:

- Upper Older Loess (Saalian) - Orzechowce, LSg 3+2 (Fig. 3)
- Lower Younger Loess (Vistulian) - Radymno, LMd (Fig. 2)
- Middle Younger Loess (Vistulian) - Nehrybka, LMs (Fig. 4)
- Middle and Upper Younger Loess (Vistulian) - Orzechowce LMs + LMg (Fig. 3).

The analysed material comprised altogether 11 gastropod species (Tab. 1). They were represented by various numbers of specimens. The predominant element of the assemblages was Succinea oblonga elongata which was present in all the samples collected. Shells of Pupilla loessica, Columella columella and Vertigo parcedentata were less numerous, whereas the remaining taxa were represented by small numbers of specimens.

Results of the quantitative analysis are presented in malacological diagrams (Fig. 5). They consider percentages of taxa (MSS) as well as of individuals (MSI) representing particular ecologic groups of gastropods, determined according to the scheme defined by Ložek (1964). The four assemblage types found in the loess of the vicinity of Przemyśl correspond to the faunas described by Ložek (1965, 1976), Remy (1968) and Alexandrowicz (1985, 1986) from loess series of Czechoslovakia, Germany and Poland.

1. Assemblage with Succinea oblonga elongata is characteristic in an absolute predominance of the nominal taxon whose share in particular samples exceeds 80%. The accessory elements of the assemblage are Pupilla loessica, Columella columella and Vertigo parcedentata. This fauna indicates an open, quite humid habitat, and cold, subpolar climate. The small number of taxa suggests, that the molluscs lived in unfavourable conditions. The assemblage was found in the Lower Younger Loess at Radymno and in the Middle Younger Loess at Nehrybka (Fig. 5 - Rdl, Pkl).

2. Assemblage with Succinea oblonga elongata and Pupilla muscorum is characterized by a great share of both its indicative taxa, as well as by the presence of other species as: Vallonia tenuilabris, Columella columella, Vertigo parcedentata, Irichia hispida and Pupilla loessica. This type of fauna may indicate an open habitat of a varying humidity, favouring a rich vegetation; it may also be a mixocenosis created by washing shells off a slope. The assemblage was found in the Upper Older Loess at Orzechowce (Fig. 5 - Or1).

3. Assemblage with Succinea oblonga elongata and Pupilla loessica exhibits a more even structure than the former two, because it has no dominant.

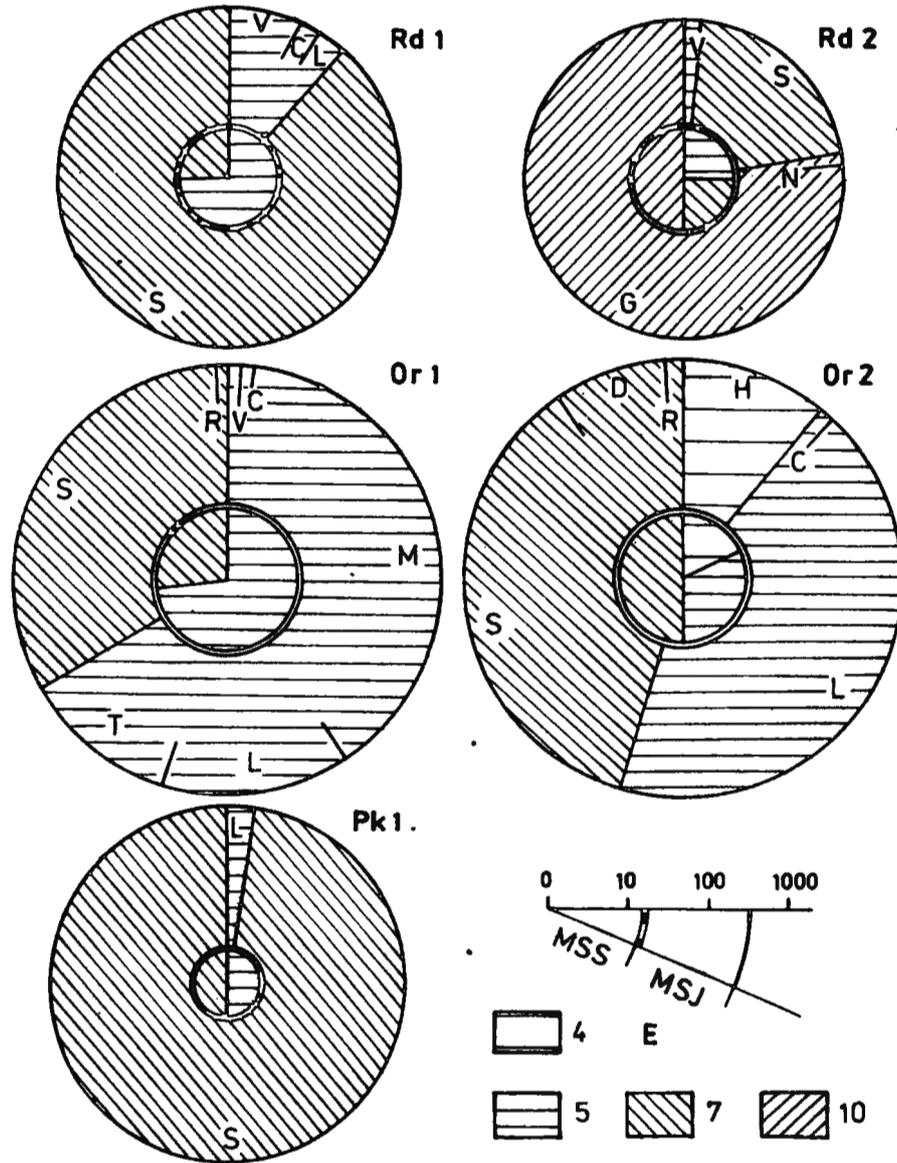


Fig. 5. Malacological spectra of molluscan assemblages of loess of the vicinities of Przemyśl. MSS - spectrum of species, MSI - spectrum of individuals, 1-1000 - number of elements (species, individuals), E - symbols of ecologic groups after Lozek (1964), 4 - steppe and xerothermic species, 5 - open environment species, 7 - mesophilous species of moderate humidity habitats, 8 - mesophilous species of humid habitats, Rd1, Rd2 - assemblages of the Radymno profile, (Fig. 2), Or1, Or2 - assemblages of the Orzechowce Profile (Fig. 3), Pk1 - assemblage of the Nehrybka Profile (Fig. 4) H - *Helicopsis*, V - *Vertigo*, C - *Columella*, M - *Pupilla muscorum*, L - *Pupilla loesica*, T - *Vallonia*, S - *Succinea*, D - *Clausilia*, R - *Trichia*, N - *Lymnaea*, G - *Gyraulus*

Besides those of the two nominal taxa, shells of Helicopsis striata and Clausilia dubia are numerous and accompanied with three other species. The fauna indicates favourable conditions of the gastropod development, as well as a markedly diversified, open habitat. The cooccurrence of gastropods typical of steppe habitats and those preferring more humid places may suggest the accumulation of shells coming from various parts of a slope (mixocenosis). Such conditions correspond to the locality at Orzechowce (Upper and Middle Younger Loess) where the fauna was found (Fig. 5 - Or2).

4. Assemblage with Gyraulus laevis is characteristic of loess which was accumulated in water environment. Shells of the land snails found (Succinea, Vertigo) come from the margin of a water reservoir into which they were washed. The nominal taxon as well as the accompanying species Lymnaea truncatula indicate a small water body. The assemblage is typical of a loess valley facies which was accumulated partly in land and partly in water environment. It was found in the Lower Younger Loess at Radymno (Fig. 5 - Rd2).

#### INTERPRETATION

The presented diversity of molluscan assemblages is controlled mainly by characters of the loess sedimentary environment and reflects ecologic conditions of the fauna development. Out of the characters, the relative relief of an area and the situation of a locality towards the bottom of the valley, as well as the humidity and vegetation of a habitat, are of great importance. The composition of the malacofauna found in loess changes with climate and with local environmental conditions. In a given climatic phase different assemblages may neighbour on one another, similar as it is observed in recent malacocenoses.

As regards loess faunas, the main indices of the character of their environment are the number of taxa and the presence of species showing a determined ecologic valence. The especially poor assemblages (Nehrybka) as well as little diversified ones (Radymno - layer e<sub>3</sub>) correspond to the habitats that do not favour a rich vegetation. In the region of Pikulice and Nehrybka the poorness might have resulted from the dryness of that habitat situated on a vast slope exposed southward and south-eastward. In Radymno the studied locality was situated within the wide bottom of the San River Valley in a pit which, probably overgrown with ruderals, was alternately sunk and dessicating.

Assemblages of a considerable number of taxa (Orzechowce) were developing in habitats that were more favourable for the existence of animals and plants. The surroundings of the Orzechowce Profile are remarkable for their diversified macro- and microrelief resulting in the close neighbourhood of habitats that differ among one another in temperature and humidity.

The layers that contain the studied malacofauna are connected with the eastern slope of a small hill, close to which there are, however, slopes of various expositions.

A given habitat type appeared repeatedly at a particular site in the successive cold phases of the Pleistocene. Hence, in profiles of loess series comprising sediments of more than one cold stage (glaciation) similar molluscan assemblages of various age may appear several times. Such a case can be observed, for instance, in the loess series at Orzechowce; another similar one was recorded from the loess profile at Odonów by Kazimierza Wielka (Alexandrowicz 1986). The favourable ecologic conditions reflected in the composition of the molluscan assemblage at Orzechowce might have been connected with the diversified macro- and microrelief as well as with slopes of various exposition. Habitats situated on slopes exposed towards the south (Pikulice - Nehrybka) as well as on vast terraces (Radymno) were less favourable for the development of vegetation and the existence of molluscs. The valley facies of loess, marked by the presence of the water fauna, is connected entirely with flood plains, what can be observed in the profile at Radymno and on several other localities described by Alexandrowicz (1985, 1986), Alexandrowicz and Jersak (1988) and Dolecki and Skompski (1986).

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#### MALAKOFAUNA LESSÓW MŁODSZYCH I STARSZYCH W REJONIE PRZEMYŚLA

Streszczenie: W okolicy Przemyśla występują lessy młodsze i lessy starsze, odpowiadające dwóm ostatnim piętróm zimnym pleistocenu (Saalian i Vistulian). Stratygrafia serii lessowych została opracowana na podstawie ich litologicznego wykształcenia i występowania gleb kopalnych oraz w oparciu o wyniki datowań metodą termoluminiscencji. Zespoły mięczaków występujące w różnowiekowych lessach obejmują takie same gatunki, a zróżnicowanie ich składu odzwierciedla głównie lokalne warunki ekologiczne. Są zespoły z Succinea oblonga elongata, z Succinea oblonga elongata i Pupilla muscorum, z Succinea oblonga elongata i Pupilla loessica oraz z Gyraulus laevis.