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Malacofauna and seed flora of Butėnai Interglacial in deposits of the Neravai outcrop, South Lithuania

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Malacological investigations of Butėnai (Holsteinian, Likhvian, Mazovian, Aleksandrian) Interglacial deposits in the reference section of Neravai describe stagnophilic mollusc fauna most probably related to oxbow lakes separated from the river channel. Faunas of such type are generally difficult to diagnose stratigraphically. However, findings of the rare Siberian immigrant *Valvata sibirica* Middendorf in the Butėnai fauna can be used as a basis for comparison and stratigraphic correlations of the fauna under discussion with other Butėnai faunas in Lithuania and adjacent regions. The Neravai tree and herbaceous flora is among the richest ones in Butėnai deposits in Lithuania. The paper deals with main representatives of this flora (*Caulinia goretskyi, Azolla interglacialia, Carex paucifloroides*) and their role in stratigraphic identification of Butėnai deposits. The new matter was detected to contain extinct species of *Potamogeton panormitanoides* Dorof. and rare remains of other species of this genus, probably another extinct species – *P. pseudorutilus* Dorof. Studies of each layer of flora-bearing deposits present a reconstruction of the development of interglacial communities of an ancient water body.

Key words: malacofauna, Butėnai Interglacial, *Valvata sibirica*, seed flora, Pleistocene, stratigraphy, Lithuania

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INTRODUCTION

Outcrops of Butėnai (Holsteinian) Interglacial organogenous deposits are rather rare in Central and North Europe. Such geological sites are unique and present rich information on the stratigraphy and palaeogeography of the Pleistocene. The Neravai section is one of such sites revealing information that was unknown about peculiarities of flora and fauna of the Butėnai Interglacial. The Butėnai (Holsteinian) Interglacial deposits serve as a key horizon for the purpose of correlation. The present paper discusses material on mollusc fauna and seed flora. The data obtained provide new criteria for stratigraphic identification of Butėnai deposits in Lithuania and adjacent regions. The Neravai outcrop near Druskininkai town (South Lithuania) is a parastratotype of the Butėnai (Holsteinian) Interglacial (Fig. 1). The Druskininkai area in South Lithuania has been a principal research region for three Interglacials: Butėnai (Holsteinian), Snaigupėlė (Drenthe–Warta) and Merkinė (Eemian) in Lithuania. The study section of the Butėnai Interglacial is located c. 2.5 km North–East of Druskininkai on the right bank of the Nemunas River near Neravai village. Interglacial deposits are represented by

Fig. 1. Location of the study section
1 pav. Tyrinėto pjūvio padėtis

lacustrine and boggy organogenic sediments. The exposure opens the socle of the first terrace above the floodplain of the Nemunas River.

HISTORY OF INVESTIGATIONS

The investigations in Neravai were carried on by Lithuanian, Belarussian and Estonian geologists. Organogenous deposits at the Neravai village had been detected by A. Basalykas and V. Čepulytė early in the 1950s. Palaeontological studies of interglacial deposits at the Neravai and Gailiūnai villages were first performed by O. Kondratienė (1958, 1965) who determined the very precise age of the deposits – between the end of the Dainava (Oka) Glaciation and the first half of the Butėnai (Alexandrian, Likhvinian) Interglacial. The Butėnai deposits lie mainly in a rather high hypsometric position of the Quaternary on the Baltic ridge, therefore V. Vonsavičius and V. Baltrūnas (1974) decided to perform geological investigations at the vicinity of the outcrops. They supposed these interglacial deposits to be of truncated nature.

The interglacial deposits in Neravai were found to be rich in palaeontological findings: a great number of ostracode shells, remains of seeds and fruits, bones and teeth of mammals, insect sclerites, mollusc shells and amphibians (Зубович, 1974, 1978; Ришкене, 1976, Величкевич, 1975, 1982; Калиновский, 1986; Мотузко, 1985; 1989; Величкевич и др., 1987; Вознячук и др., 1984; Sanko, Gaigalas, 2004). Analysis of palaeontological remains of different groups from the Neravai deposits confirmed the opinion of O. Kondratienė about the Butėnai (Alexandrian, Likhvinian) age of the deposits. The absolute age of the Neravai mollusc shells, as determined by the ESR-method, was 356 ± 34.0, 336.0 ± 30.0 and 298.0 ± 28.0 ka (Gaigalas, Molodkov, 2002). One more dating of these deposits was obtained by L. Voskovskaya using thermo-luminescence analysis (TL). Sand deposits occurring as a lens between the layers Nos. 8 and 9 were found to be ≥ 175 ka old (TLM-462), as it was determined at the Moscow State University. This dating, although different from the three above ones obtained by the ESR-method, indicates that these deposits are older than those of Merkinė (Eemian) Interglacial.

Fauna of small mammals, i.e. remains of Mosbachian water vole *Arvicola mosbachensis* found in the deposits, gained a diagnostic value. This species was common on the Russian plain during two interglacials (close in age but different) – Smolensk (Smolensky Brod section) and Butėnai (Neravai section). Phylogenetically, this species evolved from the genera Mimomys–Arvicola. In general, *Arvicola* from Smolensky Brod is closer to its ancestors *Mimomys,* while that of Neravai is closer to the later *Arvicola chosaricus* (Вознячук и др., 1984; Мотузко, 1985). Such a specific species composition of fauna enabled A. Motuzko to attribute it to a separate (Neravai) regional faunal complex. The Neravai fauna is of a transitional character between the Cromerian faunas of Central and West Europe and the Singilian (Middle Dnieper?) faunas. The index species of the Neravai faunal complex is *Arvicola mosbachensis* followed by *Trogontherium cf. cuvieri* and *Pitymys aff. arvaloides.*

OCCURRENCE CONDITIONS OF INTERGLACIAL DEPOSITS

The interglacial deposits of Neravai at the Druskininkai town are outcropping at the toe of the right bank (6 m) of the first terrace above the floodplain of the Nemunas River, where on the other bank there is the central part of the Gailiūnai section of the interglacial deposits (Fig. 1). The humus layer in Neravai occurs between two till horizons at the depths ranging within 70.8–79.6 m above the sea level. The peak position of the roof of the interglacial deposits is determined to be at 2.5 m, while the base lies at 7 m below the contemporary low water level of the Nemunas (Вознячук и др., 1984). The geological setup is given in Fig. 2, where the numbers mark the following layers: 1 – Dainava (Berezina) till: greenish-grey boulder loam; 2 – Late Dainava (Berezina) deposits: grey medium-grained sand (2) and bluish and bluish-grey fine sandy loam; 3–12 – Butėnai (Likhvinian, Holsteinian) deposits: 3 – bluish grey gyttja with peat gyttja lamina (to 2 cm); 4 – grey, dark grey with olive tint gyttja with abundant ostracode shells and rare mollusń shells; 5 – grey various-grained sand with gravel and cobble; 6 – peaty dark brown gyttja; 7 – olive-grey gyttja with obscure lamination and abundant mollusń shells, for-

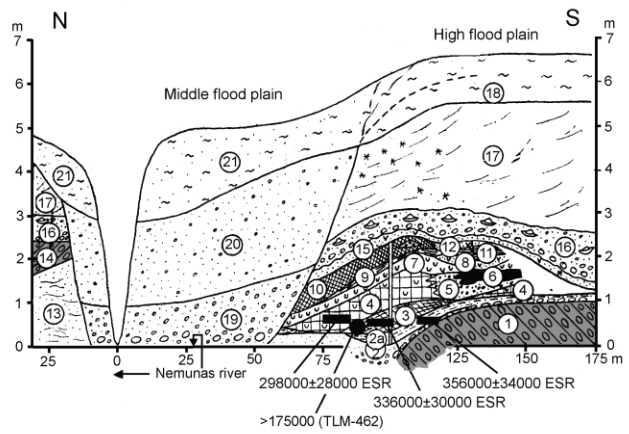

Fig. 2. Neravai outcrop on the right bank of the Nemunas River near to the town of Druskininkai; after L.Voznyachyuk and V. Fedenya, with supplements by A. Sanko, 2005 (Вознячук и др., 1984)

Bed numbers in Fig. 2 and text are the same. The vertical line indicates the site of sampling for malacological and palaeocarpological and spore-and-pollen analyses. Black rectangles and black circles show sampling sites for ESR and TL analyses

2 pav. Neravų atodanga dešiniajame Nemuno upės krante prie Druskininkų; pagal L. Vozniačiuką ir V. Fedinią su A. Sanko (2005) papildymais) (Вознячук и др., 1984)

ming accumulations in some places with interrupting lamina of dark-brown peat; 8 – bluish grey medium-grained sand with lamina and nests of vegetative detritus; 9 – pale yellow and bluish grey gyttja with obscure lamina and rare shells of mollusńs in the upper part; 10 – loamy gyttja, from dark grey to black, with brownish and olive tint, fractured, lumpy in the upper part, obscurely laminated, rapidly becoming darker in the air, with rare mollusń shells in the middle part and lenses of bluish grey loam and pale grey aleurite (to 0.8 m); 11 – peaty gyttja (peat), dark grey with brownish tint to black, sandy, with sand lenses, remains of fishes, insectivores and rodents; 12 – a lens composed of various-grained sand with gravel grains, nests and lamina of dark grey brownish peat, abundant bone remains of fishes and small mammals; 13 – Early Žemaitija (Dnieper) alluvial sand, light grey, medium-grained, well sorted with oblique–undulating and oblique lamination; 14 – Žemaitija (Dnieper) till: grey with brownish tint loamy sand; 15–21 – Holocene alluvial (channel and floodplain) deposits of high and medium floodplain with accumulations of rheophilic unionid shells (*Unio crassus, U. pictorum* etc.) in the stream facies (layer No. 16). The vertical line indicates the sampling sites for malacological and palaeocarpological investigations. Black rectangles show the sampling sites for ESR analysis.

The Pleistocene deposits occur above the normal stratigraphic sequence of bedding with no glaciotectonic disruptions determined. These facts deny the opinion about the truncated nature of interglacial deposits.

MALACOFAUNA

A. Sanko and A. Gaigalas (2004) informed that shells of a mollusc *Valvata sibirica* which is rare in Central Europe, was found in the Neravai section deposits. Occurrence of this species exceptionally in the Butėnai Interglacial is very important for the stratigraphic dating of Butėnai deposits in Lithuania. With this in mind, we have made attempts to perform additional investigations of these fauna-bearing deposits (Table 1).

The fauna studied comprises two different complexes of various age: the Lower Butėnai (Alexandrian) complex with *Valvata sibirica* (interglacial gyttja at the toe of the first terrace, Fig. 3, samples 1–14) and the Upper Holocene complex (basal horizon of the first terrace lying at a depth 2.31–2.74 m below the present surface, Fig. 3, samples 15–16) without *V. sibirica*, but

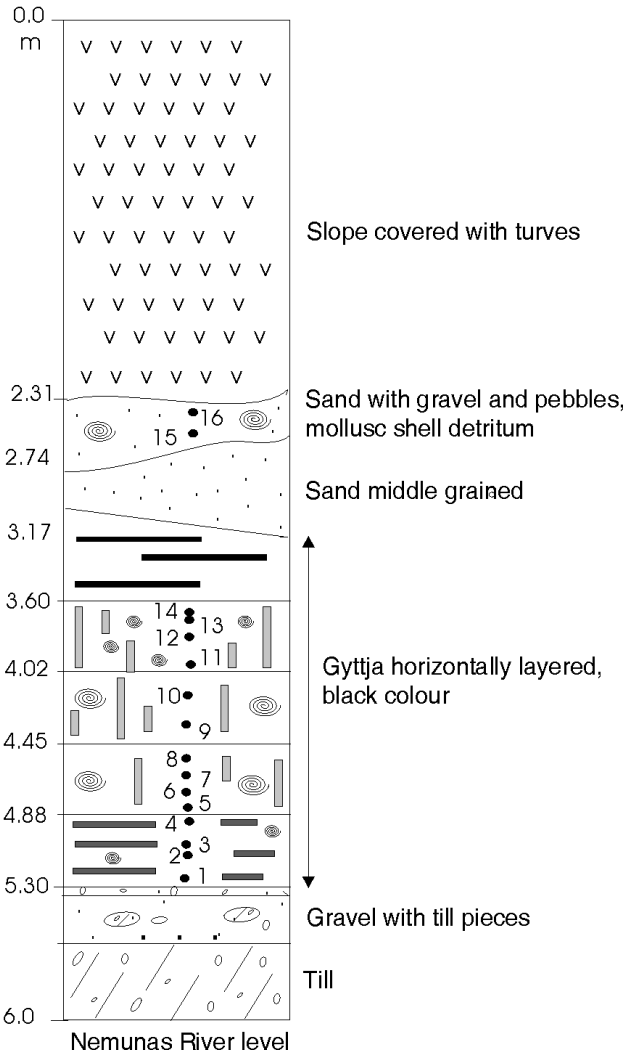

Fig. 3. Section Neravai with the location of samples (1–16) for mollusc research

3 pav. Tyrinėtų moliuskų mėginių (1–16) paėmimo vietos Neravų atodangoje

with prevalence of the interglacial species *Bithynia tentaculata*.

According to a type, the Butėnai mollusc fauna is attributed to the stagnophilic molluscs with freshwater species (16 taxa) of still water prevailing. A significant role is played by species (6 taxa) of rapidly overgrowing lakes. The rest of the mollusńs are rare both taxonomically and quantitatively. They belong to into the thanatocoenosis that was being formed at that time due to washout of land molluscs down the slope. The key component of Neravai fauna is considered to be a complex of widely spread freshwater molluscs *V. cristata, V. piscinalis* and *Armiger crista* (Fig. 4). The ecology of these species fully reflects the character of the Butėnai water body in Neravai.

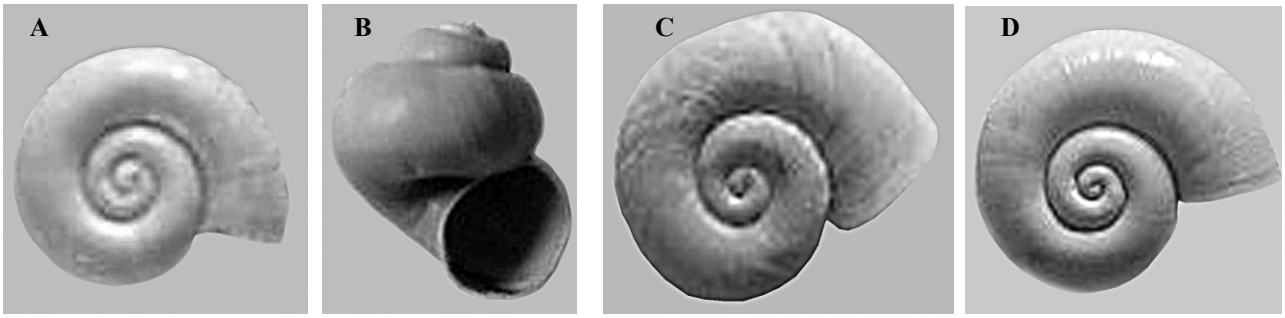

Fig. 4. Shells of the most often found molluscs from The Butėnai deposits in Neravai: *A – Valvata cristata*, *B – V. piscinalis*, *C – Armiger crista, D – Valvata sibirica*

4 pav. Neravų atodangos Butėnų tarpledynmečio nuogulose labiausiai paplitusios kriauklės: A – *Valvata cristata*, B – *V. piscinalis*, C – *Armiger crista*, D – *Valvata sibirica*

Table 1. **Malacofauna from Butėnai Interglacial deposits in Neravai section**
1 lentelė. **Neravų atodangos Butėnų tarpledynmečio nuogulų malakofauna**

E	Species	Samples							
		1	2	3	4	5	6	7	8
7	*Limacidae* gen. (large)							5	3
9	*Carychium minimum* Müller			1					
10	*Valvata cristata* (Müller)	2	3	3	115	467	1757	2326	804
10	*Valvata sibirica* Middendorf	10			10	17	105	166	26
10	*Lymnaeae* gr. *peregra* (Müller)	3	2			1			
10	*Planorbis planorbis* (Linnaeus)				3	1	8	10	5
10	*Anisus leucostomus* (Millet)					2	67	62	26
10	*Segmentina nitida* (Müller)					2	5	2	1
10	*Pisidium obtusale* (Lamarck)	1		2		2	11	16	3
11	*Valvata piscinalis* (Müller)	307	93	165	87	178	326	381	116
11	*Bithynia tentaculata* (Linnaeus) – operculata							1	1
11	*Lymnaea stagnalis* (Linnaeus)						2	5	14
11	*L. auricularia* (Linnaeus)	1	1	10	11	13	30	30	30
11	*Bathyomphalus contortus* (Linnaeus)					1	4	8	2
11	*Armiger crista* (Linnaeus)	7		7	10	34	300	255	68
11	*Acroloxus lacustris* (Linnaeus)					1	5	6	4
11	*Sphaerium corneum* (Linnaeus)	25	25	35	70	15	23	96	32
11	*Pisidium henslowanum* (Sheppard)	1				3	2	1	2
11	*P. milium* Held					2	13	10	4
11	*P. subtruncatum* Malm				2		9	4	
11	*P. pulchellum* Jenyns							2	
11	*P. casertanum* (Poli)	15	6	1		2	3		
11	*P. moitessierianum* Paladilhe	4	2		1	1	9	3	
11	*Pisidium* sp.	5	2	10	5	10	30	45	34
12	*Unio* sp.	7	35	25	25	15	19	41	85
12	*Pisidium nitidum* Jenyns			5	4	5	30	30	8
	Total	388	169	264	343	772	2758	3505	1268

E – ecological groups.

Table 1 (continued).
1 lentelės tęsinys.

E	Species	Samples							
		9	10	11	12	13	14	15	16
7	*Limacidae* gen. (large)	1	2						
5	*Vallonia costata* (Müller)					1			
10	*Valvata cristata* (Müller)	64	113	280	5	186	97		2
10	*Valvata sibirica* Middendorf	9	11	17	4	3	2		
10	*Lymnaeae* gr. *peregra* (Müller)							1	3
10	*Planorbis planorbis* (Linnaeus)	2	10	11	10				
10	*Anisus leucostomus* (Millet)					2	3	7	1
10	*Segmentina nitida* (Müller)	1	2		1		2		
10	*Sphaerium lacustre* (Müller)					2			
10	*Pisidium obtusale* (Lamarck)		6						
11	*Valvata piscinalis* (Müller)	37	110	70	37	21	8	2	28
11	*Bithynia tentaculata* (Linnaeus) - shalls							28	80
11	*Bithynia tentaculata* (Linnaeus) – operculata	3	3			1	1	15	8
11	*Lymnaea stagnalis* (Linnaeus)	1		1	1				
11	*L. auricularia* (Linnaeus)	32	11	30	11	1	2		
11	*Planorbarius corneus* (Linnaeus)			1					
11	*Bathyomphalus contortus* (Linnaeus)		1						
11	*Armiger crista* (Linnaeus)	2	14	27		14	7		
11	*Acroloxus lacustris* (Linnaeus)	1	7	2	3				
11	*Sphaerium corneum* (Linnaeus)	30	20	35	70		7	2	3
11	*Pisidium henslowanum* (Sheppard)	1	7		4			27	80
11	*P. milium* Held	2	8		3				
11	*P. subtruncatum* Malm		6						
11	*P. pulchellum* (Jenyns)		2						
11	*P. casertanum* (Poli)		3						
11	*Pisidium* sp.	5	150	3	30	6	7		
12	*Unio* sp.	19	25	6	17		2	13	18
12	*Pisidium amnicum* (Müller)							1	10
12	*P. nitidum* Jenyns	2	16	5	4				
	Total	212	527	488	200	237	138	96	233

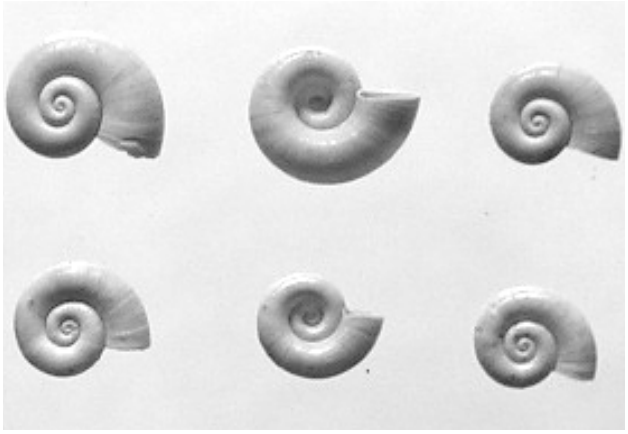

Fig. 5. Shells of *Valvata sibirica* Middendorf – upper row, and *V. cristata* (Müller) – lower row, from the Butėnai Interglacial deposits in Neravai section, sample No. 6
5 pav. *Valvata sibirica* Middendorf (viršutinėje eilutėje) ir *V. cristata* (Müller) (apatinėje eilutėje) kriauklės iš Neravų atodangos Butėnų tarpledynmečio nuogulų (mėginys Nr. 6)

V. cristata dwells now in still parts of slow-running rivers, their oxbow lakes, creeks, lake nearshores, as well as many shallow water bodies, both stable and disappearing for a time. They like rapidly overgrowing water bodies with a silt bottom. Macroscopically, the specimens of this species resemble those of *V. sibirica* (Fig. 5), and most probably, this was the reason why it was difficult to identify the latter species in the Quaternary deposits.

V. piscinalis feeds mainly on fine floral detritus and, therefore, is attributed to the dwellers of lake and river bottoms. The optimal depth for dwelling of this species is within the interval of 1.5–2.0 m; although these molluscs can descend significantly deeper to the zone beyond aquatic vegetation. Presence of this species on the sites rich in aquatic vegetation can be explained by the necessity for them to find a hide-out from sudden movements of water. The lifetime of this mollusc reaches two years, during which it takes part in vertical migration. During a warm season the mollusc keeps on aquatic vegetation or silt bottom, while in cold season it

buries itself in bottom silt. This eurytopic species inhabits fresh water bodies of all types, but their peak in number is observed in the lakes; hence, they are often attributed to the group of lake species.

Armiger crista inhabits mainly still water bodies with rich vegetation. It is rarely seen in running water and as a rule does not inhabit ephemeral pools. In lakes, it never descends deeper than 3 m, and its optimal depth is about 1.5 m. A peculiarity of life cycle for these molluscs is that they are closely related to water plants needed for feeding and sticking their follicles. The following plants could be mentioned first of all: *Lemnaceae, Chara, Potamogeton, Myriophyllum*, etc.

Based on the ecological characteristics of key mollusc species in Butėnai fauna, as well as on the general ecological evaluation, this fauna is supposed to have been formed in a rather small and rapidly over-growing water body. It was quite possible that this body was an oxbow lake having no connection with its river and not inundated during floods. The absence of typical rheophilic species confirms this presumption.

The malacofauna of such a type is referred to stagnophilic molluscs. They are often observed among the interglacial faunas or in more scanty quantities among the interstadial thermophils of the Pleistocene. From the stratigraphical standpoint, such faunas are considered to be neutral. However, due to occurrence of the Siberian immigrant *Valvata sibirica*, the Neravai fauna is of stratigraphical (or, to be more precise, climatostratigraphical) significance for a rather wide area, including the Baltic states. Their stratigraphic significance lies within the fact that *V. sibirica* inhabited a rather wide area during the Butėnai Interglacial. This species is not known in other Pleistocene interglacials of Central Europe. The nature of such a phenomenon lies in the ecological peculiarity of this species, i.e. in the Pleistocene climate in general and the Butėnai Interglacial in particular.

In total, 370 shells of *V. sibirica* have been identified. Their peak in fauna reaches 4.7% (sample No. 7). The species belongs to the contemporary Siberian fauna. Its southern boundary in the European part of Russia, according to V. Zhadin (Жадин, 1952) goes along the floodplains of the Kama and Vetluga rivers. The species inhabits also Kola Peninsula and Sweden. V. Zhadin stressed in the same work that findings of shells of this species were unknown in the Quaternary deposits of the USSR. Nowadays, the species is also known in Holocene, Pleistocene and Pliocene faunas of Siberia (Filipov et al., 2000; Arslanov et al., 2004; Зыкин, 1986). On the territory of the East-European platform, this species as a fossil was detected for the first time only in 2004 in the fauna of two Lithuanian sections – Gailiūnai and Neravai (Sanko, Gaigalas, 2004). The southern boundary of the Butėnai area for *V. sibirica* was drawn across the central part of Belarus and the northern part of Poland. Findings of shells of this species in the space between its southern areas of the contemporary and Butėnai distribution in the Quaternary provide a solid basis for attributing this malacofauna and related deposits to the Butėnai Interglacial (Fig. 6).

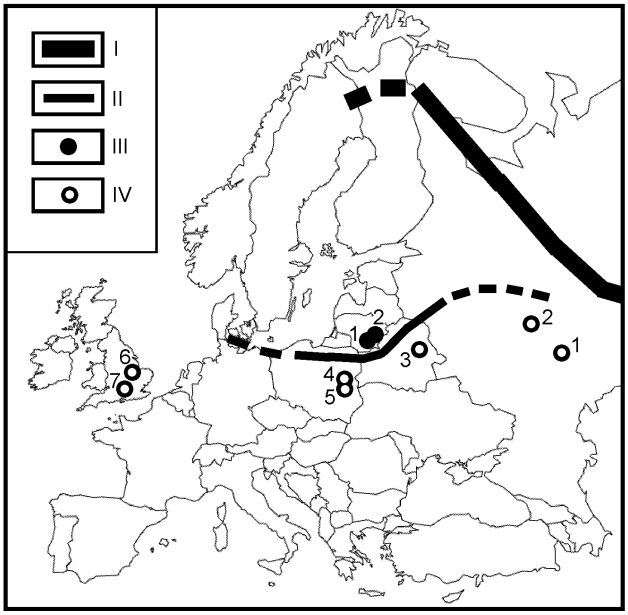

Fig. 6. Distribution of *Valvata sibirica* during the Butėnai (Holsteinian, Likhvian, Mazovian, Alexandrian) Interglacial in Europe:
I – southern boundary of contemporary distribution area after V.I. Zhadin (Жадин, 1952): II – southern boundary of the Butėnai area; III – sections of the Butėnai deposits with *V. sibirica*: 1 – Gailiūnai, 2 – Neravai; IV – sections of the Butėnai deposits without *V. sibirica*: *1* – Strelitsa (Красненков и др., 1984), *2* – Likhvin (Старобогатов, 1975), *3* – Malaya Aleksandriya (Санько, 1999), *4* – Chrud (Lindner et al., 1991), *5* – Komarovo (Lindner et al., 1991), *6* – Woodston (Horton et al., 1992), *7* – Frog Hall Pit (Keen et al., 1997)
6 pav. *Valvata sibirica* paplitimas Butėnų (Holšteino, Lichvino Mazovio, Aleksandrijos) tarpledynmečiu Europoje

By its general view and flatness, *V. sibirica* resembles greatly *Valvata cristata* Müller (see Fig. 5). But there is an obvious difference in the sculpture of the shell surface – *V. sibirica* is more densely covered with thin and sharp cross ribs. The whorls are convex and growing rapidly. The next-to-last whorl rises sometimes above the last one that is obviously broader at the mouth. The mouth is round and broader than that of *V. sibirica*. The shell width of *V. sibirica* can reach 5 mm, while that of *V. cristata* does not exceed 3 mm. Rather small differences between these two species might be a reason why this species is not yet known in the Likhvian Interglacial of Russia.

The distribution of shells in the sections was rather monotonous (Fig. 7). Two malacological zones can be defined more or less reliably. The lower one is related to the eurytopic mollusc *V. piscinalis*. At that time the lake was maximum deep. The second (upper) malacological

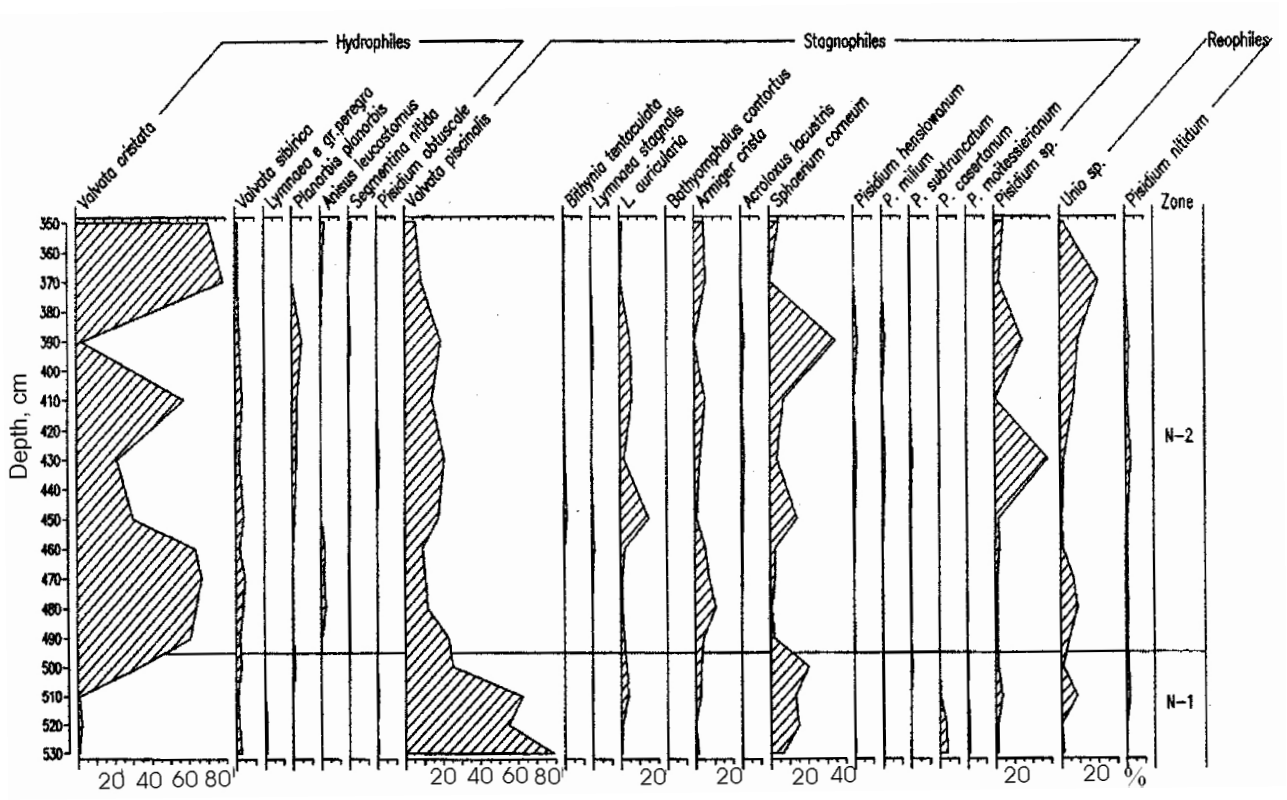

Fig. 7. Malacological diagram of the Neravai outcrop sediments
7 pav. Neravų atodangos nuogulų malakofaunos diagrama

zone is singled out according to the prevailing content of *V. sibirica* in the fauna. The distribution of these molluscs indicates the shallowing of the water body and its gradual (with breaks) overgrowing. *V. sibirica* shells are observed nearly constantly throughout the section, although in low numbers.

Two malacological samples (Nos. 15 and 16) were taken from the coarse sand layer No. 16 overlying the Neravai organogenous bed. According to geological description, the sand of this layer belongs to the Holocene alluvium. This is well confirmed by malacological data – the occurrence of such rheophils as *Unio pictorum, U. crassus* and *Pisidium amnicum*. The fauna was also found to contain dominating eurytopic molluscs which can dwell in still and running water. These both groups of species make a rheophilic association of molluscs. Shells of the ephemeral pool look as occasional elements of fauna.

PALAEOCARPOLOGY

After the deposit samples were washed for malacofauna and shells were selected, the deposits were investigated by the palaeocarpological method (Table 2). The seed complexes, representative enough, were detected in eight of 16 samples. The upper part of the interglacial layer was found to contain some fragments of seeds and fruits of several species.

The flora obtained contained 35 taxa of arboreal and grass species; this enabled to reconstruct the pre-optimal and optimal phase in the development of vegetation of the interglacial type. All the identified taxa had been found in the Neravai section even before (Āåėč÷źāāč÷, 1975, Ščųźåķå, 1976); moreover, the then work described the flora that was studied in large samples of floral detritus washed from the outcrop with a special purpose of palaeocarpological investigations; therefore it was even richer (76 taxa). Determination of the Alexandrian (Butėnai) age of the flora-bearing Neravai deposits from the flora study data was based on an extremely high amount (more than 1000) of seeds of the extinct species *Caulinia goretskyi* accompanied with *Azolla interglacialica* and *Carex paucifloroides*. New material on this flora showed also extinct *Potamogeton panormitanoides* and sparse remains of another species of the same genus, most probably belonging to extinct species of *P. pseudorutilus* which occurs for the first time in the interglacial floras of Lithuania. All these facts are convincingly in favour of the Alexandrian age of the Neravai flora, whereas the layer-after-layer studies of the flora-bearing bed (Fig. 8) enabled a more detailed reconstruction of the development dynamics of interglacial communities in a lake-type water body.

CONCLUSIONS

The Neravai section is the locality of the Butėnai formations of Lithuania which is richest in different palaeontologic rests. Its pollen and spore flora, seed flora, fauna of small mammals, fauna of ostracodes had been investigated

Table 2. **Palaeocarpological remnants from Butėnai Interglacial deposits in Neravai section**
2 lentelė. **Paleokarpologinės liekanos Butėnų tarpledynmečio nuogulų Neravų pjūvyje**

Species	Type of remains	Samples							
		1	2	3	4	5	6	7	8
Pinus sylvestris L.	s		2						
Picea sect. *Eupicea* Willkm.	s/n		1/1	2/1	2/3	2/1	7/13	9/5	1/1
Larix decidua Mill.	s/n			1/	5/2	6/1	1/	3/	
Sparganium minimum Wallr	s/t					1		1	
Potamogeton alpinus Balb.	e					1	2		1
P. compressus L.	e							2	1
P. cf. *crispus* L.	e								1
P. filiformis Pers.	e	6			1				
P. natans L.	e					1	2	2	
P. panormitanoides Dorof.	e						1	3	
P. pectinatus L.	e			1					1
P. perfoliatus L.	e	9	3		2				1
P. praelongus Wulf.	e	2	2		1	1			
P. gr. *rutilus* Wolfg.	e						1		4
P. vaginatus Turcz.	e	6							
Zannichelia palustris L.	s								1
Najas marina L.	s	1	37	105	863	2360	521	94	16
Caulinia goretskyi Dorof.	s		1	1	82	126	24	8	4
Schoenoplectus lacustris (L.) Palla	f	5	9	9	8	10	3	8	2
Carex sp. div.	f	7	3	8	6	9	12	28	19
Betula sect. *Albae*	f/ds	2/4	3/	2/1	2/	3/1	1/3	4/	2/
Alnus sp.	f					1	3	9	2
Rumex maritimus L.	f						1	1	
Nuphar cf. *lutea* (L.) Sm.	s	1	21	15	8	27	46	39	11
Nymphaea alba L.	s							1	
Ceratophyllum demersum L.	f				12	73	158	68	24
C. submersum L.	f						6	2	
Batrachium sp.	f			1	2	1	1	1	
Ranunculus sceleratus L.	f			1			1	1	
Myriophyllum cf. *spicatum* L.	f				2	2			
Hippuris vulgaris L.	f	1						1	
Arctostaphylos uva-ursi (L.) Spreng.	s							1	
Menyanthes trifoliata L.	s					2		9	6
Carduus sp.	s							2	
Asteraceae gen.	s						1		

earlier. The first geochronological materials in the country are received owing to shells of freshwater molluscs from the Butėnai Interglacial sediments of Neravai. The palaeontologic materials give a lot of new data for the Pleistocene stratigraphy and palaeogeography of Lithuania and all Middle-East Europe. Data on the Neravai malacofauna are not an exception, either. We have informed in our first publication concerning the finds of shells of the freshwater mollusc *Valvata sibirica* (Sanko, Gaigalas, 2004) that it had penetrated to the territory of Lithuania only once in the Quaternary during the Butėnai Interglacial. The species is not fixed in the Snaigupėlė, Merkinė and Holocene faunas. This fact allowed to ascribe a climatestratigraphical value to it. Association with *V. sibirica* and its relation with seed flora are shown in the present work on the basis of a new series of samples. It is confirmed that *V. sibirica* plays a climatostratigraphical role on a significant part of Middle Europe. New arguments for the stratigraphy of Butėnai sediments have been found according to palaeocarpologic data.

The Neravai exposure of Butėnai sediments is a unique site of fossil flora and fauna. It deserves recognition for the quality of the hypostratotype (secondary, additional stratotype) of the Butėnai sediments of Lithuania.

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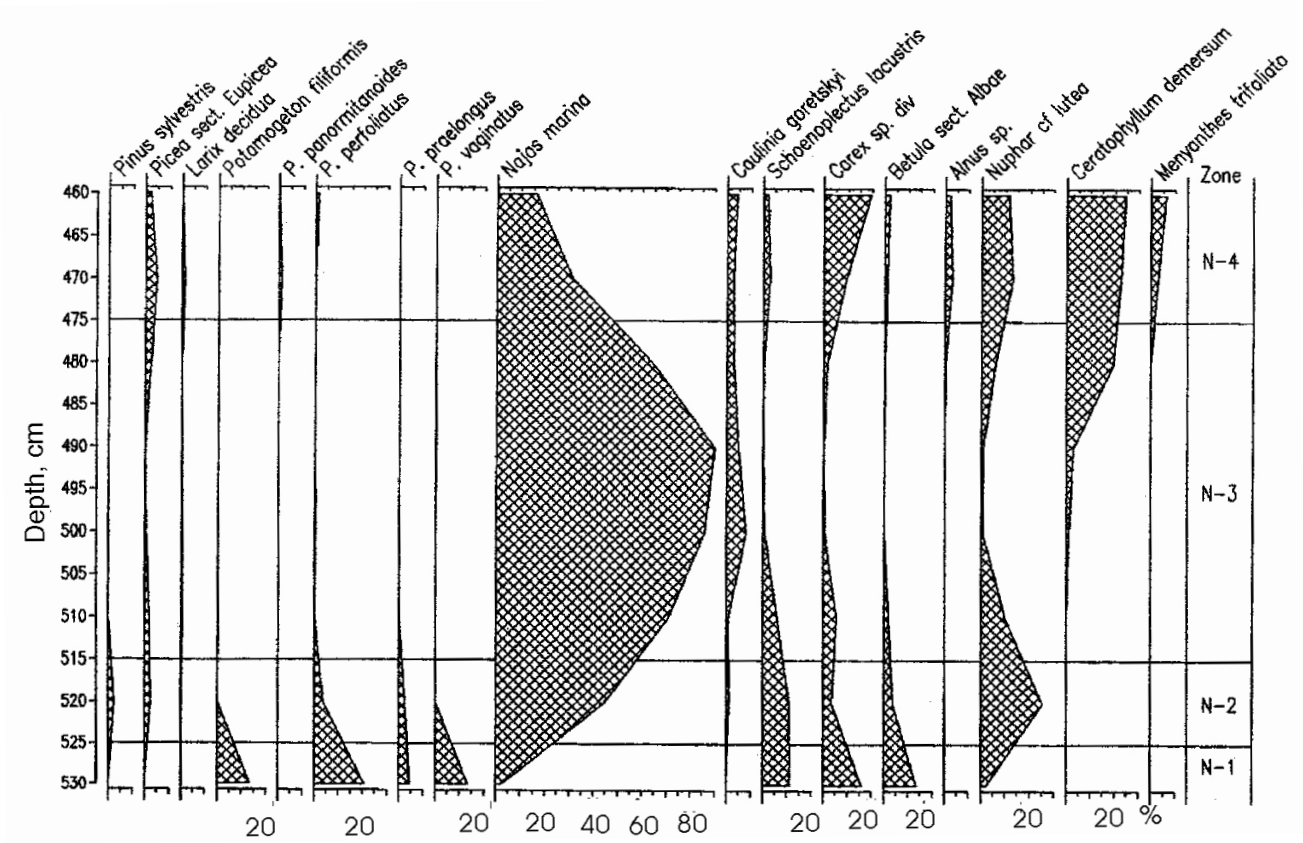

Fig. 8. Palaeocarpological diagram of the Neravai outcrop sediments
8 pav. Neravų atodangos nuogulų paleokarpologinė diagrama

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BUTĖNŲ TARPLEDYNMEČIO MALAKOFAUNA IR PALEOFLORA NERAVŲ ATODANGOS NUOGULOSE (PIETŲ LIETUVA)

Santrauka

Neravų pjūvyje aprašyta Butėnų (Lichvino, Holšteino, Mazovio, Aleksandrijos) tarpledynmečio stagnofilinė moliuskų fauna, kuri priklausė greičiausiai senvaginei facijai, neturėjusiai ryšio su upės vaga, tai yra egzistavusiai ežerinėmis sąlygomis. Tokio tipo malakofauna stratigrafiškai yra sunkiai interpretuojama. Įdomu tai, kad Neravų atodangos malakofaunos sudėtyje yra reta Sibiro imigrantinė rūšis *Valvata sibirica* Middendorf. Reikia manyti, kad ateityje ši forma gali turėti didelę reikšmę kvartero stratigrafijos klausimų gvildenimui.

Neravų atodangos medžių ir žolinių augalų paleokarpologiniai radiniai yra vieni turtingiausių iš Butėnų tarpledynmečio laikų Lietuvoje. Straipsnyje pabrėžiama šios floros svarbiausių atstovų (*Caulinia goretskyi, Azolla interglacialica*, *Carex paucifloroides*) stratigrafinė reikšmė. Ištirtose nuosėdose buvo surasta išmirusi rūšis *Potamogeton panormitanoides* Dorof., kuri anksčiau nebuvo nustatyta. Kitos šios genties rūšys, matyt, taip pat išnykusios, negausūs *P. pseudorutilus* Dorof. radiniai. Naujas nuoseklus floros tyrimas atskleidžia tarpledynmečio paleobaseino floros raidą.

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МАЛАКОФАУНА И СЕМЕННАЯ ФЛОРА БУТЕНСКОГО МЕЖЛЕДНИКОВЬЯ ПО ОТЛОЖЕНИЯМ ОБНАЖЕНИЯ НЯРАВАЙ, ЮЖНАЯ ЛИТВА

Резюме

Малакологическими исследованиями бутенских (лихвинских, гольштейнских, мазоветских, александрийских) межледниковых отложений в опорном разрезе Няравай описана стагнофильная фауна моллюсков, принадлежащая, скорее всего, древней старице, не имевшей связи с руслом реки, существовавшая в озерных условиях. Фауны подобного типа обычно являются трудно диагнос-цируемыми в стратиграфическом отношении. Однако присутствие в бутенской фауне редкого сибирского иммигранта *Valvata sibirica* Middendorf дает основание для сопоставлений и стратигра-фических корреляций рассматриваемой фауны с другими бутенскими фаунами Литвы и соседних регионов. Няравайская флора древесных пород и травянистых растений одна из богатейших бутенских флор Литвы. В статье обсуждаются важнейшие представители этой флоры (*Caulinia goretskyi, Azolla interglacialica*, *Carex paucifloroides*) и их значение для стратиграфической трактовки бутенским возрастом. При повторном изучении обнаружены вымерший *Potamogeton panor-*

mitanoides Dorof. и немногочисленные остатки другого вида этого рода, вероятно принадлежащие также к вымершему виду *P. pseudorutilus* Dorof. Послойное изучение флороносной толщи более детально воспроизводит динамику развития растительности ископаемого водоема.