Characteristic features of Muravian (Eemian) pollen succession from various regions of Belarus

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ABSTRACT. A comparative analysis of 9 pollen diagrams derived from 7 sections of the Muravian (= Eemian, Mikulinski) Interglacial deposits from several areas of Belarus were carried out. They were investigated by the author in various periods. Six diagrams from 4 sections are published for the first time. Distinct differences were revealed between sites from the Neman (the western Belarus) and Dnepr (the southeastern Belarus) drainage basins. These differences concern the Sozhski (= Wartanian, Moskovski) Late Glacial, the Muravian Interglacial and the Poozerski (Vistulian, Valdanski) Early Glacial phases of the vegetation development. Prevalence of Pinus along with decreasing Picea values are characteristic of the Sozhski Late Glacial pollen zone Sz of the section from the Neman basin. Larix is present continuously up to the mr5 zone. The Sozhski Late Glacial pollen zone from the southeastern part of Belarus in the section of the Dnepr basin is characterized by domination of Picea along with a high NAP percentage, while Larix appears for the first time only at the phase mr5. Significant amounts of Quercus appear in the sections of the Neman basin earlier than elsewhere. Comparatively high contents of Ulmus are peculiar for these sections. Pollen of Corylus and Carpinus appear first in the Dnepr drainage basin. The other differences in results reflect a gradual transition from the vegetation of the Neman basin to the vegetation of the Dnepr basin.

KEY WORDS: pollen and spores, pollen zones, pollen stratigraphy, Muravian (=Eemian, Mikulinski) Interglacial, Belarus

INTRODUCTION

During the last several years a number of sites of Muravian (=Eemian, Mikulinski) deposits have been investigated by the author using pollen analysis. They are presented in Fig. 1:

- western Belarus at the Neman drainage basin (outcrops Pyshki, Knyazhevodtsy and Bogatyrevichi 1 and 2);
- southeastern Belarus at the Dnepr drainage basin (outcrops Loyev 1 and 2);
- central Belarus within the Minsk Upland (outcrop Khmelevka);
- northwestern Belarus in the flood plain of the Vilija river near the Vladyki village (borehole 4);
- southern Belarus in the northwestern part of the Pripyat Trough near the Sheteno village (borehole 4860).

The Pyshky, Bogatyrevichi and Loyev sections have been studied since the beginning of the 20th century by many scientists (Szafer 1925, 1932, Trela 1935, Tsapenko & Makhnach 1959, Voznyuchuk 1961, Velichkevich 1982. Shalaboda studied the sites of the Neman drainage basin in the seventies (Valchik & Shalaboda 1977, Shalaboda & Yakubovskaya 1978). The Loyev section has been investigated twice: in 1974 using the samples provided by Makhnach (Loyev 1) and later on the basis of Litvinik's sampling Loyev 2). Six diagrams from 4 sections investigated by the author are published for the first time (Bogatyrevichi 1, Bogatyrevichi 2, Vladyki, Khmelevka, Loyev1, Loyev 2).

The studied deposits of the Neman and Dnepr drainage basins are represented by
oxbow and oxbow/lacustrine environment types (gyttja, peat, and interbedding of sand and sandy loams). Their thickness vary from 1.5 m (Bogatyrevichi 2) to 3.7 m (Pyshki). In northwestern and southern Belarus the cores went through lacustrine deposits (marl, diatomite) of 15.1 m thickness (Vladyki) and of 29.0 m thickness (Sheteno). Thin deposits (1.5 m) investigated in Khmelevka consist of peat which has been accumulated in a shallow lake. Thickness, absolute height of the section bases and pollen zones of the sites examined are given in the Table 1. Pollen diagrams (Figs 2–10) cover the Sozhski (=Wartanian, Moskovski).

Table 1. The investigated sites

<table>
<thead>
<tr>
<th>Section</th>
<th>Fig.</th>
<th>Absolute height of the base (m)</th>
<th>Thickness (m)</th>
<th>Pollen zones</th>
</tr>
</thead>
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<tr>
<td>Pyshki</td>
<td>2</td>
<td>100.3</td>
<td>3.7</td>
<td>mr1</td>
</tr>
<tr>
<td>Bogatyrevichi 1</td>
<td>3</td>
<td>104</td>
<td>1.7</td>
<td>mr2</td>
</tr>
<tr>
<td>Bogatyrevichi 2</td>
<td>4</td>
<td>104</td>
<td>1.5</td>
<td>mr3</td>
</tr>
<tr>
<td>Knyazhevodtsy</td>
<td>5</td>
<td>102</td>
<td>1.6</td>
<td>mr4</td>
</tr>
<tr>
<td>Vladyki</td>
<td>6</td>
<td>166.5</td>
<td>15.1</td>
<td>mr5</td>
</tr>
<tr>
<td>Khmelevka</td>
<td>7</td>
<td>218</td>
<td>1.5</td>
<td>mr6</td>
</tr>
<tr>
<td>Sheteno</td>
<td>8</td>
<td>93.5</td>
<td>29.0</td>
<td>mr7</td>
</tr>
<tr>
<td>Loyev 1</td>
<td>9</td>
<td>112</td>
<td>2.1</td>
<td>mr8</td>
</tr>
<tr>
<td>Loyev 2</td>
<td>10</td>
<td>110.3</td>
<td>3.3</td>
<td>pzs</td>
</tr>
</tbody>
</table>
Fig. 2: Pollen diagram of interglacial deposits from the Pyshki section (Lat/Lon: 53°40'00''N/23°45'00''E).
Fig. 3. Pollen diagram of interglacial deposits from the Bogatyrevichi 1 section (Lat/Lon: 53°30'45"N/24°11'00"E).

Valentin L. Shalabkha (1976)
Fig. 4. Pollen diagram of interglacial deposits from the Bogatyrevichi 2 section (Latitude: 53°30'45"N, Longitude: 24°11'10"E).
Fig. 5. Pollen diagram of interglacial deposits from the Knyazhevodsky section (Lat/Lon: 53°27'45"N/ 24°17'00"E)
Fig. 6. Pollen diagram of interglacial deposits from Vladyki (borehole 4) Lat/Lon. 54°27'00"N 27°27'00"E
Fig. 7. Pollen diagram of interglacial deposits from the Khmelevka section (Lat/Lon. 54°00'00"N/ 27°15'00"E)

Valentina L. Shalaboda (1984)
Fig. 8. Pollen diagram of interglacial deposits from Sheteno (borehole 4860). Lat/Lon: 52°47'00"N/ 27°12'00"E

Valentina L. Shalaboda (1987)
Fig. 9. Pollen diagram of interglacial deposits from the Loyev 1 section (Lat/Lon: 51°56'00"N/30°45'00"E).
Fig. 10. Pollen diagram of interglacial deposits from the Loyev 2 section. Lat/Lon: 51o56'10''N/ 30o45'00''E.
Late Glacial (pollen zone sz), the whole Muravian (=Eemian, Mikulinski) Interglacial (pollen zones mr1 - mr3) the beginning of the Poozersky (=Vistulian, Valdanski) Early Glacial (pollen zone pz2) and illustrate some regional peculiarities.

Spore-pollen analysis revealed the regional features of the vegetation communities forming. The percentages of all the AP and NAP taxa have been calculated of the total pollen sum AP+AP (AP = pollen sum of trees and shrubs; NAP = pollen sum of upland herbs). The percentages of the pteridophytes and aquatics have been calculated of the total pollen sum. Indication of the pollen zones has been fulfilled according to the scheme of Makhnach et al. (1981) with some corrections based on more recent investigations.

Below is given a short description of the resemblance and differences of the pollen zones beginning from the Sozhski Late Glacial.

DESCRIPTION OF THE POLLEN ZONES

SOZHSKI (=WARTANIAN, MOSKOVSKI) LATE GLACIAL

sz1 — Picea-NAP-Betula / Pinus-Picea-NAP-Betula

Loyev 2 (Fig. 10) and Pyshki (Fig. 2).

Domination of the conifer species and herbs is characteristic of this zone as a whole. Along with that a high percentage of the NAP among which Artemisia and Chenopodiaceae are especially notable. In the southeast of Belarus, Picea and Betula prevail and Alnus, Corylus and Carpinus occur as a slight admixture. In the west, Pinus is the dominant taxon, Picea and Betula are abundant and Larix is usual. Artemisia prevails among the NAP.

MURAVIAN (=EEMIAN, MIKULINSKI) INTERGLACIAL

mr1 — Betula

Loyev 2 (Fig. 10) and Pyshki (Fig. 2).

In general a dominance of Betula and conifer trees pollen is peculiar for this zone. In the southeast of Belarus Betula and Picea are dominants. Slight admixtures of Pinus, Alnus and Corylus, first appearance of the broad-leaved forests and abundant NAP (Artemisia, Chenopodiaceae and Poaceae) are observed. In the west a high percentage of Betula and Pinus along with the presence of Larix are recorded. In addition a significant amount of Polypodiaceae is fixed.

mr2 — Pinus

Loyev 2 (Fig. 10) and Pyshki (Fig. 2).

In general, a dominance of Pinus is peculiar for this zone. The southeastern region differs from the others by a still high value of the NAP and higher content of Pinus along with a significant composition of Picea and Betula. In the west, the portions of Pinus and Betula are approximately equal, Quercus appears in noticeable amounts, Larix and Picea are present continuously and the NAP is less abundant.

mr3 — Pinus-Betula-Quercus / Pinus-Betula-Carpinus

Loyev 2 (Fig. 10), Pyshki (Fig. 2), Knyazhevodtsy (Fig. 5) and Sheteno (Fig. 8).

In general, a domination of Pinus and Betula as well as a significant participation of the NAP at the background of the permanent Quercetum mixtum occurrence are characteristic of this zone. Among the peculiarities of the pollen spectra of the Loyev 2 section is an essential percentage of Carpinus and Corylus. In the Pyshky section (western Belarus), this zone is characterized by roughly equal amounts of Quercus and Betula as well as by significant percentages of Ulmus. In the Sheteno section (southern Belarus) increased values of Pinus are recorded.

mr4 — Quercus-Pinus-Corylus

Loyev 1 (Fig. 9), Loyev 2 (Fig. 10), Pyshki (Fig. 2), Knyazhevodtsy (Fig. 5), Sheteno (Fig. 8) and Vladyki (Fig. 6).

Maximum of Quercus along with an increasing percentages of Corylus and decreasing participation of Pinus is a common feature of this zone over the whole study area. In the Loyev 2 section worthy of note are close values of Quercus and Pinus and low values of Carpinus. In Sheteno, an increased Pinus content and significant amount of Alnus are fixed. The proportion of Corylus increases from the southeast to the west. In the Pyshki section, this zone is characterized by the maximum of Ulmus and by still occurring Larix and Picea.

mr5 — Corylus-Tilia-Alnus

Loyev 1 and 2 (Figs 9, 10), Pyshki (Fig. 2), Knyazhevodtsy (Fig. 5), Sheteno (Fig. 8), Vladyki (Fig. 6), Bogatyrevichi 1 and 2 (Figs 3, 4) and Khmelevka (Fig. 7).
This zone is distinguished in all of the studied sections. Arboreal species dominate while the herb plants are few. Synchronous maxima of Tilia and Alnus, preceded by the maximum of Corylus are characteristic of this zone. In most sections these events take place against a background of an increasing role of Carpinus with the exception of the Pyshky section, where Carpinus has relatively low values. In Pyshky, an occurrence of Quercus, an increasing portion of Polyopodiaceae and sporadic grains of Pinus, Betula, Larix are observed in this zone. In Bogatyrevichi 1 and 2 and Vladyki, increase of Polyopodiaceae values and sporadic grains of Pinus, Betula, Ulmus were recognized. In Sheteno this zone is thin, the maximum of Tilia is not distinct and synchronous to the decline of Pinus and growing role of Carpinus. In Khmelevka the pollen-abundant samples alternate with the pollen-deficient ones, although a certain regularity of the pollen zone sequence is observed. In Loyev 1 and 2 this zone is also not thick and a Tilia maximum is insignificant, being attended by decrease of Pinus and Quercus. Content of Alnus and Betula is poor. Carpinus has low values in Loyev 2 but in Loyev 1 its values exceed 40%. In Vladyki high values of Picea are present.

mr6 — Carpinus
Loyev 1 and 2 (Figs 9, 10), Knyazhevodtsy (Fig. 5), Sheteno (Fig. 8), Vladyki (Fig. 6), Bogatyrevichi 1 and 2 (Figs 3, 4) and Khmelevka (Fig. 7).

This zone is present in eight examined sections. Its common feature is the maximum of Carpinus, the presence of Picea and, increase of its percentage by the end of the zone. In Knyazhevodtsy rare grains of Abies are met and Betula, Ulmus, Quercus are present. In Bogatyrevichi 1 and 2 a significant amount of Pinus and sporadic grains of Larix and Abies are registered at the end of the zone. The percentages of Corylus and Tilia become lower. In Sheteno, Alnus, Corylus, Pinus and Quercus are continuously present, the role of Tilia falls and of Picea increases. In Vladyki, the values of Alnus, Corylus, Pinus, Betula, Quercus and Tilia, remain more or less stable while amounts of Picea fluctuate. Arboreal species dominate but Polyopodiaceae are also present. In Khmelevka, the portions of Corylus and Tilia fall, Alnus, Picea, Betula and Quercus remain at the former level, and the role of Pinus becomes more significant. Arboreal pollen dominates, although a small percentage of spores is fixed with Sphagnum and Polyopodiaceae prevailing among them. In Loyev 1 and 2, values of Alnus and Betula are permanent, Picea appears for the first time and then becomes more abundant in spectra while the portion of Corylus decreases. Arboreal pollen prevails. A low portion belongs to spores of which Sphagnum and Polyopodiaceae dominate.

mr7 — Pinus-Corylus-Carpylus / Pinus-Corylus-Quercus-Carpylus
Loyev 1 and 2 (Figs 9, 10), Sheteno (Fig. 8), Vladyki (Fig. 6) and Bogatyrevichy 1 and 2 (Figs 3, 4).

This zone is defined in six studied sections. It is characterized by the maximum of Pinus and by the second (small) peak of Carpinus. In Bogatyrevichy 1, Betula, Picea, Corylus and Alnus are present, Quercus, Tilia and Ulmus are rare, and the NAP values (Artemisia, Ericaceae, Poaceae) are abundant. Sphagnum and Polyopodiaceae prevail among spores. In Sheteno, Betula, Picea, Corylus and Alnus are present, sporadic grains of Quercus and Ulmus are recorded, and an appearance of the NAP (Poaceae) is observed. Sphagnum and Polyopodiaceae dominate among spores. In Vladyki, Corylus, Alnus, Quercus and Betula show a rather essential percentages, Picea is present, Tilia and Ulmus are rare, and an appearance of the NAP (Artemisia, Chenopodiaceae) is fixed. Sphagnum and Polyopodiaceae prevail among spores. In Loyev 1 and 2, Betula, Picea, Corylus and Alnus are present, sporadic grains of Quercus and Ulmus are met, and the NAP values (Artemisia, Ericaceae and Chenopodiaceae) are enough high. Sphagnum and Polyopodiaceae prevail among spores.

mr8 — Betula - NAP
Loyev 1 and 2 (Figs 9, 10).

This zone can be seen only in two sites. Its peculiar feature is a high content of Betula and the NAP accompanied by still preserved role of the broad-leaved species, and by the first appearance of Larix.

POOZERSKI (WISTULIAN, VALDANSKI)
EARLY GLACIAL

pz3 — NAP - Betula
Loyev 1 (Fig. 9).

This zone is distinguished in only one section, and high percentages of Betula in combi-
nation with NAP are characteristic of the zone. Pollen of the broad-leaved trees is rare.

CONCLUSIONS

All the studied deposits are referred to the Muravian time corresponding to the Eemian Interglacial. The revealed regional variations enable the elucidation of the stages of the vegetation development in Belarus.

The most distinct differences can be seen when the Pyshki and Loyev sections are compared. The Sozhski Late Glacial pollen zone sz has been stated in Loyev 2 and Pyshki sections. The Poozerski Early Glacial pollen zone pz has been stated in Loyev 1 section.

It was stated that the lakes of the Muravian (Eemian) age were the most numerous in Belarus during the phases mr5 (the maximum of Tilia) and mr6 (the maximum of Carpinus). Shallow lakes existed even within uplands in small depressions of relief (Khmelevka).

Worthy of note is a rather significant percentage of Picea (mr6 – mr7) in the western (Bogatyrevichi), northwestern (Vladyki) sections and its stable (although not high) values in the southern section (Sheteno), and very few amounts in the southeast sections (Loyev 1 and 2).

The pollen spectra of Sozhski Late Glacial (sz zone) are characteristic of Loyev and Pyshki sections. Within the zone sz in the Loyev 2 section, Picea achieves its maximum content, and in the Pyshki section Picea is also abundant. According to carpological data of Velichkevich (1982), the cones of Picea obovata prevail in the sediments of this horizon in Loyev 2 section. In the Pyshky section the cones of Picea sp. were found in the same horizon (Shalaboda & Yakubovskaya 1978).

The transition from the Sozhski Late Glacial to the Muravian Interglacial was gradual. In the Loyev 2 section, pollen of the arboreal species of the interglacial appears for the first time at the background of a rather high percentage of the NAP, Artemisia, Chenopodiaceae and Poaceae being the dominants among the latter. Rare grains of Quercetum mixtum appear first in the southeastern sections, although the noticeable percentage of this pollen is recorded in the older pollen zones in the diagrams derived from the western sections. A significant difference in the Tilia contents is observed between the studied sections. Its maximum amounts fall to the pollen spectra of the western sections. Amounts of Corylus decrease from the west to the southeast.

Any reconstruction and description of the forests of the period under consideration have been deliberately avoided. Nevertheless, the composition of the pollen spectra enables to distinguish the dominant taxa for each zone and to correlate the different sections.

It seems that an increased portion of hornbeam pollen at the background of high values of the pine pollen (mr7) should not be considered as the second optimum. Most probably there took place a cooling with a gradual shift of dominants in the pollen spectra. Pinus with Carpinus were the dominant taxa in the sections of the western (Bogatyrevichi), southern (Sheteno) and southeastern (Loyev) parts of the study region, and Pinus with Corylus and Quercus in those of more northern areas (Vladyki). It should be mentioned a resemblance of the pollen spectra of the Loyev, Sheteno, Vladyki sections and of the Polish section Szwajcaria (Borówko-Dluzakowa 1975). The second climatic optimum is not distinguished by the author in the Belarusian sites what is in agreement with Mamakowa’s opinion regarding this problem in Polish sites (Mamakowa 1989).

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