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Results of pollen analysis of the Poznań 1 profile (Kock vicinity, Eastern Poland)

The present study deals with the results of palaeobotanic research on lacustrine deposits recorded in a borehole at Poznań, near Kock. The results of pollen analysis allowed the author to describe an interglacial vegetational succession. The following six phases of vegetation have been distinguished: pine-birch forests, birch-pine forests, pine-spruce-alder forests, fir-hornbeam forests, pine-birch forests and forest-tundra. Vegetational changes allowed to infer about climatic changes and to determine the age of deposits studied have been the Mazovian Interglacial.

INTRODUCTION

The present paper is a report on palaeobotanic studies of the lacustrine deposits recorded in a borehole Poznań 1 (Adamów sheet[1]) and geologically elaborated by J.Rzechowski.

Laboratory processing of the samples consisted of treating with 10% HCl to remove $CaCO_3$. Then the samples were boiled in 5.5% KOH to dissolve humus. Mineral particles were separated from the organic matter by means of treatment with CdJ_2 and KJ water solution of 1.2 density. Next the organic matter was subjected to Erdtman's acetolysis. Frequency of pollen was different and in some cases it was not sufficient to carry out a complete pollen analysis. The state of preservation of pollen grains was good or very good. The pollen basic sum includes trees and shrubs (AP) as well as herbaceous plants (NAP). The percentages of aquatic flora pollen, spores,

[1] *Detailed Geological Map of Poland* in the scale 1:50 000.

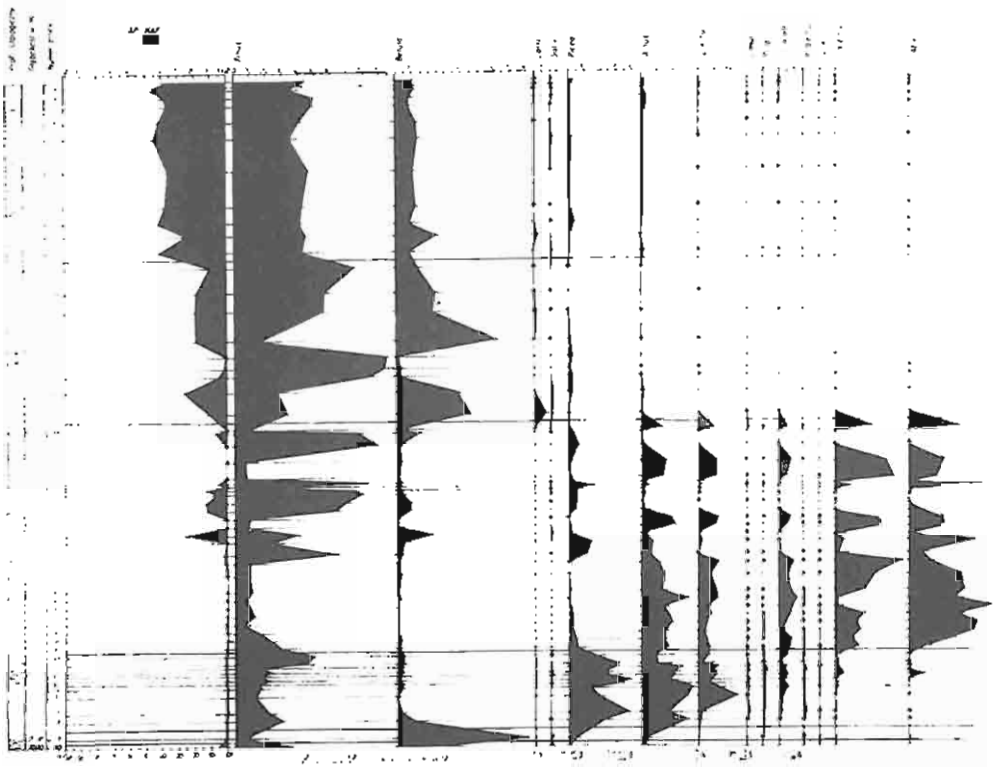

Fig. 1. Pollen diagram of the Mazovian Interglacial of the Poznań 1 profile (Kock vicinity)
1 – clays; 2 – silts; 3 – silty clays; 4 – sands; 5 – bituminous shales; 6 – gyttjas

plankton and sporomorphes older than Quaternary have been calculated in relation to the basic sum. The results of pollen analysis are presented in the form of a pollen diagram.

The admixture of non Quaternary specimens was found in many samples however a single one contains more than 2% of them.

RESULTS OF POLLEN ANALYSIS

The analysis of the pollen diagram of the Poznań 1 borehole (Fig. 1) permitted to distinguish six phases of the development of vegetation.

P h a s e I – light pine-birch forests with sea buckthorn (sample no. 60, depth 20.90 m).

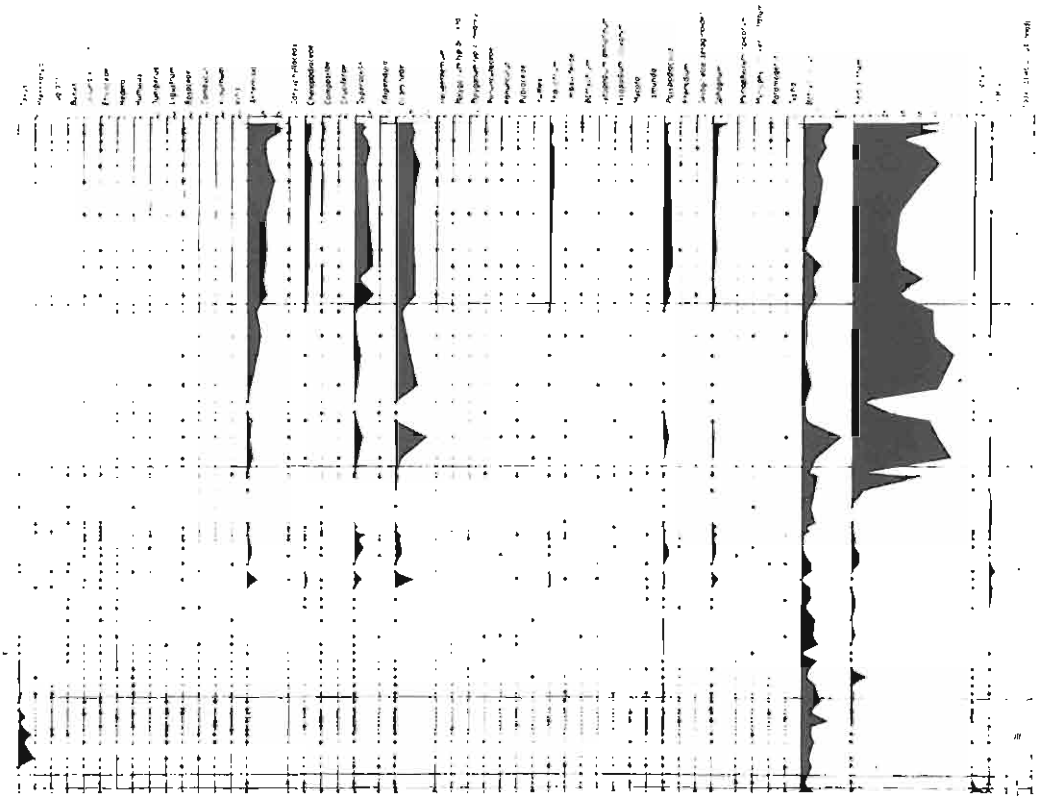

Diagram pyłkowy interglacjału mazowieckiego z profilu Poznań 1 koło Kocka
1 – iły; 2 – mułki; 3 – iły mułkowate; 4 – piaski; 5 – łupki bitumiczne; 6 – gytie

In this phase *Pinus* and *Betula* prevail (33.52 and 27.43% respectively). There is also a remarkably high proportion of *Hippophaë rhamnoides* pollen (up to 31%) which is a typical heliophilous shrub. Two other heliophilous taxa have been recorded i. e. *Ephedra* and *Helianthemum*. The percentage of NAP is 5.99% with predominance of *Gramineae* (2.82), *Cyperaceae* (1.36%) and *Artemisia* (0.73%). Light pine-birch forests are typical of this phase. Treeless territories were covered with various heliophilous plants — see buckthorn, *Ephedra*, rock-rose and herbaceous plants. Boreal climate prevailed in this phase.

P h a s e I I – dense birch-pine forests (sample no. 59, depth 20.81 m).

Birch pollen content amounts the highest value of the entire profile of this sample (80.40%). Accompanying trees are *Pinus* and *Picea*. NAP percentage is about 2%. Birch forests with admixture of pine, spruce and alder evidence still moderately cold

climatic conditions with tendency of warming up. It is confirmed by decline of heliophilous plants and decrease of frequency of NAP.

P h a s e I I I – pine spruce-alder forests (samples no. 48–58, depth 19.80–20.60 m).

Birch (*Betula*) becomes less significant as it does not reach 5% in pollen spectra. Pine (*Pinus*) and spruce (*Picea*) contents considerably grow up. The maximum of *Picea* (38.39%) has been recorded in sample no. 53 (depth 20.10 m). In the same phase alder (*Alnus*) reaches the maximum amount of 31.67% (sample no. 55, depth 20.20 m). There is a considerably occurrence of pollen of same deciduous trees (*Quercus*, *Tilia*, *Fraxinus*, *Ulmus*) and hazel (*Corylus*) among shrubs. Oak prevails among deciduous trees with the maximum of 24.77% in sample no. 56 (depth 20.30 m). Single pollen grains of *Juglans* and *Ligustrum* appeared in this phase well.

Yew (*Taxus*) presence is worthy of notice. Its maximum content (9.32%) has been recorded in sample no. 57 (depth 20.50 m). In the phase described dense pine-spruce--alder forests dominated. Oak content was considerably high and other deciduous trees (linden, ash and elm) were scarce. Wet areas were occupied by alder. Understorey was composed of yew (*Taxus*), hazel (*Corylus*), evonymus (*Evonymus*) and buckthorn (*Rhamnus*). At the end of the IIIrd phase spruce (*Picea*) pollen content decreased while hornbeam and fir proportions rose up what indicates the beginning of the IVth phase.

Phase III reflects temperate climate with mild winters and wet summers. It is confirmed by the appearance of yew which is recognized as an Atlantic floral representative.

P h a s e I V – fir-hornbeam forests (samples no. 22–47, depth 17.00–19.70 m).

The increased percentages of hornbeam (*Carpinus*) with maximum content of 40.2% in sample no. 38 (depth 18.65 m) and fir (*Abies*) with maximum content of 53.58% in sample no. 42 (depth 19.2 m) are characteristic of this phase. Oak (*Quercus*) content remained not higher than 13%, linden (*Tilia*) pollen as well as *Fraxinus* and *Ulmus* generally do not exceed 1%. However hazel (*Corylus*) is represented by continuous curve with maximum value of 12% in sample no. 41 (depth 19.10 m). Single pollen grains of *Pterocarya* and *Buxus* began to appear there. *Juglans* is still present.

In the IVth phase the vicinities of Poznań were covered with fir-hornbeam forests. Besides birch, hornbeam was the only taxon with prevailed on the conifers for the short period. Moreover these mixed forests were inhabited by deciduous trees like hazel, linden, ask and elm. Alder was still growing in wet places and the under storey vegetation was represented by hop (*Humulus*), ivy (*Hedera*), grape-vine (*Vitis*), *Viburnum*, elder (*Sambucus*), yew (*Taxus*) and uniquely founded *Ligistrum* and box (*Buxus*). At the beginning the climate was as warm as during the IIIrd phase then. Successively taxonomic composition of forests changed. Although fir and hornbeam continuousely prevailed but gradually deciduous trees withdrew to be replaced by

pine, spruce and birch. The above described vegetational changes evidences the cooling of the climate.

P h a s e V – pine-birch-forests with glade meadows (samples no. 13–21, depth 15-16.80 m).

Pine (*Pinus*) and birch (*Betula*) dominate in this phase. They were accompanied with unnumerous spruce (*Picea*), alder (*Alnus*), fir (*Abies*), hornbeam (*Carpinus*) and larch (*Larix*). Herbs were relatively abundant, pollen value NAP rise to 26%. Hence the forest were of open pine-birch type (park type) with broad meadows overgrew with herbaceous plants including *Artemisia*, *Gramineae* and *Cyperaceae*. Phase V is recognized a moderately cool period.

P h a s e V I – forest-tundra (samples no. 1–12, depth 12.70–14.80 m).

High percentage of NAP (over 48%) is typical of this phase. Main components of trees' assemblage was pine (*Pinus*) accompanied by birch (*Betula*). Single pollen grains of deciduous trees derived from far localities due to long transport. The occurrence of heliophilous plants' pollen is worthy of notice. They included *Ephedra*, sea-buckthorn (*Hippophaë rhamnoides*) and rock-rose (*Helianthemum*). The latter is represented by almost continuous curve. Among herbaceous plants mostly abundant were the following: *Artemisia* (max. 20.47% in sample no. 2, depth 12.47 m), *Gramineae* (max. 14.04% in sample no. 12). Moreover *Chenopodiaceae*, *Compositae* and *Thalictrum* range high content values. The occurrence of thrift (*Armeria*), representatives of the family *Saxifragaceae* and bird's nest moss (*Selaginella selaginoides*) was recorded, too.

In described phase probably the forest-tundra was covering the area. The major tree was pine, and the open area was covered with motherwort, cyperaceous, grasses and heliophilous plants like rock-rose, *Ephedra* and sea-buckthorn. The open treeless territories were inhabited by dwarf-birches and dwarf-willows, and in places by *Ericacea*. The climate was severe, and subpolar at the end of the period described.

THE AGE OF THE FLORA AT POZNAŃ

The analysis of the pollen diagram of Poznań profile indicates a complete interglacial vegetational succession. Careful consideration of particular diagram's sections allowed to follow vegetational changes and to distinguish six phases of the development of vegetation. However two first phases (I and II) are represented only by one sample. The present interpretation is based on changes of taxonomic composition of plant assemblages and variable percentages of particular taxa.

From among of this distinguished six phases of vegetation, first five of them belong to the interglacial period, and the last (VIth) one may be related to the glacial period because of dominating flora assemblage which imply climatic suggestions.

In the VIth phase (fir-hornbeam forests) some unexpected pollen spectra have been recorded. Percentages of hornbeam, fir, oak, elm and hazel decreased, and pine,

birch and spruce pollen became more abundant e.g. hornbeam and fir pollen frequencies were 25.80 and 20.55% respectively in sample no. 33 (depth 18.10 m) while in the following sample no. 32 (depth 18.00 m) their percentages radically decreased to 0.58 and 7.23% respectively. Consequently pine pollen content changed from 9.96 to 62.98% and birch percentage rose from 1.42 to 9.54%. As far as the reasons are considered climatic changes are not necessary responsible for this fact. Climatic changes generally result in gradual change of pollen percentages. In the case described an abrupt decrease of pollen content of the above taxa is followed by their instant rise in the upper horizons. This indicates some local reasons. However the lithology of deposits accumulated in the IVth phase is highly changeable. They are composed of intercalated gyttja and bituminous shales. Each lithologic type reveals an individual pollen spectrum. Intense slumping processes are supposed to cause lithologic alteration of deposits and changes of pollen spectra throughout the sample. Similar situation has been described by S.Tołpa (1961) at Sławno. Despite of the influence of deformational processes the author undoubtedly refers the investigated flora to the Mazovian Interglacial (according to W.Szafer, 1953). Interglacial of Poznań fulfils the condition of floristic subdivision defined by W.Szafer for the Mazovian Interglacial. It contains all four periods and a phase assigned to the glacial period.

Following the present interpretation, phase I and II of Poznań may be related to the Ist bottom forest period by W.Szafer which "bears the character of forest where birch (*Betula*) pollen prevails on pine (*Pinus*). There are also other but scarce pollen of spruce, hazel, oak, alder, hornbeam and fir". The present IIIrd phase relates to the IInd period by W.Szafer ("considerable decrease of *Pinus* and *Betula* pollen together with the prevailing content of spruce".)

The IVth phase can be correlated with the IIIrd period by W.Szafer, which "represents the thermal optimum of the interglacial and covers its most typical period. The most important pollen curves belong to *Abies* and *Carpinus*: the *Abies* curve is more or less distinctly two-peaked and the hornbeam curve reaches its maximum in between". Although in the diagram of Poznań, in its IVth phase, particular taxa reveal irregularities in their percentages, it is out of question that this phase is relevant to the IIIrd period by W.Szafer.

The present Vth phase is equal to the IVth (top) period by W.Szafer. It begins with an abrupt rise of pine (*Pinus*) pollen frequency and slightly smaller increase of birch (*Betula*). Spruce (*Picea*) pollen is not typical of this period (as it was in the IIIrd one).

Mazovian Interglacial recorded in the profile of Poznań resembles many other Mazovian floral successions known from many sites and very well documented. However the comparison of the Poznań profile with all Mazovian records remains beyond the limits of the present paper. Thus only the following three sites have been selected for the purpose of comparison: Biała Podlaska (K. M. Krupiński et al., 1988), Nowiny Żukowskie (J.Dyakowska, 1952) and Gościęcin (A.Środoń, 1957). In all

three cases the pollen diagram of Poznań is similar to others regarding the phases of the development of vegetation, shape of pollen curves and percentages. However yew (*Taxus*) pollen known from Poznań and Biała Podlaska is missing at Nowiny Żukowskie and Gościęcin. Moreover oak (*Quercus*) appears and culminates earlier at Poznań and Gościęcin while at Biała Podlaska and Nowiny Żukowskie it is a component of hornbeam-fir forests.

The pollen diagram of Poznań profile follows major Mazovian features very strictly as far as a permanent domination of conifers is considered. Among dedicuous trees only birch and hornbeam prevail. The latter prevails for a short time. Another important characteristic is an early appearance and considerable increase of spruce pollen content which culminates together with alder (*Alnus*) during the first half of the interglacial period.

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WYNIKI ANALIZY PYŁKOWEJ W PROFILU WIERCENIA POZNAŃ 1 K. KOCKA

Streszczenie

Artykuł jest wynikiem paleobotanicznego opracowania osadów jeziornych nawierconych w profilu Poznań 1 koło Kocka. Prace wiertnicze wykonano dla *Szczegółowej mapy geologicznej Polski* w skali 1 : 50 000. Wykorzystanie analizy pyłkowej jako metody badawczej pozwoliło na opisanie zmian florystycznych, a także na wnioskowanie o zmianach klimatu oraz umożliwiło określenie wieku badanych osadów. W wyniku

analizy pyłkowej zobrazowano interglacjalną sukcesję roślinną. Wyróżniono 6 faz rozwoju roślinności o zdecydowanie różnym charakterze.

Faza I – faza wodnych lasów sosnowo-brzozowych z rokitnikiem. Fazę tę charakteryzuje występowanie widnych lasów sosnowo-brzozowych z płatami roślinności bezleśnej, których głównymi składnikami były rośliny światłożądne (rokitnik, przęśl, posłonek) i zielne. W fazie tej panował klimat borealny.

Faza II – faza zwartych lasów brzozowo-sosnowych. Dla tej fazy charakterystyczne są zwarte lasy brzozowe z domieszką sosny, świerka i olchy.

Faza III – faza lasów sosnowo-świerkowo-olchowych. Lasy tej fazy są zwartymi lasami sosnowo-świerkowo-olchowymi z dużym udziałem dębu i niewielką domieszką innych drzew liściastych. Faza III jest odcinkiem profilu o klimacie umiarkowanym, o łagodnych zimach i wilgotnym lecie.

Faza IV – faza lasów jodłowo-grabowych. W fazie tej okolice Poznania porośnięte były przez lasy jodłowo-grabowe z domieszką ciepłolubnych drzew takich, jak: dąb, lipa, jesion i wiąz. Klimat tej fazy był początkowo ciepły i wilgotny, przy czym obserwowane zmiany roślinności mogą świadczyć o jego stopniowym ochładzaniu się.

Faza V – faza lasów sosnowo-brzozowych z płatami łąk śródleśnych. Były to luźne lasy sosnowo-brzozowe prawdopodobnie typu parkowego, z dużymi łąkami porośniętymi przez rośliny zielne. Faza V jest fazą klimatu umiarkowanie chłodnego.

Faza VI – faza lasotundry. Roślinnością panującą w tej fazie była prawdopodobnie lasotundra z sosną jako głównym drzewem, a tereny bezleśne porastały rośliny zielne i światłożądne: posłonek, przęśl, rokitnik. Klimat tej fazy był surowy, a pod koniec subarktyczny.

Opisane wyżej zmiany florystyczne charakteryzują sukcesję interglacjalną, która dobrze mieści się w ramach podziału florystycznego, ustalonego przez W.Szafera dla interglacjału mazowieckiego. Profil z wiercenia Poznań 1 obejmuje wszystkie cztery piętra wyróżnione przez tego autora oraz fazę należącą do zlodowacenia.