Acta Palaeobot. 43(1): 61–76, 2003

Revision of plant macrofossils from the Mazovian interglacial locality Nowiny Żukowskie (SE Poland)*

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Received 15 October 2002; accepted for publication 10 April 2003

ABSTRACT. The paper presents results of revision of plant macrofossil collection from Nowiny Żukowskie locality in Lublin Upland – SE Poland. The locality is referred to the Mazovian interglacial (= Holsteinian) and to the Middle Polish Glaciation (= Saalian). It was investigated by Dyakowska in 1952. The collection revised is housed at the Palaeobotanical Museum of the W. Szafer Institute of Botany, Polish Academy of Sciences in Kraków. It contains plant remains from two profiles (borehole and well). The revised macrofossil flora is presented and compared to the results of former identifications published by Dyakowska. Systematic position of more than half of taxa number is changed. Many new extant and some extint species have been distinguished. The most important remains newly determined are described and illustrated. A complete list of revised taxa is given.

KEY WORDS: macroscopic plant remains, revision, Mazovian interglacial, Poland.

INTRODUCTION

Fossil plant remains from Nowiny Żukowskie locality which represent the Mazovian interglacial vegetation have been investigated by Dyakowska (1952). This material has been studied by this author by the palynological and macroremains analyses, according to the tradition of the Polish palaeobotanical School of Professor W. Szafer. The macrofossil flora listed in Dyakowska's publication contains 43 taxa of trees, shrubs and herbaceous plants, including species *Abies fraseri* Poiret and *Picea omoricoides* Web. The fossil flora of Nowiny Żukowskie has been selected for revision because many determinations stated by Dyakowska needed corrections.

GEOLOGICAL SITUATION OF THE INTERGLACIAL DEPOSITS

A sequence of interglacial gyttja and peat was discovered by Rühle (1952) in the Nowiny Żukowskie village in the Lublin Upland (Fig. 1). In the eastern part of the village a well profile and five boreholes around the well were made. On the basis of those boreholes Rühle (1952) constructed two geological cross-sections. Below the interglacial organic deposits Rühle recognized two glacial horizons (the oldest one and Cracovien) separated by sands, clays and silts with traces of soil which he referred to the oldest interglacial. Gyttja and peat overlaying the second (Cracovien = Elsterian) glacial horizon, Rühle referred to the Masovien interglacial I (at present = Mazovian interglacial = Holsteinian) and varied clays overlying peat to the first phase of the Varsovien glaciation I (at present = Middle-Polish Glaciation = Saalian).

* The completation of this work was possible thanks to a scholarship grant received by Prof. Dr F.Yu. Velichkevich in 1998 from the Józef Mianowski Fund, a Foundation for the Promotion of Science

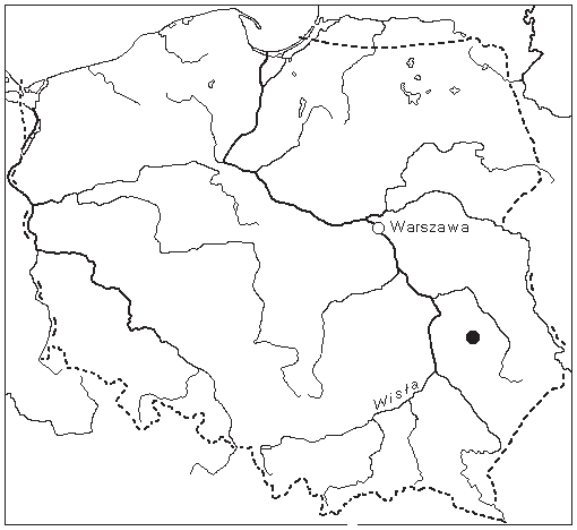

Fig. 1. Location of the Nowiny Żukowskie site

The stratigrafic position of organic deposits, as well as clays overlying them, was based by Rühle (1952) on the results of palaeobotanical studies made by Dyakowska (1952). She performed pollen and macrofossil analyses from borehole 4 (251.1 m a.s.l.) and the well except for wood fragments identified by Supniewska and mosses by Szafran both from borehole 4 (in Dyakowska 1952).

MATERIAL AND METHODS

The fruit and seed remains from Nowiny Żukowskie are housed at the Palaeobotanical Museum of the W. Szafer Institute of Botany, Polish Academy of Sciences in Kraków as a separate collection (KRAM-P, Q-115). They have been preserved in a mixture of glycerine, alkohol and thymol which made difficult an comparative-morphological study. For this reason in the latest years the method has been changed. All specimens were dried and then determined using the comparative-morphological study.

The results of revision from two profiles borehole 4 and well are presented in Tabs 1 and 2 that show taxa names after present revision and according to Dyakowska (1952). In the Dyakowska paper some taxa have different names in the description part and in the museum collection. Then we gave the name which was in the description part of Dyakowska paper.

Names of specimen determinated by Dyakowska (1952) which are changed after revision are in Tabs 1 and 2 underlined. Taxa not found in the museum collection are marked as missing. Number of specimens on the right was established by Dyakowska (1952) on the left after actual studies. A complete list of taxa after present revision is given in the Tab. 3.

Table. 1. List of macroscopic plant remains from Nowiny Żukowskie (borehole 4) (KRAM-P-Q-115). Abbreviations: e – endocarp, f – fruit, l – leaf, n – needle, sc – scale, st – sclerotium

After revision	Type of remains	Number of specimens	After Dyakowska 1952
Betula sect. *Albae* Rgl.	f	14/13	*Betula alba* L.
Betula sect. *Albae* Rgl.	f	5/1	*Carex* sp. div.
B. humilis Schrank	f	1/-	*Carex* sp. div.
Juniperus communis L.	s	1/1	*Cotoneaster* cf. *integerrima* Med.
Juniperus communis L.	s	1/1	*Lonicera* cf. *xylosteum* L.
Juniperus communis L.	s	2/2	*Sparganium* cf. *ramosum* Huds.
Larix sp.	s	24/34	*Larix* sp.
Larix sp.	n	8/8	*Larix* sp.
Larix sp.	s	1/-	*Carex* sp. div.
Larix sp.	s	2/2	*Ranunculus* cf. *lingua* L.
Larix sp.	s	4/4	*Ranunculus* sp.
Picea sect. *Eupicea* Willkm.	n	6/9	*Picea excelsa* Link
Picea sp.	s	1/-	*Nuphar luteum* (L.) Sm.
Pinus sp.	n	1/-	*Picea excelsa* Link
Rubus idaeus L.	f	1/1	*Rubus idaeus* L.
Aracites interglacialis Wieliczk.	s	1/-	*Cladium mariscus* (L.) R. Br.
Alchemillia sp.	f	1/-	*Viola* sp.
Andromeda polifolia L.	s	6/6	*Andromeda polifolia* L.
Arctostaphylos uva-ursi (L.) Spreng.	f	1/1	cf. *Actaea spicata* L.
Batrachium sp.	f	197/198	*Batrachium* sp.

Table 1. Continued

After revision	Type of remains	Number of specimens	After Dyakowska 1952
Brasenia sp.	s	3/2	*Brasenia purpurea* Mich.
Carex sp. (3-sided)	f	2/2	*Caltha palustris* L.
Carex sp. div. (3-sided)	f	49/68	*Carex* sp. div.
Carex sp. div. (2-sided)	f	12/-	*Carex* sp. div.
Carduus sp.	s	4/4	cf. *Carduus* sp.
Cenococcum graniformae (Snow.) Ferd. & Winge	st	694/8	*Cenococcum*
Hippuris vulgaris L.	f	1/1	*Hippuris vulgaris* L.
Menyanthes trifoliata L.	s	44/109	*Menyanthes trifoliata* L.
Menyanthes trifoliata L.	s	1/-	*Potamogeton* sp. div.
Myriophyllum verticillatum L.	f	1/1	*Myriophyllum alternifolium* DC.
Nuphar lutea (L.) Sibth. & Sm.	s	9/10	*Nuphar luteum* (L.) Sm
Nuphar pumila (Timm.) DC.	s	27/40	*Nuphar pumilum* (Timm.) DC.
Nymphaea cf. candida *C. Presl.*	s	1/-	*Nuphar pumilum* (Timm.) DC.
N. cinerea Wieliczk.	s	14/-	*Nuphar pumilum* (Timm.) DC.
N. cinerea Wieliczk.	s	16/14	*Nymphaea candida* Presl.
Potamogeton filiformis Pers.	e	2/-	*Potamogeton* sp. div.
P. granineus L.	e	2/-	*Potamogeton* sp. div.
P. natans L.	e	75/95	*Potamogeton* sp. div.
P. obtusifolius Mert. & Koch	e	2/-	*Potamogeton* sp. div.
P. praelongus Wulf.	e	1/-	*Potamogeton* sp. div.
P. pusillus L.	e	1/-	*Potamogeton* sp. div.
P. cf. *rutilus* Wolfg.	e	4/-	*Potamogeton* sp. div.
Potamogeton sp.	e	1/-	*Potamogeton* sp. div.
Sagittaria sagittifolia L.	s	3/3	*Sagittaria sagittifolia* L.
Sparganium hyperboreum Laest.	e	5/6	*Cladium mariscus* (L.) R. Br.
S. minimum Wallr.	e	2/-	*Carex* sp. div.
Viola cf. *palustris* L.	f	1/2	*Viola* sp.
not revised	l	+/+	*Dryas octopetala* L.
missing	n	-/4	*Picea omoricoides* Web.
missing	s	-/1	*Calla palustris* L.
indeterminable			*Epilobium* cf. *dodonaei* Vall.
Plant remains present in the collection, not included in the paper by Dyakowska (1952)			
Aracites interglacialis Wieliczk.	s	238	indeterminate "A"
Betula sect. *Albae* Rgl.	sc	2	*Betula alba* L.
Betula sect. *Albae* Rgl.	f	4	indeterminate
Cicuta virosa L.	f	1	indeterminate
Larix sp.	s	2	Coniferae
Larix sp.	s	1	*Picea* sp.
Larix sp.	s	4	*Picea/Pinus*
Larix sp.	s	4	*Pinus* sp.
Picea sp.	s	9	Coniferae
Picea sp.	s	2	*Picea* sp.
Picea sp.	n	4	*Picea* sp.
Picea sp.	n	12	indeterminate
Potamogeton alpinus Balb.	e	2	*Potamogeton* sp. div.
Potamogeton sp.	e	1	indeterminate

Table 2. List of macroscopic plant remains from Nowiny Żukowskie (well) (KRAM-P-Q-115). Abbreviations: ds. – dwarf shoot, e – endocarp, f – fruit, n – needle, s – seed, sc – scale, st – sclerotium, ws – wings of seed

After revision	Type of remains	Number of specimens	After Dyakowska 1952
Abies alba Mill.	n	7/11	*Abies fraseri* Poiret
Betula sect. *Albae* Rgl.	f	4/4	*Betula alba* L.
Betula sect. *Albae* Rgl.	f	1/-	*Betula nana* vel *humilis*
Betula sect. *Albae* Rgl.	f	1/-	*Carex* sp.
B. humilis Schrank	f	4/-	*Betula nana* vel. *humilis*
B. cf. *humilis* Schrank	f	1/-	*Betula nana* vel. *humilis*
B. cf. *humilis* Schrank	f	1/-	*Carex* sp. div.
B. cf. *nana* L.	f	4/-	*Betula nana* vel. *humilis*
Betula sp.	f	1/1	*Ranunculus* cf. *sceleratus* L.
Carpinus betulus L.	f	1/1	*Carpinus betulus* L.
Juniperus communis L.	s	1/1	*Cotoneaster* cf. *integerrimus* Medik.
Juniperus communis L.	s	2/2	*Lonicera* cf. *xylosteum* L.
Juniperus communis L.	s	2/2	*Najas marina* L.
Juniperus communis L.	s	1/1	*Sparganium* cf. *ramosum* L.
Larix sp.	ds	1/-	*Larix* sp.
Larix sp.	n	66/-	*Larix* sp.
Larix sp.	s	7/-	*Larix* sp.
Larix sp.	n	2/3	*Juniperus*
Larix sp.	s	2/2	*Ceratophyllum submersum* L.
Picea sect. *Eupicea* Willkm.	n	11/7	*Picea excelsa* Link
Picea sect. *Eupicea* Willkm.	n	1/-	*Pinus* sp.
Picea sect. *Omorica* Willkm.	n	2/-	*Picea excelsa* Link
Picea sect. *Omorica* Willkm.	n	49/41	*Picea omoricoides* Web.
Pinus sylvestris L.	n	2/+	*Pinus* sp.
Pinus sylvestris L.	n	2/-	*Picea excelsa* Link
Alchemilla sp.	f	1/-	*Viola* sp.
Arctostaphylos uva-ursi (L.) Spreng.	s	1/1	cf. *Actaea spicata* L.
Batrachium sp.	f	63/63	*Batrachium* sp.
Brasenia borysthenica var. *heterosperma* Wieliczk.	s	2/4	*Brasenia purpurea* Mich.
Brasenia sp.	s	2/-	*Brasenia purpurea* Mich.
Carex cf. *rostrata* Staokes	f	4/-	*Carex* sp. div.
Carex sp. div. (3-sided)	f	31/37	*Carex* sp. div.
Carex sp. div. (2-sided)	f	41/-	*Carex* sp. div.
Cenococcum graniformae (Sow.) Ferd. & Winge	st	3/12	*Cenococcum*
Comarum palustre L.	f	1/1	*Comarum palustre* L.
Hippuris vulgaris L.	f	"	*Hippuris vulgaris* L.
Menyanthes trifoliata L.	s	12/26	*Menyanthes trifoliata* L.
Menyanthes trifoliata L.	s	1/1	*Plantago* cf. *ramosa* (Gilib.) Aschers.
Nuphar pumila (Timm.) DC.	s	8/34	*Nuphar pumilum* (Timm.) DC.
Nymphaea candida C. Presl.	s	19/-	*Nuphar pumilum* (Timm.) DC.
N. cinerea Wieliczk.	s	6/-	*Nuphar pumilum* (Timm.) DC.
Nymphaea candida C. Presl.	s	4/6	*Nymphaea candida* Presl.
N. cf. *cinerea* Wieliczk.	s	2/-	*N. candida* Presl.
Potamogeton alpinus Balb.	e	1/24	*Potamogeton* sp. div.
P. friesii Rupr.	e	1/-	*Potamogeton* sp. div.
P. natans L.	e	14/-	*Potamogeton* sp. div.
P. cf. *natans* L.	e	3/-	*Potamogeton* sp. div.
P. obtusifolius Mert. & Koch	e	1/-	*Potamogeton* sp. div.
P. cf. *pusillus* L.	e	2/-	*Potamogeton* sp. div.
Potamogeton sp.	e	2/-	*Potamogeton* sp. div.
Scabiosa cf. *columbaria* L.	f	1/1	*Scabiosa* cf. *columbaria* L.
Sparganium hyperboreum Laest.	e	1/-	*Carex* sp. div.
S. hyperboreum Laest.	e	1/-	*Hippuris vulgaris* L.
S. minimum Wallr.	e	2/2	*Cladium mariscus* (L.) R. Br.
Thalictrum cf. *simplex* L.	f	2/2	*Thalictrum* cf. *simplex* L.
Viola cf. *palustris* L.	f	11/13	*Viola* sp.

Table 2. Continued

After revision	Type of remains	Number of specimens	Specimens in the collection
Plant remains present in the collection, not included in the paper by Dyakowska (1952)			
Andromeda polifolia L.	s	1	indeterminate
Aracites interglacialis Wieliczk.	s	57	indeterminate "A"
Betula sect. *Albae* Rgl.	f	1	*Betula alba* L.
Betula sect. *Albae* Rgl.	sc	2	*Betula alba* L.
Betula sect. *Albae* Rgl.	f	1	*Betula nana* vel. *humilis*
Betula sect. *Albae* Rgl.	f	1	indeterminate
Humulus lupulus L.	s	1	indeterminate
Larix sp.	s	1	indeterminate
Larix sp.	n	1	indeterminate
Larix sp.	ds	1	indeterminate
Picea sect. *Omorica* Willkm.	n	12	indeterminate
Picea sect. *Eupicea* Willkm.	n	7	indeterminate
Picea sp.	s	1	*Picea* sp.
Picea sp.	ws	3	*Picea* sp.
Picea sp.	s	2	*Coniferae*
Pinus sylvestris L.	s	2	*Coniferae*
Pinus sylvestris L.	n	1	indeterminate
Sparganium sp.	e	2	indeterminate
Viola sp.	f	1	indeterminate

Table 3. List of taxa from Nowiny Żukowskie after revision. Abbreviations: f – fruit, s – seed, e – endocarp, sc – scale, ws – wing of seed, n – needle, ds – dwarf shoot, l – leaf, st – sclerotia

Name of taxon	Type of remains	Number of specimens	
		borehole 4	well
Abies alba Mill.	n	–	7
Betula sect. *Albae* Rgl.	f/sc	23/2	9/2
B. humilis Schrank	f	1	4
B. cf. *humilis* Schrank	f	–	2
B. cf. *nana* L.	f	1	4
Betula sp. (fragm.)	f	–	1
Carpinus betulus L.	f	–	1
Juniperus communis L.	s	4	6
Larix sp.	n/s/ds	8/42/–	68/9/1
Picea sect. *Omorica* Willkm.	n	–	63
Picea sect. *Eupicea* Willkm.	n	6	19
Picea sp.	n/s/ws	16/12/–	-/3/3
Pinus sylvestris L.	s/n	-/–	2/5
Pinus sp.	n	1	–
Rubus idaeus L.	f	1	–
Alchemilla sp.	f	1	1
Andromeda polifolia L.	s	6	1
Aracites interglacialis Wieliczk.	s	239	57
Arctostaphylos uva-ursi (L.) Spreng.	s	1	1
Batrachium sp.	f	197	63
Brasenia borysthenica Wieliczk. var. *heterosperma* Wieliczk.	s	–	2
Brasenia sp.	s	3	2
Carduus sp.	s	4	–
Carex sp. div. (3-sided)	f	51	31
Carex sp. div. (2-sided)	f	12	41
C. cf. *rostrata* Stokes	f	–	4
Cicuta virosa L.	f	1	–
Comarum palustre L.	f	–	1

Table 3. Continued

Name of taxon	Type of remains	Number of specimens	
		borehole 4	well
Dryas octopetala L.	l	+	–
Hippuris vulgaris L.	f	1	1
Humulus lupulus L.	s	–	1
Menyanthes trifoliata L.	s	45	13
Myriophyllum verticillatum L.	f	1	–
Nuphar lutea (L.) Smith	s	9	–
Nuphar pumila (Timm.) DC.	s	27	8
Nymphaea candida Presl.	s	–	23
Nymphaea cf. *candida* Presl.	s	1	–
Nymphaea cinerea Wieliczk.	s	30	6
Nymphaea cf. *cinerea* Wieliczk.	s	–	2
Potamogeton alpinus Balb.	e	2	1
P. filiformis Pers.	e	2	–
P. friesii Rupr.	e	–	1
P. gramineus L.	e	2	–
P. natans L.	e	75	14
P. cf. *natans* L.	e	–	3
P. obtusifolius Mert.& Koch	e	2	1
P. praelongus Wulf.	e	1	–
P. pusillus L.	e	1	–
P. cf. *pusillus* L.	e	–	2
P. cf. *rutilus* Wolfg.	e	4	–
Potamogeton sp.	e	2	2
Sagittaria sagittifolia L.	s	3	–
Scabiosa cf. *columbaria* L.	f	–	1
Sparganium hyperboreum Laest.	e	5	2
Sparganium minimum Wallr.	e	2	2
Sparganium sp.	e	–	2
Thalictrum cf. *simplex* L.	f	–	2
Viola cf. *palustris* L.	f	1	11
Viola sp.	f	–	1
Cenococcum graniformae (Sow.) Ferd.& Winge	st	694	3

MOST IMPORTANT CHANGES IN DETERMINATIONS AND SYSTEMATIC NOTES

Gymnospermae

Cupressaceae

Juniperus communis L.

Fig. 2: 1–6

Lonicera cf. *xylosteum* L., Dyakowska (1952), p. 128, (borehole 4: sample 25; well: sample 28).
Sparganium cf. *ramosum* Huds., Dyakowska (1952), p. 124 (borehole 4: samples 31, 15; well: sample 26).
Cotoneaster cf. *integerrima* Med., Dyakowska (1952), p.127, (borehole 4: sample 25; well: sample 29).

Material. KRAM-P, Q-115/260 – 267 (8 seeds).

Description. Seeds 3.1 – 3.8 × 1.8 –2.5 mm, irregularly oval, broad to narrow obovate in outline, slightly deformed, flattened to convex on the dorsal side with large oval pits. Surface rough, dark grey-brown, mat.

Comparison. Three seeds (Fig. 2: 1–3) were determined by Dyakowska (1952) as *Lonicera* cf. *xylosteum* L., but stones of this species are totally different in structure. They are obliquely oval in outline, weakly biconvex or almost flat with surface distinctly celled, brown, glossy.

Three seeds (Fig. 2: 4,5) were determined by Dyakowska as *Sparganium* cf. *ramosum* Huds. However, endocarps of the collective species *Sparganium ramosum* Huds. (= *S. neglectum* Beeby and *S. microcarpum* (Neum.) Raunk.) are elongate and larger (4.0–4.5 mm long), with distinctly ribbed surface and transversely truncate apex.

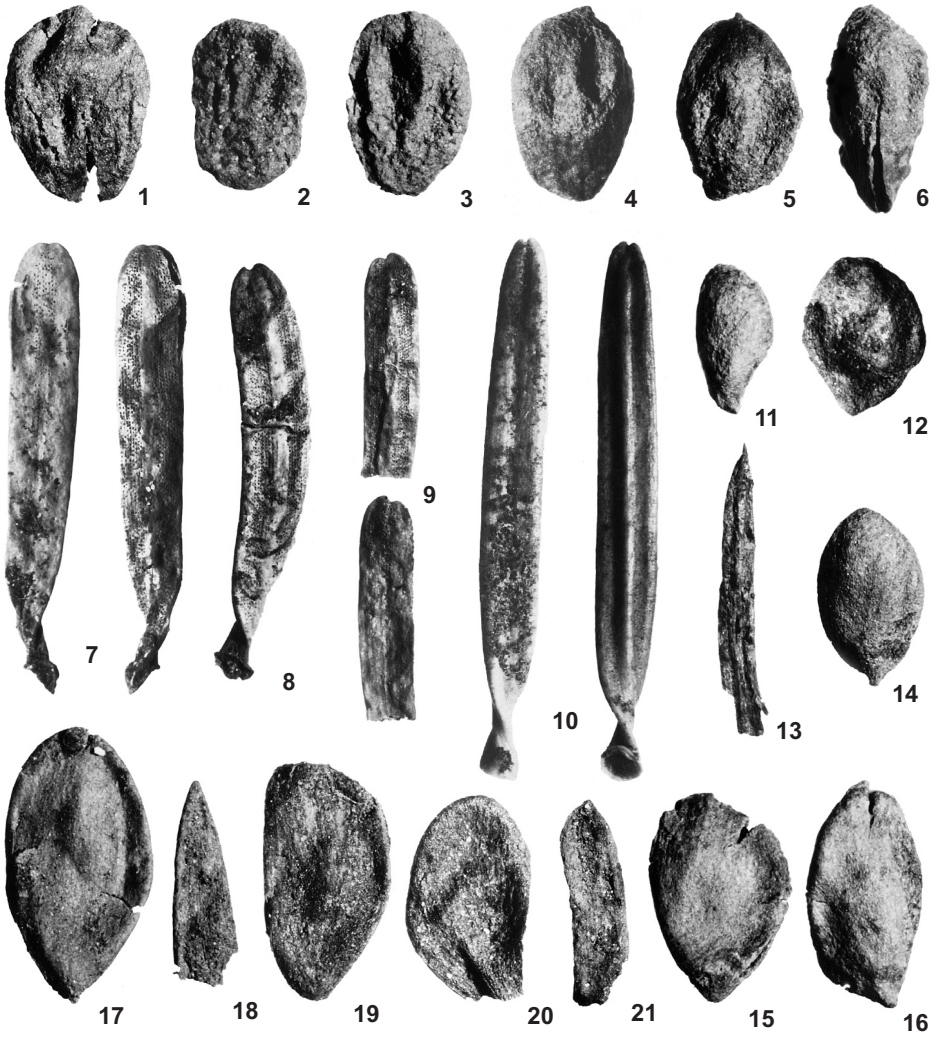

Fig. 2: **1–6** – *Juniperus communis* L., seeds × 10 (**1** – borehole 4 sample 25, KRAM-P Q-115/specimen 261; **2–3** – well profile sample 28, KRAM-P Q-115/265,266; **4** – borehole 4 sample 15, KRAM-P Q-115/260; **5** – well profile sample 26, KRAM-P Q-115/267; **6** – borehole 4 sample 25, KRAM-P Q-115/262); 7 **-10** – *Abies alba* Mill., needles × 8 (**7** – needle from both sides, well profile sample 34, KRAM-P Q-115/2; **8** – needle from down side, well profile sample 35, KRAM-P Q-115/1; **9** – needle from both sides, well profile sample 35, KRAM-P Q-115/1; **10** – needle from both sides, recent); **11–16** – *Larix* sp. × 10 (**11** – seed, borehole 4 sample 36, KRAM-P Q-115/287; **12** – seed, borehole 4 sample 20, KRAM-P Q-115/275; **13** – needle, well profile sample B, KRAM-P Q-115/304; **14** – seed, well profile sample 29, KRAM-P Q-115/290; **15** – seed, borehole 4 sample 28, KRAM-P Q-115/279; **16** – seed, borehole 4 sample 33 KRAM-P Q-115/285); **17–18** – *Pinus sylvestris* L. × 10 (**17** – seed, well profile sample 30, KRAM-P Q-115/391; **18** – needle, well profile sample 30, KRAM-P Q-115/396); **19–20** – *Picea* sp., seeds × 10 (**19** – well profile sample B, KRAM-P Q-115/383; **20** – borehole 4 sample 14, KRAM-P Q-115/381); **21** – *Picea* sect. *Picea*, needle, well profile sample 30, KRAM-P Q-115/373. Phot. A. Pachoński

Two seeds (Fig. 2:6) were determined by Dyakowska (1952) as stones of *Cotoneaster integerrimus* Medik. Stones of this species are quite similar in shape to seeds of *Juniperus communis* L., but somewhat larger (4.0 × 2.2 mm) with broad and regularly rounded apex and base cuneiformly narrowed. Dorsal side is convex, distinctly divided into three parts by horizontal and transverse grooves, T-shaped. Upper part of dorsal side (1/3 of stone length) is covered with thick epidermis, with surface smooth and lustrous, the rest of dorsal side devoid of epidermis.

Juniperus cf. ***communis*** L.

Najas marina L., Dyakowska (1952), p. 124 (well: samples 19 and 29).

M a t e r i a l. KRAM-P, Q-115/268, 269 (2 seeds).

R e m a r k s. Two fragments with specific sculpture for *Juniperus communis* L. (see above descriptions) were determined as *Najas*

marina L. Their surface is without cell sculpture specific for *Najas* subgen. *Najas*.

Pinaceae

Abies alba Mill.

Fig. 2: 7–9

Abies fraseri Poiret, Dyakowska (1952), pp. 118–122 (well: samples 30, 34, 35).

M a t e r i a l. KRAM-P, Q-115/1–3 (7 needles).

Description. Two complete needles 10.0 × 1.5 and 8.1 × 1.6 mm (Fig. 2: 7, 8) linear, slightly curved, flattened, with incised apices. Lower side with two longitudinal bands of stomata rows. Upper side smooth, indistinctly fine-celled, dark brown, slightly lustrous, with a few short rows of stomata at the apex. Another apical fragments of needles have also the same stomata rows on the upper side.

R e m a r k s. Dyakowska (1952) identified needles of *Abies* as *A. fraseri* Poiret comparing fossil needles with present-day needles of *Abies alba* Mill., *A. sibirica* Ledeb., *A. lasiocarpa* (Hook) Nutt, *A. bornmülleriana* Mattf., *A. balsamea* (L.) Mill. and *A. fraseri* Poiret. Number of stomata rows in bands on the lower side of needles, the presence of stomata on the upper side, location of resin ducts in parenchyma and arrangement of mechanical elements were taken into account.

On the basis of these studies Dyakowska stated that the permanent occurrence of stomata on the upper surface of needles and the presence of resin ducts in parenchyma of needles from Nowiny Żukowskie rule out their affiliation to *Abies alba* Mill. Presence of mechanical elements under the epidermis, close to the nerve and at the needle edges bring them closer to *A. fraseri* Poiret.

Earlier, on the basis of the stomata occurrence on the upper needle surface and the resin ducts presence in parenchyma, Kulczyński (1940, 1949) distinguished *Abies fraseri* Poiret in the Mazovian interglacial locality from Olszewice, changing determination of Lilpop (1930) who identified these needles as *A. alba* Mill.

Features, on the basis of which Kulczyński and Dyakowska identified *Abies fraseri* Poiret are not commonly accepted as those excluding *Abies alba* Mill. Jessen (Jessen et al. 1959) disagreed with them and despite the presence of these features in some needles from the interglacial locality Gort in Ireland, he determined them as *Abies alba* Mill. Jessen (1959) disapproved Rehder's concept (1947) that *Abies alba* needles have no stomata on the upper side and that they have only marginal resin ducts. He based on Fitschen's (1930) and Krüssmann's (1955) data and, first of all, on Professor Gram's information from the Botanical Department of the Royal Agricultural High-school, Copenhagen, "...that in the floral region of *A. alba* Mill. the leaves normally or at all events very often have internal resin ducts and a few short rows of stomata on the upper side at the top."

Yakubovskaya (1976) and Velichkevich (1979, 1982) were of similar opinion. They considered that despite the presence of stomata on the upper side of needles from localities of the Alexandrian interglacial (= Mazovian = Holsteinian) Prinemanskaya (Zhidovshchizna), Ruba, Gralevo, Matveyev Rov, Rudakov Rov and others these needles belong to *Abies alba* Mill. and that this feature is indicative for evolutional changes.

According to Kvacek's opinion (2002 letter comm.), who was asked to investigate one needle fragment of *Abies* from Nowiny Żukowskie collection, it is neither typical *A. fraseri* Poiret nor *A. alba* Mill.

The review of *Abies alba* Mill. needles in the contemporary reference collection at the Palaeobotanical Museum of the W. Szafer Institute of Botany, Polish Academy of Sciences in Kraków indicates many more needles with stomata on the upper side, at least few, than needles with no stomata. It is difficult to find essential difference between fossil needles from Nowiny Żukowskie and present-day needles of *Abies alba* Mill. considering morphological features (see Fig. 2: 10).

In the present revision above cited data determined us to accept needles from Nowiny Żukowskie as belonging rather to *Abies alba* Mill. and not to *Abies fraseri* Poiret.

Larix sp.

Fig. 2: 11–16

Seeds: *Ranunculus* cf. *lingua* L., Dyakowska (1952), p. 125 (borehole 4: samples 31, 20).
Ranunculus sp., Dyakowska (1952), p. 125 (borehole 4: samples 36, 34, 31).

Ceratophyllum submersum L., Dyakowska (1952), p. 127 (well: sample 29).
Picea sp., Dyakowska in coll. (borehole 4: sample 28).
Picea/Pinus, Dyakowska in coll. (borehole 4: sample 33).
Larix sp., Dyakowska (1952), p. 123 (borehole 4: samples 33, 32, 26, 11, 10; well: samples 19, 27, 31).
Carex sp. div., Dyakowska (1952), p. 124 (borehole 4: sample 24).
Coniferae, Dyakowska in coll., (borehole 4: samples 14, 9).
Pinus sp., Dyakowska in coll., (borehole 4: sample 22).
Indet. in coll., (well: sample 21).
Needles: *Juniperus* L., Dyakowska (1952), p. 123. (well: samples 27, B).
Larix sp., Dyakowska (1952), p. 123 (borehole 4: samples 34, 33, 24, 23; well: samples 26, 27, 28, 29, 30, B).
Indet. in coll., (well: sample B).

Material. KRAM-P, Q-115/270–294 (52 seeds). KRAM-P, Q-115/283, 288, 291, 295–404, 478 (74 needles).

Description. Seeds 2.7–4.1 × 1.3–2.5 mm, irregularly obovate in outline, plano-convex in cross-section, sometimes flattened or slightly deformed. Walls thick, firm. Surface indistinctly small-celled. Cells long, narrow, situated in longitudinal rows. Needles are linear, flat or almost romboidal in cross-section. Apex regularly rounded, base slightly narrowed and horizontally truncate. Stomata rows on the upper side of needle. Lower side with thin longitudinal striae.

Comparison. Seeds of *Larix* sp. (Fig. 2: 11, 12) in samples from borehole 4 identified by Dyakowska as *Ranunculus* sp. and *Ranunculus* cf. *lingua* L. after thorough examination show wall structure specific for *Larix* sp., but they are slightly flattened. Seeds of *Larix* sp. identified as *Ranunculus* cf. *lingua* L. have no features characteristic for this species. Nutlets of *R. lingua* L. have fibrous rim on their margins, surface obliquely striate and pointed beak of style or at least its monticule base.

Two seeds of *Larix* sp. from well profile determined by Dyakowska as *Ceratophyllum submersum* L. (Fig. 2: 14) are smaller and with walls thinner than at fruits of *Ceratophyllum submersum* L. Some their similarity to *C. submersum* L. occurs only when pointed base is accepted as upper part of fruits of *C. submersum* L. with spine trace. Probably this was a reason for the incorrect identification by Dyakowska.

Two seeds of *Larix* sp. from borehole 4 determined by Dyakowska as *Picea* sp. (Fig. 2: 15) and *Picea/Pinus* (Fig. 2:16) are not included into Dyakowska's (1952) publication. One seed is obovate in outline, second one elliptic. Their apexes are rounded, bases gradually narrowed and slightly extended. Walls thick, firm, surface fine-called, pale with rounded cells arranged longitudinally, on flat sides in straight and on convex sides in oblique rows, sometimes with no visible arrangement.

Two slightly atypical needles of *Larix* sp. with pointed apexes, from well profile, one from sample B (Fig. 2: 13) and second from sample 27 were identified by Dyakowska as *Juniperus* L. Such features as narrow general shape and very small thicknes of needles and almost rhomboidal cross-section refer them undoubtedly to *Larix* sp.

***Picea* sp.**

Fig. 2: 19, 20

Nuphar luteum L., Dyakowska (1952), p. 126 (borehole 4: sample 14).
Coniferae, Dyakowska in coll., (borehole 4: samples 15, 14; well: sample B).
Picea sp., Dyakowska in coll., (borehole 4: samples 13, 12; well: sample B).

Material. KRAM-P, Q-115/378–384 (15 seeds).

Description. Seeds 4.2 × 2.2 mm and 3.7 × 2.1 mm, obliquely obovate in outline, distinctly striate, walls fairly thin and fragile, surface rough, black, mat. The more accurate identification of the *Picea* seeds is impossible.

Comparison. Seeds of *Nuphar lutea* (L.) Sibth. & Sm. are larger (about 5–6 mm long), ovate in outline, round in cross-section, walls are rather thick, resilient, surface distinctly fine-celled, yellow-brown, lustrous.

***Picea* sect. *Eupicea* Willkm.**

Fig. 2: 21

Pinus sp., Dyakowska (1952), p. 123 (well: sample 26).
Picea excelsa Link, Dyakowska (1952), p. 122 (borehole 4: samples 18, 17, 14; well: samples 29, 34, 35, B).
Indet. in coll., (well: samples 30, 32, 35, B).

Material. KRAM-P, Q-115/367–377 (25 needles).

Description. Fragment of a needle 3.5 × 1.0 mm, bluntly pointed, quadrilateral, flattened. Bands of stomata on all four margins (Fig. 2: 21). These features are characteristic for all extant species of *Picea* sect. *Eupicea*.

Remarks. In both profiles Dyakowska determined 17 needles as *Picea excelsa* Link (= *P.*

abies (L.) Karst) which in the present paper are determined as *Picea* sect. *Eupicea* because morphology of needles of various *Picea* species from this section is very similar. Seven needles left by Dyakowska in the collection as indeterminate specimens have also morphology typical for species of *Picea* sect. *Eupicea*.

Pinus sylvestris L.

Fig. 2: 17, 18

Seeds: Coniferae, Dyakowska in coll., (well: samples 30, 32).
Needles: Indet. in coll., (well: sample 30).
Picea excelsa Link, Dyakowska (1952), p. 122 (well: samples 34, 35).
Pinus sp., Dyakowska (1952), p. 123 (well: samples 31, 34).

Material. KRAM-P, Q-115/390–396 (2 seeds, 5 needles).

Description. One seed in sample 30 from well 4.8 × 2.5 mm, obovate in outline, slightly biconvex (Fig. 2: 17). Apex slightly rounded, base gradually narrowed. Walls thin, resilient (broken). Surface fine-celled, pale brown, lustrous, covered all over with scarce resin ducts grouped into "stains". Second seed in sample 32 covered with many more resin ducts forming two distincts "stains".

A fragment of a needle in sample 30 from well, secondarily flattened, 3.5 mm long (Fig. 2: 18), with gradually pointed tip. It is indistinctly longitudinally striate, weakly convex on one side and shallowly grooved on other side. Stomata in single rows on both sides of a needle.

Remarks. The fragment of *Pinus sylvestris* L. needle described above was left in the collection as indeterminate specimen. A few fragments of *Pinus sylvestris* L. needles identified from *Picea excelsa* Link and *Pinus* sp. have the same morphological features as the above-mentioned fragment.

Angiospermae

Apiaceae

Cicuta virosa L.

Fig. 3: 1

Indet. in coll. (borehole 4: sample 35).

Material. KRAM-P, Q-115/229 (1 fruit).

Description. Fruit 1.9 × 1.2 mm with distinctly visible longitudinal ribs on dorsal side meeting together on ventral side are the features permitting to identify this specimen as *Cicuta virosa* L.

Remarks. This very flattened and deformed fruit was left in collection as indeterminate specimen.

? Araceae

Aracites interglacialis Wieliczk.

Indet. "A", Dyakowska in coll. (borehole 4: samples 27–22, 20–15; well: samples 26, 28–30, 32, 34, 35, B; borehole 1a).
Cladium mariscus (L.) R.Br., Dyakowska (1952), p. 124 (borehole 4: sample 23).

Material. KRAM-P, Q-115/10–120 (321 seeds).

Description. Seeds 1.3–2.1 × 0.8–1.6 mm, obovate to cordate, sometimes wide-elliptic or narrow-elliptic, oval or round in cross-section. Base tapering and pointed or rounded, sometimes drawn out into a short conic pedicle. Top unevenly truncate, with a broad funnel-shaped micropylar opening. Surface smooth, dark-brown to nearly black, lustrous. Walls thick, firm. Internal cavity irregularly roundish or

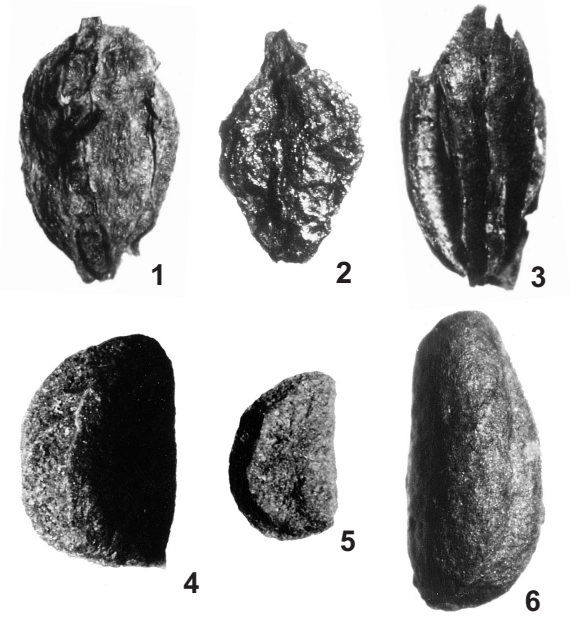

Fig. 3: **1** – *Cicuta virosa* L., fruit × 20, borehole 4 sample 35, KRAM-P Q-115/229; **2** – *Betula humilis* Schrank, fruit × 20, borehole 4 sample 23, KRAM-P Q-115/149; **3** – *Carex* sp. 3-sided, fruit × 20, borehole 4 sample 29, KRAM-P Q-115/207; **4–5** – *Arctostaphylos uva-ursi* (L.) Spreng., fruits × 10 (**4** – recent; **5** – well profile sample 30, KRAM-P Q-115/122); **6** - *Myriophyllum verticillatum* L., fruit × 20, borehole 4 sample 34, KRAM-P Q-115/326. Phot. A. Pachoński

pear shaped. Pictures of *Aracites interglacialis* Wieliczk. seeds from Nowiny Żukowskie are given in the paper Mamakowa and Velichkevich (1993b; Plates 2, 5, 6, 7).

Remarks. The very abundant plant remains left in the collection as "indeteminate A" belong to extinct species *Aracites interglacialis* Wieliczk. One specimen in sample 23 from borehole 4 was identified by Dyakowska as *Cladium mariscus* (L.) R.Br.

The history of *Aracites interglacialis* Wieliczk. in central-eastern Europe was described in a separate paper (Mamakowa & Velichkevich 1993b). During the present revision of the whole collection from Nowiny Żukowskie samples earlier considered as lost were found and a general number of *Aracites interglacialis* Wieliczk. seeds in all profiles (including profile from borehole 1a) increased to 321 in comparison with a number 259 given earlier. Numbers of seeds in samples from well profile and borehole 4 are presented in Tabs 1, 2. From borehole 1a were identified 25 seeds.

Betulaceae

Betula humilis Schrank

Fig. 3: 2

Carex sp., Dyakowska (1952), p. 124 (borehole 4: sample 23).
Betula nana vel *humilis*, Dyakowska (1952), p. 125 (well: sample 31).

Material. KRAM-P, Q-115/149–150 (5 fruits).

Description. Fruit 1.7 × 1.1 mm, elliptically-rhomboid in outline with relatively broad base. Walls firm, rugose, distinctly thin-striate. Surface black, oily and shiny (Fig. 3: 2).

Remarks. *Betula humilis* Schrank fruit described above was found amids fruits of *Carex* sp. div. The other fruits of *B. humilis* Schrank are identified from *B. nana* vel *humilis* from which also two fruits were identified as *B.* cf. *humilis* Schrank in well profile.

Cabombaceae

Brasenia borysthenica Wieliczk. var. ***heterosperma*** Wieliczk.

Fig. 4: 1

Brasenia purpurea Mich., Dyakowska (1952), p. 126 (well: samples 34, 35).

Material. KRAM-P, Q-115/177–178 (2 seeds)

Description. Two seeds 2.3 × 1.7 mm (Fig. 4: 1) and 2.2 × 1.9 mm oval in shape, round in cross-section. Top slightly narrowed and irregularly truncate, base broadly rounded. Conic opercle with microphyle and chalasa preserved on one seed. Testa thick, hard. Surface smooth slightly lustrous. without tubercles.

Remarks. Both seeds from Nowiny Żukowskie are exactly of the same shape and surface type as seeds of smaller morphotype of this variety of which holotype occurs in flora of Verkhove-1 in Belarus (Velichkevich 1982, pp. 184, 187–188, Pl. 22 fig. 7). Detailed description and photographs of this polymorphic variety from Verkhove-1 as well as from the Mazovian interglacial in Olszewice are given in a paper by Mamakowa & Velichkevich (1993a, pp. 309–310, Pl. 4 figs 1–8). However, seeds from Nowiny Żukowskie, described at the moment, are not included into this paper because they were found just now during a current revision of a whole collection. Two seeds from well profile and three from profile of borehole 4 are determined as *Brasenia* sp. because of their deformation (compressed and broken).

Cyperaceae

***Carex* sp.** (3-sided)

Fig. 3: 3

Caltha palustris L., Dyakowska (1952), p. 125 (borehole 4: sample 29).
Carex sp. div., Dyakowska (1952), p. 124 (borehole 4: samples 47, 45, 43, 36–33, 30–28, 26–21, 11, 10, 7; well: samples 16–18, 23, 26, 28–31, 35, B).

Fig. 4: **1** – *Brasenia borysthenica* Wieliczk. var. *heterosperma* Wieliczk., seed × 20, well profile sample 34, KRAM-P Q-115/178; **2** – *Menyanthes trifoliata* L., fragment of seed from inner side × 20, well profile sample 19, KRAM-P Q-115/324; **3** – *Alchemilla* sp., fruit × 20, well profile sample 14, KRAM-P Q-115/5. Phot. A. Pachoński

Material. KRAM-P, Q-115/197–227 (81 nutlets)

Description. One crushed, broken nutlet 2.0 × 1.1 mm in size irregularly elliptic in shape, triangular in cross-section. Despite deformation there are visible three margins running along a nutlet, and also their ends at apex and base. Surface is unclearly fine-celled, dark brown, slightly lustrous.

Comparison. The above described fruit of *Carex* sp. (3-sided) was determined as *Caltha palustris* L. Its comparison with present-day seeds of *C. palustris* L. makes it possible to state that cells of *C. palustris* L. seeds are larger, elongate, with convex central parts, while surface cells of a fossil fruit are much smaller, rounded, with collapsed central parts. All the features make it possible to change the identification of the specimen from *C. palustris* L. into *Carex* sp. (3-sided).

Ericaceae

Arctostaphylos uva-ursi (L.) Spreng.

Fig. 3: 4, 5

cf. *Actea spicata* L., Dyakowska (1952), p. 125 (borehole 4: sample 23; well: sample 30).

Material. KRAM-P, Q-115/121–122 (2 stones)

Description. One stone from well 2.5 × 1.6 mm (Fig. 3: 5) and the second one 3.3 × 1.8 mm from boring 4 are semicircular in outline, narrowly triangular in cross-section. Dorsal side is passing to side walls without acute margins. Ventral margin is straight, gradually pointed. Surface rough with inconspicuous wrinkles, gray-brown, mat.

Remarks. The above described stones previously determined as cf. *Actea spicata* L. have no features characteristic for this species. Lack of acute margins passing from dorsal side to side walls and missing cell sculpture of surface – very characteristic for fruits of *A. spicata* L. Dyakowska acknowledged as a result of abrasion of fossil fruits during fossilization. However, she disregarded completely different shape of ventral margin which is flattened and grooved in *A. spicata* L. Lack of this feature in fossil specimens prejudges their affiliation to *Arctostaphylos uva-ursi* (L.) Spreng. Contemporary stones of *Arctostaphylos uva-ursi* (L.) Spreng. (Fig. 3: 4) are somewhat larger (3.3 × 2.25 mm) and thicker but their general shape and morphological features do not differ from those of fossil stones. Fossil stones of this species from the Pleistocene of Belarus (Velichkevich 1973) have similarly small stones (1.9–3.5 × 1.2–1.9 mm) as these from Nowiny Żukowskie.

Haloragaceae

Myriophyllum verticillatum L.

Fig. 3: 6

Myriophyllum alternifolium DC., Dyakowska (1952), p. 128 (borehole 4: sample 34).

Material. KRAM-P, Q-115/326 (1 fruit).

Description. Fruit elongate, 2.1 × 0.9 mm, and has dorsal side with longitudinal axis slightly curved, ventral margin straight, obtuse. Surface smooth, lacking tubercles.

Remarks. Fruits of *M. alterniflorum* DC., to which Dyakowska referred the above specimen, are smaller, with rounded base, thinner walls and broad opening at apex.

Menyanthaceae

Menyanthes trifoliata L.

Fig. 4: 2

Plantago cf. *ramosa* (Gilib.) Aschers., Dyakowska (1952), p. 129 (well: sample 19).
Menyanthes trifoliata L., Dyakowska (1952), p. 128 (borehole 4: samples 39, 38, 36, 32, 31, 28, 26, 25, 24, 22, 21; well: samples 18, 21, 26, 27, 29, 30, 31).
Potamogeton sp. div., Dyakowska (1952), p. 124 (borehole 4: sample 39).

Material. KRAM-P, Q-115/306–325 (58 seeds).

Description. Fragment of seed 1.4 × 0.7 mm, convex-concave, irregularly elliptic in outline. Walls thick, firm. Surface from both sides rough, dark brown, mat.

Comparison. This tiny fragment of seed has no sculpture on convex side similarly as seeds of *Menyanthes trifoliata* L. devoid of epidermis. Walls have distinct spongy structure (at large magnification) which is similar to the structure of walls of *M. trifoliata* L. seeds in cross-section. It is important that even the smallest seeds of *Plantago ramosa* (Gilib.) Aschers. (= *Plantago arenaria* Waldst. & Kit.) are larger (2.7 × 1.3 mm) than specimen identified by Dyakowska as *Plantago* cf. *ramosa* (Gilib.) Aschers.

Remarks. According to data by Dyakowska a number of *Menyanthes trifoliata* L. seeds in Nowiny Żukowskie was 135. At the moment 56 specimens are left in the collection. Jentys-Szaferowa and Truchanowiczówna (1953) took 100 seeds to biometrical studies. Unfortunately, most of the seeds were lost and never returned to the Palaeobotanical Museum collection. In the well profile in sample 19, from which above described seed fragment of *Menyanthes trifoliata* L. derived, 11 specimens occurred and they were forwarded to biometrical studies.

Seeds from Nowiny Żukowskie subjected to biometrical studies were identified as *Menyanthes trifoliata* L. var. *interglacialis* n.var. (Jentys-Szaferowa & Truchanowiczówna 1953, pp. 45, 50, 54, 58, Pl. 5 figs 8a,b).

Nymphaeaceae

Nymphaea cinerea Wieliczk.

Nuphar pumilum (Timm.) DC., Dyakowska (1952), p. 126 (borehole 4: samples 35–33, 23, 14; well: samples 27, 30).
Nymphaea candida Presl., Dyakowska (1952), p. 126 (borehole 4: samples 36, 35, 33–31).

Material. KRAM-P, Q-115/344–355, 357 (36 seeds).

Description. Seeds 2.2–2.7 × 1.5–2.1 mm, oval to broad-ovate in outline, usually deformed, with soft, lightly wrinkled testa. Surface distinctly small celled, brown, slightly lustrous. Cells of surface rectangular, drawn out across the seed, situated in longitudinal rows. Central parts of cells are concave. Cells of testa in cross-section also rectangular and weakly thickened over the whole outline.

Remarks. The seeds of this extinct species from Nowiny Żukowskie were described first time by Mamakowa and Velichkevich (1993a). Then a few seeds identified by Dyakowska (1952) as *Nuphar pumilum* (Timm.) DC. from well profile were given. Now, after a complete taxonomic revision of the whole collection 36 seeds of *Nymphaea cinerea* Wieliczk. and two *N.* cf. *cinerea* Wieliczk. were identified inclusively from both profiles. Some seeds were identified by Dyakowska as *Nuphar pumilum* (Timm.) DC., and some of them as *Nymphaea candida* Presl. Changes in identifications of particular samples are shown in Tabs 1, 2.

The most charakteristic feature of *Nymphaea cinerea* Wieliczk. seeds is not so much their broadly ovate general shape in comparison with narrower and adequately longer seeds of *N. alba* L. and *N. candida* Presl., as completely different surface sculpture. Distinct at large magnification and particularly in SEM, central parts of cells in *N. cinerea* Wieliczk. are always concave in comparison with contemporary species of this genus of which central parts of surface cells are convex (see Mamakowa & Velichkevich 1993b, Pl. 3 figs 2–4 – *N. cinerea* Wieliczk. and 5–6 – *N. alba* L.).

Potamogetonaceae

Potamogeton sp. div., Dyakowska (1952), p. 124 (borehole 4: samples 49, 48, 46, 37–32, 27–22, 18, 15–13, 11, 10, 8, 7; well: samples 16–19, 23, 28–30).
Indet. in coll. (borehole 4: sample 21).

Material. KRAM-P, Q-115/398–443 (115 endocarps).

Remarks. Endocarps of *Potamogeton* were identified by Dyakowska only as *Potamogeton* sp. div. In 1974 Aalto, during her stay at the Institute of Botany PAS in Kraków, identified those endocarps. Her unpublished results are noted down in the collection. The change of the identification of six endocarps and the identification of several next endocarps, left by Aalto as *Potamogeton* sp. or “not revised”, are a result of the present revision. A current list includes 9 species among which *Potamogeton natans* L. prevailes. Other species i.e. *P. alpinus* Balb., *P. filiformis* Pers., *P. friesii* Rupr., *P. gramineus* L., *P. obtusifolius* Mert. & Koch, *P. praelongus* Wulf., *P. pusillus* L., and *P. rutilus* Wolfg. are represented by single specimens (1–3). Morphological descriptions of these species are given in papers Velichkevich and Lesiak (1996) and Velichkevich & Mamakowa (1999).

Rosaceae

***Alchemilla* sp.**

Fig. 4: 3

Viola sp., Dyakowska (1952), p. 127 (borehole 4: sample 23; well: sample 14).

Material. KRAM-P, Q-115/4–5 (2 fruits).

Description. Two fruits 1.6 × 1.1 mm (Fig. 4: 3) and 1.6 × 1.0 mm, asymetrically ovate in outline, apex pointed, base is broadly rounded

with a small place of attachment. Walls thick, surface fine-celled, with cells arranged in indistinct striae. Fragments of mesocarp tissue are left on the fruit surface.

Comparison. Fruits of *Alchemilla* are, in fact, somewhat similar to fruits of *Viola* but *Viola* have much thinner walls, distinct small celled sculpture of surface, more obtuse apex and broader place of attachment.

Sparganiaceae

Sparganium hyperboreum Laest.

Fig. 5: 1–3

Carex sp., Dyakowska (1952), p. 124 (well: sample 30).
Cladium mariscus (L.) R.Br., Dyakowska (1952), p. 124 (borehole 4: samples 27, 24, 22).
Hippuris vulgaris L., Dyakowska (1952), p. 128 (well: sample 26).

Material. KRAM-P, Q-115/448–452 (7 endocarps).

Description. Endocarps 1.9 × 1.1 mm, 1.7 × 1.3 and 2.0 × 1.3 mm, elliptic in outline and round in cross-section, with apexes slightly narrowed and unevenly truncate. Two of them have bases pointed, one rounded. Walls are bent towards opening at apex. Surface rough, indistinctly striate, grey-brown, mat.

Comparison. Endocarps *Sparganium hyperboreum* Laest. were determined by Dyakowska as *Carex* sp. (Fig. 5: 1), *Cladium mariscus* (L.) R.Br. (Fig. 5: 3) and *Hippuris vulgaris* L. (Fig. 5: 2). Fruits of these taxa are, in fact, somewhat resamble to endocarps described above, but they differ considerably in details of shape, wall thickness, sculpture of surface and other basic diagnostic features.

Remarks. Velichkevich and Mamakowa (1999) first time determined endocarp of *Sparganium hyperboreum* Laest., the very interresting arctic-boreal circumpolar species, in the Vistulian flora from Zator (Koperowa & Środoń 1965).

Sparganium minimum Wallr.

Fig. 5: 4–6

Carex sp., Dyakowska (1952), p. 124 (borehole 4: samples 35, 24).
Cladium mariscus (L.) R.Br., Dyakowska (1952), p. 124 (well: sample 30).

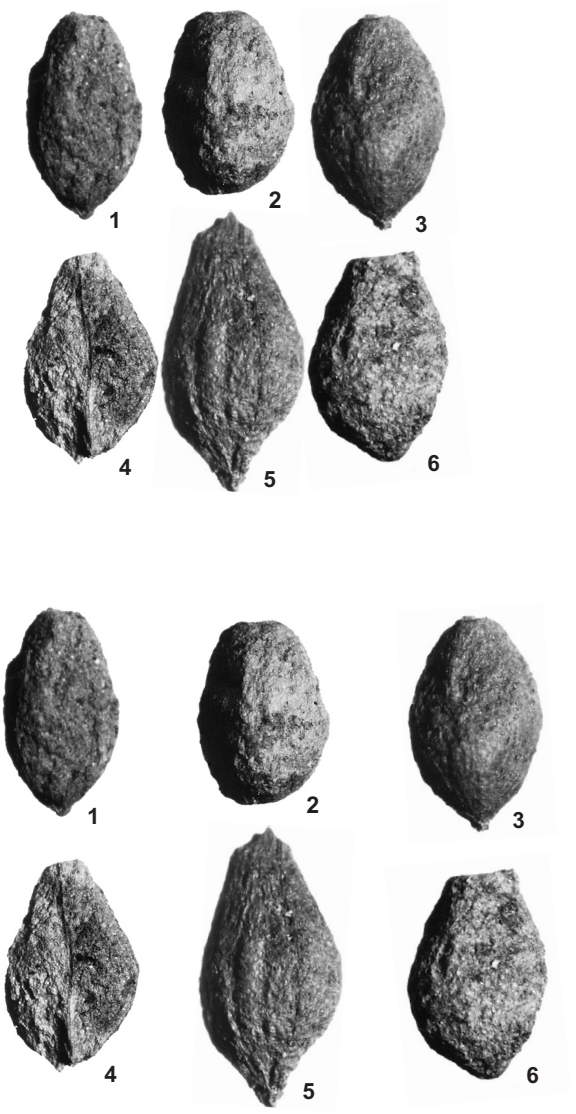

Fig. 5: **1–3** – *Sparganium hyperboreum* Laest., seeds × 20 (**1** – well profile sample 30, KRAM-P Q-115/451; **2** – well profile sample 26, KRAM-P Q-115/452; **3** – borehole 4 sample 24, KRAM-P Q-115/449); **4–6** – *Sparganium minimum* Wallr., seeds × 20 (**4** – borehole 4 sample 35, KRAM-P Q-115/453; **5,6** – well profile sample 30, KRAM-Ps Q-115/455,454). Phot. A. Pachoński

Material. KRAM-P, Q-115/453–456 (4 endocarps).

Description. The endocarps 1.9 × 1.3 mm, 2.0 × 1.3 and 2.6 × 1.3 mm, ovoid, distinctly narrowed into specific neck obliquely truncate at apex. Vascular bundles not deepened into walls of endocarp. Base narrowed, conical stalk is preserved only in one of the endocarps (Fig. 5: 5).

Remarks. These endocarps were determined by Dyakowska as *Cladium mariscus* (L.) R.Br. (Fig. 5: 5,6) and *Carex* sp. (Fig. 5: 4) but they are quite unlike to these taxa.

CONCLUSION

On the basis of presence in the flora of Nowiny Żukowskie such trees as *Abies alba* Mill., *Picea* sect. *Omorica*, *Larix* sp. and exotic herbaceous plants as *Brasenia borysthenica* var. *heterosperma* Wieliczk., *Nymphaea cinerea* Wieliczk., *Aracites interglacialis* Wieliczk., typical for Mazovian interglacial floras, it should be assumed that it is one of the most expressive Mazovian flora of Poland. The presence in the collection of remains of such cold loving species as *Dryas octopetala* L., *Betula nana* L., *Sparganium hyperboreum* Laest. indicated that floristic complex of Nowiny Żukowskie contains plant remains not only from interglacial deposits but also from the successive glacial.

The present view on the stratigraphical position of the deposits from Nowiny Żukowskie is consistant with the view of Dyakowska (1952) and Rühle (1952). However, basing on the pollen succession presented by Dyakowska it cannot be excluded that the boundary between the interglacial and successive glacial deposits ought to be placed below the first high increase of herb pollen (NAP) and not only below the second one as decided Dyakowska. In the pollen diagram from borehole 4 it would be placed below sample 30 in the well profile below the sample 21. Such placing of this boundary allows to suggest that early glacial pollen succession in the profile from Nowiny Żukowskie is representing two stadials and dividing them interstadial (Mamakowa, present opinion).

ACKNOWLEDGEMENTS

The authors wish to express their heartfelt thanks to Professor Zlatko Kvaček from the Charles University in Prague for his opinion on the problem of the *Abies* needles taxonomy, Ms Danuta Moszyńska-Moskwa (Institute of Botany, PASc) and MSc Renata Stachowicz-Rybka (PhD Study in the Institute of Botany, PASc) for taking pains to arrange and dry the remains from the collection subjected to actual revision, to MSc Jerzy Mamak for thoroughly compiling tables and to Mr Antoni Pachoński (Institute of Botany, PASc) for taking and preparing of photographs.

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