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EXOTIC PLANTS IN THE FLORAS OF THE MAZOVIAN (ALEXANDRIAN) INTERGLACIAL OF POLAND AND BELARUS

Rośliny egzotyczne we florach interglacjału mazowieckiego (aleksandryjskiego) z Polski i Białorusi

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ABSTRACT. Seeds of five extinct species and one variety of an extinct species and fruits of an extra-European species which have lately been discovered in the Mazovian floras from Poland have been described. They were earlier described from the Alexandrian floras of Belarus and Velichkevich (1975, 1977, 1982) regards them as the most characteristic of this interglacial.

KEY WORDS: exotic plants, seeds, nutlets, morphological and anatomical features, Mazovian (Alexandrian) Interglacial.

INTRODUCTION

Palaeobotanical studies of Pleistocene deposits in the territory of Poland were started as early as the first decades of the present century (Hartmann, Żmuda, Lilpop, Kräusel, Kulczyński and others) but they acquired a truly regular nature only thanks to W. Szafer's works and activity and to the palaeobotanical school created by him (Brem, Dyakowska, Jaroń, Łańcucka-Środoniowa, Sobolewska, Środoń, Trela and others).

In the years 1930–1950 many floras were discovered in Poland and subjected to complex investigation by macroscopic and pollen analyses. In these studies numerous floras of the Mazovian (= Alexandrian, Likhvinian, Holstein) Interglacial constitute a separate problem; in Poland and Belarus they are better known than from other regions of the East-European plain. Such Mazovian floras as Olszewice (Lilpop 1929, Sobolewska 1956a), Syrniki (Sobolewska 1956b), Nowiny Żukowskie (Dyakowska 1952), Ciechanki Krzesimowskie (Brem 1953), Wylezin (Dyakowska 1956) and Gościęcin (Środoń 1957) were thoroughly studied in that period and became typical sites of that interglacial.

In 1970–1980 many new sites of the Alexandrian (Likhvinian)-type carpological floras (Velichkevich 1982) were examined in Belarus and the adjacent regions of the Baltic

countries as well as in Russia and it was found difficult to correlate those floras with the Mazovian carpological floras in Poland, although the nature of the vegetation reconstructed is similar in all of them. The foregoing allows the supposition that one of the main causes of this phenomenon were differences between the methods used in field and laboratory investigations by specialists from different palaeobotanical schools. In this connection, the present authors undertook a revision of the coeval floras of Poland and Belarus and they eventually managed to obtain some interesting data. In particular, in the composition of carpological Mazovian floras several taxa were discovered (Fig. 1, Tab. 1) such as had been described from the Alexandrian floras of Belarus as extinct or extra-European at present (Velichkevich 1975, 1977, 1982). Description and illustrations of these taxa characteristic of the Mazovian (Alexandrian) Interglacial are given below.

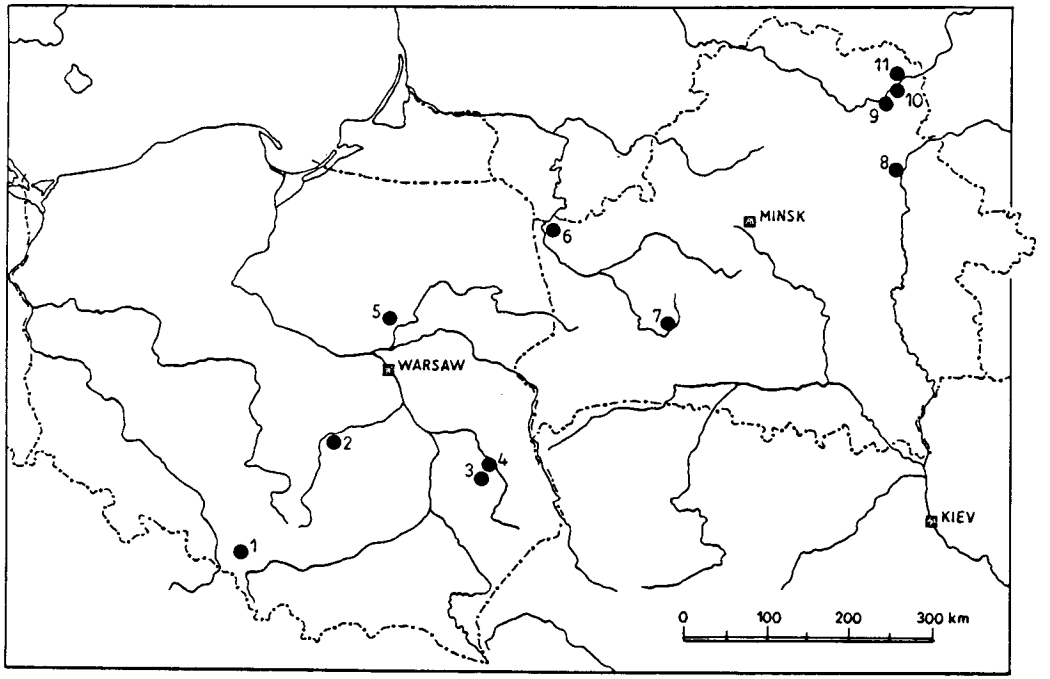

Fig. 1. Mazovian (Alexandrian) sites with exotic plants in Poland and Belarus.1 – Stanowice, 2 – Olszewice, 3 – Nowiny Żukowskie, 4 – Ciechanki Krzesimowskie, 5 – Maków Mazowiecki, 6 – Zhidovshchizna, 7 – Minichi, 8 – Matveyev Rov, 9 – Ruba, 10 – Gralevo, 11 – Verkhove-1

SHORT DESCRIPTIONS OF TAXA

Aldrovanda dokturovskyi Dorof.

Pl. 1 figs 1–5

1963. *Aldrovanda dokturovskyi* sp. nov., Dorofeev, p. 146, Pl. VIII, 15–18; Fig. 42, 10–14.

Seeds from the Belarus floras (Tab. 1, Pl. 1 figs 1, 2), 1.2–1.4 × 0.85–1.1 mm in size, somewhat asymmetrical. The length: width ratio is 1.4 or slightly lower. Chalaza well developed, neck short, obliquely truncated. Flattenings – "mirrors" – not infrequent on sides.

In Poland the seeds of *A. dokturovskyi* Dorof. from Olszewice (Pl. 1 figs 3, 4), 1.3 × 0.92 and 1.25 × 0.95 mm in size are somewhat asymmetrical, with not high but distinct chalaza and short neck with flattenings "mirrors" on sides. They differ from the typical specimens chiefly in greater width and less distinct chalaza and so in the characters which are readily perceived in fairly large material. Lilpop (1929) did not determined these seeds. The seed from Ciechanki Krzesimowskie (Pl. 1 fig. 5), 1.35 × 1.0 mm in size, is slightly asymmetrical, without any flattenings on the sides but with other typical characters of *A. docturovskyi.* Brem (1953) identified this seed as *Aldrovanda vesiculosa* L.

The recent species *A. vesiculosa* L., to which the fossil species under study is usually wrongly referred, has bigger seeds (1.25–1.50 × 0.95–1.15 mm), broad (length: width ratio – 1.3) and symmetrical, with low and smoothened chalaza and no flattenings on sides (see *A. vesiculosa* from the Muravian (Eemian) – Pl. 1 figs 6, 7).

Aracites interglacialis Wieliczk.

Pl. 1 figs 8–17

1977. *Aracites interglacialis* sp. nov., Velichkevich, p. 1158–1161, Fig. 1, 10–16.

Seeds from the Belarus floras (Tab. 1), 1.2–2.0 × 1.0–1.5 mm in size, obovate in shape, at base pointed and sometimes drawn out into a short pedicel, at top concave or unevenly truncated (Pl. 1 figs 14–17), smooth, shiny, brown, varying in intensity of coloration.

Table 1. Exotic plants from the Mazovian (Alexandrian) floras

Taxa	Localities										
	Poland					Belarus					
	Stanowice	Olszewice	Nowiny Żukowskie	Ciechanki Krzesimowskie	Maków Mazowiecki	Zhidovshchizna	Minichi	Matveyev Rov	Ruba	Gralevo	Verkhove-1
Aldrovanda dokturovskyi Dorof.		+		+		+	+			+	
Aracites interglacialis Wieliczk.	+	+	+		+	+	+		+	+	+
Carex paucifloroides Wieliczk.				+	+				+		+
Caulinia goretskyi Dorof.	+	+		+		+	+			+	+
Nymphaea cinerea Wieliczk.			+	+			+	+	+	+	+
Brasenia borysthenica var. *heterosperma* Wieliczk.		+		?					+		+
Scirpus torreyi Olney		+			?				+		+

In Poland (Pl. 1 figs 8–13) in the flora from Nowiny Żukowskie there are more than 200 seeds in the excellent state of preservation, with all the basic diagnostic characters of the species *A. interglacialis,* determined from this flora by Velichkevich (Mamakowa & Velichkevich this volume). Big specimens (1.6–1.9 × 1.1–1.4 mm)[1], lying within the limits of typical dimensions, prevail in the collection. A much richer collection of seeds comes from Olszewice (Lilpop 1929); they were first determined by Łańcucka-Środoniowa (1966, p. 118) as *Aracispermum johnstrupii.* These seeds, mostly 1.4–1.8 × 1.0–1.3 mm in size, are in a certain part damaged by unknown factors, their bases being broken off, which distorts the primary shape of these seeds. Numerous seeds from Stanowice (Sobolewska 1977) were also determined as *Aracispermum johnstrupii.* Moreover, in the collection from Maków Mazowiecki (Gołąbowa 1957) Velichkevich found one seed.

The seeds of the Pliocene species *A. johnstrupii* (Hartz) Nikit. are shorter and comparatively broader (1.2–1.7 × 0.9–1.7 mm), elliptic, cordate, sometimes entirely spherical, rounded at base, rarely narrowed but not pointed (Nikitin 1957).

Carex paucifloroides Wieliczk.

Pl. 1 figs 18–25

1975. *Carex paucifloroides* sp. nov., Velichkevich, p. 125–126, Table I, 24–25.

Nutlets from the Belarus floras (Tab. 1), 1.6–2.6 × 0.6–1.1 mm in size, oblongo-elliptical, flat or with slightly convex upper side, gradually tapering towards the base to form a short, broad pedical. The top of the nutlet passes abruptly and with a bend into an awl-shaped, often curved (slanting) beak, the length of which does not exceed the width of the nutlet (Pl. 1 figs 18–20). A thin membranous utricle with 15–20 longitudinal, unbranched ribs (veins) survives rarely unless in fragments.

In Poland in the flora from Maków Mazowiecki there were 10 nutlets of this species (1.8–2.3 × 0.8–1.1 mm) showing no significant differences in relation to the typical specimens (Pl. 1 figs 21–24). These nutlets were determined by Gołąbowa (1957) as *Carex* sp. One nutlet from Ciechanki Krzesimowskie was identified as *C.* cf. *paucifloroides* (Pl. 1 fig. 25). Brem (1953) determined it also as *Carex* sp.

Caulinia goretskyi (Dorof.) Dorof.

Pl. 2 figs 1–7a

1973. *Najas goretskyi* sp. nov., Dorofeev, p. 391–392, Pl. I, 7–11, Fig. 1, 10.
1978. *Caulinia goretskyi* (Dorof.) comb. nov., Dorofeev, p. 1089.

Seeds from Belarus (Tab. 1, Pl. 2 figs 1, 2), 1.6–3.1 × 0.7–1.2 mm, lanceolate, with lightly bent axis, thin walled, fine cellular, varying in height and shape in various fossil floras. The main character differentiating it from recent *Caulinia flexilis* Willd. is the elongated shape of penta- or hexagonal cells of the seed surface, arranged in rows hard to trace. In *C. flexilis (= Najas flexilis)* the cells are larger, irregular in shape – approaching isodiametrical one – with undulate walls (Pl. 2 figs 8–8b and 9–9c). The two

[1] The dimensions of seeds differ somewhat from those given in the preliminary report (Velichkevich & Mamakowa 1991), because the present ones are based on measurements taken on all the seeds.

species are easy to tell one from the other on the basis of the anatomical structure of cells in cross-sections of seeds: in *C. goretskyi* they are weakly and regularly thickened, while in *C. flexilis* the thickening is stronger and irregular (thinner inner walls). From other species of this genus *C. goretskyi* differs distinctly both in the shape of cells and in that of seeds.

In Poland the seeds of *Caulinia goretskyi* from Ciechanki Krzesimowskie (Pl. 2 figs 4–7) – where they are particularly abundant – are rather variable as regards the morphological features, but the characteristic elongate-polygonal type of cells of the surface prevails absolutely (Pl. 2 figs 6a, 7a). The presence of numerous seeds with the convex middle parts of cells and the distinct sunken boundaries between them is an interesting property of this population of *C. goretskyi.* Seeds, measuring 2.3–2.9 × 0.9–1.2 mm, predominate. Brem (1953) identified these seeds as *Najas flexilis.* One seed was found at Olszewice (Pl. 2 fig. 3) and four at Stanowice and now they were determined as *Caulinia* cf. *goretskyi.* Lilpop (1929) had not determined the seed from Olszewice at all and Sobolewska (1977) had referred the seeds from Stanowice to *Najas flexilis.*

Nymphaea cinerea Wieliczk.

Pl. 3 figs 1–4

1982. *Nymphaea cinerea* sp. nov., Velichkevich, p. 190, Pl. XXIV, 1.

Seeds from Belarus (Tab. 1, Pl. 3 fig. 1), 1.4–2.7 × 1.1–2.1 mm in size, broad-oval, broad-ovate, with soft, lightly wrinkled seed coat. The cells of the surface layer of the coat are rectangular, drawn-out across the seed. Their central parts are concave, usually intensely coloured. In cross-sections of the coat the cells are also rectangular and weakly thickened over the whole outline.

In the similar species *Nymphaea alba* L. the seeds are on the average larger, narrower, more frequently oval, with a weakly raised top. The coat of this species is thicker, strong, the surface cells are narrower with convex central parts (see Pl. 3 figs 5–6b). In cross-sections the cells are much thicker than in *N. cinerea.*

Nymphaea cinerea occured from the end of the Pliocene to the Middle Pleistocene, being most characteristic of the Early Pleistocene floras. In the Alexandrian Interglacial of Belarus, in addition to *N. cinerea,* also *N. alba* has been reliably determined and both these species occur together in some sites.

In Poland in the flora from Nowiny Żukowskie there are several seeds that closely resemble *N. cinerea* (Pl. 3 figs 2–4) and in the flora from Ciechanki Krzesimowskie there is only one. The seeds from Nowiny Żukowskie were identified by Dyakowska (1952) as *Nuphar pumilum* and Brem (1953) had referred the seed from Ciechanki Krzesimowskie to *Nymphaea candida.*

Brasenia borysthenica Wieliczk. var. *heterosperma* Wieliczk.

Pl. 4 figs 1–8

1982. *Brasenia borysthenica* sp. nov., var. *heterosperma* var. nov., Velichkevich, p. 184, 187–188, Pl. XXII, 7.

Seeds from Belarus (Tab. 1) referred to this polymorphic variety, measuring 2.0–

2.8 × 1.6–2.1 mm and varying in their basic morphological features, show two clearly distinguishable main morphotypes:
a/ smaller, short, somewhat narrowing towards the base and smooth (Pl. 4 figs 1, 2), and b/ larger, oval or broadly elliptical, with sparse secondary verrucae by the base or all over the seed (Pl. 4 figs 3, 4). The two morphotypes are connected together by transitional forms, which permits us to regard them as the result of intrapopulation polyformism (polyformism of this population).

In Poland a fine collection of *Brasenia* seeds has been preserved in the Olszewice flora (Pl. 4 figs 5–8); both basic morphological types and a complete set of intermediate forms can be distinguished among them. The seeds from Olszewice are on the average somewhat larger than the typical seeds from Belarus, they are 2.3–3.2 × 1.8–2.6 mm in size. Oval or barrel-shaped seeds prevail among them, but the clearly obovate specimens are also fairly numerous. The seed coat is thick and hard, the secondary verrucae occur all over the surface but there are also some quite smooth seeds. The Olszewice collection stands nearest to the population of this variety from Ruba in Belarus (meas. 2.2–3.5 × 1.8–2.5 mm, see Velichkevich 1982, Pl. XXII, Figs 10–16).

Two seeds from Ciechanki Krzesimowskie and several from Olszewice have been identified as *Brasenia borysthenica* Wieliczk. s.l.

The seeds from both Olszewice and Ciechanki Krzesimowskie were previously determined as *B. purpurea* Mich. (Lilpop 1929, Brem 1953).

The seeds of the Eemian (Muravian) species *B. holsatica* (Web.) Weberb. from Belarusian sites (Pl. 4 figs 9–14) differ from *B. borysthenica* var. *heterosperma* mainly in their considerably greater dimensions (1.8–3.5 × 1.0–3.0 mm), ovate or oval shape, higher opercle and other secondary morphological and anatomical features.

Scirpus torreyi Olney

Pl. 3 figs 7–11

Recent North-American species, widely distributed in Belarus and adjacent areas of the East-European plain in the Pleistocene, chiefly in the floras of the last interglacial (Velichkevich 1982). In the Alexandrian floras of Belarus it is relatively rare (Tab. 1, Pl. 3 figs 7–9). The nutlets from these floras (dimensions: 1.6–3.0 × 1.0–1.9 mm) are from broad-ovate, gradually tapering towards the base, to longitudinally narrow-elliptical, in cross-sections flat-convex or triangular. Dorsal side broad, flat or slightly concave, ventral side with a longitudinal furrow (groove) in the place of contact of the side margins. Nutlet apex rounded, ending in a short triangulare base of the beak. Nutlet base gradually tapering, horizontally truncated, with thin flat setae, which are usually as long as or longer than the nutlet. Walls thin and hard, surface even, smooth, unctuous, black or dark brown in colour, at high magnifications very fine-celled.

In Poland only three typical nutlets of this species (measuring 2.0 × 1.3, 2.2 × 1.5 and 2.3 × 1.4 mm without the beak) and three less typical were found in the flora from Olszewice (Pl. 3 figs 10, 11). Lilpop (1929) determined them as *Scirpus* sp. div. One less typical nutlet, which may also belong to this species, was besides collected at Maków Mazowiecki. Gołąbowa (1957) determined it as *Scirpus lacustris.*

REMARK

Thanks to the above-presented new discoveries the list of exotics in the floras of the Mazovian Interglacial in Poland has been markedly extended. In this connection their similarity (affinity) to the Alexandrian floras from Belarus appears stronger than it seemed to be earlier.

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PLATES

Plate 1

1–5. *Aldrovanda dokturovskyi* Dorof., seeds, × 20
1, 2 – Zhidovshchizna
3, 4 – Olszewice
5 – Ciechanki Krzesimowskie

6–7. *Aldrovanda vesiculosa* L., seeds from Muravian (Eemian) Interglacial for comparison with *A. docturovskyi*, × 20
6 – Loyev, Belarus
7 – Góra Kalwaria, Poland

8–17. *Aracites interglacialis* Wieliczk., seeds – different shape types from several sites, × 20
8, 9 – Olszewice
10, 11 – Nowiny Żukowskie
12, 13 – Stanowice
14, 15 – Ruba
16, 17 – Minichi

18–24. *Carex paucifloroides* Wieliczk., nuts, × 15
18–20 – Verkhove-1
21–24 – Maków Mazowiecki

25. *Carex* cf. *paucifloroides* Wieliczk., × 15, Ciechanki Krzesimowskie

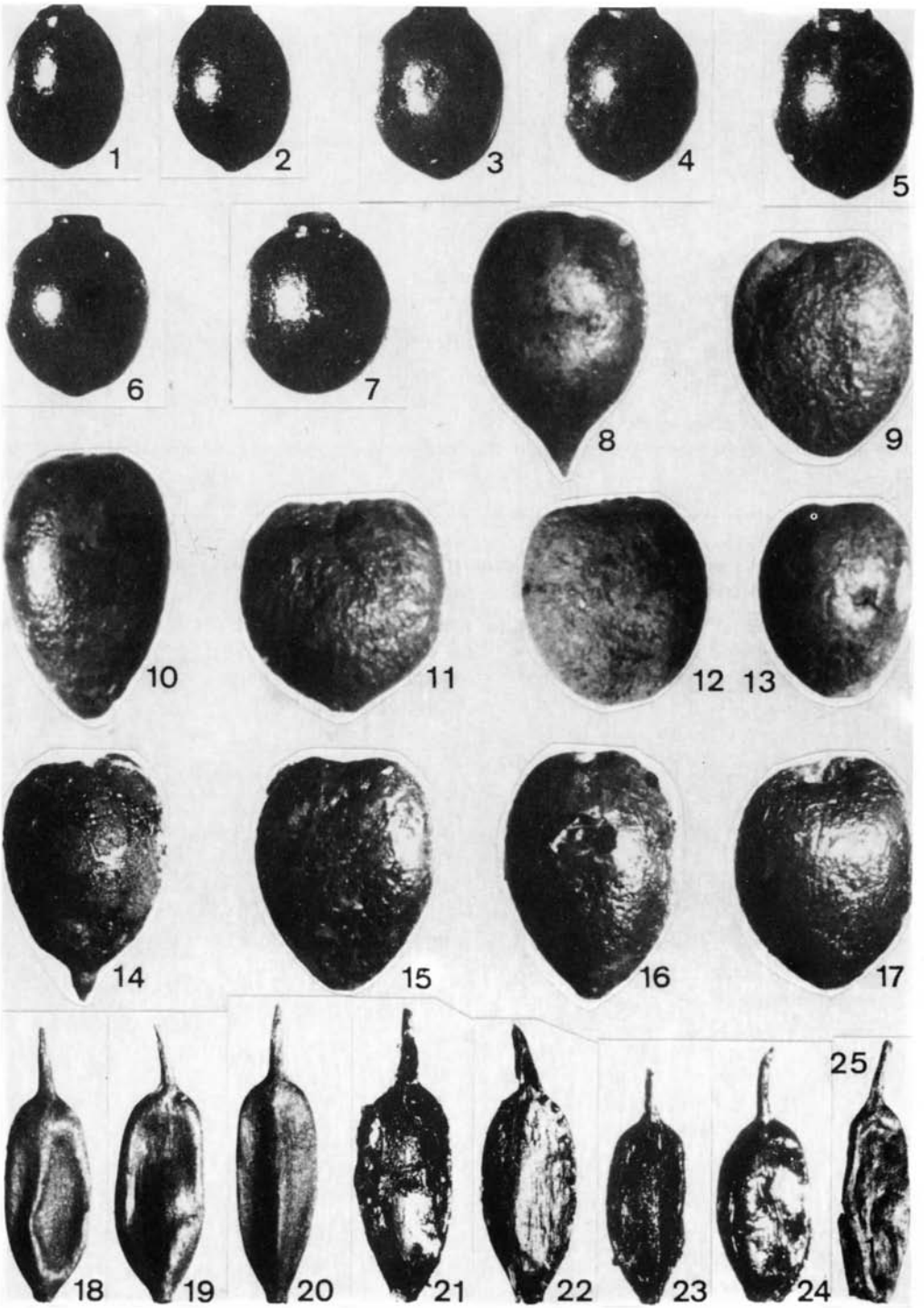

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Plate 2

1–7. *Caulinia goretskyi* (Dorof.) Dorof., seeds – different shape types, light photograph × 15
1, 2 – Zhidovshchizna
3 – Olszewice
4–7 – Ciechanki Krzesimowskie
6a and 7a – details showing fragments of the seed surface with elongated cells; SEM micrographs × 208

8. *Caulinia flexilis* Willd. light photograph × 15; seed from Muravian (Eemian) site Komotovo, Belarus
8a, b – details of the seed surface with cells approaching isodiametrical shape, SEM micrographs: 8a – × 64, 8b – × 208

9. *Najas flexilis* (Willd.) Rost. et Schm. – recent seed from Liperi, Finland, det. A.L. Backman; SEM micrograph × 20.8
9a–c – details of the seed surface, SEM micrographs: 9a – × 64, 9b, c – × 208

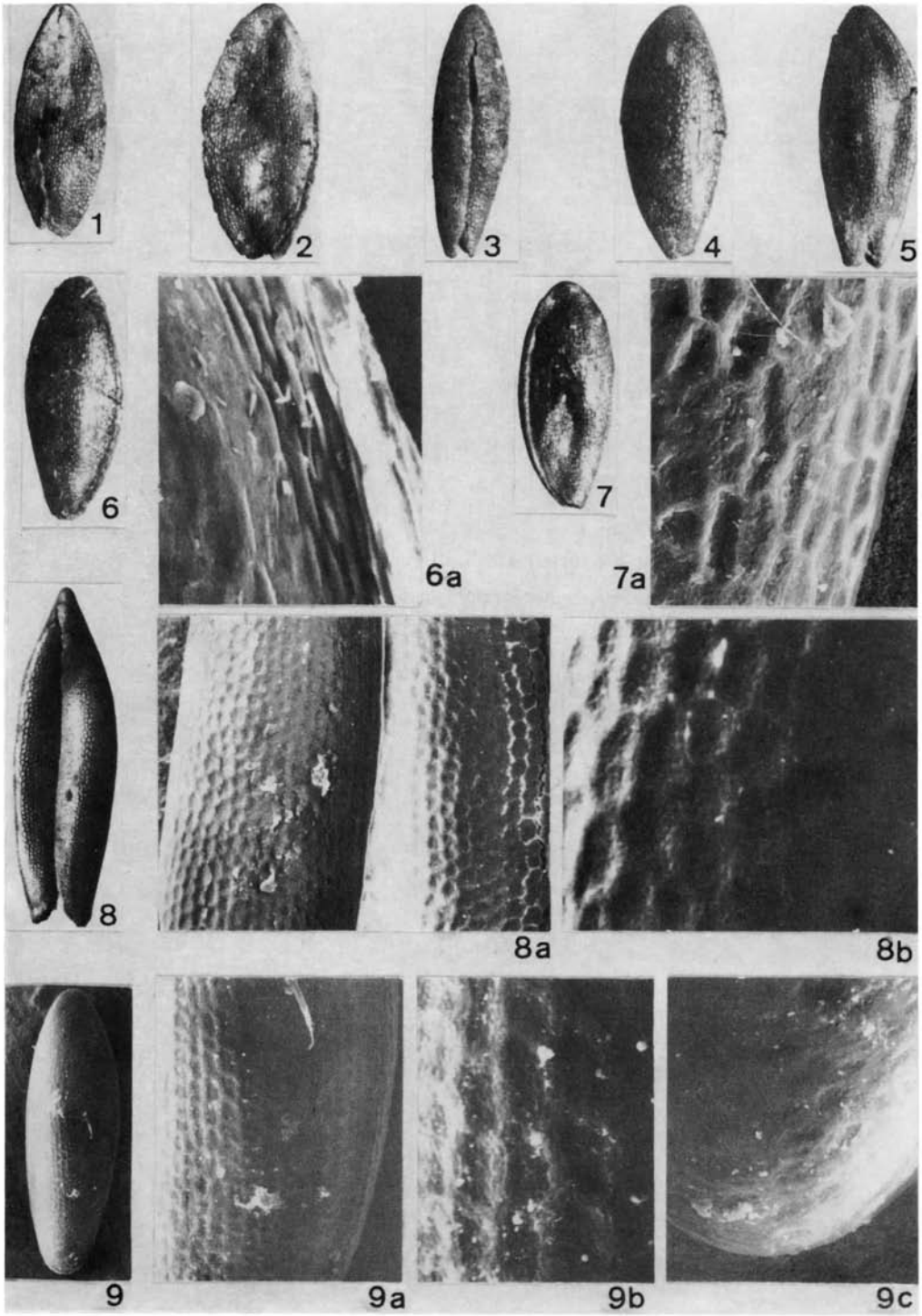

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Plate 3

1–4. *Nymphaea cinerea* Wieliczk., seeds, light photographs × 15
1 – Matveev Rov
2–4 – Nowiny Żukowskie
2a – SEM micrograph × 24
2b – SEM micrograph × 208 – detail with well visible concave central parts of cells

5–6. *Nymphaea alba* L., light photograph × 15, seeds from Muravian (Eemian) site Samostrelniki, Belarus
6a – SEM micrograph × 20.8
6b – SEM micrograph × 208, detail with well visible convex central parts of cells

7–11. *Scirpus torreyi* Olney, nutlets, light photographs × 15
7–9 – Ruba
10–11 – Olszewice

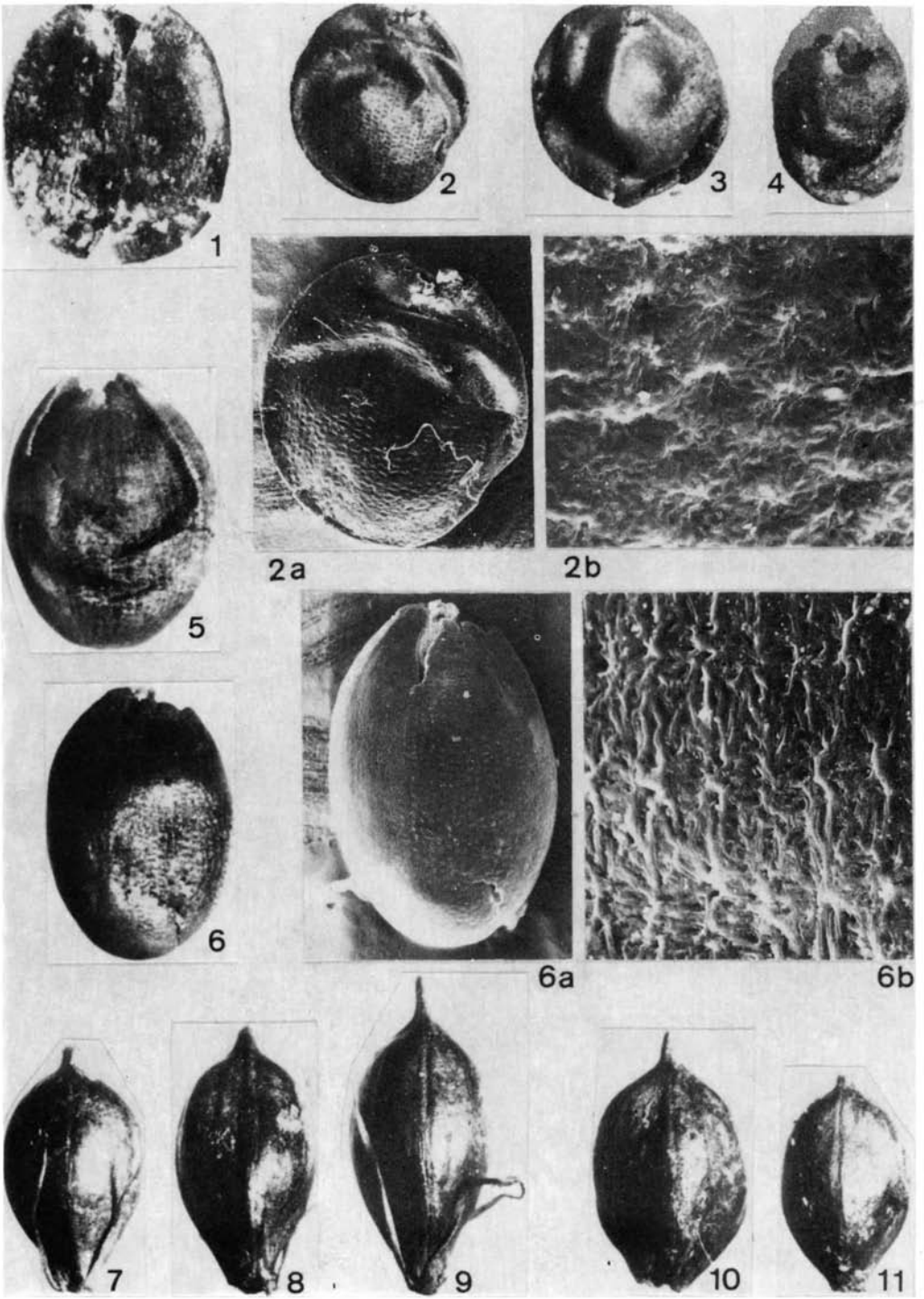

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Plate 4

1–8. *Brasenia borysthenica* Wieliczk. var. *heterosperma* Wieliczk., seeds, × 12
1–4 – Verkhove-1
5–8 – Olszewice

9–16. *Brasenia holsatica* (Web.) Weberb., × 12, seeds from Muravian and Eemian sites for comparison with *B. borysthenica* var. *heterosperma*
9–11 – Loyev, Belarus
12–14 – Samostrelniki, Belarus
15 – Bedlno, Poland (in Środoń, Gołąbowa 1956 det. as *B. purpurea* Casp.)
16 – Imbramowice, Poland (in Mamakowa 1989 det. as *B. schreberi* Gmel.)

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