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ARACITES INTERGLACIALIS WIELICZK. – EXTINCT PLANT FOUND IN THE FLORAS OF THE MAZOVIAN (ALEXANDRIAN, LIKHVINIAN) INTERGLACIAL IN POLAND, BELARUS, RUSSIA AND THE UKRAINE

Aracites interglacialis Wieliczk. – wymarła roślina znaleziona we florach interglacjału mazowieckiego (aleksandryjskiego, lichwińskiego) Polski, Białorusi, Rosji i Ukrainy

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ABSTRACT. A nomenclatural revision concerning the taxon *Aracites interglacialis* Wieliczk. has been carried out. The morphology and anatomy of seeds of this extinct plant have been described on the basis of their rich collections in the floras of the Mazovian (Alexandrian, Likhvinian = Holstein) Interglacial in Poland, Belarus, Russia and the Ukraine. Correlation of the occurrence of seeds of *Aracites interglacialis* with the results of pollen analysis shows that it occurred mainly in the younger part of the interglacial and reached its it maximum proportion most probably in the younger part of the firn-hornbeam zone.

KEY WORDS: extinct species, fossil seeds, morphological and anatomical features, Mazovian (Alexandrian, Likhvinian = Holstein) Interglacial

The studies carried out on macrofossil floras in Europe were still in their initial stage, when palaeobotanists found remains of an interesting plant, whose taxonomy has not been elucidated up to now.

These are small seeds (or fruits), up to 2.2 mm long and 1.6 mm wide, obovate, oval, or cordate in shape, with smooth surface (if the epidermis is preserved) and of brown coloration varying in intensity. A well-developed pear-shaped or round inner chamber, ending in a broad canaliculus at the top, is visible in a longitudinal section. The canaliculus is sometimes closed with a cylindrical opercle.

Various authors ascribed these remains to different genera and families. Discovered

for the first time by C. Reid and E. M. Reid in 1915 in Pliocene floras at the Danish-German boundary, they were described as *Hippuris globosa* (det. E. M. Reid). Szafer (1961) described analogous remains from the Miocene flora of Stare Gliwice in Silesia under the same name. P. A. Nikitin (1957) found some remains of this plant in the Pliocene flora of the Voronezh region of Russia and considered them to be identical with the remains from Jutland which had been described by Hartz (1909) as *Carpolites johnstrupii* Hartz. On this basis he separated the formal genus *Aracites* and established a new combination, *Aracites johnstrupii* (Hartz) Nikitin. According to P. A. Nikitin (1957) the genus *Aracites* belongs probably to the *Araceae* family. Although it was later found that the *Myrica* fruits from the subgenus *Morella* had been described under the name *Carpolites johnstrupii* Hartz (Kircheimer 1957, Friis 1985), still the name *Aracites* remained in use in taxonomy. It was applied for a new species described from the Pleistocene of Belarus, *Aracites interglacialis* Wieliczk. (Velichkevich 1977, 1982), which was also observed in the Pleistocene of Finland (Aalto & Hirvas 1987). Recently, Bennike (1990) has referred the remains described by C. Reid and E. M. Reid (1915) to this formal genus and proposed the new combination *Aracites globosa* (Reid & Reid) Bennike for the Plio-Pleistocene specimens from northern Geenland.

It is worth mentioning that P. A. Nikitin used the name *Aracispermum* as early as 1948 but it was not established officially until his posthumous work (P. A. Nikitin 1965) was published. Dorofeev, who described several new species of *Aracispermum* from the Tertiary floras of Belarus and Siberia, used that name widely in his papers (Dorofeev 1955, 1960, 1963a, b), and so did Chandler (1962), Łańcucka-Środoniowa (1966), V. P. Nikitin (1979) and Bůžek at al. (1985).

Another opinion on the taxonomy of this plant has appeared recently. Mai described two species of the genus *Caricoidea* from the family *Cyperaceae* from the Oligocene flora of the Haselbacher Series in Germany (Mai & Walter 1978), to which genus he referred all the species of *Aracispermum* erected by Nikitin and Dorofeev as well as *Hippuris globosa* C. et E. M. Reid. In a later paper Mai went still further (Mai & Walter 1988) and included even young – Pliocene and Pleistocene – species of *Aracites (Aracispermum)* in *Caricoidea*. The remains that Mai presented in the first work (Mai & Walter 1978) as *Caricoidea nitens* (Heer) Chandler and *C. jugata* (Nikit.) Mai are in fact not similar to *Aracispermum*, whereas the remains described in the second work (Mai & Walter 1988) also as *Caricoidea* according to us, bear morphological characters of *Aracispermum*. Środoń also used the name *Caricoidea* in his latest work (Środoń 1992), describing the remains typical of *Aracites* from the flora of Katowice in Silesia as *Caricoidea globosa* (C. et E. M. Reid) Mai.

It should be emphasized that Chandler (1962) herself acknowledged the distinctness of the genera *Caricoidea* and *Aracispermum*. In the Eocene flora from the Pipe-Clay Series of Dorset she distinguished both these genera.

The above-presented taxonomic problem is very complex and undoubtedly should be given a monographic study. The authors of the present paper agree with V. P Nikitin's (1979) opinion; he proposed to use the name *Aracispermum* for remains from the Palaeogene and older Neogene, and *Aracites* for the Pliocene and, especially, Pleis-

tocene remains. In this connection, the authors use the name *Aracites interglacialis* Wieliczk. for the seeds from the Mazovian (Alexandrian, Likhvinian = Holstein) floras and withdraw the name *Caricoidea* given in parenthesis beside the name *Aracites* in the paper by Velichkevich and Mamakowa (1991).

? Araceae
Aracites interglacialis Wieliczk.

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

The seeds from eleven Belorusian, Russian and Ukrainian floras (Fig. 1, 6–16) are 1.2–2.0 × 1.0–1.5 mm in size. They are obovate to cordate, sometimes wide-elliptic or narrow-elliptic. They are usually somewhat flattened, oval or round in cross-section. The base is tapering and pointed and not infrequently drawn out into a short pedicle, which break easily; sometimes, however, it is more or less rounded. The top is slightly narrowed and unevenly truncate, sometimes concave, with a broad funnel-shaped micropylar opening (see Pl. 2 figs 13–20 and Pl. 3 and 4). The external surface is smooth, shiny, dark-brown to black if the epidermis is preserved or matt, greybrown if it is missing. In sections the walls are thick, the thickest at the base and at the top (Pl. 7

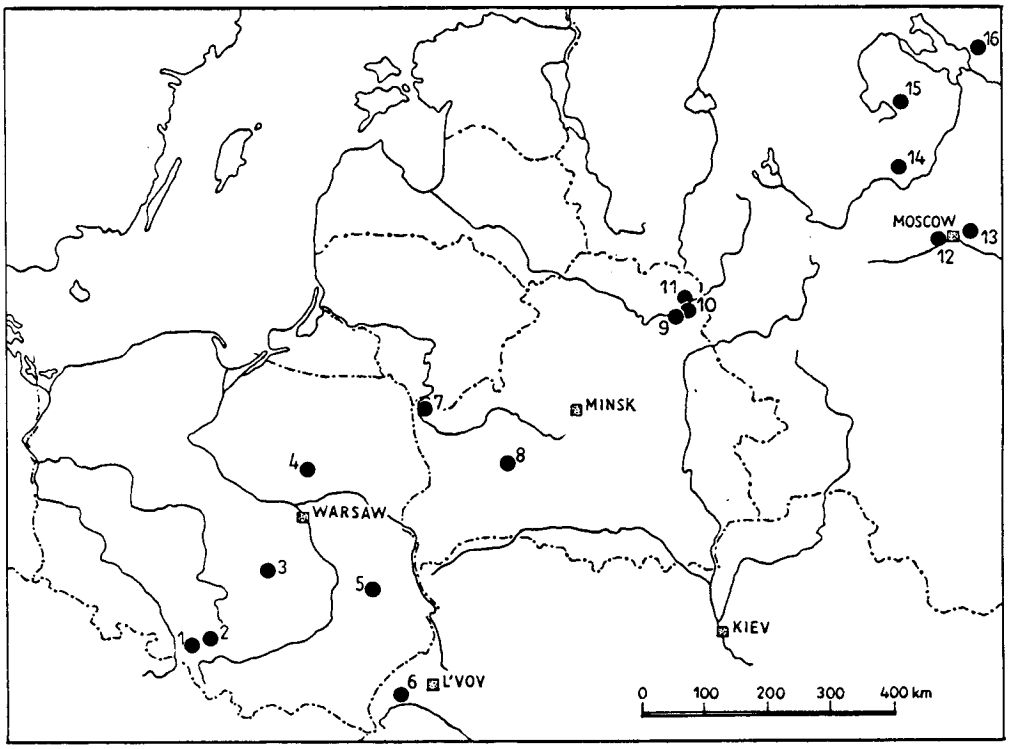

Fig 1. Mazovian (Alexandrian, Likhvinian) sites with *Aracites interglacialis* in Poland, Belarus, Russia and Ukraine. 1 – Stanowice, 2 – Katowice, 3 – Olszewice, 4 – Maków Mazowiecki, 5 – Nowiny Żukowskie, 6 – Krukenichi, 7 – Zhidovshchizna, 8 – Minichi, 9 – Ruba, 10 – Gralevo, 11 – Verkhove-1, 12 – Akulovo, 13 – Balashikha, 14 – Alkhimkovo, 15 – Kablukovo, 16 – Yakovlevskoye

figs 3–3b). The internal cavity (chamber) irregularly roundish or pear-shaped, covered by coal-black membraneous integument of distinct cellurar structure. On both sides of the chamber single ducts extend from base to top and the seed walls are thickest in these places.

At present five sites of *Aracites interglacialis* Wieliczk. are known from Poland (Fig. 1, 1–5). They are Olszewice, Stanowice, Nowiny Żukowskie, Maków Mazowiecki and Katowice.

The richest collection comes from Olszewice (Pl. 1 figs 1–14), from two profiles studied by Lilpop (1929). He did not mention these seeds in his paper. They were kept in the Paleobotanical Museum, W. Szafer Institute of Botany, in Kraków as an undetermined taxon. Łańcucka-Środoniowa (1966, p. 118) identified them as *Aracispermum johnstrupii.*

The collection from Olszewice consists of 610 whole seeds (sometimes somewhat damaged), 1.1–2.2 mm long (with pedicle) and 0.8–1.5 mm wide. Most seeds (514) lie in the middle size intervals: 1.4–1.8 × 1.0–1.3 mm. The collection from Olszewice shows much shape variability. The obovate seeds prevail (ca 240), some of them being lightly truncate at the top. Part of them (ca 50) have the base pointed and drawn out into a sharp pedicle. The next group in respect of abundance consists of cordate seeds (ca 170). The narrow-elliptic seeds, ending in a pedicle, and wide-elliptic ones, often truncate at the top to round in shape are also numerous (ca 70 and 80, respectively). About 50 seeds are of various intermediate shapes. On the top of a seed, sometimes in a hollow is the micropylar opening (in some seeds closed by an opercle – see Pl. 5 fig. 1 and 1a). The seeds are smooth, lightbrown to darkbrown.

On the basis of palynological results obtained by Trela (1929) it may be inferred that the seeds of *Aracites interglacialis* come from the younger part of the interglacial, from zones with high *Abies* values and next a great frequency of *Pinus.*

Sobolewska (1977) determined 106 seeds from Stanowice as *Aracispermum johnstrupii* (Hartz) Nikit. foss. These are mainly seeds from the so-called sample 0 taken for macroscopic study from the peat in profile 1. At present all the seeds from sample 0 (92 specimens) have been measured and analysed in respect of shape (Pl. 1 figs 15–23). Fourteen seeds obtained from other parts of profile 1 and from profile 3 have been lost.

Dimensions: length 1.2–1.8 mm, width 0.9–1.4 mm, but seeds measuring 1.4–1.6 × 1.1–1.3 mm prevail. The most specimens are obovate (above 30) and wide-elliptic (27). There are besides 10 elliptic specimens and 9 cordate. The cylindrical and subround seeds are sporadic. All the specimens have their tops lightly truncated and often hollow. Micropylar openings, often closed by an opercle, occur on truncated tops or in hollows.

There are no seeds with typically pointed base and sharp pedicles in the flora from Stanowice. Even the cordate seeds lack such pointed bases. The seed surface is brown, matt and slightly glistening.

The pollen analysis results from sample 0 (see Sobolewska 1977, fig. 1) show high pollen values of *Abies* and *Alnus* and relatively low ones of *Carpinus*, which on the

basis of the full diagram from profile 1 permits the linking of sample 0 with the upper part of phase III (acc. to the scheme of Szafer 1953) i.e. with subphase IIIb.

In Nowiny Żukowskie Dyakowska (1952) found "fruitlets", which she failed to determine and designated with the letter "A" (p. 129). As undetermined remains they were transferred to the Paleobotanical Museum, W. Szafer Institute of Botany, in Kraków. They were obtained from borehole 4 and the well from which materials were studied palynologically by Dyakowska (1952) and from a peat layer in borehole 1a, which were not included in that study. Looking over the collection of fossil fruits and seeds in the Department of Paleobotany, W. Szafer Institute of Botany, in Kraków, Velichkevich identified these seeds as *Aracites interglacialis* Wieliczk. (Velichkevich & Mamakowa 1991).

Now this collection consists of 259 seeds. Their dimensions are 1.3–2.1 × 0.8–1.6 mm, but big seeds 1.6–1.9 × 1.1–1.4 mm in a very good state of preservation predominate (Pl. 2 figs 5–12). The obovate seeds are most numerous (above 100 specimens) and are followed by wide-elliptic ones (above 80). The elongate cordate and short cordate seeds form a large group (ca 50 and ca 30, respectively). In each morphological group about half the seeds bear a short fragment of the pedicle or its distinct trace. The tops of seeds with the micropylar opening are lightly truncated or concave.

The same numeration used for samples in macrofossil and pollen analyses makes it possible to correlate the occurrence of *Aracites interglacialis* and the pollen zones distinguished by Dyakowska (1952).

In the profile from borehole 4, which is more complete and embraces the whole interglacial, two seeds of *Aracites* occurred at the beginning of the interglacial, in the zone with a maximum proportion of *Betula* pollen (designated by Dyakowska (1952) as phase A). However, the continuous occurrence of seeds begins only towards the end of the spruce-alder zone (phase B) and extends through the whole fir-hornbeam zone (phase C) and pine-birch zone (phase D). The highest proportion of seeds falls in the decline of the fir-hornbeam zone. There are no samples with *Aracites* from the top part of the profile, representing the Early Glacial of the next glaciation (phases E and F with high NAP values).

In addition to these three sites with an abundance of *Aracites* seeds, while examining the fossil floras, Velichkevich found one seed in the collection from Maków Mazowiecki (Gołąbowa 1957). The seed, 1.0 × 1.1 mm in size, is well preserved, obovate, with a truncated top and lightly pointed base (Pl. 2 fig. 1).

Recently, Środoń (1992) has found a fifth site of this interresting plant. There were three whole and four damaged specimens in a small peat sample taken occasionally during the sinking of a well at Katowice (Fig. 1). Środoń identified them as *Caricoidea globosa* (C. et E. M. Reid) Mai. These specimens possess all the basic characters of *Aracites interglacialis* Wieliczk. (Pl. 2 figs 2–4) and lie well within the limits of the variability of seeds of this species from big collections. It is hard to determine the age of this site, but the Mazovian Interglacial, as assumed by Środoń (1992), is the most probable, although no doubt it demands a confirmation from further studies carried out at this site.

The sections of several specimens from Olszewice, Stanowice and Nowiny Żukowskie (Pl. 5–7) show that the walls of the seeds are thick, usually the thickest in the top part and at the base (Pl. 5 fig. 4, Pl. 6 figs 1, 2 and Pl. 7 figs 1, 2). The cavity is pear-shaped and towards the top passes into a canalicule (micropyle ?), which opens at the top (Pl. 6 figs 1, 1a, 2, 2a and Pl. 7 figs 1 and 2–2b). The wall is divided into two layers – a thick external and a very thin internal. The thick external layer is built of nearly identical parenchyma cells with smooth walls (Pl. 7 fig. 1a) and the thin internal one (integument) lines the cavity (Pl. 5 figs 4a–c and Pl. 6 fig. 1a). The integument on the cavity side has a distinct cellular structure, while its other side is smooth (Pl. 5 figs 4–4c and Pl. 6 figs 1–1c). It very readily loosens and comes off the external layer of the wall. The external layer of wall on the cavity side (without integument) has a very indistinct sculpture formed by flat, elongate cells (Pl. 6 fig. 2b, Pl. 7 fig. 2a). In some sections (Pl. 6 figs 2 and 2c, d and Pl. 7 figs 2 and 2a) ducts running from the top to the bottom are visible in the thick layer.

In conclusion we should give some attention to the position of *Aracites interglacialis* from the profiles of Mazovian age from Stonava (Vodičková-Kneblová 1961). It was announced as *Caricoidea globosa* (C. et E. M. Reid) Mai by Mai & Walther (1988), probably on the basis of a photograph (Vodičková-Kneblová 1961, Taf. III, 7), which presents several seeds belonging undoubtedly to *Aracites interglacialis*. Vodičková-Kneblová (l.c.) identified them as *Scheuchzeria palustris* L. If all the seeds of *S. palustris* from the profiles at Stonava (about 2000 specimens) represent *Aracites interglacialis*, that would be the most abundant collection of this species of Mazovian age in Central Europe.

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PLATES

Plate 1

Aracites interglacialis Wieliczk., × 20

1–14. Seeds from Olszewice, Poland:
- 1, 2 – obovate with pedicle
- 3, 4 – obovate
- 5–7 – cordate (5, 6 elongate)
- 8 – narrow-elliptic with pedicle
- 9, 10 – elliptic
- 11, 12 – wide-elliptic
- 13 – wide-elliptic with slightly pointed base
- 14 – almost round

15–23. Seeds from Stanowice, Poland:
- 15, 16 – obovate
- 17, 18 – cordate
- 19, 20 – elliptic
- 21 – cylindrical
- 22 – wide-elliptic
- 23 – almost round

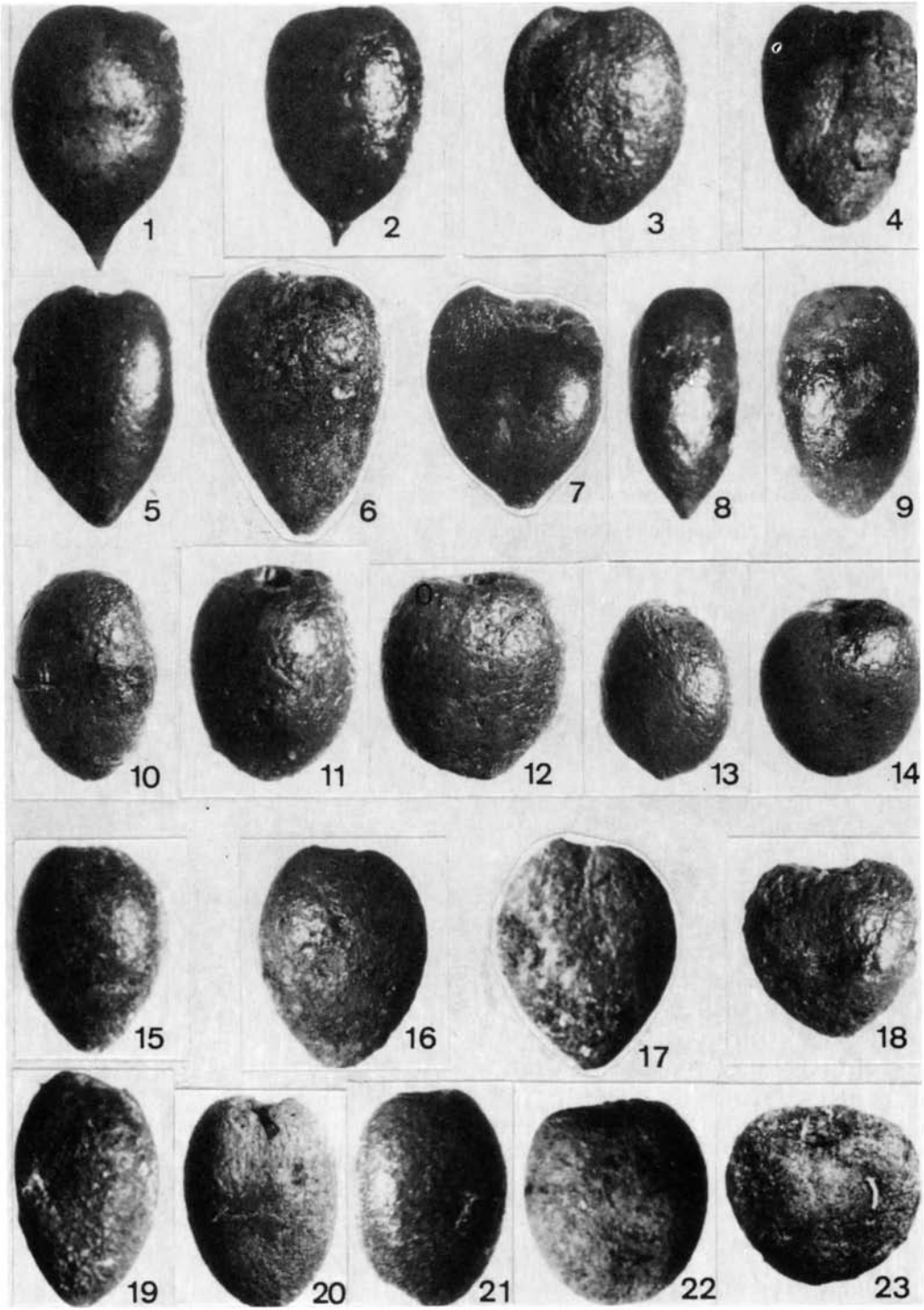

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Plate 2

Aracites interglacialis Wieliczk., × 20

1. Obovate, elongated seed from Maków Mazowiecki, Poland

2–4. Seeds from Katowice, Poland:
2 – cordate
3 – elliptic
4 – wide-elliptic (almost cylindrical)

5–12. Seeds from Nowiny Żukowskie, Poland:
5–7 – obovate
8–10 – cordate
11, 12 – wide-elliptic

13–20. Seeds from Krukenichi, Ukraine:
13, 14 – obovate
15, 16 – cordate, elongate
17, 18 – wide-elliptic
19, 20 – almost round

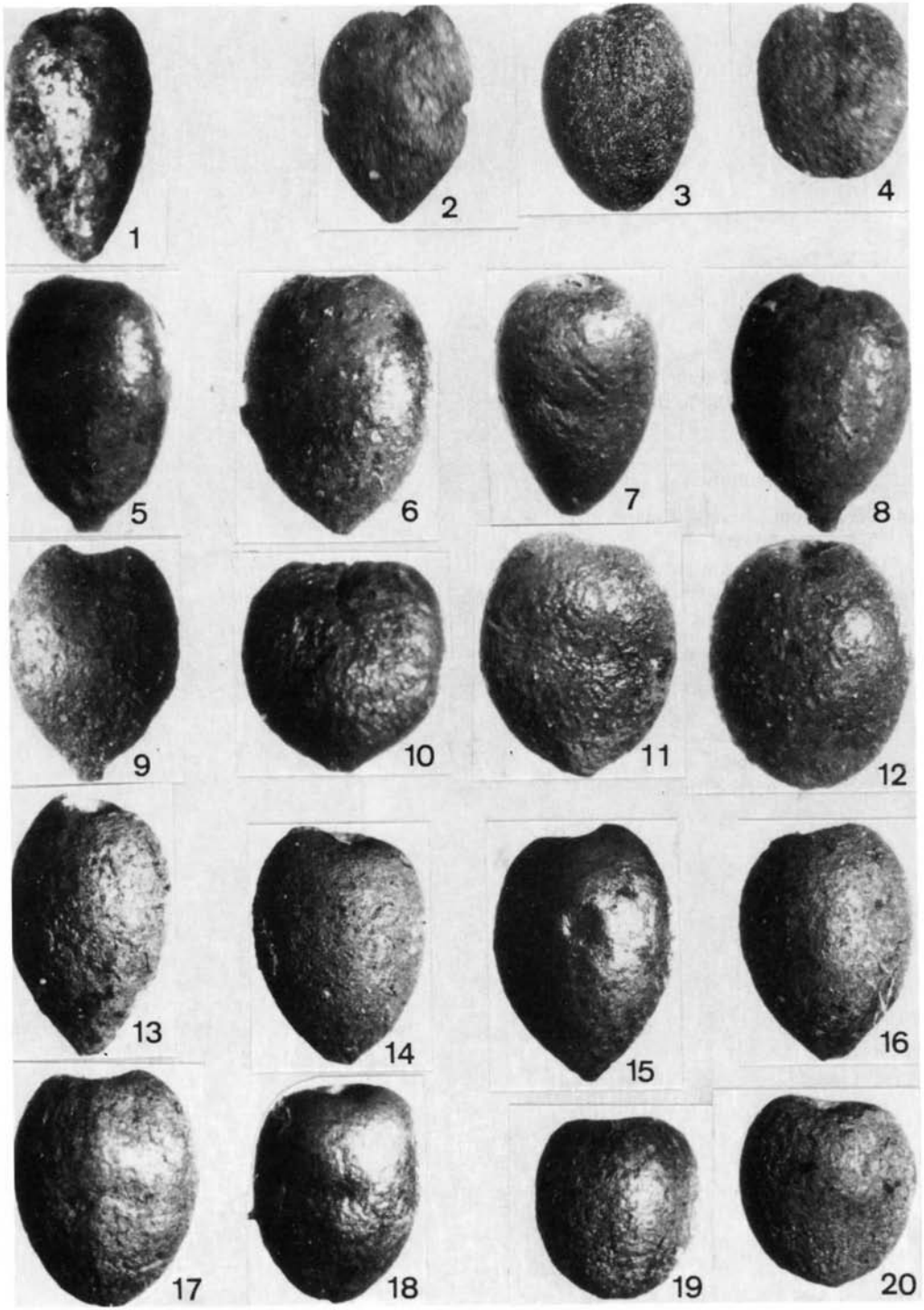

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Plate 3

Aracites interglacialis Wieliczk., × 20

1–6. Seeds from Zhidovshchizna, Belarus:
- 1 – narrow-elliptic distinctly truncated at the top
- 2 – elliptic
- 3, 4 – cordate
- 5, 6 – wide-elliptic

7–14. Seeds from Minichi, Belarus:
- 7–9 – obovate
- 10 – cordate with rounded base
- 11, 12 – elliptic (11 – with slightly pointed base)
- 13 – cylindrical

15–22. Seeds from Ruba, Belarus:
- 15 – obovate, elongate and pointed
- 16, 17 – obovate with pedicle
- 18–20 – cordate
- 21 – elliptic
- 22 – wide-elliptic

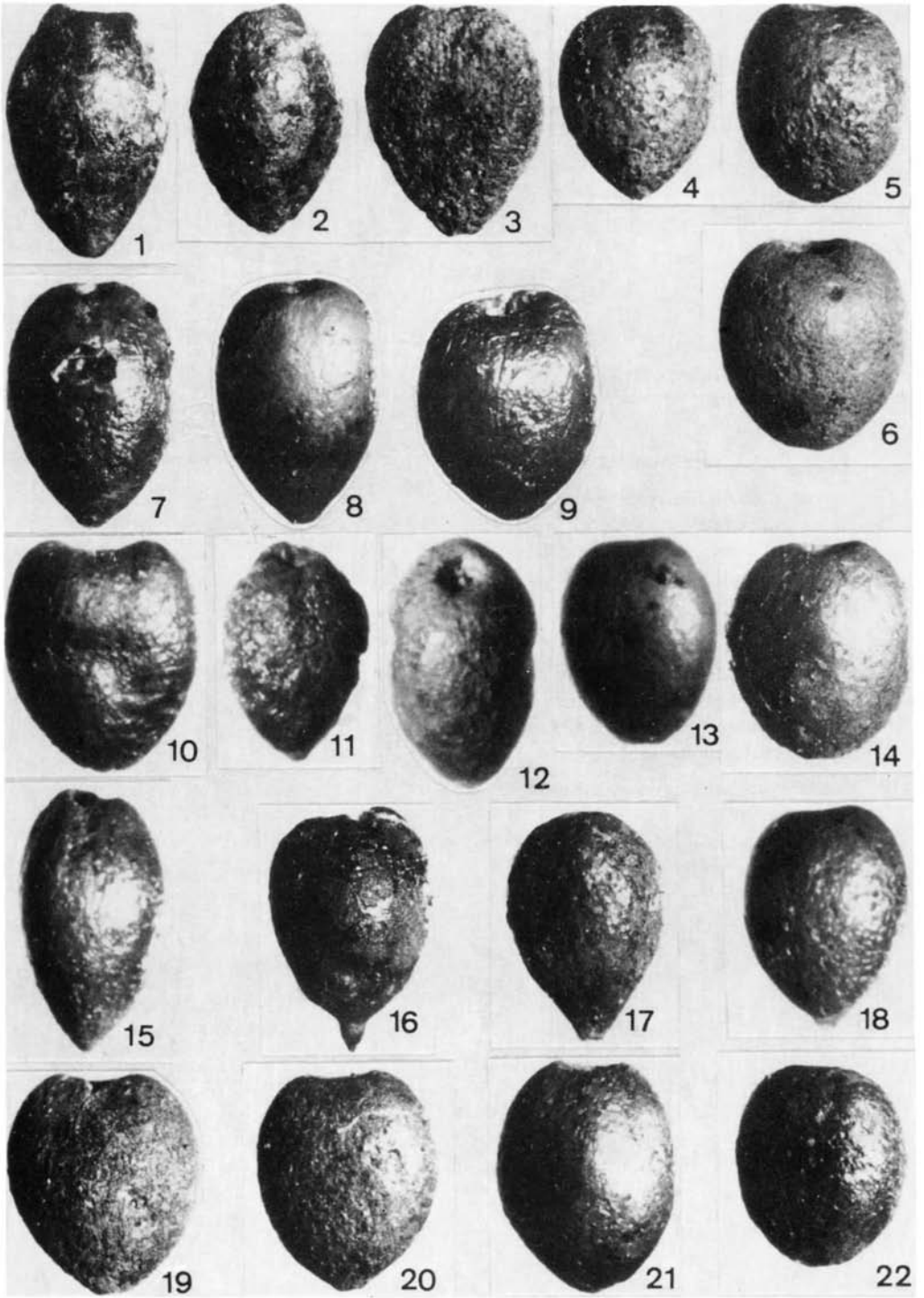

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Plate 4

Aracites interglacialis Wieliczk., × 20

1–3. Seeds from Gralevo, Belarus:
1, 2 – obovate
3 – cordate

4. Wide-elliptic seed from Akulovo, Russia

5–13. Seeds from Alkhimkovo, Russia:
5 – obovate
6–9 – cordate, elongate
10 – elliptic with short pedicle
11, 13 – wide-elliptic
12 – almost round

14. Cordate seed from Balashikha, Russia

15–16. Seeds from Kablukovo, Russia:
15 – obovate
16 – cordate, elongate

17–19. Seeds from Yakovlevskoye, Russia:
17 – obovate
18 – elliptic, pointed
19 – cordate-elliptic

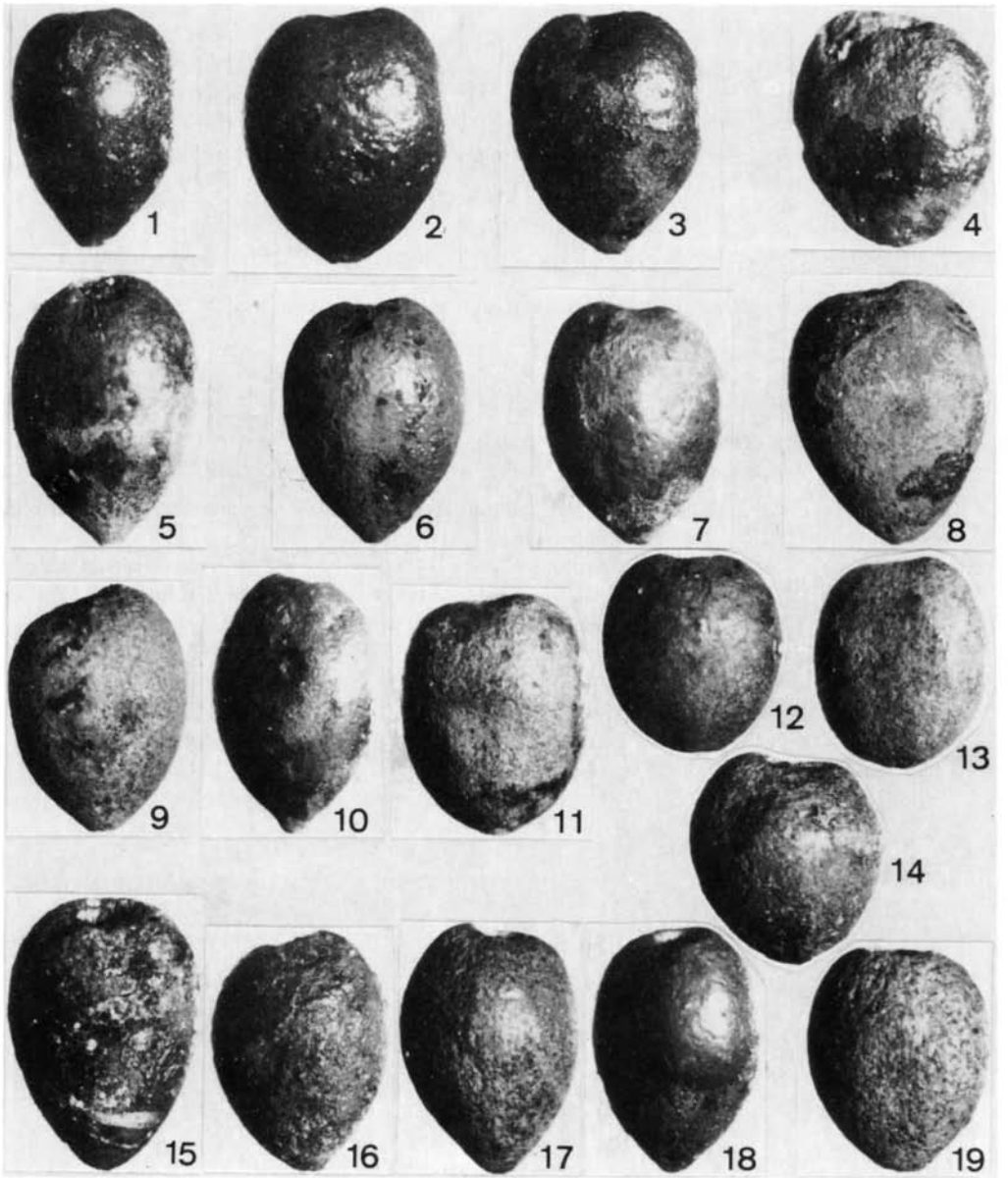
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Plate 5

Aracites interglacialis Wieliczk.

1. Seed with opercle; epidermis destroyed mostly in the basal part of seed, × 28.8; Olszewice
   1a – opercle (o); × 64
2. Seed with pedicle, × 28.8; Olszewice
   2a – arrow indicates the place where pedicle can break, × 128
3. Seed with strongly destroyed epidermis, × 28.8; Stanowice
   3a – details of 3 with parenchyma cells visible from the seed surface side; × 192
4. Longitudinal section of the seed with thin internal layer of the wall (integument) preserved which lines the cavity, × 28.8; Nowiny Żukowskie
   4a–c – details of 4 showing integument loosening and coming off the outer layer of the wall, with distinct cells (c) on the cavity side and smooth (s) on its other side. On the rigth hand side of the cavity parenchyma cells (p) of the outer part of the wall are visible

All figures are SEM micrographs

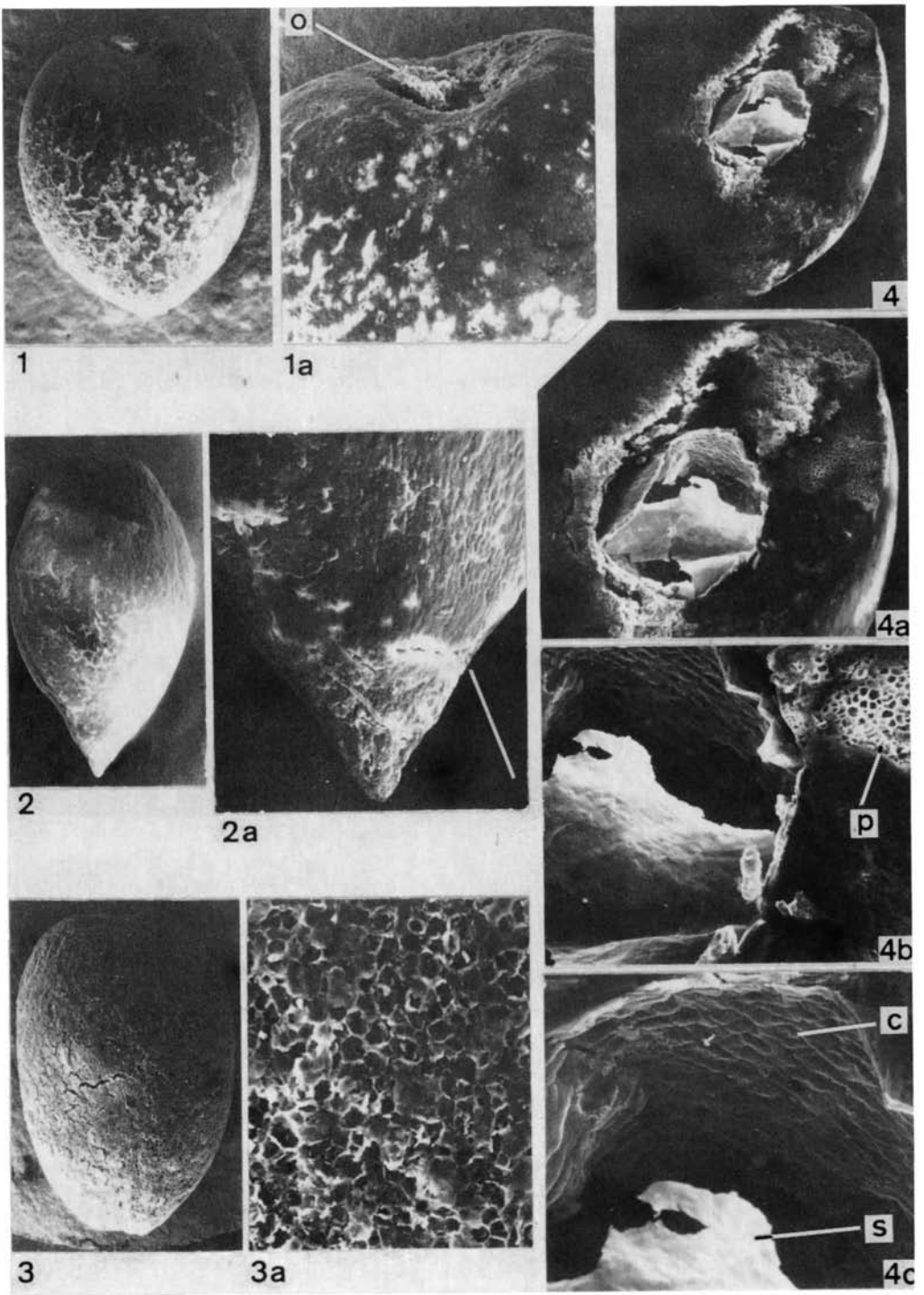

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Plate 6

Aracites interglacialis Wieliczk.

1. Longitudinal section of the seed with partly loosened internal layer of the wall (integument) lining the cavity; × 28.8; Olszewice
   1a–c – integument cells on the cavity side: 1a – × 64, 1b – × 192, 1c – × 640
2. Longitudinal section of the seed with well visible pear-shaped cavity without integument and two ducts (d) running in the external, thick part of the wall, × 28.8; Nowiny Żukowskie
   2a – cavity with canaliculus (micropyle) at the top of the seed, × 48
   2b – fragment of the cavity without integument, × 208
   2c – fragment of the duct at the bottom part of the seed, × 64
   2d – fragment of the duct and parenchyma cells of the external part of the wall are visible, × 208

All figures are SEM micrographs

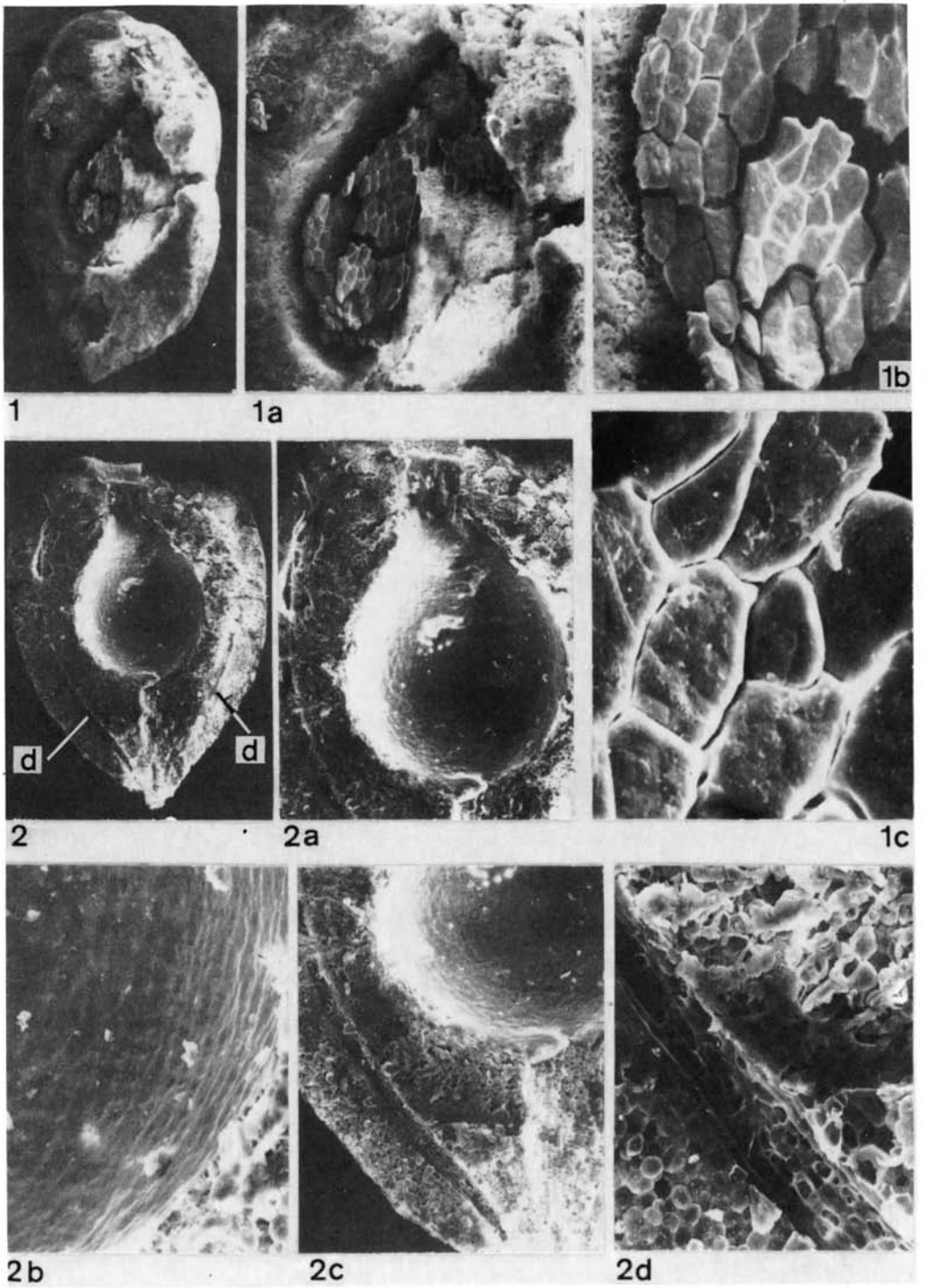

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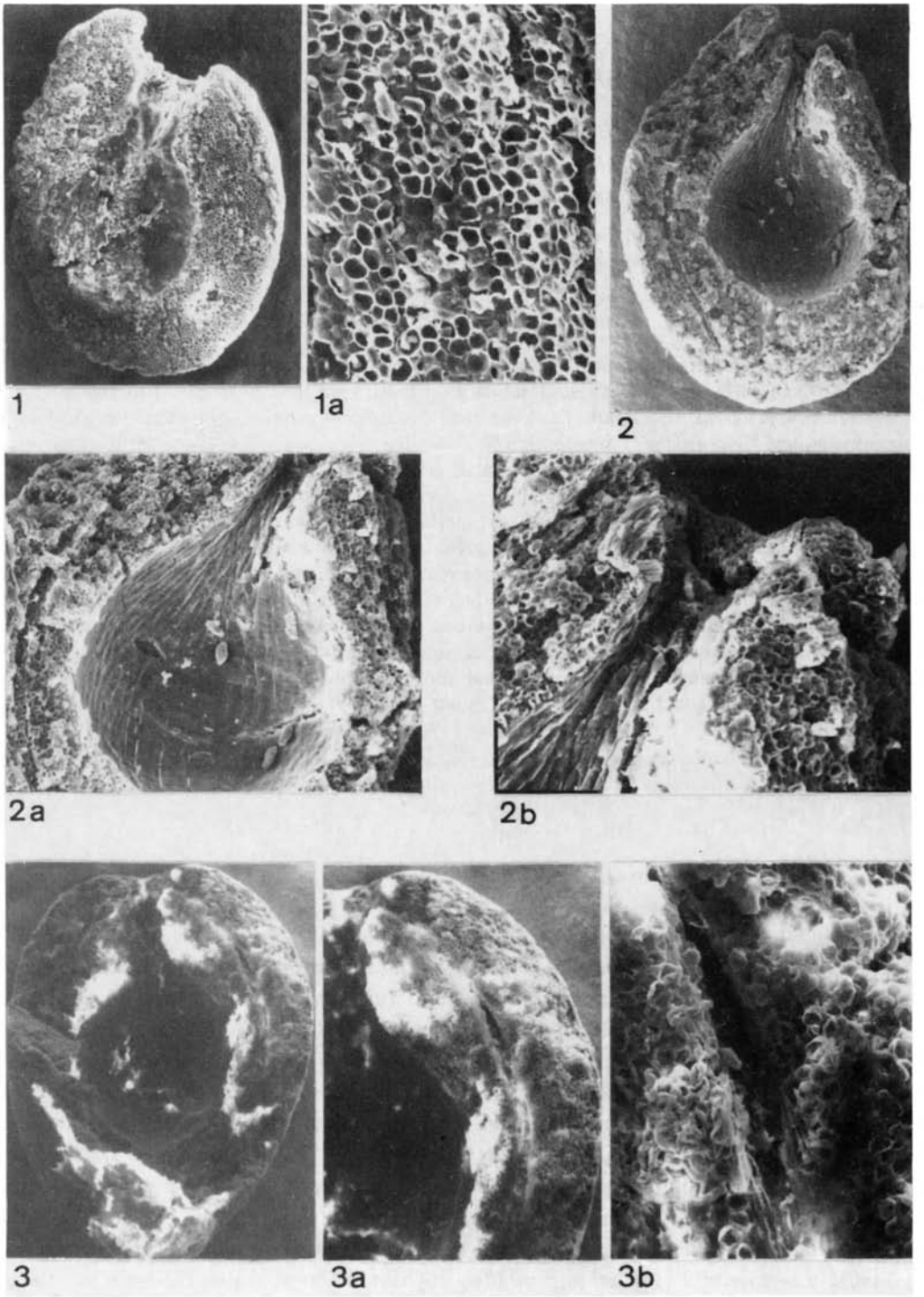
Plate 7

Aracites interglacialis Wieliczk.

1. Longitudinal section of the seed with well visible parenchyma cells of the external layer of the wall, × 38.4; Stanowice
   1a – parenchyma cells, × 208
2. Longitudinal section of the seed with pear-shaped cavity without integument; duct visible on the left hand side of the cavity, × 38.4; Nowiny Żukowskie
   2a – cavity × 64
   2b – canaliculus opening at the top of the seed, × 128
3. Longitudinal section of the seed with the duct running to the top of the seed, × 38.4; Alkhimkovo
   3a, b – details of 3: 3a – × 64, 3b – × 208

All figures are SEM micrographs


1
1a
2
2a
2b
3
3a
3b