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TAXONOMIC REVISION OF THE COLLECTIONS OF PLANT MACROFOSSILS FROM SOME LOCALITIES OF POLAND NOW REFERRED TO THE VISTULIAN GLACIATION*

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ABSTRACT: The paper presents results of a taxonomic revision of the collections of plant macrofossils from ten Polish localities now referred to the Vistulian Glaciation. All these collections are housed at the Palaeobotanical Museum of the Władysław Szafer Institute of Botany, Polish Academy of Sciences in Kraków. The results of the revision are presented in tables comparing the checklist of taxa given in papers published by the former authors and new ones introduced after the revision. Descriptions and photographs of some remains newly determined after the revision are also given, as are some remarks concerning the stratigraphical position of the re-examined floras and comments on the relationships and correlations between the macrofossil floras of Poland and those of Belarus and some other eastern countries.

KEY WORDS: flora, macroscopic plant remains, taxonomy, Vistulian, interstadial, stadial, Poland, Belarus

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INTRODUCTION

The overall collection of fossil macroscopic remains of plants from the Neogene and Quaternary deposits of Poland, housed at the Palaeobotanical Museum of the Władysław Szafer Institute of Botany, Polish Academy of Sciences, in Kraków has been assembled over a period of more than eighty years and is now one of the richest in Europe. Particularly interesting are the Pleistocene floras, numerous and diversified in respect of age and type. They come from localities usually studied in diverse ways using the methods of pollen and macroscopic analyses. In addition to fruits and seeds, this last analysis includes Charophyta, mosses, pieces of wood and other vegetative parts of plants and sometimes also animal remains.

In conformity with the practice of many

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years observed at the Palaeobotanical Museum of the Władysław Szafer Institute of Botany in Kraków, macroscopic remains are stored in a mixture of glycerine, alcohol and thymol. This method is good for the preservation of fruits and seeds, but it is troublesome in any comparative-morphological and taxonomic study. Moreover, the storage of materials in Petri dishes and various glass tubes needed much room and made unification of the assembled collections difficult.

Experience gained by other palaeobotanical centres (Berlin, Prague, Minsk, St. Petersburg) indicates that fossil floras can also be kept for decades in a dry state without taking any special preservative measures. For this reason, in recent years, parts of the Neogene and Quatenary remains have been kept dry. A decision was also reached to dry out slowly collections which have so far been kept wet. In the course of this labour-consuming activity it appeared that many fossil floras needed taxonomic revision. The most important reasons for undertaking a revision are 1/ the possibility, noted in a preliminary survey, of identifying many specimens placed in the collections as undetermined, 2/ the need to correct wrong determinations and 3/ to utilize progress in studies of many plants which have made it possible to determine remains more exactly than was done by the former authors.

The first results of the revision were given in publications about exotic and extinct plants in the Mazovian Interglacial in Poland (Mamakowa & Velichkevich 1993 a, b) followed by a taxonomic revision and rearrangement of the *Potamogeton* collection from the classical Neogene flora of Mizerna (Velichkevich & Lesiak 1996).

This pattern is being continued in the present work, which comprises a rearrangement and revision of the collections from ten localities in southern Poland now regarded as Vistulian in the literature (Fig. 1). Having carried out the revision, the authors suggest other stratigraphic positions for some of these floras. Such stratigraphic reconsiderations are justified not only by taxonomic changes but also – in Velichkevich's opinion – by certain morphological features and the general nature and state of preservation of taxa, all of which are dependent on the age of the given flora. Sometimes an age other than that currently assumed is suggested on the basis of various, more recent studies.

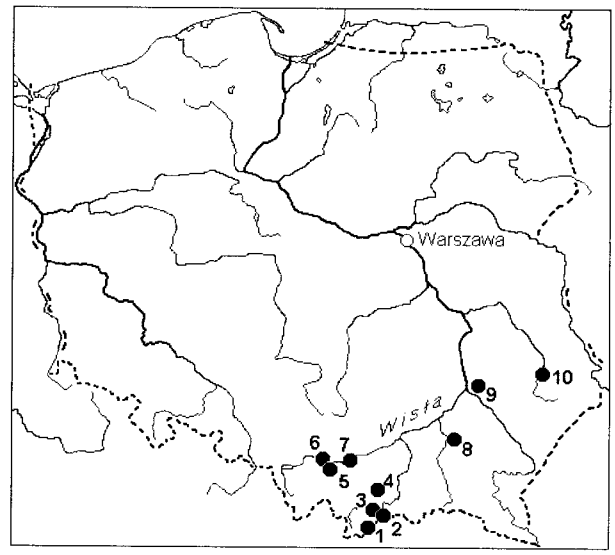

Fig. 1. Location of the sites of the revised plant macrofossil collections: **1 – Białka Tatrzańska** (Sobolewska & Środoń 1961), **2 – Kąty** (Dyakowska 1947, Mamakowa, Mook & Środoń 1975), **3 – Brzeziny** (Birkenmajer & Środoń 1960), **4 – Dobra** (Środoń 1968), **5 – Wadowice** (Szafer 1956, Sobolewska, Starkel & Środoń 1964), **6 – Zator** (Koperowa & Środoń 1965), **7 – Ściejowice** (Mądalski 1935, Dyakowska 1939), **8 – Rzochów** (Środoń 1976), **9 – Łążek** (Mamakowa 1968), **10 – Tarzymiechy** (Środoń 1954).

The exceptionally important role of Polish macrofossil floras results from their being correlated to palaeobotanical materials from eastern and western Europe and from the Baltic countries. Numerous collections of macroscopic remains have been gathered, and publications devoted to them have appeared in Belarus, Russia and the Ukraine. However, on account of the language barrier, they remain beyond the reach of west European palaeobotanists. The establishment of the basic relationships and correlations between the fossil floras of Poland and those of Belarus will be a bridge leading to further correlations between the east and west European fossil floras.

PRESENTATION OF RESULTS OF THE TAXONOMIC REVISION

The results of the revision are presented in Tables 1–17, each of which gives a description of the state of a given collection before and after the revision. Each table contains the names of taxa (before and after revision), the

kinds of remains and their numbers in particular samples or layers. The arrangement of the tables is based on the source publications, with the order of listing of taxa and samples (layers) used in the original publications being retained. Remains excluded from the revision on principle, i.e. Charophyta, pieces of wood, mosses and other vegetative remains have been omitted. The revision of *Carex* is incomplete, as it is mainly restricted to the division of fruits into 2-sided and 3-sided ones.

Nomenclature in the first column of the tables strictly follows that applied by the authors of the relevant publications, or it agrees with that used in the collections, if these contained specimens identified but not published. Abbreviations of the creators of names are given only when they appear in the source publication. In the second column (names of taxa after revision) we have tried to use up-to-date nomenclature, availing ourselves mainly of the work "Vascular plants of Poland, a checklist" (Mirek et al. 1995). New names introduced on the basis of the revision are marked by underlining. Remains which could not be determined were described in this column as "indeterminable" and those with an inaccurate original determination, but which it was not possible to correct in the course of the present revision as "indeterminate". Remains not found in the collections but mentioned in the source publications are described as "missing". Lastly, remains not determined in the collections and remaining indeterminate after the revision have not been included in the tables.

The next columns of the tables show the type of remains – according to their state after the revision, and the number of specimens in particular samples (layers) of the profile – first those given by the author(s) of the source publication, then (after the sign /) actually found in the collection. In the table for Wadowice (Szafer 1956) only the number of specimens after revision is shown, because in his paper the author did not give these numbers for each of the taxa determined.

Dots (in the vertical) as ditto marks are used to indicate repetitions of the names of taxa and the numbers of specimens, when within one taxon obtained in the initial determination, some new taxa were distinguished as a consequence of the revision.

Indeterminate remains present in the collection and sometimes those determined but not included in the source publication are listed below the appropriate table as a separate section under the heading "Plant remains present in the collection....", whereas remains derived from other samples (layers, profiles, etc.) and not tabulated in the source publication, or not described by its author at all, have been placed in additional columns. Such additional columns occur in the tables: Ściejowice (Tab. 2) as sample "AX", Kąty (Tab. 3) as "other profiles"; Wadowice (Tab. 11) as "peat", mentioned in the paper but not entered in the list of macroscopic remains, and as profiles "1953", "1954", "1960" – left out of the work in general; Brzeziny (Tab. 12) as "extra samples"; and Dobra (Tab. 15) as the jointly treated layers "Dobra", "Dobra C" and "Dobra X", not described in the work. In the collection from Tarzymiechy, two additional samples which it was possible to localize in profile I, but which were not given in the table or mentioned in the source publication (Środoń 1954) are shown in a separate table (Tab. 8). Naturally, in all these cases, the number of remains refers to the state "after revision".

FLORAS SUBJECTED TO REVISION

Ściejowice (Mądalski 1935, Dyakowska 1939)

Tables 1, 2

The first data about the flora of this locality appeared in a paper by Mądalski (1935), who, based on the results of a palaeobotanical study of a small peat sample from the middle part of the profile, inferred that this deposit was Mazovian (= Holsteinian) in age, not excluding, however, the possibility of its older (Sandomirien) origin.

Dyakowska (1939) carried out pollen and macroscopic remains analyses from the whole of the 1.85 m-thick peat layer. She was not quite certain as to the stratigraphical position of this deposit either, but regarded it as interglacial. Środoń (1952, 1960) referred this flora to the Aurignacian Interstadial (at present = Brørup).

The revision of Mądalski's materials presented in Table 1 covers only part of the collection handed over to the Institute of Botany. In its taxonomic composition the collec-

tion agrees with the data from his work, but it is quantitatively poorer. The other part, presumably, is in Lvov.

The results of the revision of Dyakowska's collection with all the supplements concerning the taxa not determined or wrongly determined by Dyakowska are shown in Table 2. Three floristic complexes can be distinguished in the profile on the basis of the distribution of plant macroscopic remains. The lower complex (acc. to Dyakowska layers G-B), representing the vegetation of a water body and adjoining moist habitats, is the richest. The most abundant remains belong to ten species of *Potamogeton* and several species of *Carex*. From this part of the profile Dyakowska (1939) mentioned several hundred seeds of *Menyanthes trifoliata,* which could not be verified because after being lent for biometrical studies (see Jentys-Szaferowa & Truchanowicz 1953) they got lost. In the collection there are, however, 97 seeds in a sample marked AX, whose position in the profile is unknown. Moreover, abundant fruits of *Carex rostrata* from layer C and one fruit of *Cladium mariscus* from layer G are also missing.

The *Potamogeton* species present have a wide range of climatic requirements (e.g. *P. praelongus, P. filiformis, P. gramineus, P. perfoliatus*) and are characteristic of the non-optimal parts of the interglacials or of the forest interstadials. It is worth mentioning the finding of the extinct species *P. dorofeevii* Wieliczk. and *P. panormitanoides* Dorof. - new to the Pleistocene of Poland. The first of them was also identified from the Middle Vistulian flora from Zator (see Tab. 14 in this paper), whereas the second was first distinguished in the Pliocene flora from Mizerna (Velichkevich & Lesiak 1996).

The combination of a fairly rich marsh-aquatic flora with the cold loving species *Betula humilis* Schrank and *Ranunculus gmelini* DC. and, as regards trees, the occurrence of only one needle of *Larix*, permit us to refer the lower floristic complex to some warmer part of the Vistulian.

The second and third floristic complexes (layers 3 and 7, respectively, in Dyakowska's work) derive from peat and peaty clay (respectively, 10 and 30 cm thick), separated by various clays devoid of identifiable plant remains. These complexes differ slightly from each other, but are both completely different from the first complex. Both represent poor treeless vegetation and perhaps come from different cold parts of the Vistulian.

The age estimation of the macroscopic flora from the profile investigated by Dyakowska (1939) does not quite agree with the results from a new profile at that site (Mamakowa & Rutkowski 1989). This profile is not so thick as the one investigated by Dyakowska. In Mamakowa's (Mamakowa & Rutkowski l.c.) opinion, the results of pollen analysis for its lower part present disturbed spectra. They have mixed pollen floras from warm and cold periods of the Pleistocene. The deposit was probably formed in the cold period of the Pleistocene, under conditions of intense solifluction, for which redeposition of pre-Quaternary material provides further evidence.

The results of pollen analysis for the upper part of the profile indicate the domination of herbaceous vegetation with a small proportion of shrubs. The C-14 dates obtained for this portion refer it to two different stratigraphic positions. The dates 23000 ± 600 BP (NaOH-SOL) and 24200 ± 600 BP (RES) point to the Late Vistulian, whereas the date 38000 ± 3600 BP suggests the Middle Vistulian. The data obtained in a pollen analysis do not show any fluctuations of the interstadial-stadial type.

Mamakowa suggests that all the dates may be too recent here, because the washing and redeposition of interglacial deposits seem more probable in the early glacial (Mamakowa & Rutkowski 1989, pp. 116, 117).

Kąty (Dyakowska 1947, Mamakowa, Mook & Środoń 1975)

Tables 3, 4

The flora bearing layers from Kąty near Sromowce were first studied by Dyakowska (1947), who placed them in the late part of an interglacial without defining its age. Środoń (1952) put forward a hypothesis suggesting an Early Vistulian age for this flora. As a result of repeated palaeobotanical studies and C-14 dating, the authors Mamakowa et al. (1975) tended to, agree with Środoń, but also took into consideration the decline of the Eemian Interglacial.

The results of the revision of Dyakowska's materials are given in Table 3. In relation to

the data contained in her work, the collection of macroscopic remains is very incomplete, because, as Dyakowska (1947, p. 1) writes, parts of the material were destroyed during the war.

The revision of A. Środoń's collection (Mamakowa et al. 1975) is shown in Table 4. It revealed that one cone of *Picea abies* in sample 7 and two needles of *Larix* in sample 19 of profile I and five cones of *Pinus sylvestris* and fruits of *Carex* sp. in profile II were missing. On the other hand, nine new taxa were identified, which were left by Środoń undetermined and not published by Mamakowa et al. (1975). Neither these new taxa nor several changes in the determinations of other species give this flora any distinct characters of stratigraphic significance. The lack of typical cold loving taxa and the relatively large group of taxa representing trees (*Picea abies, Pinus sylvestris, Betula* sect. *Albae, Alnus incana*) shift the age determination closer to the decline of the interglacial. According to Mamakowa, in the light of present-day knowledge of the Eemian pollen succession in Poland, the pollen diagrams from Kąty (Mamakowa et al. 1975) represent the decline of the Eemian Interglacial and not the Brørup Interstadial, while the Kąty II profile covers also the beginning of the Early Vistulian. The pollen succession permits their assignment to the decline of regional pollen assemblage zones E6 – *Picea-Abies-Alnus* and E7 – *Pinus*, and, in the Kąty II profile, to the first stadial of the Early Vistulian EV1 – Gramineae-*Artemisia-Betula nana* (cf. Mamakowa 1989).

Tarzymiechy (Środoń 1954)

Tables 5–9

Two Pleistocene macroscopic floras representing different stratigraphic units come from the site at Tarzymiechy in the Wieprz river valley. Both these floras were studied by Środoń (1954).

One of them, the so-called interstadial flora, was obtained from profiles from two boreholes situated on either side of the River Wieprz, about 50 m apart (Środoń 1954). These profiles, in Środoń's work referred to as I and II, figure in the museum collection as profiles IIIA (= prof. I) and IIIB (= prof. II). The revision of macroscopic remains from these profiles is shown in Tables 5 and 6 and, jointly for profiles I and II, in Table 7, which comprises the species of the genus *Potamogeton*. The combination of the species of *Potamogeton* into one collective "sample" for both profiles was made by M. Aalto during her revision of these materials carried out when staying at the Institute of Botany, PAS, in 1974. The separation of the endocarps in the collection into particular samples matching those in Środoń's (1954) work, proved impossible, which was unfortunately, disadvantageous in drawing climatic-stratigraphic conclusions. In addition to the published materials the museum collection possesses macroscopic remains from two samples from profile I (depth 9.60–10.45 m and 10.45–10.90 m), which were omitted by Środoń as indeterminate. They have been determined now and are presented in Table 8.

As a result of the revision the group of *Potamogeton* species (in Środoń's work identified by J. Mądalski), underwent the greatest number of changes. The species distinguished at present most frequently occur in interglacial floras varying in age and in interstadial forest floras.

An exotic species represented by one endocarp is noteworthy in this group. M. Aalto identified it as *Potamogeton oxyphyllus* Miq., which now occurs in Japan, Korea, and the far eastern part of Russia. Since some fragments of this endocarp (style, base, crest on lid) are lacking, it has been determined in the present revision as *P.* cf. *oxyphyllus* Miq., although it may well be that it is an endocarp, changed during fossilization, of the Late Pleistocene species *P. sukaczevii* Wieliczk., recently found in the Early Vistulian part of the profile from Horoszki (Velichkevich & Granoszewski 1996). This endocarp is also somewhat similar to those of the extinct Middle Pleistocene species *P. sarjanensis* Wieliczk. (Velichkevich 1979).

Other changes are associated with the enrichment of this flora by the introduction new taxa resulting from the identification of remains left undetermined by Środoń (1954), and, in several cases, from corrections to former identifications. Unfortunately, the remains of more than ten species named in Środoń's work have been lost, as shown in Tables 5 and 6.

The other macroscopic flora from Tarzymiechy is a classical *Dryas* flora derived from

Dryas silts overlying the lacustrine sediments. It comes from an exposure in the middle terrace of the River Wieprz. The results of the revision of this flora are summarized in Table 9. Apart from the remains published by Środoń (1954), it also lists undetermined remains present in the museum collection and a *Draba* sp. and *Silene* sp. determined by Środoń but not included in his publication (Środoń 1954).

The additionally identified taxa do not change the nature of this flora but enrich it. That is particularly true of the seed identified as *Silene wahlbergella* Chowd. (= *S. uralensis* (Rupr.) Bocquet), an arctic-montane plant at present distributed circumboreally, hitherto known only from two Vistulian localities, namely, Dobra and Sowliny (Środoń 1973).

The age of the deposits from which the above floras come has been controversial ever since their discovery. Środoń (1954) declared the flora from lake gyttja to be interstadial within the decline of the Cracovian Glaciation before the Mazovian Interglacial and he referred the *Dryas* flora and overlying sediments to the Middle Polish Glaciation. Dylik (1956) and Jahn (1956) associated the *Dryas* silts with the Middle Polish Glaciation and, based on Środoń's (1954) opinion, assigned the gyttja to the Mazovian Interglacial. A completely different view was held by Jersak (1973); he suggested Early Vistulian age for the gyttja from Tarzymiechy, attributing it to the Brørup Interstadial (Jersak 1973, p. 98) and placing the silts together with the *Dryas* flora in the older part of the "climax of the last cold period" (Jersak 1973, p. 114).

In 1977 Środoń, too, changed his stratigraphical estimation and referred the gyttja from Tarzymiechy to the Vistulian Interpleniglacial and the *Dryas* silts with the overlying sediments to the Upper Pleniglacial (Mamakowa & Środoń 1977). Later, Jersak (1991) dated the *Dryas* silts by the C-14 method to 18400 ± 320 and 19320 ± 320 BP, thus placing them in the upper horizon of the Middle Vistulian. This determination of their age was supported by Jersak et al. (1992), and for the gyttja they suggested Amersfoort age.

Another opinion on the age of these floras has recently been expressed by Harasimiuk et al. (1988), who put the lake deposits (peats and gyttjas) in a stratigraphic position between the maximal stadial of the Middle Polish Glaciation and the Warta Stadial, termed the Pilica Interstadial. The *Dryas* silts in the valley of the River Wieprz Tl dated to 142000 ± 20000 BP are referred by those authors to the Warta Stadial. This age determination for these silts is supported by Harasimiuk (1991) and recently also by Superson (1996), who stated that the C-14 dates presented by Jersak (1991) do not fall within the true period of deposition of the *Dryas* silts.

Admittedly, the *Dryas* floras have no indicator taxa allowing their assignment to a definite glaciation. Their stratigraphic position must be established by some other means. According to Velichkevich, however, the macroscopic flora from the lake gyttja does contain some stratigraphic indicators.

Evidence against referring it to the Middle Pleistocene is provided by the presence of *Najas flexilis* (Willd.) Rostk. & W.L.E. Schmidt, the present-day species whose history did not begin before the Eemian Interglacial. A similar but clearly separate species, *Caulinia goretskyi* (Dorof.) Dorof. (= *Najas goretskyi* sp. nov. Dorof.), occurs in older interglacials (Velichkevich 1982, 1992; Mamakowa & Velichkevich 1993a). At the same time this flora cannot be (in both authors' opinions) assigned to the Interplenivistulian because of its very great taxonomic diversity and the presence of relatively thermophilous species such as *Najas marina, N. minor, N. flexilis, Ceratophyllum demersum, C.* cf. *submersum,* some species of *Potamogeton*, etc.

In Velichkevich's opinion, the distribution of plant macrofossils in the profile from Tarzymiechy indicates that two different floristic complexes are contained in it. The lower complex contains samples 33–27, the upper one samples 25–19; sample 26 points to the occurrence of a change in the natural environment at that time. Remains of tree birches occur only in the upper complex, which is also richer in herbaceous taxa and this complex might be assigned to one of the Early Vistulian interstadials. It is, however, difficult to interpret stratigraphically the lower complex.

The results obtained so far from the study of profile I by pollen analysis, presented in Środoń's (1954) paper, indicate, according to Mamakowa, that the whole accumulation of this deposit took place in a period characterized by a very open landscape. This is evidenced by the very high values of *Artemisia*

pollen and the total of other herbs, reaching, respectively, 980 and 903% in relation to the total tree pollen. However, a decrease in the value of *Artemisia* pollen and the sum of other NAP in the upper part of the profile, indicate for certain a definite change in the vegetation, manifested in its somewhat greater density. This change in the proportion of pollen of herbaceous plants bears the hallmarks of a transition from stadial to interstadial, but in itself is not specific to a definite stratigraphic position in the Pleistocene. Nevertheless, it does not contradict the conclusions based on the macroscopic flora.

It should be stated that the studies of the gyttja by pollen analysis ought to be repeated on account of the possibilities of identifying the herbaceous pollen and differentiating among the *Pinus* and *Betula* pollen. The NAP total given by Środoń (1954) contains too many unknown components.

Wadowice (Szafer 1956, Sobolewska, Starkel & Środoń 1964)

Tables 10, 11

The first report on the fossil flora of Wadowice referred to solifluctional formations containing a glacial flora, which Szafer (1956) assigned to the last glaciation. This flora is interesting but not rich; unfortunately, it is very incomplete. The results of its revision are summarized in Table 10.

At the bottom of the solifluctional deposits a layer of forest peat varying in thickness was later found and studied in several exposures (Sobolewska et al. 1964).

On the basis of micro- and macroscopic analyses, although mainly on geomorphological studies, the authors suggested Brørup age for the organic deposit (Sobolewska et al. 1964). The macroscopic plant remains from this site come from a brickyard, from four profiles marked with the letters C, E, F, W2. All these profiles contain a layer of wood peat varying in thickness (max. 0.5 m).

In addition to the materials published, the museum collection also contains samples which are not connected with any definite profile and have not been published so far. In Table 11 of the present paper these samples are listed together in two additional columns. In comparison with Table IV in the paper by Sobolewska et al. (1964) several samples which were devoid of fossils are omitted (C 1, 2; F 1, 2; W2, 1, 3, 4).

Having viewed the macrofossils, Velichkevich is of opinion that this large and interesting flora could not have come from the Brørup Interstadial. It may represent either a fragment of some interglacial or a very warm interstadial, but from a part of the Pleistocene older than the Eemian Interglacial. The basis for this conclusion is the presence of thermophilous species, characteristic of the interglacial optima, such as *Potamogeton acutifolius* (Pl. 2, figs 18, 19), *P. trichoides* (Pl. 2, fig. 16) and *P.* cf. *nodosus* (Pl. 3, fig. 12). Besides – and this is very significant – the morphology of *P. acutifolius* shows such archaic characters as a strongly fringed lid and a distinct process on the ventral margin, which are characteristic of the population of this species in interglacials older than the Eemian (Dorofeev 1986). In the Eemian floras the endocarps of *P. acutifolius* have almost smooth lids and no process on the ventral margin or, at the most, a very small rounded protuberance.

The age of this flora, older than Late Pleistocene, may also be indicated by the extra-European species *Sparganium* cf. *stenophyllum* Maxim., which was identified during the revision. The presence of needles of *Picea* sect. *Omorica* (= *Picea omoricoides* Web.) and pollen of *P. omoricoides* (Sobolewska et al. 1964) does not contradict the age older than Brørup Interstadial assumed for this flora, because its needles are known in Poland from the Mazovian Interglacial at Nowiny Żukowskie (Dyakowska 1952) and Ciechanki Krzesimowskie (Brem 1953). Sobolewska, too, mentions other sites (Sobolewska et al. 1964, Pl. V). Szafer (1953) even held it to be a characteristic species of the Mazovian Interglacial. According to Velichkevich, this opinion of Szafer finds confirmation in Belarus and west-central Russia (see Velichkevich 1982).

Brzeziny (Birkenmajer & Środoń 1960)

Table 12

Macroscopic plant remains have been extracted from profile A. Two layers of plate-like peat and clayey and sandy layers adjacent to them, altogether 1.25 m in thickness, have been analysed. This profile was situated on

the left bank of the River Dunajec, 0.5 km upstream from Czorsztyn. On the basis of micro- and macroscopic studies Środoń (Birkenmajer & Środoń 1960) determined the age of this flora as Aurignacian Interstadial (= Brørup, in today's stratigraphy).

The results of the revision of this flora are listed in Table 12. The depth of sampling is given twice, because, in the museum collection, these depths are given from the bottom of the flora-bearing layer upwards and in Birkenmajer & Środoń's (1960) paper the other way round, that is, from top to bottom. In Table 12 these last are parenthesized.

In the museum collection, in addition to the remains published by Birkenmajer & Środoń (1960), there were also some indeterminate remains not mentioned in their work. After identification they have been included in Table 12. A great many taxa, however, were lost from the collection, as is shown in the table.

The composition of the Brzeziny macroscopic flora, even with the alterations made in it taken into account, does not necessitate any change in the nature of the vegetation based on Środoń's reconstruction of it. It is one of the richest macroscopic floras of the Early Vistulian of Poland. In Belarus and Lithuania the macroscopic floras of this age are very similar in taxonomic composition (Velichkevich 1982) to that of the flora from Brzeziny, but they show a significantly lower proportion of *Larix* which does not occur at all in the macroscopic floras of that age in western Russia.

The results of pollen analysis from the Brzeziny profile presented by Środoń (Birkenmajer & Środoń 1960), according to Mamakowa, point to alternating phases in the vegetation between more open and more woodland landscapes. The nature of these changes is different from those of the Early Vistulian continuous sequences distinguished above the Eemian Interglacial in the diagrams from central Poland (Mamakowa 1989). Moreover they seem to involve not only the Brørup Interstadial and its adjoining stadials but also a fairly large segment of the Vistulian Glaciation. In order to obtain a more reliable age determination it would be advisable to repeat the studies both by pollen analysis and dating the deposits.

Białka Tatrzańska (Sobolewska & Środoń 1961)

Table 13

At this site the macroscopic remains were derived from varied silts, 2 m thick, which occur in an outcrop in the left-bank terrace of the River Białka in the Nowy Targ Basin.

A palaeobotanical study by pollen and macrofossil analyses (Sobolewska & Środoń 1961) provided no basis for an unequivocal age determination. A hypothesis was formulated that this flora is derived either from the decline of the Aurignacian Interstadial (= Brørup) or from the Paudorf Interstadial. Later, it was explicitly referred by Środoń (1968) to the Paudorf Interstadial (= Denekamp).

The revision of this not very rich flora shows that significant changes involved only a group of *Ranunculus* species. It was found that the remains of European species with moderate climatic requirements idntified by Środoń (*Ranunculus flammula, R.* cf. *oreophilus* and *R. sceleratus*), did in fact belong to the more cold loving species *R. reptans* and *R. gmelini* (see Tab. 13).

The macroscopic flora has some characters which bring it nearer to the cold flora from Zator (see p. 36). However, taking into consideration the situation of the locality at an altitude of 700 m a.s.l. one may assume that it represents the Denekamp Interstadial. The results of a pollen analysis also show a succession of an interstadial nature, referred to the Denekamp Interstadial.

Zator (Koperowa & Środoń 1965)

Table 14

The flora of this site comes from peaty silts and thin peat layers, which in the fifties became uncovered in the northern face of a claypit, 1.5 km south of Zator (30 km west of Kraków). Deposits, about 3 m thick, with abundant plant remains, occur on river gravels and are covered by a layer of loess-like clays about 5 m thick. On the basis of palaeobotanic data and the C-14 date >40000 years BP obtained from the older part of the profile, this flora was recognized as Middle Vistulian and referred to the cool and moist Pleniglacial A (Koperowa & Środoń 1965).

The revision of this flora made it possible to distinguish several new species among the remains in the collection which had not been identitified by Środoń (Koperowa & Środoń 1965), while several species' determinations were changed. The finding of endocarps of the extinct species *Potamogeton dorofeevii* Wieliczk., which had been identified as *P. lucens* L. before, is most significant. *P. dorofeevii* Wieliczk. (Velichkevich 1977), described a relatively short time ago, had never been recorded from the Pleistocene floras of Poland. Interesting also is the presence of the circumpolar arctic-boreal species *Sparganium hyperboreum* Laest. and *Ranunculus gmelini* DC., resembling it in its climatic requirements. The remains of these species appeared in Środoń's (Koperowa & Środoń 1965 – Tab. 2, p. 10) list as *Sparganium minimum* Wallr. and *Ranunculus sceleratus* L., taxa characteristic of the forest floras of Europe.

All three newly determined cold loving species together with *Armeria maritima* (Mill.) Willd., *Betula nana* L. and *Selaginella selaginoides* (L.) PB. ex Schrank & Mart., noted by Środoń, make up a distinct floristic complex, which represents a sedge-and-moss-type tundra vegetation. Many other species of the flora from Zator, such as *Myriophyllum spicatum* L., *Hippuris vulgaris* L., *Potamogeton filiformis* Pers., *P. vaginatus* Turcz., *Ranunculus reptans* L., *Batrachium* sp. and *Eleocharis palustris* (L.) Roem. & Schult. usually accompany the species of the arctic-boreal complex in these types of fossil floras, although in the present-day flora their range is considerably wider.

This slightly changed composition thoroughly confirms the original estimated age of the Zator flora which may be acknowledged as standard for the cold part of the older Plenivistulian. In Belarus and western Russia the floras from the Shapurowo and Konevich sites on the Kaspla and western Dvina rivers, together with that from Liejasciems in Latvia (Arslanov et al. 1975) may well be of the Zator type.

Dobra (Środoń 1968)

Table 15

Plant macrofossils of this site were obtained from several layers of silt with plant detritus, lying between layers of fluvial gravels of the River Łososina at a depth of 9.5–12.5 m and covered with a 9.5-metre-thick layer of clays incorporating large amounts of gravel.

The greatest amounts of macroscopic remains were obtained from the lower (12.0–12.5 m) and upper parts (9.5–9.9 m) of that range. Only a few taxa represented by single or a small number of specimens were collected at depths between 9.9 and 10.45 m. Środoń referred this flora to the upper part of the Paudorf Interstadial on the basis of the C-14 date of 32550 ± 450 years BP (= Denekamp Interstadial).

The results of the taxonomic revision of the museum collection are shown in Table 15. It gives the depths of layers in metres after Środoń (1968) and the designations of these layers as they appear in the museum collection. The table contains the remains presented in Środoń's (1968) paper in Table 2 and a list of additional remains which were present in the collection but were not (with few exceptions) identified by Środoń and have not hitherto been published. Among these additional remains there is one seed of *Silene wahlbergella* Chowd., which was published in a separate paper (Środon 1973). It had been found by Środoń in residual deposits from the C-14 dated layer. Missing remains listed by Środoń (1968) have been included in this table as well.

A specific feature of the flora from Dobra is the great diversity of remains of terrestrial herbaceous plants, not only from wet habitats, but also of heliophytes from drier places. The cold loving plants (*Betula nana* L., *Salix herbacea* L., *Polygonum viviparum* L., *Silene wahlbergella* Chowd., *Armeria alpina* (DC.) Willd., *Thalictrum alpinum* L., etc.), which suggest quite a cool climate at that time, form a big group. In view of the fairly great altitude of Dobra above sea level, they may have occurred at this site in the Denekamp Interstadial. The results of the pollen analysis are consistent with those of the study of the macroscopic remains.

Łążek (Mamakowa 1968)

Table 16

The museum collection comprises a poor macroscopic flora (only ten taxa), which had been extracted from a 25-cm-thick layer of peat in the terrace of the River Sanna, a right-

bank tributary of the Vistula. On the basis of the C-14 date of 25580years BP and the results of palynological studies, Mamakowa (1968) assigned this flora to the decline of the Paudorf Interstadial (at present = Denekamp Interstadial – Mamakowa 1994).

After completion of the revision, some changes were made to the original determinations. The more important of them are: a change in the determination of the nutlets of *Betula nana*, (which, acc. to Velichkevich, are of *B.* cf. *humilis*), the finding of two seeds of *Pinus sylvestris* among the seeds of *Larix* and the suggestion that the remains identified as *Larix* sp. belong to *Larix* cf. *decidua* Mill.

It should be stated that the attribution of the deposits from Łążek to the Denekamp Interstadial was for the most part based on their C-14 dating. The nature of the macroscopic flora and the pollen diagram do not preclude another interstadial oscillation, even an Early Vistulian one.

Rzochów (Środoń 1976)

Table 17

The profile of deposits from the terrace of the River Wisłoka at Rzochów, in which some bones of a steppe mammoth (*Mammuthus trogontheri)* were discovered by Borsuk-Białynicka (Borsuk-Białynicka & Wysoczański-Minkowicz 1969), was studied using pollen analysis by Niklewski (Laskowska-Wysoczańska & Niklewski 1969). The terrace from which these deposits came has been referred to the Vistulian Glaciation on the basis of geological findings by Laskowska-Wysoczańska. From this profile Środoń (1976) analysed one sample from the layer of dark grey sandy loam underlying the bone bearing peat horizon. The taxonomic revision of this flora, shown in Table 17, covered the macroscopic remains published by Środoń (1976) and those present in the collection as indeterminate and Varia.

The specific nature of the flora from Rzochów lies in the almost exclusive presence of terrestrial taxa, chiefly from moist and wet habitats. Only three aquatic taxa (*Salvinia natans, Nymphaea* cf. *alba, Potamogeton* sp.) are represented and by a small number of specimens at that. Herbs are most abundantly represented by the fruits of various *Carex* species, which were subjected to revision only on a small scale. As regards other taxa, relatively abundant are *Lycopus europaeus, Comarum palustre, Filipendula ulmaria* and *Urtica dioica.* Very abundant also are the remains of *Pinus sylvestris* and *Betula* sect. *Albae*, which indicate the forest nature of this flora. The remaining taxa are represented by single or a few specimens.

In connection with the revision, attention should be given to the changes whereby the fruits determined originally as *Alnus glutinosa* have been referred to *A. incana*, and those determined biometrically by Białobrzeska (see Środoń (1976) as *Betula* t. *humilis* reallocated to *B.* sect. *Albae* (see Pl. 1, figs 6, 7). Only 75 fruitlets were revised because 105 had been lost. Fruit scales of *Betula pendula* (Pl. 1, fig. 11), typical of the species and present in this flora, correlate very well with the fruits of tree birches.

The macroscopic flora from Rzochów did not reveal an indicator taxon after revision that would have determined the exact stratigraphic position of these deposits. Nor were there any representatives of floras pertaining to the cold periods of the Pleistocene. Its floristic composition assigns it to the optimal parts of the interstadials of the Early Vistulian, notably the Brørup Interstadial, but the occurrence of macrospores and microsporangia of *Salvinia natans* points to the decline of the Eemian Interglacial. According to Mamakowa this latter inference may be drawn from the pollen diagram constructed by Niklewski, an assessment in full agreement with Niklewski's (Laskowska-Wysoczańska & Niklewski 1969), but Środoń (1976) preferred to link up this profile with the Brørup.

SYSTEMATIC DESCRIPTIONS

GYMNOSPERMAE

CUPRESSACEAE

Juniperus communis L.

Pl. 1, fig. 4

Picea sp. in coll. Q-104, det. A. Środoń.

Material. Coll. KRAM-P No Q-104/21 (1 specimen).

Description. One seed 3.4 × 1.6 mm, elongate, obovate in outline, abnormally triangular in cross-section. Ventral wall rather flat, both dorsal walls slightly convex with oval pits. Surface irregularly rough, grey, mat.

Remarks. In its atypical shape (more elongate than usual), this specimen differs from present-day seeds.

PINACEAE

Larix cf. *decidua* Mill.

Pl. 1, fig. 2

1968 *Larix* sp., Mamakowa: p. 34.

Other record: *Picea* sp. in coll. Q-104, det. A. Środoń.

Material. Coll. KRAM-P Nos Q-42/6c_1, 6f (37 specimens), Q-104/24 (12 specimens)

Description. One seed 4.5 × 2.5 mm, obovate in outline, plano-convex in cross-section. Apex uniformly rounded; base attenuate and somewhat extended. Walls thick, firm. Surface dark beige to dark brown, indistinctly striate, striae more clearly visible on the plane face adjoining the wing.

Picea sect. *Picea*

Pl. 1, fig. 3

1964 *Picea* sp., Sobolewska, Starkel & Środoń: p. 32.

Other records: 1947 *Picea* sp., *Picea excelsa* Lk., Dyakowska: p. 18; 1960 *Picea excelsa* Lk., Birkenmajer & Środoń: pp. 20, 25; 1964 *Larix* sp., Sobolewska, Starkel & Środoń: p. 32; 1975 *Juniperus* sp., *Picea abies* (L.) Karst., Mamakowa, Mook & Środoń: p. 160.

Material. Coll. KRAM-P Nos Q-2/4d, 7a-c (5 specimens); Q-104/39 (3 specimens); Q-106/5, 7, 10, 22, 26 (31 specimens); Q-106A/18, 19 (2 specimens).

Description. One seed 4.3 × 2.5 mm, obovate in outline, plano-convex, somewhat asymmetric. Apex slightly narrowed, rounded, base narrowly cuneiform. Walls fairly thin and fragile. Surface dark brown to black, finely tuberculate, covered all over with the dark dots of resin ducts. Inconspicuous striae radiate fan-like from the base on the flat side.

Pinus sylvestris L.

Pl. 1, fig. 1

1968 *Larix* sp., Mamakowa: p. 34.

Other records: 1960 *Picea excelsa* Lk., Birkenmajer & Środoń: p. 20; *Picea* sp. in coll. 104, det. A. Środoń; 1964 *Picea* sp., Sobolewska, Starkel & Środoń: p. 32; Varia in coll. Q-2; 1975 *Picea abies* (L.) Karst., Mamakowa, Mook & Środoń: p. 160; 1976 *Pinus silvestris* L., Środoń: p. 302; Indet. in coll. Q-32.

Material. Coll. KRAM-P Nos Q-2/7a_2, 50g (4 specimens); Q-32/5g, 53c_1 (7 specimens); Q-42/6c_2 (2 specimens); Q-104/40, 22 (18 specimens); Q-106A/65 (6 specimens).

Description. One seed 3.8 × 2.4 mm, obliquely obovate in outline, weakly biconvex. Apex broadly rounded, with a small, black wart in the middle. Base tapering, with a blunt tip. Walls thin, resilient; surface fine-celled, pale brown or dirty beige, somewhat oily and shining. Black dots (resin ducts), prominent on the pale surface, merge into "stains" at the base.

ANGIOSPERMAE

BETULACEAE

Betula sect. *Albae*

Pl. 1, figs 5–7

1954 *Betula* cf. *humilis* Schrank., Środoń: p. 17.
1976 *Betula* t. *humilis* Schrank, Środoń: pp. 302, 304.

Other records: 1954 *Betula humilis* Schrank, *B. "alba"* L., Środoń: pp. 14, 19; *Betula "alba"* L. in coll. Q-104, det. A. Środoń; indet. in coll. Q-104; 1964 *Betula "alba"* L. Sobolewska, Starkel & Środoń: p. 32; *Betula* sp. in coll. Q-42, det. K. Mamakowa; 1975 *Betula* t. *alba*, Mamakowa, Mook & Środoń: p. 160; indet. in coll. Q-32.

Material. Coll. KRAM-P Nos Q-2/3a, 3b (16 specimens); Q-32/3, 52i, 53c_2 (77 specimens); Q-42/5 (1 specimen); Q-104/47, 107, 108, 109, 112 (64 specimens); Q-105/IIIB-29n, 31h, 30n (22 specimens); Q-105/IIIA-19j, 20l, 21m, 24k, 25o (10 specimens); Q-105/9.60–10.45/15 (2 specimens); Q-106A/71 (2 specimens).

Description. Nutlets 1.5–2.3 × 0.8–1.3 mm, narrowly obovate to irregularly rhomboid in outline, broadest in the upper half, flat. Apex

weakly narrowed or rounded, with two short beaks. Base tapering and horizontally truncate. Wall thin, resilient. Surface indistinctly striate, dark brown to almost black, slightly lustrous.

Betula pendula Roth.

Pl. 1, fig. 11

1976 *Betula* t. *verrucosa* Ehrh., Środoń: pp. 302, 304.

Material. Coll. KRAM-P No Q-32/4a, 4b (27 specimens).

Description. The scales of this species are wide and thick, with a short cuneate central lobe and wide, rounded and slightly reflexed lateral lobes.

Betula humilis Schrank

Pl. 1, figs 8–10

1954 *Betula humilis* Schrank, Środoń: pp. 14, 19.
1968 *Betula nana* L., Środoń: p. 8.

Other records: 1939 *Betula nana* L., Dyakowska: pp. 4, 7; 1954 *Betula "alba"* L., Środoń: pp. 14, 17; 1960 *Betula humilis* Schrank, Birkenmajer & Środoń: pp. 20, 27; 1968 *Betula humilis* Schrank, Mamakowa: p. 35; Varia in coll. Q-82.

Material. Coll. KRAM-P Nos Q-1/48, 49, 50, 51 (4 specimens); Q-42/2a_1, 2b_1 (6 specimens); Q-82/89b, 94c, 108e (65 specimens); Q-104/107 (1 specimen); Q-105/IIIA-23m, 26$g_{1,2}$, 27h (15 specimens).

Description. In comparison with *Betula* sect. *Albae* the nutlets of *B. humilis* Schrank (Pl. 1, figs 8, 9) are mostly narrowly to broadly ovate to oval in section, with a thicker wall and with a more lustrous surface. The scales of *B. humilis* Schrank are smaller, with a short, broad base and widely spreading lobes, of which the central is always somewhat broader and considerably longer than the lateral ones (Pl. 1, fig. 10).

Betula nana L.

Pl. 1, figs 12–14

1968 *Betula nana* L., Środoń: p. 8.

Other records: 1935 *Betula nana* L., Mądalski: pp. 5, 6; 1954 *Betula nana* L., Środoń: pp. 14, 19; Varia in coll. Q-82;

Material. Coll. KRAM-P Nos Q-1A/35c (4 specimens); Q-82/87, 89a, 92e, 94b (64 specimens); Q-105/IIIA-26g_3, 27i (6 specimens), Q-105/D-30 (1 specimen).

Description. The scales of *Betula nana* L. have all three lobes more or less identical (Pl. 1, figs 13, 14). The nutlets are broad and ovate or irregularly circular in outline, sometimes narrowly winged (Pl. 1, fig. 12).

CERATOPHYLLACEAE

Ceratophyllum demersum L.

Pl 1, figs 30–32

1954 *Ceratophyllum demersum* L., Środoń: pp. 14, 17.

Other record: indet. in coll. Q-105.

Material. Coll. KRAM-P Nos Q-105/IIIA-19e, 20b, 21b, 22c, 23f, 24c, 25c, 26a, 27a, 28a_2, 29a, 31e (71 specimens); Q-105/IIIB-30a, 31m (3 specimens); Q-105/9.60–10.45/1 (5 specimens); Q-105/10.45–10.95/1 (7 specimens).

Description. Fruits 3.8–4.5 × 2.4–3.0 mm, elliptic in outline, biconvex. Apical spine usually longer than fruit, basal ones generally shorter, sometimes reduced to knoblike processes. Walls thick, durable, surface smooth, black, slightly glossy; epidermis if present, indistinctly celled.

Remarks. This plant is widespread in aquatic communities throughout the whole of Eurasia. In the Pleistocene it appears mostly in interglacial floras, more rarely in forest interstadials.

Ceratophyllum pentacanthum Haynald

Pl. 1, figs 27, 28

1954 *Ceratophyllum demersum* L., Środoń: pp. 14, 17.

Material. Coll. KRAM-P No Q-105/IIIA-27b, 29b (5 specimens).

Description. Fruits similar to those of the preceding species in shape and size, but having additional, short, flattened lateral processes or sometimes just two distinct knobs, one on each side. The apical spine is somewhat laterally displaced and the basal ones are longer, sometimes exceeding the fruit. The fruits of the present-day plant have a long stalk at the base, which in fossil fruits is missing.

Remarks. Fruits of *C. pentacanthum* occur exclusively in interglacial floras, represented by a very small number of specimens amidst numerous specimens of the previous species.

Ceratophyllum cf. ***submersum*** L.

Pl. 1, fig. 29

Indet. in coll. Q-105.

Material. Coll. KRAM-P No Q-105/9.60–10.45/2 (1 specimen).

Description. One half of a fruit measuring 4.3 × 3.0 mm, elliptic in outline, weakly convex. At the top and base there are only small tubercles instead of spines. The surface is black, rough and slightly glossy. Although the apical spine is absent, the nature of the cells on the interior walls of the fruit does not preclude the possibility that it may have been broken off. Typical fruits of *Ceratophyllum submersum* L. are, as a rule, larger and broader than the fruits of *C. demersum* L.

Remarks. Środoń also referred four other spineless fruits to this species. However, these are missing, but one of them is shown in Plate I in his paper (Środoń 1954).

CYPERACEAE

Carex bohemica Schreb.

Pl. 1, fig. 15

Varia in coll. Q-2.

Material. Coll. KRAM-P No Q-2/50m (17 specimens).

Description. Fruits 1.8–2.2 × 0.8–0.9 mm, irregularly elliptic in outline, slightly extended in the lower part. Apex passing gradually into the cylindrical base of the style (one of the specimens has a fragment of vascular bundle). Surface fine-celled, with the cells arranged in distinct longitudinal rows.

Remarks. Fruits of this type often occur in the floras of the older interglacials of Belarus.

Schoenoplectus tabernaemontani (C.C. Gmel.) Palla

Pl. 1, fig. 16

1954 *Scirpus holoschoenus*, Środoń: p. 18.

Other records: 1954 *Scirpus* sp., Środoń: p. 15; indet. in coll. Q-105.

Material. Coll. KRAM-P Nos Q-105/IIIA-19g, 20f, 21s (9 specimens); Q-105/IIIB-29e, 30l, 31i, 32c (17 specimens); Q-105/9.60–10.45/17 (1 specimen).

Description. Fruit 1.8 × 1.4 mm, obovate in outline, plano-convex. Apex broadly rounded, with acute style base. Base of fruit horizontally truncate, with fragments of spiny setae. Surface fine-celled black, mat. Setae ribbon-shaped, resilient, with spiny margins.

Remarks. In the Late Pleistocene floras it occurs more rarely than *Schoenoplectus lacustris* and, as a rule, in the non-optimal phases of interglacials or in forest interstadials.

Schoenus nigricans L.

Pl. 1, figs 19, 20

Indet. in coll. Q-104 and Q-106A.

Other record: Varia in coll. Q-82.

Material. Coll. KRAM-P Nos Q-82/92a, 93a, 95b, 98c, 101d, 102d, 103b, 108c (54 specimens); Q-104/33, 98 (37 specimens); Q-106A/60, 61 (17 specimens).

Description. Fruits convex-trigonous, 1.7 and 2.0 mm long, with projecting ridges and the flattened style base at the top. Walls thin, resilient, generally deformed in various directions.

Remarks. This species is characteristic of the interglacial floras of Belarus. In Polish fossil collections its remains usually occur amidst indeterminate specimens.

Scirpus sylvaticus L.

Pl. 1, fig. 21

1975 *Urtica dioica* L., Mamakowa, Mook & Środoń: p. 160.

Material. Coll. KRAM-P No Q-106A/7 (1 specimen).

Description. Fruit 0.9 × 0.65 mm, obovate in outline, triangular (compressed). Apex broadly rounded, with rounded, projecting style base. Base of fruit narrowed and rounded, without setae. Surface with delicate longitudinal striae; slightly lustrous.

Remarks. Relatively scarce in fossil floras.

EMPETRACEAE

Empetrum nigrum L.

Pl. 1, fig. 17

1939 *Potamogeton filiformis* Pers., Dyakowska: pp. 4, 6.

Material. Coll. KRAM-P No Q-1/13a_4 (1 specimen).

Description. Seed 1.8 × 1.2 mm, narrow-obovate in outline, triangular in cross-section. Dorsal surface uniformly convex, passing onto sides at nearly right angle. Sides flat, smooth. Ventral margin straight, obtuse, with a central wart. Surface fine-celled, grey-brown, mat.

Remarks. In the Pleistocene it occurs exclusively in forest-type floras. It is not frequent, single specimens usually being found. At the present time it is circumpolarly distributed in the northern hemisphere, in the tundra and forest belts.

HALORAGACEAE

Myriophyllum alterniflorum DC.

Pl. 1, fig. 25

1939 *Myriophyllum alternifolium* DC., Dyakowska: pp. 4, 7.

Material. Coll. KRAM-P No Q-1/8c_1, 8e_1 (2 specimens).

Description. Fruit 1.6 × 0.9 mm, short, comparatively broad, weakly bent longitudinally, subcircular in cross-section. Ventral margin straight, rounded. Dorsal surface uniformly convex, obscurely grooved. Base rounded, passing almost imperceptibly into the ventral margin. Apex broad, obliquely truncate. Surface usually smooth, lacking tubercles.

Remarks. *Myriophyllum alterniflorum* DC. = *Myriophyllum alternifolium* DC. It differs from *M. spicatum* L. and *M. verticillatum* L. in its smaller fruit with rounded base, broad apex and usually lack of tubercles. In Pleistocene floras it occurs very rarely and singly.

Myriophyllum spicatum L.

Pl. 1, figs 22–24

1954 *Myriophyllum alternifolium* DC. + *M. spicatum* L., Środoń: pp. 14, 20.

Other records: 1939 *Myriophyllum alternifolium* DC., Dyakowska: pp. 4, 7; 1954 *Myriophyllum spicatum* L., Środoń: pp. 43, 46; indet. in coll. Q-105; 1965 *Myriophyllum* sp., Koperowa & Środoń: p. 11.

Material. Coll. KRAM-P Nos Q-1/8a, 8b, 8c_2, 8d, 8e_2 (12 specimens); Q-3/10 (1 specimen); Q-105/IIIA-33b, 32b, 31a, 30d, 29d, 28b, 27d, 26b, 25h, 23l, 20j (83 specimens); Q-105/9.60–10.45/10 (3 specimens); Q-105/10.45–10.95/6 (4 specimens); Q-105/D-66 (1 specimen).

Description. Fruits 1.5–2.2 × 0.9–1.1 mm, narrow, slightly bent longitudinally, broadest below the middle, triangular in cross-section. Ventral margin straight, acute. Dorsal surface somewhat convex, tuberculate all over or only below, sometimes nearly smooth, with obscure longitudinal grooves and minute tubercles. Base rounded, contact between ventral and basal margins is in the lower part of ventral margin. Apex obliquely truncate, entrance to interior cavity of fruit covered by a circular operculum, which is usually missing.

Remarks. The fossil fruits are most characteristic of the deposits of the non-optimal parts of interglacials or interstadials, and also of the periods characterized by tundra. It is noteworthy that in cold loving complexes the fruits of this species are elongate and fairly smooth, whereas in interglacial floras they are more often broader and strongly verrucose.

Myriophyllum verticillatum L.

Pl. 1, fig. 26

1954 *Myriophyllum alternifolium* DC. + *M. spicatum* L., Środoń: pp. 14, 20.

Other records: 1964 *Myriophyllum* sp., Sobolewska, Starkel & Środoń: pp. 33, 35.

Material. Coll. KRAM-P Nos Q-2/28 (8 specimens); Q-105/IIIA-20k, 21g, 24h, 25i (5 specimens).

Description. Fruits 1.5–2.3 × 1.0–1.3 mm, more or less elongate, with longitudinal axis slightly curved, triangular in cross-section. Ventral margin straight, obtuse. Dorsal surface uniformly convex, with narrow grooves. Apex obliquely truncate. Base narrowed, cuneiform. Surface smooth, lacking tubercles.

Remarks. In fossil floras the fruits of this species are relatively rare and most frequently associated with cool floristic complexes.

POACEAE

Glyceria maxima (Hartm.) Holmb.

Pl. 1, fig. 18

1964 *Glyceria* sp., Sobolewska, Starkel & Środoń: p. 32.

Material. Coll. KRAM-P No Q-2/20.

Description. Seed 1.9 × 1.0 mm, elliptical in outline, irregularly biconvex, somewhat bent longitudinally. Ventral face strongly convex, with a smooth surface and an elongated process emerging from a circular hollow at its base. Dorsal surface weakly convex, with a shallow longitudinal groove. Tip bearing a short process formed from the remains of the style. Grain coat thin, brittle. Surface black with indistinct cells, and a dimmed lustre.

Remarks. This species is rather rare in Pleistocene floras. At present widespread, on river banks, lake shores and in marshes in both forest and steppe zones.

POTAMOGETONACEAE

Potamogeton compressus L.

Pl. 2, fig. 20

1954 *Potamogeton acutifolius* Link, Środoń: p. 14.

Material. Coll. KRAM-P No Q-105/P-17, 31 (3 specimens).

Description. Endocarp with its lid open, 3.2 mm long, obovoid, sides slightly convex. Ventral margin convex in its upper part, concave below, with a thick ventral spine. Base narrowly cuneiform, stalk small, conical, directed downward. Style missing, lid with crispate keel. Pointed end of lid ending in a subulate spine reaching base of style. Sides sunken, central depression wide and rather deep, with its mouth opening on to the ventral margin. Surface with indistinct small cells, rough, pale, mat.

Remarks. The endocarps of *Potamogeton acutifolius* Link (Pl. 2, figs 18, 19) are broader, not narrowed at the base, with a strongly fringed lid. The walls are thick with an inconspicuous central depression, completely convex ventral margin and a long, sharp ventral spine.

Potamogeton crispus L.

Pl. 3, fig. 14

1954 *Potamogeton crispus* L., Środoń: p. 14.

Other record: indet. in coll. Q-105.

Material. Coll. KRAM-P Nos Q-105/P-7, 33, 37 (14 specimens); Q-105/9.60–10.45/5 (1 specimen).

Description. Endocarps medium-sized: 2.2–2.7 × 1.8–2.4 mm, irregularly ovoid or subglobose, flat. Ventral margin distinctly keeled, convex. Lid broad, keeled, with a plate-like crest, often poorly preserved. Large nipple, usually well-preserved, at the base of lid. Style very large, long, straight, centrally positioned, with a broad base, mostly broken off. Stalk small, aculeolate, inserted laterally at base, sometimes inconspicuous. Sides flattened, with a broad, shallow central depression. Walls rather thick, firm. Surface rough, grey-brown, mat.

Remarks. The endocarps of this contemporary European species are comparatively rare in the Quaternary floras, but are sometimes numerous in interglacial and interstadial floras of forest type.

Potamogeton dorofeevii Wieliczk.

Pl. 2, figs 1–4

1939 *Potamogeton alpinus* Balb., Dyakowska: pp. 4, 5.
1965 *Potamogeton lucens* L., Koperowa & Środoń: pp. 11, 20.

Other records: 1939 *Potamogeton filiformis* Pers., Dyakowska: pp. 4, 6; 1965 *Potamogeton* sp., Koperowa & Środoń: p. 11.

Material. Coll. KRAM-P Nos Q-1/10a_1, 10b, 10c_2, 13b_4, 13c_3, 79 (49 specimens); Q-3/13a, 13b, 13c, 14a, 14b_2 (12 specimens).

Description. Endocarps 2.1–2.7 × 1.5–2.0 mm, asymmetrically ellipsoidal. Ventral margin ± strongly convex in the upper two thirds, straight or slightly concave below, rounded. Beak central, stout, sometimes broadened at tip, upright or dorsally inclined. Stalk pointed, subulate, continuing the ventral margin and directed obliquely downwards. Dorsal margin falcate or arched. Lid broad, thick, without keel, thicker in its lower part. The top of the lid reaches the base of the style. Shoulder absent, sides strongly convex, smooth or with a small central depression, whose mouth opens

on to the ventral margin. Surface smooth, with indistinct small cells, sometimes delicately rugose, mat. Some endocarps, perhaps unripe, have their sides more flattened, a considerably smaller central depression and a fairly distinct keel on the lid.

Remarks. This extinct species, described from the Middle Pleistocene of Belarus (Velichkevich 1977), occurs also in other periods of the Pleistocene of the East-European Plain (Velichkevich 1982). It is most characteristic of the cold loving floristic complexes of forest interstadials or non-optimal phases of interglacials. There are distinct characters pointing to a relationship between *Potamogeton dorofeevii* Wieliczk. and the contemporary East-Siberian species *P. sibiricus* A. Benn. and a species very similar to it, *P. anadyrensis* V. Vass. In some features *P. dorofeevii* also resembles the East-Asiatic *P. oxyphyllus* Miq. (Dorofeev 1986, Pl. 37, figs 15, 16). In comparison with *P. dorofeevii* Wieliczk. the endocarps of *P. alpinus* Balb. are somewhat smaller, with a broad longitudinal shoulder, a thin straight style and a flat keel on the lid (Pl. 2, figs 5, 6). As for *P. lucens* L. (Alto 1970, p. 30, figs 58–62), it is hard to find any essential similarities. This is the first find of *Potamogeton dorofeevii* Wieliczk. in the fossil floras of Poland.

Potamogeton friesii Rupr.

Pl. 2, fig. 17

1954 *Potamogeton mucronatus* Schrad., Środoń: pp. 15, 17.

Other records: 1954 *Potamogeton pusillus* L., Środoń: pp. 15, 17; indet. in coll. Q-105; 1960 *Potamogeton pusillus* L., Birkenmajer & Środoń: p. 22.

Material. Coll. KRAM-P Nos Q-104/19 (1 specimen); Q-105/P-2, 6, 22, 26 (160 specimens); Q-105/9.60–10.45/6 (10 specimens).

Description. Endocarps 1.9–2.2 × 1.4–1.7 mm, ellipsoidal, ovoid or obovoid. Ventral margin convex, sometimes slightly concave below. Lid keeled, with a small thickening in its lower part. Top of lid not reaching base of beak; shoulder very short, sometimes indistinct. Style thick, point of insertion displaced towards the ventral margin, usually dorsally inclined. Stalk distinctly aculeate, sides strongly convex, without central depression.

Remarks. *Potamogeton friesii* Rupr. = *Potamogeton mucronatus* Schrad. is a species widespread in the European flora. Its fossil endocarps are rather variable, especially so in the floras of the older interglacials.

Potamogeton gramineus L.

Pl. 3, figs 9, 10

1939 *Potamogeton filiformis* Pers., Dyakowska: pp. 4, 6.

Other records: 1939 *Potamogeton coloratus* Vahl., Dyakowska: pp. 4, 5; *Potamogeton* sp. div. in coll. Q-1, det. J. Dyakowska;

Material. Coll. KRAM-P No Q-1/11b_3, 13a_2, 13b_2, 13c_2, 13d_3, 14a_2, 14b_2, 14c_2, 14d_2, 14e_1 (87 specimens).

Description. Endocarps 1.9–2.2 × 1.6–1.9 mm, broadly obovate to semicircular in outline. Ventral margin sigmoid, rounded. Lid broad, weakly keeled, its pointed top reaching the base of the style which is thin, short, central or more rarely displaced towards the ventral margin. Stalk very small, sometimes absent. Sides flat, with a broad but not deep central depression. Surface finely striate, rough and mat.

Remarks. The endocarps of *Potamogeton filiformis* Pers. (Pl. 3, figs 7, 8) have similar dimensions to those described above, but are of quite different shape with a broad and steep shoulder, sides convex, thicker and firmer. Surface fine-celled, weakly oily lustrous.

Potamogeton natans L.

Pl. 2, figs 11, 12

1954 *Potamogeton nitens* Weber, Środoń: p. 15.
1964 *Potamogeton obtusifolius* Mert. & Koch, Sobolewska, Starkel & Środoń: pp. 33, 37.

Other records: 1954 *Potamogeton densus* L., *P. zosteraceus* Fries, Środoń: p. 15; 1964 *Potamogeton fluitans* Roth, Sobolewska, Starkel & Środoń: pp. 33, 36.

Material. Coll. KRAM-P Nos Q-2/32, 33 (7 specimens); Q-105/P-5, 13, 15, 19, 20, (14 specimens).

Description. Endocarps 2.7–2.9 × 1.9–2.1 mm, obovate in outline, crescentic. Ventral margin slightly convex in the upper part and straight below. Lid weakly keeled, its pointed top not reaching the base of the style.

Shoulder relatively short, but always present. Style centrally positioned, thick, stalk very small, sometimes absent. Sides weakly convex with a deep cavity or opening right through.

Potamogeton cf. ***nodosus*** Poir.

Pl. 3, fig. 12

1964 *Potamogeton praelongus* Wulf., Sobolewska, Starkel & Środoń: pp. 33, 38, 39.

Material. Coll. KRAM-P No Q-2/35 (1 specimen).

Description. Endocarp 2.5 × 1.9 mm, slightly obovate in outline. Ventral margin somewhat convex, weakly keeled. Lid keeled, broad, its pointed top falling short of the style base. Shoulder nearly as long as breadth of lid. Sides convex, without central depression.

Remarks. The characteristic features of the endocarps of this species are: the shoulder slightly raised at its junction with the lid and the presence of rounded tubercles on the sides in the basal part of the endocarp. Since both these characters are indistinct, the identification of this endocarp is tentative. Its referral to *Potamogeton praelongus* Wulf. (see Pl. 3, fig. 11) as suggested by A. Środoń (in Sobolewska et al. 1964) is excluded on account of its very small size. It is considerably smaller than even the smallest recorded endocarps of *P. praelongus*. However, that this is an unusually large endocarp of *P. alpinus* Balb. (Pl. 2, figs 5, 6) cannot be completely ruled out.

Potamogeton obtusifolius Mert. & Koch

Pl. 2, fig. 9

1939 *Potamogeton alpinus* Balb., Dyakowska: pp. 4, 5.

Other records: 1939 *Potamogeton* cf. *perfoliatus* L., Dyakowska: pp. 4, 5; *Potamogeton* sp. div. in coll. Q-1, det. J. Dyakowska; 1954 *Potamogeton obtusifolius* Mert. & Koch, Środoń: pp. 15, 17.

Material. Coll. KRAM-P Nos Q-1/10a_2, 10c_1, 14c_4, 15a (9 specimens); Q-105/P-34 (2 specimens).

Description. The endocarps, 2.6–2.9 × 1.9–2.2 mm, resemble those of *P. dorofeevii* Wieliczk. in overall shape but the surface of the lid is crispate or even fringed. The rounded top of the lid does not reach the base of the style, the shoulder is very short, somewhat raised, occasionally absent.

Remarks. The endocarps of *Potamogeton alpinus* Balb. (Pl. 2, figs 5, 6) are smaller, with a broad shoulder, strongly convex sides and a keeled lid.

Potamogeton cf. ***oxyphyllus*** Miq.

Pl. 2, fig. 7

1954 *Potamogeton* cf. *vaginatus* Turcz., Środoń: p. 15.

Material. Coll. KRAM-P No Q-105/P-1 (1 specimen).

Description. Endocarp 2.8 × 2.3 mm, broadly obovoid, thick, massive. Ventral margin irregularly S-shaped, rounded. Lid broad, with poorly developed keel. The blunt top of the lid does not reach the base of the style, the shoulder is broad and sloping. Sides slightly convex, with a small, deep cavity in the centre. Distinct basal wart present in lower part of side. Style and stalk absent, possibly destroyed during fossilization.

Remarks. Certain characters in this endocarp indicate a similarity to the endocarps of the East-Asiatic species *Potamogeton oxyphyllus* Miq. (Miki 1961), but the lack of some other important diagnostic features makes exact determination difficult. In general shape the endocarps of the extinct Middle Pleistocene species *P. sarjanensis* Wieliczk. (Pl. 2, fig. 8) most resemble the endocarp of *P.* cf. *oxyphyllus* Miq. described above, but, on the other hand, they possess some characters which clearly suggest a relationship with the present-day East-Asiatic species *P. maackianus* A. Benn. The endocarps of *P. oxyphyllus* differ significantly in many respects from those of *P. vaginatus* (Pl. 2, fig. 10).

Potamogeton panormitanoides Dorof.

Pl. 3, figs 1–3

1939 *Potamogeton coloratus* Vahl., Dyakowska: pp. 4, 5.
Indet. in coll. Q-105.

Other records: 1939 *Potamogeton filiformis* Pers., Dyakowska: pp. 4, 6; *Potamogeton* sp. div. in coll. Q-1, det. J. Dyakowska; 1954 *Potamogeton mucronatus* Schrad., *P. pusillus* L., Środoń: pp. 15, 17.

Material. Coll. KRAM-P Nos Q-1/11a_1, 11b_4, 11c_1, 11d, 13a_5, 13b_5, 14b_3, 14e_2 (305 speci-

mens); Q-105/P-3, 21, 23 (22 specimens); Q-105/9.60–10.45 (11 specimens).

Description. Endocarps small, 1.3–1.6 × 1.1–1.3 mm, asymmetrically obovoid. Ventral margin strongly convex, rounded. Stalk very small, aculeate, ventrally inclined. Style central, thin, short (generally missing). Dorsal margin semicircular, with slightly keeled lid. Top of lid reaching base of style or, rarely, leaving a short shoulder. Sides slightly convex, usually with shallow central depression not reaching the ventral margin. Surface flat, smooth.

Remarks. This is the extinct species described from the Middle Pleistocene flora of Russia (Dorofeev 1986) and characteristic of the floras of the older interglacials of the East-European Plain. Endocarps of *Potamogeton panormitanoides* are somewhat similar to those of *P. coloratus* Vahl. and *P. pusillus* L. However, the endocarps of *P. coloratus* are flat with a thinner lid and an opening right through on the sides (Pl. 3, fig. 4), and the endocarps of *P. pusillus* have a thicker style dilated at the tip, more convex sides, a horizontally truncate base and rough surface (Pl. 3, figs 5, 6). In respect of its climatic requirements *P. panormitanoides* is similar to the European species *P. rutilus* Wolfg., *P. friesii* Rupr., *P. pusillus* L., and to its contemporary analogue *P. panormitanus* Biv. In Poland *P. panormitanoides* was first found in the Neogene flora of Mizerna (Velichkevich & Lesiak 1996).

Potamogeton pectinatus L.

Pl. 3, fig. 13

1954 *Potamogeton zosteraceus* Fries, Środoń: p. 15.

Other records: 1954 *Potamogeton pectinatus* L., Środoń: p. 15; indet. in coll. Q-105.

Material. Coll. KRAM-P Nos Q-105/P-8, 11, 29 (7 specimens); Q-105/10.45–10.95/2 (2 specimens).

Description. Endocarps 2.8–3.4 × 2.3–2.7 mm, obovoid, flat, sturdy. Ventral margin slightly convex, sometimes nearly straight. Lid short, with a flat keel which ends at a considerable distance from the style base. Shoulder extensive, in length approximating to the radius of the endocarp, straight or sloping, rounded or angled at edge. Sides slightly convex or flat, central depression wide but not deep, with its mouth opened on to the ventral margin.

Remarks. It is a variform species in which a distinct variety, *Potamogeton pectinatus* var. *zosteraceus* (Fries) Casp., has been distinguished. Sometimes this taxon was ranked as a separate species, *P. zosteraceus* Fries, the name used by J. Mądalski in the above-quoted work by Środoń (1954).

Potamogeton perfoliatus L.

Pl. 2, figs 13–15

1939 *Potamogeton acutifolius* Link, Dyakowska: pp. 4, 6.

1954 *Potamogeton perfoliatus* L., Środoń: pp. 15, 17.

Other records: 1939 *Potamogeton densus* L., *P. filiformis* Pers., *P. praelongus* Wulfen., Dyakowska: pp. 4, 5, 6; *Potamogeton* sp. div. in coll. Q-1, det. J. Dyakowska; 1954 *Potamogeton lucens* L., Środoń: pp. 15, 17; indet. in coll. Q-105.

Material. Coll. KRAM-P Nos Q-1/9a, 9b, 9c, 12a, 12b, $13a_3$, $13b_3$, $14a_1$, $14b_1$, $14c_1$, $14d_1$, $16b_2$, $16d_2$, 80 (138 specimens); Q-105/P-27, 28, 32, 36 (77 specimens); Q-105/10.45–10.95/13 (7 specimens).

Description. Endocarps 2.5–3.0 × 1.9–2.3 mm, obovoid, sturdy. Ventral margin S-shaped, somewhat acute. Style straight, rather stout and long, broadened towards the tip, ventrally positioned. Stalk aculeate, inserted laterally in the transversely truncate base of the endocarp. Lid broad with a distinct keel, sometimes with a flat dentate crest in its upper half. The pointed free end of the lid reaches the base of the beak. Sides slightly convex, with an opening right through, more rarely only with a deep central depression.

Remarks. Palaeobotanists have always pointed out the morphological variability of the endocarps of this species (Nikitin 1957, Dorofeev 1963, Aalto 1970, etc.). This is also true of the endocarps of *Potamogeton perfoliatus* L. from Ściejowice and Tarzymiechy, which are variable but their assignment to this species is unquestionable. That *P. perfoliatus* L. is distinct from *P. acutifolius* Link is clear and unequivocal (cf. Pl. 2, figs 18, 19). The endocarps of *P. lucens* L. are larger and wider, with a stout short style and flat sides lacking

holes. *P. lucens* occurs very rarely in Pleistocene floras.

Potamogeton cf. ***polygonifolius*** Pourr.

Pl. 3, fig. 15

1964 *Potamogeton* cf. *polygonifolius* Pourr., Sobolewska, Starkel & Środoń: pp. 33, 37.

Material. Coll. KRAM-P No Q-2/34 (1 specimen).

Description. Endocarp small, 1.9 × 1.6 mm, broadly-obovoid, flat. Ventral margin slightly convex, rounded. Lid narrow, keeled, without a crest. The pointed top of the lid does not reach the style base, shoulder raised, conspicuous. Style very small, aculeolate, ventrally positioned. Stalk absent. Sides concave, with a small, deep central cavity. Surface rather smooth, pale brown, mat.

Remarks. Contemporary West European species; rare in the fossil floras of Eastern Europe.

RANUNCULACEAE

Ranunculus gmelini DC.

Pl. 3, figs 16–20

1939 *Comarum palustre* L., Dyakowska: pp. 4, 7.

Indet. in coll. Q-104.

1961 *Ranunculus sceleratus* L., Sobolewska & Środoń: pp. 6, 7.

1965 *Ranunculus sceleratus* L., Koperowa & Środoń: p. 11.

Other records: 1939 *Ranunculus* cf. *aquatilis* L., Dyakowska: pp. 4, 7; 1964 *Ranunculus sceleratus* L., Sobolewska, Starkel & Środoń: pp. 33, 41.

Material. Coll. KRAM-P Nos Q-1/4a_1, 4b, 4c_1, 19b_2, 19c_2, 20 (24 specimens); Q-2/38 (6 specimens); Q-3/17a, 17b (14 specimens); Q-31/20a, 20b, 20c (16 specimens); Q-104/50 (1 specimen).

Description. Fruits 1.3–1.5 × 0.9–1.4 mm, irregularly globose, weakly biconvex, strongly thickened on one side. Surface uneven, undivided into central part and rim, with indistinct fine cells.

Remarks. An arctic-boreal species usually occurring in the interstadial floristic complexes of forest-tundra or tundra type. The fruits of *Ranunculus sceleratus* L. (Pl. 3, fig. 21) are smaller and uniformly thickened at the edges, with a convex middle part which shows more or less distinct transverse wrinkles.

Ranunculus reptans L.

Pl. 3, figs 23–26

1939 *Comarum palustre* L., Dyakowska: pp. 4, 7.

1960 *Ranunculus acer* L., Birkenmajer & Środoń: p. 22.

1965 *Ranunculus flammula* L., Koperowa & Środoń: p. 11.

1968 *Ranunculus flammula* L., Środoń: p. 8.

Other records: indet. in coll. Q-104; 1961 *Ranunculus flammula* L., Sobolewska & Środoń: p. 6; 1961 *Ranunculus* cf. *oreophilus* M.B., Sobolewska & Środoń: p. 6; indet. in coll. Q-31.

Material. Coll. KRAM-P Nos Q-1/4c_2 (4 specimens); Q-3/16a-e (48 specimens); Q-31/18a-c, 19, 23a_1(16 specimens); Q-82/18, 59 (5 specimens); Q-104/6, 84a (2 specimens).

Description. Fruits 1.5–2.2 × 1.2–1.9 mm, variously obovate, irregularly elliptic or angular-subcircular in outline, biconvex, with a distinct marginal rim. Sides strongly convex, nearly smooth, with a slightly rugose surface.

Remarks. The fruits of *Ranunculus flammula* L. (Pl. 3, fig. 22) are smaller, somewhat elongate, narrowed at base, sometimes pointed with distinct pits on the surface. A narrow rim is visible mostly on the ventral side. In the Pleistocene floras of the East-European Plain *R. reptans* L. usually accompanies species of the arctic-boreal complex (*Betula nana* L., *Selaginella selaginoides* (L.) PB. ex Schrank & Mart., *Polygonum viviparum* L. etc). The climatic requirements of this species are similar to those of the above-mentioned taxa.

SPARGANIACEAE

Sparganium emersum Rehm.

Pl. 3, figs 30, 31

1964 *Sparganium simplex* Huds., Sobolewska, Starkel & Środoń: pp. 33, 42.

Material. Coll. KRAM-P No Q-2/43a_1, 43b, 43c (63 specimens).

Description. Endocarps 1.8–2.8 × 1.4–1.8 mm, ovoid to nearly ellipsoidal. Apex short, slightly elongate and irregularly truncate, more rarely a conic frustum. The base passes

abruptly into the stout, conical stalk. Sides strongly convex with distinct marginal grooves.

Remarks. *Sparganium emersum* Rehm. = *Sparganium simplex* Huds. In its climatic requirements *S. emersum* Rehm. resembles *S. minimum* Wallr.

Sparganium hyperboreum Laest.

Pl. 3, fig. 32

1965 *Sparganium minimum* Fries, Koperowa & Środoń: p. 11.

Material. Coll. KRAM-P No Q-3/19 (1 specimen).

Description. Endocarp 1.7 × 1.2 mm, ovoid, irregularly circular in transverse cross-section. Base slightly tapering and rounded, without stalk. Apex narrowed and irregularly truncate. Edges of the apex sometimes slightly curved into the opening. Surface uneven with a fine longitudinal shading.

Remarks. The endocarp appears to have been slightly threadbare. It lacks some characteristic features of this species but differs markedly from *S. minimum* Wallr. in its general shape, short apex and absence of stalk. It is an arctic-boreal circumpolar species widespread in the tundra and north forest belt. This is its first identification in the fossil floras of Poland.

Sparganium minimum Wallr.

Pl. 3, figs 27–29

1960 *Sparganium minimum* Fries, Birkenmajer & Środoń: pp. 22, 35, 36.

1964 *Sparganium minimum* Fries, Sobolewska, Starkel & Środoń: pp. 33, 42.

Material. Coll. KRAM-P Nos Q-2/41a-c (33 specimens); Q-104/49 (4 specimens).

Description. Endocarps 1.9–2.5 × 1.1–1.4 mm, ovoid, mostly narrowly so. Base gradually tapering into the short, conical stalk. Apex elongate, conical, irregularly truncate. Vascular bundles obscurely projecting above the surface of the endocarp.

Remarks. *Sparganium minimum* Wallr. (= *Sparganium minimum* Fries) is a common European species characteristic of fossil floras of the woodland type.

Sparganium neglectum Beeby

Pl. 3, figs 34–36

1976 *Sparganium ramosum* Huds., Środoń: p. 303.

Material. Coll. KRAM-P No Q-32/40 (17 specimens).

Description. Endocarps 3.0–4.8 × 1.6–2.4 mm, narrowly to broadly ovoid. Base somewhat narrowed and irregularly truncate. Apex slightly elongate and transversely truncate. Surface shallowly, coarsely but distinctly ribbed.

Remarks. The collective species *Sparganium ramosum* L. was later divided into several separate species (Dorofeev 1979). In Pleistocene floras, most frequently the interglacial, two species usually occur: *S. neglectum* Beeby and *S. microcarpum* (Neum.) Raunk. In the Rzochów flora single, narrow and long specimens resembling this latter species occur among the endocarps of typical *S. neglectum* Beeby.

Sparganium cf. ***stenophyllum*** Maxim.

Pl. 3, fig. 33

1964 *Sparganium simplex* Huds., Sobolewska, Starkel & Środoń: pp. 33, 42.

Material. Coll. KRAM-P No Q-2/43a$_2$ (1 specimen).

Description. Endocarp 2.0 × 1.3 mm, broadly ovoid. Apex broad, narrowing and transversely truncate . Opening to the internal cavity of the endocarp relatively small. Base with a small knoblike stalk. Walls thick, robust. Surface furnished with deep grooves.

Remarks. In the collection from Wadowice this is the only endocarp differing greatly from the other endocarps of this genus. Contemporary endocarps of this far-eastern species (Dorofeev 1979; Text-Fig. 3, figs 6, 7) are somewhat larger but have the same general shape. Endocarps of the extinct Pliocene species *S. crassum* Nikit. are thicker, but also similar (Nikitin 1957, Pl. 1, figs 42, 43; Velichkevich 1990, Pl. VII, fig. 3). Single endocarps identified as *S.* cf. *stenophyllum* Maxim., are present in some of the floras of the older interglacials of Belarus (Velichkevich 1982). This species has not been reported hitherto from the Pleistocene floras of Poland.

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PLATES

Plate 1

Figs 1–4 and 27–32 × 7, Fig. 11 × 8, Figs 5–10 and 12–26 × 15

1. ***Pinus sylvestris*** L., seed, Łążek, KRAM-P no Q-42/6c$_2$
2. ***Larix*** cf. ***decidua*** Mill., seed, Łążek, KRAM-P no Q-42/6f
3. ***Picea*** sect. ***Picea***, seed, Wadowice, KRAM-P no Q-2/7a$_1$
4. ***Juniperus communis*** L., seed, Brzeziny, KRAM-P no Q-104/21
5–7. ***Betula*** sect. ***Albae***, fruits
   5. Tarzymiechy, KRAM-P no Q-105/IIIB-31h
   6, 7. Rzochów, KRAM-P no Q-32/3
8–10. ***Betula humilis*** Schrank, fruits and fruit scale
   8. Tarzymiechy, fruit, KRAM-P no Q-105/IIIA-26g$_1$
   9. Dobra, fruit, KRAM-P no Q-82/89b
   10. Dobra, fruit scale, KRAM-P no Q-82/89b
11. ***Betula pendula*** Roth, fruit scale, Rzochów, KRAM-P no Q-32/4a
12–14. ***Betula nana*** L., fruit and fruit scales
   12. Dobra, fruit, KRAM-P no Q-82/89a
   13, 14. Dobra, fruit scales, KRAM-P no Q-82/89a
15. ***Carex bohemica*** Schreb., fruit, Wadowice, KRAM-P no Q-2/50m
16. ***Schoenoplectus tabernaemontani*** (C.C. Gmel.) Palla, fruit, Tarzymiechy, KRAM-P no Q-105/IIIB-31i
17. ***Empetrum nigrum*** L., Ściejowice, KRAM-P no Q-1/13a4
18. ***Glyceria maxima*** (Hartm.) Holmb., fruit, Wadowice, KRAM-P no Q-2/20
19, 20. ***Schoenus nigricans*** L., fruits
   20. Brzeziny, KRAM-P no Q-104/98
   21. Kąty, KRAM-P no Q-106A/60
21. ***Scirpus sylvaticus*** L., fruit, Kąty, KRAM-P no Q-106A/7
22–24. ***Myriophyllum spicatum*** L., fruits, Tarzymiechy, KRAM-P no Q-105/IIIA-27d
25. ***Myriophyllum alterniflorum*** DC., fruit, Ściejowice, KRAM-P no Q-1/8c1
26. ***Myriophyllum verticillatum*** L., fruit, Tarzymiechy, KRAM-P no Q-105/IIIA-21g
27, 28. ***Ceratophyllum pentacanthum*** Haynald, fruits
   27. Tarzymiechy, KRAM-P no Q-105/IIIA-29b
   28. Tarzymiechy, KRAM-P no Q-105/IIIA-27b
29. ***Ceratophyllum*** cf. ***submersum*** L., fruit, Tarzymiechy, KRAM-P no Q-105/9,60–10,45/2
30–32. ***Ceratophyllum demersum*** L., fruits
   30. Tarzymiechy, KRAM-P no Q-105/IIIA-28a$_2$
   31. Tarzymiechy, KRAM-P no Q-105/IIIA-29a
   32. Tarzymiechy, KRAM-P no Q-105/IIIA-27a

phot. A. Pachoński

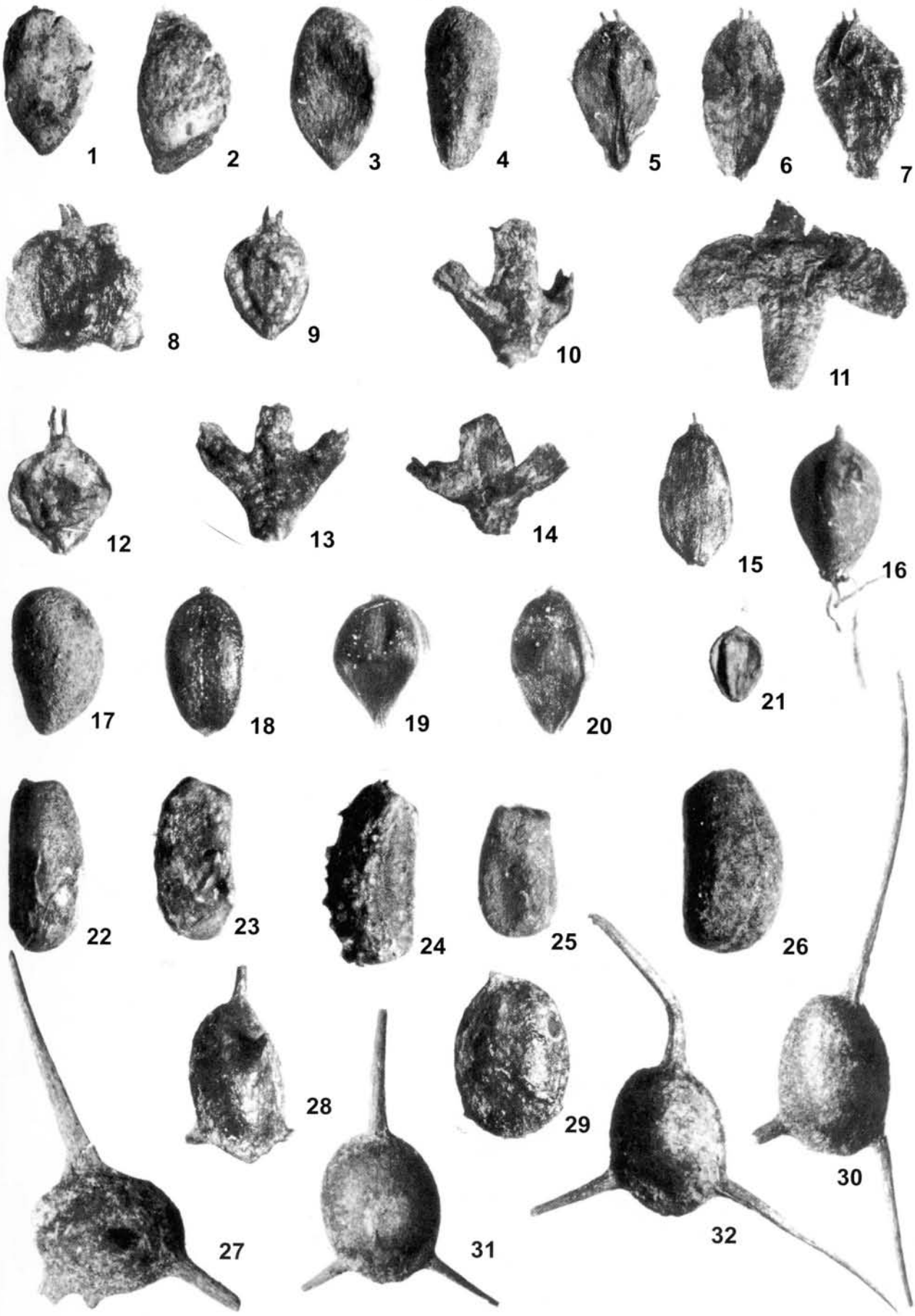
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Plate 2

Figs 1–20 × 15

1–4. ***Potamogeton dorofeevii*** Wieliczk., endocarps
1. Ściejowice, KRAM-P no Q-1/10c_2
2. Ściejowice, KRAM-P no Q-1/10b
3. Ściejowice, KRAM-P no Q-1/10a_1
4. Zator, KRAM-P no Q-3/13a

5, 6. ***Potamogeton alpinus*** Balb., endocarps
5. Miniczi, no Q-KW-1/20
6. Tarzymiechy, KRAM-P no Q-105/P-9 (holocen)

7. ***Potamogeton*** cf. ***oxyphyllus*** Miq., endocarp, Tarzymiechy, KRAM-P no Q-105/P-1

8. ***Potamogeton sarjanensis*** Wieliczk., endocarp, Motol, no Q-KW-3/10a

9. ***Potamogeton obtusifolius*** Mert. & Koch, endocarp, Ściejowice, KRAM-P no Q-1/10c1

10. ***Potamogeton*** cf. ***vaginatus*** Turcz., endocarp, Zator, KRAM-P no Q-3/14b3

11, 12. ***Potamogeton natans*** L., endocarps
11. Wadowice, KRAM-P no Q-2/33
12. Tarzymiechy, KRAM-P no Q-105/P-19

13–15. ***Potamogeton perfoliatus*** L., endocarps
13. Ściejowice, KRAM-P no Q-1/9c
14. Tarzymiechy, KRAM-P no Q-105/P-32
15. Ściejowice, KRAM-P no Q-1/9b

16. ***Potamogeton trichoides*** Cham. et Schltdl., endocarp, Wadowice, KRAM-P no Q-2/36

17. ***Potamogeton friesii*** Rupr., endocarp, Tarzymiechy, KRAM-P no Q-105/P-2

18, 19. ***Potamogeton acutifolius*** Link, endocarps, Wadowice, KRAM-P no Q-2/31a

20. ***Potamogeton compressus*** L., endocarp, Tarzymiechy, KRAM-P no Q-105/P-31

phot. A. Pachoński

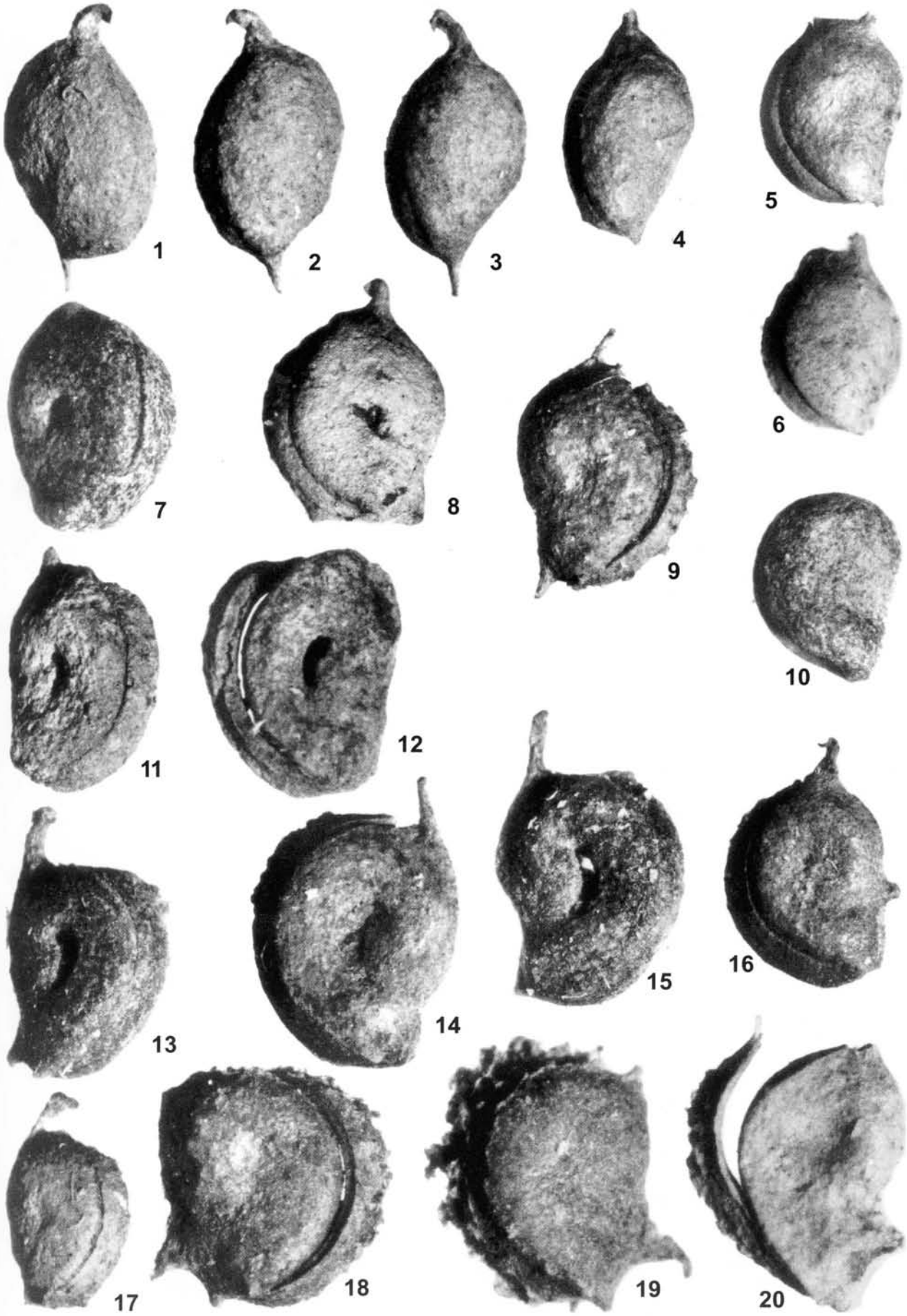
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Plate 3

Figs 1–26 × 15; Figs 27–33 × 10; Figs 34–36 × 7

1–3. ***Potamogeton panormitanoides*** Dorof., endocarps
1. Tarzymiechy, KRAM-P no Q-105/9,60–10,45/7
2. Ściejowice, KRAM-P no Q-1/11b$_4$
3. Ściejowice, KRAM-P no Q-1/11d

4. ***Potamogeton coloratus*** Hornem., endocarp, Ściejowice, KRAM-P no Q-1/11b1

5, 6. ***Potamogeton pusillus*** L., endocarps
5. Ściejowice, KRAM-P no Q-1/11a$_2$
6. Ściejowice, KRAM-P no Q-1/17a

7, 8. ***Potamogeton filiformis*** Pers., endocarps
7. Ściejowice, KRAM-P no Q-1/13e$_1$
8. Zator, KRAM-P no Q-3/12b

9, 10. ***Potamogeton gramineus*** L., endocarps
9. Ściejowice, KRAM-P no Q-1/13a$_2$
10. Ściejowice, KRAM-P no Q-1/13c$_2$

11. ***Potamogeton praelongus*** Wulf., endocarp, Ściejowice, KRAM-P no Q-1/16c3

12. ***Potamogeton*** cf. ***nodosus*** Poir., endocarp, Wadowice, KRAM-P no Q-2/35

13. ***Potamogeton pectinatus*** L., endocarp, Tarzymiechy, KRAM-P no Q-105/P-29

14. ***Potamogeton crispus*** L., endocarp, Tarzymiechy, KRAM-P no Q-105/P-7

15. ***Potamogeton*** cf. ***polygonifolius*** Pourr., endocarp, Wadowice, KRAM-P no Q-2/34

16–20. ***Ranunculus gmelini*** DC., fruits
16. Ściejowice, KRAM-P no Q-1/4b
17. Zator, KRAM-P no Q-3/17a
18. Brzeziny, KRAM-P no Q-104/50
19. Białka Tatrzańska, KRAM-P no Q-31/20c
20. recent

21. ***Ranunculus sceleratus*** L., fruit, Rzochów, KRAM-P no Q-32/34

22. ***Ranunculus flammula*** L., fruit, recent

23–26. ***Ranunculus reptans*** L., fruits
23. Dobra, KRAM-P no Q-82/18
24. Ściejowice, KRAM-P no Q-1/4c$_2$
25. Brzeziny, KRAM-P no Q-104/84a
26. Zator, KRAM-P no Q-3/16d

27–29. ***Sparganium minimum*** Wallr., endocarps
27. Brzeziny, KRAM-P no Q-104/49
28, 29. Wadowice, KRAM-P no Q-2/41a

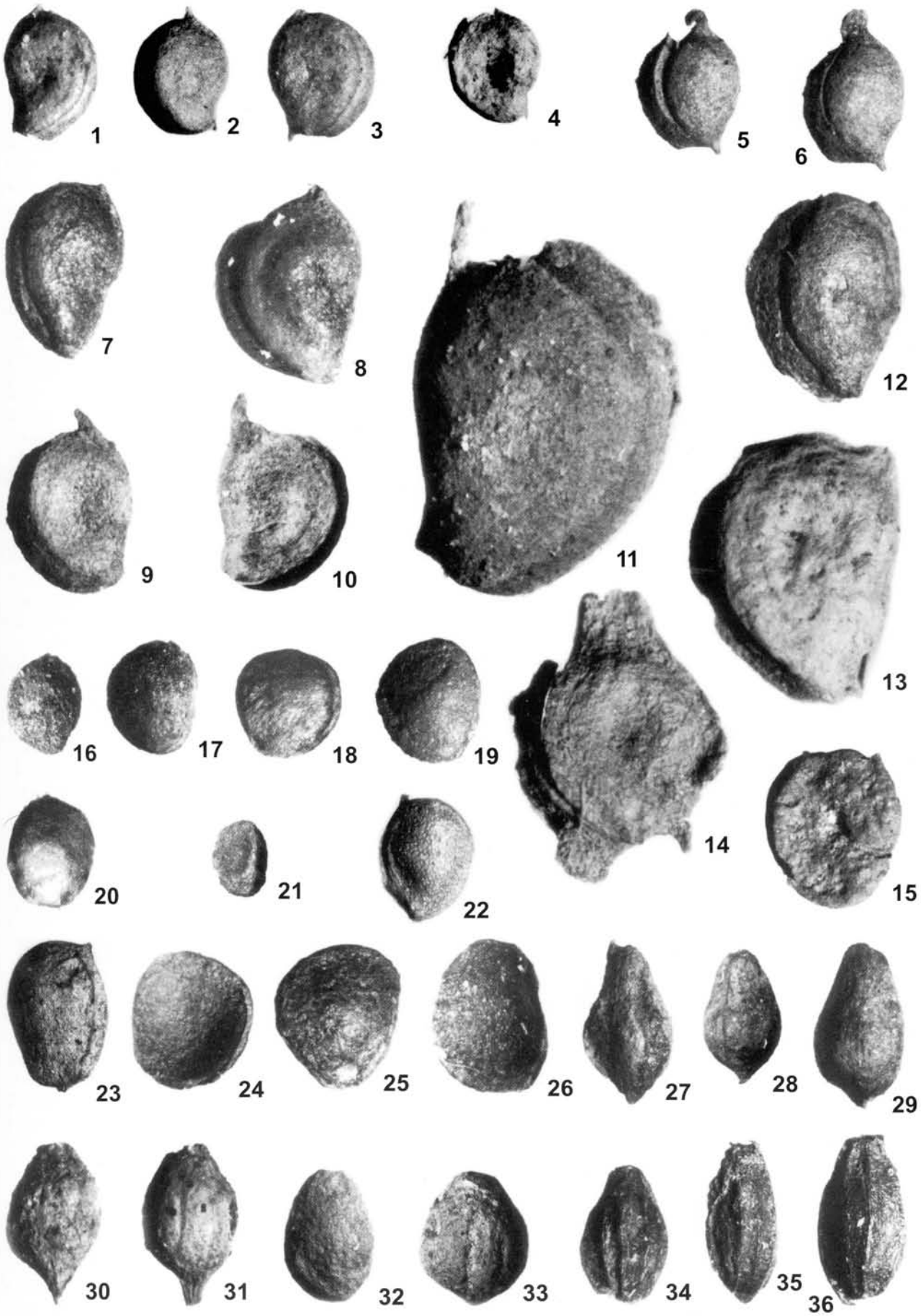
30, 31. ***Sparganium emersum*** Rehm., endocarps, Wadowice, KRAM-P no Q-2/43c

32. ***Sparaganium hyperboreum*** Laest., endocarp, Zator, KRAM-P no Q-3/19

33. ***Sparganium*** cf. ***stenophyllum*** Maxim., endocarp, Wadowice, KRAM-P no Q-2/43a$_2$

34–36. ***Sparganium neglectum*** Beeby, endocarps, Rzochów, KRAM-P no Q-32/40

phot. A. Pachoński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LIST OF TAXA
presented in Tables 1–17 after revision

[The numerals denote the serial numbers of tables: **1** – Ściejowice (coll. Q-1A), **2** – Ściejowice (coll. Q-1), **3** – Kąty (coll. Q-106), **4** – Kąty (coll. Q-106A), **5–9** – Tarzymiechy (**5** – coll. Q-105/IIIA, **6** – coll. Q-105/IIIB, **7** – coll. Q-105/P, **8** – coll. Q-105/9.60–10.45 & 10.45–10.95, **9** – coll. Q-105/D), **10** – Wadowice (coll. Q-2A), **11** – Wadowice (coll. Q-2), **12** – Brzeziny (coll. Q-104), **13** – Białka Tatrzańska (coll. Q-31), **14** – Zator (coll. Q-3), **15** – Dobra (coll. Q-82), **16** – Łążek (coll. Q-42), **17** – Rzochów (coll. Q-32); unrevised taxa are parenthesized]

Abies alba Mill. 3
Abies sp. 3
Ajuga reptans L. 11
Alchemilla sp. 10, 11, 13, 15
Alisma plantago-aquatica L. 11, 17
Alismataceae ? 4
Alnus incana (L.) Moench 4, 11, 12, 17
A. cf. *incana* (L.) Moench 15
Alnus sp. 11, 17
Alyssum montanum L. 15
Alyssum sp. 9, 14
Apiaceae 4, 5, 9
Arabis alpina L. 9, 15
Arctostaphylos uva-ursi (L.) Spreng. 1
Armeria alpina (DC.) Willd. 15
A. maritima (Mill.) Willd. 14
Armeria sp. 9, 10, 15
Asteraceae 4, 12
Barbarea vulgaris L. 4
Batrachium sp. 1, 2, 3, 4, 5, 8, 9, 12, 14
(cf. *Bellidiastrum* Michelii) (9)
Berteroa sp. 9
Betula humilis Schrank 2, 5, 12, 15, 16
B. cf. *humilis* Schrank 4, 5, 6, 8, 12, 16, 17
B. nana L. 1, 5, 9, 13, 15
B. cf. *nana* L. 5, 9, 12, 13, 14, 15
B. pendula Roth 16, 17
Betula sect. *Albae* 4, 5, 6, 8, 11, 12, 16, 17
Betula sp. 12, 16
Brassicaceae 9, 14, 15, 17
Calla palustris L. 17
Callianthemum coriandrifolium Rchb. 15
Callitriche autumnalis L. em. Wahlenb. 14
C. cf. *cophocarpa* Sendtn. 17
Caltha palustris L. 1, 14
Cardamine cf. *flexuosa* With. 15
C. pratensis L. 13
Cardamine sp. 12
cf. *Carduus* sp. 12
(*Carex acutiformis*) (17)
Carex cf. *appropinqua* Schumach. 12
C. bohemica Schreb. 11
(*C. leporina*) (17)
(*C. panicea*) (17)
(*C. paniculata*) (17)
C. cf. *paradoxa* Willd. 17
C. cf. *pauciflora* Lightf. 17
C. pseudocyperus L. 6, 17
C. rostrata Stokes 2, 6, 12, 16
C. cf. *rostrata* Stokes 2, 12
C. vesicaria L. 1
C. cf. *vesicaria* L. 11
Carex sp. (3-sided) 4, 11, 14, 17
Carex sp. div. (2-sided) 2, 5, 6, 8, 9, 10, 11, 12, 14, 15, 16, 17
Carex sp. div. (3-sided) 2, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 17
Carex sp. 12
Caryophyllaceae 9, 10, 13, 15
Cenococcum graniformae (Sow.) Ferd. & Winge 2, 3, 4, 6, 9, 11, 12, 13, 15, 17
Cerastium alpinum L. 9
C. cf. *alpinum* L. 15
C. arvense L. 4
C. lanatum Lam. 15
C. cf. *sylvaticum* Waldst.& Kit. 11
Ceratophyllum demersum L. 5, 6, 8
C. pentacanthum Haynald 5
C. cf. *submersum* L. 8
Ceratophyllum sp. 12
Chenopodium album L. 5
Ch. cf. *album* L. 9
Chenopodium sp. 5, 8
Cirsium oleraceum (L.) Scop. 12
C. palustre Scop. 8, 11, 12
Cirsium sp. 4, 11, 12
Cicuta virosa L. 1, 2, 5, 6
Comarum palustre L. 1, 2, 11, 12, 13, 16, 17
Cyperaceae 4, 12, 14
Dianthus sp. 9, 15
(*Draba* cf. *aizoides*) (9)
Draba sp. 9
Dryas octopetala L. 9
Eleocharis ovata (Roth) Roem. & Schult. 11
E. palustris (L.) Roem. & Schult. 5, 6, 8, 11, 12, 14, 16, 17
Eleocharis sp. 14
(*Elyna myosuroides*) (9)
Empetrum nigrum L. 2
(*Epilobium* sp.) (9)
(*Erica* sp.) (9)
Eriophorum sp. 9
Eriophorum sp. div. 9
Euphorbia sp. 5
Filipendula ulmaria (L.) Maxim. 5, 12, 17
Fragaria vesca L. 5
Galeopsis sp. 15
Glyceria maxima (Hartm.) Holmb. 11
G. cf. *maxima* (Hartm.) Holmb. 17
(*Hedysarum obscurum*) (9)
(*Helianthemum* cf. *alpestre*) (9)
Hippuris vulgaris L. 1, 2, 5, 6, 8, 12, 14
Hottonia palustris L. 17
Hydrocharis morsus-ranae L. 17
Hypericum cf. *hirsutum* L. 2
Juncus sp. 4, 11, 12
Juniperus communis L. 12
J. cf. *communis* L. 3
Lamiaceae 3
Larix cf. *decidua* Mill. 12, 16
Larix sp. 2, 11, 12
Lemna trisulca L. 11

Leontodon autumnalis L. 9, 15
L. pseudotaraxaci Schur 15
Linum extraaxillare Kit. 9
Linum sp. 5
Luzula luzuloides (Lam.) Dandy & Wilmott 12
L. cf. *luzuloides* (Lam.) Dandy & Wilmott 15
Luzula sp. 15
Lychnis cf. *chalcedonica* L. 15
L. flos-cuculi L. 12
Lycophytina 2
Lycopus europaeus L. 5, 6, 11, 17
Lysimachia thyrsiflora L. 11
L. cf. *vulgaris* L. 11
Lythrum salicaria L. 17
Melandrium rubrum (Weigel) Garcke 15
M. cf. *rubrum* (Weigel) Garcke 4
Mentha aquatica L. 4, 17
Mentha sp. 4, 11
Menyanthes trifoliata L. 1, 2
Myriophyllum alterniflorum DC. 2
M. spicatum L. 2, 5, 8, 9, 14
M. verticillatum L. 5, 11
Najas flexilis (Willd.) Rostk. & W.L.E. Schmidt 5, 6, 8
N. marina L. 5, 6, 8
N. minor All. 5, 8
Nuphar lutea (L.) Smith 5, 6, 8
Nymphaea cf. *alba* L. 17
Oenanthe aquatica (L.) Poir. 5, 6, 11
(*Oxyria dygina*) (9)
Pedicularis verticillata L. 9
(*Phragmites communis*) (17)
Picea cf. *abies* (L.) Karst. 12
Picea sect. *Picea* 3, 4, 11, 12, 15
Picea sect. *Omorica* 11
Picea vel *Larix* 12
Picea sp. 3, 4, 12
Pinaceae 11
Pinus sylvestris L. 4, 11, 12, 16, 17
Pinus sp. 12
Poaceae 4, 9, 13, 14
(*Poa trivialis*) (17)
Polygonaceae 9, 15, 17
Polygonum aviculare L. 9, 10, 14
P. bistorta L. 15
P. hydropiper L. 14
P. lapathifolium L. 5, 6, 11
P. persicaria L. 5, 14
P. viviparum L. 9, 10, 15
Polygonum sp. 4, 6
(*Populus tremula* L.) (11)
Potamogeton acutifolius Link 11
P. cf. *alpinus* Balb. 2
P. coloratus Hornem. 2
P. compressus L. 7
P. cf. *compressus* L. 7
P. crispus L. 7, 8
P. dorofeevii Wieliczk. 2, 14
P. filiformis Pers. 2, 7, 9, 13, 14
P. cf. *filiformis* Pers. 2, 7
P. friesii Rupr. 7, 8, 12
P. cf. *friesii* Rupr. 7
P. gramineus L. 2
P. natans L. 7, 11
P. cf. *nodosus* Poir. 11
P. obtusifolius Mert. & Koch 2, 7
P. cf. *obtusifolius* Mert. & Koch 2
P. cf. *oxyphyllus* Miq. 7
P. panormitanoides Dorof. 2, 7, 8
P. pectinatus L. 7, 8
P. perfoliatus L. 2, 7, 8
P. cf. *polygonifolius* Pourr. 11
P. praelongus Wulf. 2, 7
P. cf. *praelongus* Wulf. 7
P. pusillus L. 2
P. rutilus Wolfg. 7, 8
P. cf. *rutilus* Wolfg. 7
P. trichoides Cham. & Schltdl. 11
P. cf. *vaginatus* Turcz. 14
Potamogeton sp. 2, 7, 14, 17
Potentilla cf. *arenaria* Borkh. 9
P. aurea L. 15
P. crantzii (Crantz) Beck ex Fritsch 15
P. cf. *crantzii* (Crantz) Beck ex Fritsch 13, 15
P. heptaphylla L. 15
P. cf. *heptaphylla* L. 15
P. cf. *inclinata* Vill. 12
P. pusilla Host. 15
Potentilla sp. 5, 6, 8, 10, 11, 12, 13, 14, 15, 17
Potentilla sp. div. 15
Ranunculus acris L. 2, 4, 12
R. cf. *acris* L. 5, 12
R. gmelini DC. 2, 11, 12, 13, 14
R. cf. *gmelini* DC. 13
R. cf. *lingua* L. 2, 4, 11
R. cf. *oreophilus* M. Bieb. 15
R. cf. *pseudomontanus* Schur 15
R. cf. *pygmaeus* Wahlenb. 2
R. repens L. 4
R. cf. *repens* L. 5
R. reptans L. 2, 12, 13, 14, 15
R. cf. *reptans* L. 11
R. sceleratus L. 17
R. cf. *sceleratus* L. 5
Ranunculus sp. 4, 5, 9, 12, 14
Ranunculus sp. div. 4, 15
Rorippa palustris (L.) Bess. 11
Rubus idaeus L. 3, 4, 11, 12, 15
R. cf. *idaeus* L. 4, 17
R. cf. *occidentalis* L. 14
R. saxatilis L. 17
Rumex acetosa L. 13
R. acetosella L. 15
R. cf. *acetosella* L. 1
R. maritimus L. 5, 6
Rumex sp. 10, 15
Sagittaria sagittifolia L. 11, 17
Salix herbacea L. 9, 10, 14
Salix ex gr. *herbacea* L. 15
(*S. myrtilloides*) (9)
S. polaris Wahlenb. 9
(*S.* cf. *purpurea*) (1)
S. reticulata L. 9
(*S. retusa*) (9)
Salix sp. 4, 9, 14, 15
Salix sp. div. 9, 15
Salvia pratensis L. 4
Salvinia natans (L.) All. 17
Sambucus racemosa L. 4, 11, 12, 15
Sambucus sp. 12
Saponaria officinalis L. 15
(*Saxifraga oppositifolia*) (9)
cf. *Scheuchzeria palustris* L. 12

Schoenoplectus lacustris (L.) Palla 5, 6, 8, 17
Sch. tabernaemontani (C.C. Gmel.) Palla 5, 6, 8
Schoenoplectus sp. 8
Schoenus nigricans L. 4, 12, 15
S. cf. *nigricans* L. 12
Scirpus sylvaticus L. 4
Scleranthus annuus L. 5
Selaginella selaginoides (L.) PB. ex Schrank & Mart. 14
Silene acaulis (L.) Jacq. 9
S. wahlbergella Chowd. 9, 15
Silene sp. 5, (9)
Sparganium emersum Rehm. 11
S. hyperboreum Laest. 14
S. minimum Wallr. 11, 12
S. neglectum Beeby 17
S. cf. *stenophyllum* Maxim. 11
Sparganium sp. 11
Spiraea salicifolia L. 11
Spiraea sp. 12
(*Spirodela polyrrhiza*) (9)
Stachys palustris L. 3
Stellaria holostea L. 12
S. media (L.) Vill. 14
S. cf. *media* (L.) Vill. 17
S. palustris Retz. 10, 12
Stratiotes aloides L. 5
Sweertia perennis L. subsp. *alpestris* 9
Taraxacum alpinum (Hoppe) Hegetschw. & Heer 15
T. officinale L. 8
Taraxacum sp. 5, 9
Thalictrum alpinum L. 9, 10, 15
T. lucidum L. 5, 12
T. cf. *lucidum* L. 5
T. minus L. 5
Thalictrum sp. 17
Thesium cf. *alpinum* L. 12
Thesium sp. 12
Typha sp. 11, 17
Urtica dioica L. 4, 5, 6, 8, 11, 12, 17
Vacciniaceae 8, 15
Valeriana dioica L. 12
V. officinalis L. 12, 17
Valeriana sp. 12
Viola cf. *palustris* L. 12
V. cf. *alba* Bess. 12
Viola sp. 12, 14, 15, 17
Viola sp. div. 12
Zannichellia palustris L. 5, 6, 8

TABLES
1–17

Table 1. List of macroscopic plant remains from Ściejowice (Mądalski 1935) – KRAM-P coll. Q-1A

Abbreviations: f – fruit, s – seed, sc – scale, l – leaf
++ – many, + – several
Dots in the vertical are ditto marks

Name of taxon		Type of remains	Number of specimens
In Mądalski 1935	After revision		
Betula nana L.	*Betula nana* L.	l	++/4
B. nana L.	*B. nana* L.	f	++/3
B. nana L.	*B. nana* L.	sc	++/1
Salix cf. *purpurea* L.	not revised	l	2/2
Rumex ucrainicus Fisch.	*Rumex* cf. *acetosella* L.	f	1/1
Cerastium sp.	indeterminate	s	1/1
Arctostaphylos uva-ursi L.	*Arctostaphylos uva-ursi* (L.) Spreng.	s	3/5
Carex vesicaria L.	*Carex vesicaria* L.	f	++/9
Menyanthes trifoliata L.	*Menyanthes trifoliata* L.	s	20/4
Caltha palustris L.	*Caltha palustris* L.	s	4/2
.	indeterminable	s	./1
Comarum palustre L.	*Comarum palustre* L.	f	40/7
Cicuta virosa L.	*Cicuta virosa* L.	f	30/3
Hippuris vulgaris L.	*Hippuris vulgaris* L.	f	+/1
Ranunculus cf. *aquatilis* L.	*Batrachium* sp.	f	+/1

Table 2. List of macroscopic plant remains from Ściejowice (Dyakowska 1939) – KRAM-P coll. Q-1

Abbreviations: f – fruit, s – seed, sc – scale, e – endocarp, l – leaf, rmg – rebedded old megaspore, st – sclerotia
∞ – more than 200 specimens
Dots in the vertical are ditto marks

Name of taxon		Type of remains	Layers												Sample "AX"
In Dyakowska 1939	After revision		G	F	E	D	C	B	A	2a	2b	3	6	7	
			Number of specimens												
Coenococcum	*Cenococcum graniformae* (Sow.) Ferd. & Winge	st	2/2	2/2	1/–										
Isoëtes vel *Selaginella*	Lycophytina	rmg												1/1	
Larix sp.	*Larix* sp.	n				1/1									
Potamogeton coloratus Vahl	*Potamogeton coloratus* Hornem.	e	62/–	120/1	103/–	16/–									
.	*P. panormitanoides* Dorof.	e	./59	./118	./90	./15									
.	*P. pusillus* L.	e	./2	./4	./14										
.	*P. gramineus* L.	e		./1											
.	*Batrachium* sp.	f			./1										
.	*Ranunculus* cf. *pygmaeus* Wahlenb.	f			./2										
P. alpinus Balb.	*Potamogeton dorofeevii* Wieliczk.	e	19/16	5/5	30/24										
.	*P. obtusifolius* Mert. & Koch	e	./2		./5										
P. cf. *perfoliatus* L.	*P. obtusifolius* Mert. & Koch	e										1/1			
P. praelongus Wulf.	*P. praelongus* Wulf.	e	16/16	15/14	93/90	7/6									
.	*P. perfoliatus* L.	e		./1		./1									
P. acutifolius Link.	*P. perfoliatus* L.	e	13/12	29/29	47/43										
P. pusillus L.	*P. pusillus* L.	e			27/29	3/3									
P. filiformis Pers.	*P. filiformis* Pers.	e	50/26	19/6	44/22	6/4							4/–	100/74	
.	*P. gramineus* L.	e	./19	./8	./14	./2									
.	*P. perfoliatus* L.	e	./1	./1											
.	*P. dorofeevii* Wieliczk.	e		./2	./2										
.	*P. panormitanoides* Dorof.	e	./1	./1											
.	*Potamogeton* sp.	e											./3	./21	
.	*Empetrum nigrum* L.	s	./1												
P. densus L.	*Potamogeton perfoliatus* L.	e		8/8	10/9										
Cladium mariscus (L.) Br.	m i s s i n g	f	1/–												
Carex aquatilis Wahlenb. vel *C. rigida* Good.	*Carex* sp. div. (2-sided)	f	1/17	1/10	1/7	7/7	2/–			1/1	2/2	42/98			
C. rostrata Stokes	*C. rostrata* Stokes	f	∞/50	∞/∞	∞/∞	∞/∞	∞/–	∞/∞							
Betula nana L.	*Betula humilis* Schrank	f	2/2												
B. nana L.	*B. humilis* Schrank	sc		1/1	1/1										

Ranunculus cf. *aquatilis*	*Batrachium* sp.	f	35/34	55/54	81/81	5/5						4/4		5/4	
.	*Ranunculus gmelini* DC.	f		./2	./1										
R. flammula L.	*R. gmelini* DC.	f										1/1			
Hypericum hirsutum L.	*Hypericum* cf. *hirsutum* L.	l			1/1										
Comarum palustre L.	*Comarum palustre* L.	f				6/5						9/–		15/–	
.	*Ranunculus gmelini* DC.	f				./1						./8		./11	
.	*R. reptans* L.	f												./4	
Myriophyllum alternifolium DC.	*Myriophyllum alterniflorum* DC.	f	5/–	5/1	2/–	2/–								2/1	
.	*M. spicatum* L.	f	./4	./3	./2	./2								./1	
Hippuris vulgaris L.	*Hippuris vulgaris* L.	f		13/12	9/–	12/12	9/9					1/1			40
.	*Cicuta virosa* L.	f		./1											
Cicuta virosa L.	*Cicuta virosa* L.	f				–/13	12/–	4/2							
Menyanthes trifoliata L.	*Menyanthes trifoliata* L.	s	4/–	2/–	6/7	11/–	562/–	187/–							97
Plant remains present in the collection but not included in the paper by Dyakowska 1939															
Carex sp.	*Carex* sp. div. (2-sided)	f			2		9								
.	*Carex* sp. div. (3-sided)	f							24		2		10	∞	
.	*C. rostrata* Stokes	f	5												
.	*C.* cf. *rostrata* Stokes	f	3							5					
Potamogeton sp. div.	*Potamogeton perfoliatus* L.	e	2	10	18	3									
.	*P. gramineus* L.	e	18	9	11	5									1
.	*P. praelongus* Wulf.	e	1		1										
.	*P. filiformis* Pers.	e	1	1											
.	*P. panormitanoides* Dorof.	e		4											17
.	*P. pusillus* L.	e		1											
.	*P. obtusifolius* Mert. & Koch	e			1										
.	*P.* cf. *obtusifolius* Mert. & Koch	e		1											
.	*P.* cf. *alpinus* Balb.	e				1									
.	indeterminate	e				1									
Ranunculus acer ?	*Ranunculus acris* L.	f		1											
R. cf. *acer* L.	*R.* cf. *lingua* L.	f					1								
indeterminate	*Potamogeton* cf. *filiformis* Pers.	f										1			

Table 3. List of macroscopic plant remains from Kąty (Dyakowska 1947) – KRAM-P coll. Q-106.

Abbreviations: f – fruit, fruit stone, s – seed, n – needle, co – cone, csc – cone scale, ca – cone axis, ws – wing of seed, t – twig, bd – bud, st – sclerotia
+++ – many, ++ – several, + – few (acc. to Dyakowska 1947)
Dots in the vertical are ditto marks

Name of taxon		Type of remains	Profile IV – layers:				Prof. II samples 94–98	Other profiles
In Dyakowska 1947	After revision		a	b	c	d		
			Number of specimens					
Abies		n	21/.	++/.	12/.	50/.		
Abies alba	*Abies alba* Mill.	n			./1			
.	*Picea* sect. *Picea*	n			./7			
Abies pectinata	*Abies alba* Mill.	n				./25		
.	*Abies* sp.	n				./1		
.	*Picea* sect. *Picea*	n				./32		
Abies	*Abies alba* Mill.	n	./8					
.	*Picea* sect. *Picea*	n	./14					
Picea		n	7/.	+++/.	50/.	25/.		
Picea excelsa	*Picea* sect. *Picea*	n			./42		++/15	
Picea	*Picea* sect. *Picea*	n	./8	./153		./26		
.	*Abies alba* Mill.	n		./1				
Picea		s		7/.	15/.	4/.		
Picea excelsa	*Picea* sect. *Picea*	s			./12			
.	*Abies alba* Mill.	s			./2			
Picea	*Picea* sect. *Picea*	s	./3	./4		./4		8
Picea	m i s s i n g	ws	+/–	+/–	+/–	2/–		
Picea	*Picea* sp.	co						1
Picea	*Picea* sp.	csc						2
Picea	*Picea* sp.	t			+/–	–/1		
Juniperus		n	30/.	+/.		40/.		
Juniperus	*Picea* sect. *Picea*	n	./32			./48	2/2	
Juniperus	*Juniperus* cf. *communis* L.	s					1/1	
Alnus	m i s s i n g	ca	4/–			4/–		
Alnus	m i s s i n g	f				1/–		
Carex rostrata	m i s s i n g	f	11/–	7/–	+/–			
Rubus idaeus	*Rubus idaeus* L.	f	1/–	1/1	5/4	1/1		1
Ranunculus cf. *aquatilis*	*Batrachium* sp.	f		1/1	3/4	1/1		3
Salvia sp.	m i s s i n g	f	2/–					
Cenococcum	*Cenococcum graniformae* (Sow.) Ferd. & Winge	st	+/2	+/–	+/–	+/8		
Plant remains present in the collection but not included in the paper by Dyakowska 1947								
Picea	*Picea* sp.	bd			23	4		
Varia	Lamiaceae	f				1		
.	*Stachys palustris* L.	f	1					

Table 4. List of macroscopic plant remains from Kąty (Mamakowa et al. 1975) KRAM-P coll. Q-106A

Abbreviations: f – fruit, fruit stone, s – seed, n – needle, cp – capsule, co – cone, csc – cone scale, a – anthers, st – sclerotia
∞ – abundant, ++ – frequent
Dots in the vertical are ditto marks

Name of taxon		Type of remains	Kąty I – samples												Kąty II C-14 sample
In Mamakowa et al. 1975	After revision		2	3	4	5	6	7	8	11	12	15	18	19	
			Number of specimens												
Alnus incana	*Alnus incana* (L.) Moench	f												1/1	
Betula t. alba	*Betula* sect. *Albae*	f													2/2
Juniperus sp.	*Picea* sect. *Picea*	s			1/1										
Larix sp.	m i s s i n g	n												2/–	
Picea abies	*Picea* sect. *Picea*	n	3/–		2/–	5/–	15/10	6/–					10/1	∞/5	∞/81
.	*Picea* sp.	n						./3							
.	*Pinus sylvestris* L.	n													./27
.	indeterminable	n	./3			./5									
P. abies	*Picea* sect. *Picea*	s					–/1								4/–
.	*Pinus sylvestris* L.	s													./6
P. abies	m i s s i n g	co						1/–							
P. abies	m i s s i n g	csc													1/–
Pinus silvestris	m i s s i n g	co													5/–
P. silvestris	*Pinus sylvestris* L.	csc													2/2
Rubus idaeus	*Rubus idaeus* L.	f		2/2			1/1			1/–	7/–		3/–	2/2	10/10
.	*Rubus* cf. *idaeus* L.	f								./1	./6		./3		
Sambucus racemosa	*Sambucus racemosa* L.	f		1/1										1/1	
Sambucus sp.	*S. racemosa* L.	f													2/2
Barbarea vulgaris	*Barbarea vulgaris* L.	s												1/1	
Batrachium sp.	*Batrachium* sp.	f					25/26	4/4							
Carex sp.	*Carex* sp. (3-sided)	f				36/26	4/2	2/1	5/5					3/3	∞/–
.	*C. rostrata* Stokes	f				./3									
Cerastium arvense	*Cerastium arvense* L.	s												3/3	21/20
Cirsium sp.	*Cirsium* sp.	s													1/1
Gramineae	Poaceae	s												3/3	11/11
Melandrium cf. *rubrum*	*Melandrium* cf. *rubrum* (Weigel) Garcke	f													7/7
Mentha cf. *aquatica*	*Mentha aquatica* L.	f				1/1									
Ranunculus acer	*Ranunculus acris* L.	f													4/4
R. repens	*R. repens* L.	f		2/2		2/–							1/–	6/6	13/13
.	*R.* cf. *lingua* L.	f				./2									

(cont.)

Table 4. Continued

Name of taxon		Type of remains	Kąty I – samples											Kąty II C-14 sample
In Mamakowa et al. 1975	After revision		2	3	4	5	6	7	8	11	12	15	18	19	
			Number of specimens												
Ranunculus repens	*Ranunculus* sp.	f											./1		
Ranunculus sp.	*Ranunculus* sp. div.	f													++/51
Rumex acetosella	Cyperaceae	f							1/1						
Salvia pratensis	*Salvia pratensis* L.	f										1/1			
Urtica dioica	*Urtica dioica* L.	f			1/–							1/1	1/1	2/2	
.	Scirpus sylvaticus L.	f			./1										
Plant remains present in the collection but not included in the paper by Mamakowa et al. 1975															
Carex rostrata	*Carex* sp. (3-sided)	f				1	2								
Cyperaceae	Cyperaceae	f													16
Picea sp.	not revised	a						3							
Varia	Apiaceae	s												1	
.	Asteraceae	s				2									
.	*Juncus* sp.	s									1				
.	*Mentha* sp.	f				1									
.	*Ranunculus* cf. *lingua* L.	f												1	
.	*Ranunculus* sp. div.	f												2	
.	*Salix* sp.	cp			1										
indeterminate	*B.* cf. *humilis* Schrank	f													1
.	Alismataceae ?	f													1
.	Asteraceae	s													1
.	*Polygonum* sp.	f													1
.	*Schoenus nigricans* L.	f													17
Cenococcum	*Cenococcum graniformae* (Sow.) Ferd. & Winge	st						15				105	75	∞	21

Table 5. List of macroscopic plant remains from Tarzymiechy (Profile I) – KRAM-P coll. Q-105/IIIA

Abbreviations: f – fruit, s – seed, sc – scale, st – sclerotia
Dots in the vertical are ditto marks

Name of taxon		Type of remains	Samples														
In Środoń 1954	After revision		33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
			Number of specimens														
Betula "alba"	*Betula* sect. *Albae*	f								2/–		2/1	1/–		5/5	1/2	2/1
.	*B. humilis* Schrank	f								./2			./1				
B. humilis	*B. humilis* Schrank	f		2/–			1/–	1/–	4/7	4/4	1/–						
.	*B.* cf. *humilis* Schrank	f					–/1										
.	*B.* sect. *Albae*	f									./1						
.	*B.* cf. *nana* L.	f		./2													
B. humilis	*B. humilis* Schrank	sc				1/–	1/–			1/1							
.	*B.* cf. *humilis* Schrank	sc				./1											
.	*B.* cf. *nana* L.	sc					./1										
B. nana	*B. nana* L.	f							6/3	3/3	1/–						
B. nana	*B.* cf. *nana* L.	sc		1/1													
Batrachium sp.	*Batrachium* sp.	f				1/–	1/1		2/1		5/3	1/–	7/5	13/13	21/18	6/6	5/2
Ceratophyllum demersum	*Ceratophyllum demersum* L.	f			1/1	1/–	16/13	13/12	24/20	1/1	1/1	1/1	3/3	4/6	3/4	9/8	1/1
.	*C. pentacanthum* Haynald	f					./2		./3								
C. submersum	m i s s i n g	f												1/–	2/–	1/–	
Myriophyllum alternifolium + *M. spicatum*	*M. spicatum* L.	f	1/1	7/5	4/4	1/1	21/18	10/10	34/30	11/11	3/1	1/–	1/1	1/–	1/–	1/1	
.	*Myriophyllum verticillatum* L.	f									./1	./1			./2	./1	
Najas flexilis	*Najas flexilis* (Willd.) Rostk. & W.L.E. Schmidt	f			1/1	1/1					28/22	12/13	2/2	1/–	42/38	47/44	30/20
N. marina	*N. marina* L.	f	1/2	2/4	1/1	13/10	21/21	56/62	63/59	2/2	67/69	47/43	51/46	36/42	55/70	67/77	55/43
N. minor	*N. minor* All.	f										1/1	1/–		6/3	7/1	3/1
Nuphar luteum	*Nuphar lutea* (L.) Smith	s									9/7	8/10	7/11	4/6	3/4	5/3	4/5
Sparganium minimum	m i s s i n g	f	1/–														
Stratiotes aloides	*Stratiotes aloides* L.	f															2/2
Zannichellia palustris	*Zannichellia palustris* L.	f				2/2	3/4	3/3	3/2	2/3	38/37	14/14	23/18	37/37	33/27	27/25	7/3
Alisma plantago	m i s s i n g	f								1/–							
Carex sp.	*Carex* sp. div. (2-sided)	f	4/–	9/3	6/1	5/3	5/4	13/10	21/13	16/8	20/6	8/5	23/15	27/12	17/8	–/2	9/7
.	*Carex* sp. div. (3-sided)	f	./4	./4	./4	./1	./1	./3	./9	./8	./5	./2	./2	./9	./2	./1	./1
.	*Eleocharis palustris* (L.) Roem. & Schult.	f				./1		./1	./5	./1	./1			./1			./1

(cont.)

Table 5. Continued

Name of taxon		Type of remains	Samples													
In Środoń 1954	After revision		33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
			Number of specimens														
Carex sp.	*Polygonum lapathifolium* L.	f					./1					./1	./1		./2		
Cicuta virosa	*Cicuta virosa* L.	s											1/1				1/1
Filipendula ulmaria	*Filipendula ulmaria* (L.) Maxim.	s										1/–	1/–	1/–	–/1		1/–
Heleocharis cf. *eupalustris*	*Eleocharis palustris* (L.) Roem. & Schult.	f			1/2												
Hippuris vulgaris	*Hippuris vulgaris* L.	f						1/–	1/1		2/2	1/1			2/2		
Lycopus europaeus	*Lycopus europaeus* L.	f						1/–				1/1	1/1		1/1		
Polygonum lapathifolium	*Polygonum lapathifolium* L.	f							2/1	1/1	1/1						
P. persicaria	*P. persicaria* L.	f					3/–						1/1		1/–		
Polygonum sp.	m i s s i n g	f									1/–	2/–	1/–				
Ranunculus sceleratus	*Ranunculus* cf. *sceleratus* L.	f					1/–	1/–	1/1								
Rumex hydrolapathum	m i s s i n g	f						1/–									
R. maritimus	*Rumex maritimus* L.	f					1/1	2/–	4/4							1/1	
Scirpus lacustris	*Schoenoplectus lacustris* (L.) Palla	f						1/1			–/3	1/1	1/3	2/2			
Scirpus sp.	*Sch. tabernaemontani* (C.C. Gmel.) Palla	f													4/2	3/4	3/3
Thalictrum flavum	*Thalictrum lucidum* L.	f										1/–	2/3			1/–	
.	*Thalictrum* cf. *lucidum* L.	f														./1	
Arctostaphylos uva-ursi	m i s s i n g	s		1/–													
Chenopodium album	*Chenopodium album* L.	s											1/1		1/–		
Ch. ficifolium	*Chenopodium* sp.	s						1/1									
Cirsium arvense	m i s s i n g	s							1/–								
Linum sp.	*Linum* sp.	s				–/1			1/–	1/1							
Melandrium album	m i s s i n g	s				1/–											
Onobrychis cf. *viciaefolia*	m i s s i n g	f					1/–										
Potentilla sp.	*Potentilla* sp.	f				–/1			1/–								
Sonchus arvensis	m i s s i n g	f											1/–				
Taraxacum sp.	*Taraxacum* sp.	f														1/1	
Thalictrum cf. *minus*	*Thalictrum minus* L.	f								1/1	1/1		1/1	1/1			
Cenococcum geophilum	m i s s i n g	st													1/–		

Plant remains present in the collection but not included in the paper by Środoń 1954																	
Indeterminate	Apiaceae	s				1											1
.	*Chenopodium album* L.	s		1													
.	*Euphorbia* sp.	s											1				
.	*Fragaria vesca* L.	f								1							
.	*Oenanthe aquatica* (L.) Poir.	s					1										
.	*Ranunculus* cf. *acris* L.	f												1			
.	*R.* cf. *repens* L.	f					1										
.	*Ranunculus* sp.	f											1				
.	*Scleranthus annuus* L.	f				1				1							
.	*Silene* sp.	s												1			
.	*Urtica dioica* L.	f												1			

Table 6. List of macroscopic plant remains from Tarzymiechy (Profile II) KRAM-P coll. Q-105/IIIB

Abbreviations: f – fruit, s – seed, sc – scale, st – sclerotia
Dots in the vertical are ditto marks

Name of taxon		Type of remains	Samples				
In Środoń 1954	After revision		33	32	31	30	29
			Number of specimens				
Alnus incana	m i s s i n g	sc					1/–
Betula cf. *humilis*	*Betula* cf. *humilis* Schrank	f			5/–	10/3	4/1
.	*B.* sect. *Albae* L.	f			./14	./5	./3
.	*B.* sect. *Albae* L.	sc					./1
Prunus cf. *avium*	m i s s i n g	f					1/-
Ceratophyllum demersum	*Ceratophyllum demersum* L.	f			1/2	1/1	
Najas flexilis	*Najas flexilis* (Willd.) Rostk. & W.L.E. Schmidt	f			5/5	1/1	4/3
N. marina	*N. marina* L.	f			15/12	17/16	13/14
Nuphar luteum	*Nuphar lutea* (L.) Smith	s			1/1	2/2	
Zannichellia palustris	*Zannichellia palustris* L.	f		–/1	11/10	13/11	7/7
Carex pseudocyperus	*Carex pseudocyperus* L.	f			1/1	–/2	
C. rostrata	*C. rostrata* Stokes	f			13/3	3/–	1/–
Carex sp.	*Carex* sp. div. (2-sided)	f			24/7	18/6	12/6
.	*Carex* sp. div. (3-sided)	f		–/1	./9	./11	./7
Cicuta virosa	*Cicuta virosa* L.	s			8/8	13/13	13/14
Hippuris vulgaris	*Hippuris vulgaris* L.	f			35/35	49/46	26/29
Lycopus europaeus	*Lycopus europaeus* L.	f			1/1		1/1
Polygonum lapathifolium	*Polygonum lapathifolium* L.	f			–/2	3/3	2/2
P. persicaria	m i s s i n g	f			1/–		
Polygonum sp.	*Polygonum* sp.	f	1/1				
Rumex maritimus	*Rumex maritimus* L.	f		–/1	2/1	2/2	1/1
Scirpus holoschoenus	*Schoenoplectus tabernaemontani* (C.C. Gmel.) Palla	f		–/1	5/7	1/1	4/8
Plant remains present in the collection but not included in the paper by Środoń 1954							
Indeterminate	*Eleocharis palustris* (L.) Roem. & Schult.	f			10	12	15
.	*Oenanthe aquatica* (L.) Poir.	s				1	
.	*Potentilla* sp.	f			1		
.	*Schoenoplectus lacustris* (L.) Palla	f			1		
.	*Urtica dioica* L.	f			3		7
.	*Cenococcum graniformae* (Sow.) Ferd. & Winge	st			2		

Table 7. List of *Potamogeton* endocarps from Tarzymiechy (Profiles I + II) – KRAM-P coll. Q-105/P

Dots in the vertical are ditto marks

Name of taxon			Number of endocarps
Acc. to J. Mądalski in Środoń 1954	After M. Aalto's revision (1974)	After present revision	
Potamogeton acutifolius	*Potamogeton compressus*	*Potamogeton compressus* L.	4/2
.	*P.* cf. *compressus*	*P.* cf. *compressus* L.	./1
.	–	*P. compressus* L.	./1
P. crispus	*P. crispus*	*P. crispus* L.	13/11
.	–	*P. crispus* L.	./3
P. densus	*P. natans*	*P. natans* L.	2/1
P. filiformis	–	*P. filiformis* Pers.	1/1
P. fluitans	–	m i s s i n g	2/–
P. lucens	–	*P. perfoliatus* L.	3/1
P. mucronatus	*P. friesii*	*P. friesii* Rupr.	135/124
.	.	*P. panormitanoides* Dorof.	./10
.	*P. rutilus*	*P. rutilus* Wolfg.	./4
.	–	*P.* cf. *rutilus* Wolfg.	./2
P. natans	*P. praelongus*	*P. praelongus* Wulf.	4/4
P. nitens	*P. natans*	*P. natans* L.	13/12
P. obtusifolius	–	*P. obtusifolius* Mert. & Koch.	3/2
P. pectinatus	–	*P. pectinatus* L.	1/1
P. perfoliatus	–	*P. perfoliatus* L.	64/45
.	*P. perfoliatus*	*P. perfoliatus* L.	./4
.	–	*P.* cf. *filiformis* Pers.	./3
.	–	*Potamogeton* sp.	./1
P. pusillus	*P. panormitanus*	*P. panormitanoides* Dorof.	47/12
.	*P. friesii*	*P. friesii* Rupr.	./36
.	–	*P.* cf. *friesii* Rupr.	./1
P. cf. *vaginatus*	*P. oxyphyllus*	*P.* cf. *oxyphyllus* Miq.	1/1
P. zosteraceus	*P. pectinatus*	*P. pectinatus* L.	14/6
.	.	*P. natans* L.	./2
.	.	*P.* cf. *praelongus* Wulf.	./1

Table 8. List of macroscopic plant remains of two extra samples from Tarzymiechy (Profile I) not determined by A. Środoń KRAM-P coll. Q-105/9.60–10.45 & 10.45–10.95

Abbreviations: f – fruit, s – seed, e – endocarp

Name of taxon as determined by F.Yu Velichkevich	Type of remains	Depth of samples (in m)	
		9.60–10.45	10.45–10.95
		Number of specimens	
Betula sect. *Albae*	f	2	
Betula cf. *humilis* Schrank	f		1
Batrachium sp.	f	1	1
Ceratophyllum demersum L.	f	5	7
Ceratophyllum cf. *submersum* L.	f	1	
Myriophyllum spicatum L.	f	3	4
Najas flexilis (Willd.) Rostk. & W.L.E. Schmidt	f	10	
N. marina L.	f	46	24
N. minor All.	f	6	
Nuphar lutea (L.) Smith	s	11	1
Potamogeton crispus L.	e	1	
P. friesii Rupr.	e	10	
P. pectinatus L.	e		2
P. perfoliatus L.	e		7
P. panormitanoides Dorof.	e	11	
P. rutilus Wolfg.	e		5
Zannichellia palustris L.	f	55	2
Carex sp. div. (2-sided)	f	8	14
Carex sp. div. (3-sided)	f	2	6
Eleocharis palustris (L.) Roem. & Schult.	f		2
Hippuris vulgaris L.	f	2	
Schoenoplectus lacustris (L.) Palla	f	2	
Sch. tabernaemontani (C.C. Gmel.) Palla	f	1	
Schoenoplectus sp.	f	1	1
Chenopodium sp.	s	1	
Cirsium palustre Scop.	s		1
Potentilla sp.	f	1	
Taraxacum officinale L.	f		1
Urtica dioica L.	f		1
Vacciniaceae	s	1	

Table 9. List of macroscopic plant remains from Tarzymiechy (*Dryas* flora) KRAM-P coll. Q-105/D

Abbreviations: f – fruit, s – seed, e – endocarp, cx – calyx, l – leaf, bl – bulbil, cp – capsule, sl – silicle, st – sclerotia
+++ – abundant, ++ – frequent, + – rare
Dots in the vertical are ditto marks

Name of taxon		Type of remains	Number of specimens
In Środoń 1954	After revision		
Alyssum sp.	*Alyssum* sp.	s	15/12
Alyssum sp.	not revised	sl	69/66
Arabis alpina	*Arabis alpina* L.	s	1/1
Armeria Iverseni	*Armeria* sp.	cx	65/61
Batrachium sp.	*Batrachium* sp.	f	1/1
cf. *Bellidiastrum* Michelii	not revised	f	1/1
Betula nana	*Betula nana* L.	l	5/6
B. nana	*B. nana* L.	f	1/1
Carex sp.	*Carex* sp. div. (2-sided)	f	+++/104
Cerastium cf. *alpinum*	*Cerastium alpinum* L.	s	4/3
Cerastium sp.	m i s s i n g	cp	1/–
Compositae	m i s s i n g	f	+++/–
Cruciferae	Brassicaceae	s	++/27
Cruciferae	m i s s i n g	sl	./
Draba cf. *aizoides*	m i s s i n g	s	14/–
.	not revised	sl	8/5
Dryas octopetala	*Dryas octopetala* L.	l	7/9
Elyna myosuroides	not revised	f	+++/56
Epilobium sp.	not revised	l	5/1
Erica sp.	not revised	l	1/1
Gramineae	Poaceae	f	+++/43
Hedysarum obscurum	not revised	l	4/6
Helianthemum cf. *alpestre*	not revised	f	29/21
Leontodon autumnalis	*Leontodon autumnalis* L.	f	5/3
Linum extraaxillare	*Linum extraaxillare* Kit.	s	2/2
Myriophyllum spicatum	*Myriophyllum spicatum* L.	f	1/1
Oxyria digyna	not revised	f	4/4
Pedicularis verticillata	*Pedicularis verticillata* L.	s	2/2
Polygonum viviparum	*Polygonum viviparum* L.	l	+++/15
P. viviparum	*P. viviparum* L.	bl	./111
P. aviculare	*P. aviculare* L.	f	2/2
Potamogeton obtusifolius	*Potamogeton filiformis* Pers.	e	2/2
Potentilla cf. *arenaria*	*Potentilla* cf. *arenaria* Borkh.	f	5/5
Ranunculus sp.	*Ranunculus* sp.	f	6/6
Salix herbacea	*Salix herbacea* L.	l	+++/18
S. polaris	*S. polaris* Wahlenb.	l	++/71
S. myrtilloides	not revised	l	+/5
S. reticulata	S. reticulata L.	l	+/8
S. retusa	not revised	l	+/1
Salix sp.	*Salix* sp.	l	+/5
Saxifraga oppositifolia	not revised	l	+++/86
Silene acaulis	*Silene acaulis* (L.) Jacq.	s	1/1
Spirodela polyrrhiza	not revised	l	3/2
Sweertia cf. *alpestris*	*Sweertia perennis* L. subsp. *alpestris*	s	4/4
Taraxacum sp.	*Taraxacum* sp.	f	3/3
Thalictrum alpinum	*Thalictrum alpinum* L.	f	14/14
Plant remains present in the collection but not included in the paper by Środoń 1954			
Draba sp.	*Draba* sp.	s	10
Silene sp.	not revised	l	1
indeterminate	Apiaceae	f	6
.	*Berteroa* sp.	s	2
.	*Betula* cf. *nana* L.	f	53

(cont.)

Table 9. Continued

Name of taxon		Type of remains	Number of specimens
In Środoń 1954	After revision		
indeterminate	Caryophyllaceae	s	1
.	*Dianthus* sp.	s	2
.	*Eriophorum* sp.	f	27
.	*Pedicularis verticillata* L.	s	1
.	*Potamogeton filiformis* Pers.	e	1
.	*Ranunculus* sp.	f	4
.	*Salix* sp.	cp	3
.	*Salix* sp. div.	l	6
.	*Silene wahlbergella* Chowd.	s	1
	Dryas flora – 1949 collection		
	Carex sp. div. (2-sided)	f	24
	Carex sp. (3-sided)	f	1
	Chenopodium cf. *album* L.	s	1
	Eriophorum sp. div.	f	∞
	Poaceae	f	1
	Polygonaceae	f	1
	Polygonum aviculare L.	f	1
	P. viviparum L.	bl	11
	Ranunculus sp.	f	2
	Salix sp.	l	2
	Cenococcum graniformae (Sow.) Ferd. & Winge	st	>100

Table 10. List of macroscopic plant remains from Wadowice (Szafer 1956) – KRAM-P coll. Q-2A

Abbreviations: f – fruit, s – seed, fcx – fruit-calyx, l – leaf, gl – glume
Dots in the vertical are ditto marks

Name of taxon		Type of remains	Number of specimens
In Szafer 1956	After revision		
Salix herbacea	*Salix herbacea* L.	l	3
Polygonum viviparum	*Polygonum viviparum* L.	l	4
Saxifraga oppositifolia	m i s s i n g	l	
Thalictrum alpinum	*Thalictrum alpinum* L.	f	3
Arabis alpina	m i s s i n g	s	
Thymus carpaticus	m i s s i n g		
Armeria sp.	*Armeria* sp.	fcx	15
Carex sp.	*Carex* sp. div. (2-sided)	f	11
.	*Carex* sp. div. (3-sided)	f	8
Potamogeton sp.	m i s s i n g	f	
Compositae	m i s s i n g	f	
Gramineae	m i s s i n g	gl	
Cruciferae	m i s s i n g	s	
	Plant remains present in the collection but not included in the paper by Szafer 1956		
Alchemilla sp.	*Alchemilla* sp.	f	2
Polygonum aviculare	*Polygonum aviculare* L.	f	1
Silene acaulis	Caryophyllaceae	s	1
.	*Stellaria palustris* Retz.	s	1
Varia	*Potentilla* sp.	f	1
.	*Rumex* sp.	f	1

Table 11. List of macroscopic plant remains from Wadowice (Sobolewska et al. 1964) – KRAM-P coll. Q-2

Abbreviations: f – fruit, fruit stone, s – seed, sc – scale, e – endocarp, n – needle, sh – short shoot, ca – cone axis, bs – bud scale, if – inflorescence, fl – flower, ws – wing of seed, st – sclerotia
Dots in the vertical are ditto marks

Name of taxon		Type of remains	Layers and samples											Extra samples	
			C		E		F			W_2					
In Sobolewska et al. 1964	After revision		3	4	1	2	3	4	5	2	5	6	7	"Peat"	"1953", "1954", "1960"
			Number of specimens												
Alnus incana	*Alnus incana* (L.) Moench	f	1/1												
A. incana	m i s s i n g	if								1/–					
.	*Alnus* sp.	ca								./1					
Betula "alba"	*Betula* sect. *Albae*	f	16/15			1/1									
.	*B.* sect. *Albae*	sc	./2												
Larix sp.	*Larix* sp.	n								9/6					
Larix sp.	*Larix* sp.	s	3/3										2/–		
.	*Picea* sect. *Picea*	s											./1		
Larix sp.	*Larix* sp.	sh	1/1												
Picea excelsa	*Picea* sect. *Picea*	n	14/14			5/5	19/17	2/2	1/–	3/3		5/3	3/7		
P. omoricoides	*P.* sect. *Omorica*	n							2/–				14/2	18	
.	*P.* sect. *Picea*	n											./2		
Picea sp.	*P.* sect. *Picea*	s	3/1		1/1	2/2									
.	*Pinus sylvestris* L.	s	./2												
Pinus silvestris	*Pinus sylvestris* L.	n								2/2					
Populus tremula	not revised	bs	8/7												
Rubus idaeus	*Rubus idaeus* L.	f	8/8		–/1	18/14	33/33	28/34	1/1				2/2		
Sambucus racemosa	*Sambucus racemosa* L.	f			4/2	2/2	6/6	2/2					1/1	2	
Spiraea salicifolia	*Spiraea salicifolia* L.	fl	1/1												
Alisma plantago-aquatica	*Alisma plantago-aquatica* L.	s	22/21		5/5					1/1					
Carex sp. div.	*Carex* sp. div. (2-sided)	f	473/114		21/3	292/31	115/8	22/17		4/1				27	
.	*Carex* sp. div. (3-sided)	f	./272		./12					./2				2	
.	*C.* cf. *vesicaria* L.	f				./232									
.	*Urtica dioica* L.	f								./1					
Cerastium cf. *silvaticum*	*Cerastium* cf. *sylvaticum* Waldst. & Kit.	s								2/1					
Cirsium cf. *palustre*	*Cirsium palustre* Scop.	s				1/1									
Cirsium sp.	*Cirsium* sp.	s	1/1												
Comarum palustre	*Comarum palustre* L.	s	14/13												
Glyceria sp.	*Glyceria maxima* (Hartm.) Holmb.	s	9/10												

(cont.)

Table 11. Continued

Name of taxon		Type of remains	Layers and samples											Extra samples	
			C		E		F			W_2					
In Sobolewska et al. 1964	After revision		3	4	1	2	3	4	5	2	5	6	7	"Peat"	"1953", "1954", "1960"
			Number of specimens												
Heleocharis acicularis	indeterminate	f	1/1												
H. ovata	*Eleocharis ovata* (Roth) Roem. & Schult.	f	1/1												
H. palustris	*E. palustris* (L.) Roem. & Schult.	f	21/20							2/2					
Juncus sp.	*Juncus* sp.	s								2/1					
Lemna sp.	*Lemna trisulca* L.	s	1/1												
Lycopus europaeus	*Lycopus europaeus* L.	f	5/5												
Lysimachia thyrsiflora	*Lysimachia thyrsiflora* L.	s	1/–	7/7			4/3	8/8						19	
.	*L. cf. vulgaris* L.	s	./1												
Myriophyllum sp.	*Myriophyllum verticillatum* L.	f		8/8											
Oenanthe aquatica	*Oenanthe aquatica* (L.) Poir.	f	59/51		9/6	152/132									
Polygonum lapathifolium ssp. *nodosum*	*Polygonum lapathifolium* L.	f	61/47												
Potamogeton acutifolius	*Potamogeton acutifolius* Link	e	15/15			4/4									
P. fluitans	*P. natans* L.	e				2/2									
P. obtusifolius	*P. natans* L.	e			–/5	5/–									
P. cf. *polygonifolius*	*P.* cf. *polygonifolius* Pourr.	e				1/1									
P. praelongus	*P. cf. nodosus* Poir.	e	1/1												
P. trichoides	*P. trichoides* Cham. & Schltdl.	e	24/24												
P. cf. *Zizii*	*P. trichoides* Cham. & Schltdl.	e				1/1									
Ranunculus sceleratus	*Ranunculus gmelini* DC.	f	6/6												
Rorippa palustris	*Rorippa palustris* (L.) Bess.	s			4/3	3/1									
Sagittaria sagittifolia	*Sagittaria sagittifolia* L.	s	5/5		4/3										
Sparganium minimum	*Sparganium minimum* Wallr.	e	17/9		3/3	20/21									
S. cf. *ramosum*	*Sparganium* sp.	e	5/1												
S. simplex	*S. emersum* Rehm.	e	14/12		5/5	59/46									
.	*S. cf. stenophyllum* Maxim.	e	./1												
Typha sp.	*Typha* sp.	s	6/3	18/15						2/2					
Urtica dioica	*Urtica dioica* L.	f	4/4			7/7									
Cenococcum geophilum	*Cenococcum graniformae* (Sow.) Ferd & Winge	st	13/11		5/7	40/29	26/24	7/4	62/–	12/6	39/38	26/19	12/50	∞	

Plant remains present in the collection but not included in the paper by Sobolewska et al. 1965															
Varia	*Larix* sp.	sh								1					
.	Pinaceae	ws	1												
.	*Pinus sylvestris* L.	s											2		
.	*Alisma plantago-aquatica* L.	s				1									
.	*Carex bohemica* Schreb.	f												17	
.	*Carex* sp. div. (2-sided)	f	52											3	
.	*Carex* sp. (3-sided)	f					1								
.	*Lysimachia thyrsiflora* L.	s												1	
indeterminate	*Picea* sect. *Picea*	n													45
.	*Picea* sect. *Omorica*	n													7
.	*Rubus idaeus* L.	f													2
.	*Alchemilla* sp.	f													3
.	*Ajuga reptans* L.	f													1
.	*Carex* sp. div. (2-sided)	f													20
.	*Carex* sp. div. (3-sided)	f											10		21
.	*Carex* sp. (3-sided)	f					1								
.	*Mentha* sp.	s	1												
.	*Potentilla* sp.	s				1									2
.	*Ranunculus* cf. *lingua* L.	f													3
.	*R.* cf. *reptans* L.	f													5

Table 12. List of macroscopic plant remains from Brzeziny – KRAM-P coll. Q-104

Abbreviations: f – fruit, fruit stone, s – seed, sc – scale, e – endocarp, n – needle, sh – short shoot, co – cone, ca – cone axis, ws – wing of seed, t – twig, st – sclerotia

∞ – abundant, + – present

Dots in the vertical are ditto marks

Name of taxon		Type of remains	Depth of sample in cm acc. to collection (acc. to paper)					Extra samples
In Birkenmajer & Środoń 1960	After revision		0–40 (125–80)	40–75 (80–50)	75–100 (50–30)	100–120 (30–20)	130 (20–0)	
			Number of specimens					
Pinus silvestris	m i s s i n g	n	13/–	5/–	1/–	5/–	36/–	
Picea excelsa	*Picea* sect. *Picea*	n	∞/62	∞/148	2/2	6/–	1/–	113
.	*Picea* sect. *Picea*	s		./3				
.	*Pinus sylvestris* L.	s		./12				
.	*Pinus* sp.	s				./2		
.	*Larix* sp.	s				./1		
P. excelsa	m i s s i n g	sc						
Larix sp.	*Larix* sp.	n	∞/45	8/8	1/1			
.	*Larix* sp.	co	2/2					
.	*Larix* sp.	ca		1/1				
Alnus incana	*Alnus incana* (L.) Moench	l				+/+	+/+	
Betula humilis	*Betula humilis* Schrank	f						1/1
Betula pubescens	m i s s i n g	f	3/–	69/–	3/–	12/–	1/–	
Rubus idaeus	*Rubus idaeus* L.	f	5/5	4/4				
Sambucus racemosa	*Sambucus racemosa* L.	f	2/2	1/1				
Batrachium sp.	*Batrachium* sp.	f	1/1					
Carex sp. div.	*Carex* sp. div. (2-sided)	f	∞/120	∞/217	∞/–	∞/219	–/43	
.	*Carex* sp. div. (3-sided)	f	./86					
.	*C. rostrata* Stokes	f	./23	./31				
.	*C.* cf. *rostrata* Stokes	f		./75		./27		
.	*C.* cf. *appropinqua* Schumach.	f		./6				
.	*Eleocharis palustris* (L.) Roem. & Schult.	f	./1					
.	*Schoenus nigricans* L.	f		./1				
Cirsium oleraceum	*Cirsium oleraceum* (L.) Scop.	f	1/1					
Cirsium palustre	*Cirsium palustre* Scop.	s		7/7				
Cirsium sp.	*Cirsium* sp.	s					1/1	
Comarum palustre	*Comarum palustre* L.	f	–/–	258/249	2/2	2/2		23
Cruciferae	*Cardamine* sp.	s	1/1					
Filipendula ulmaria	*Filipendula ulmaria* (L.) Maxim.	f		101/90	6/6	2/2		4
Hippuris vulgaris	*Hippuris vulgaris* L.	f		27/26	1/1			
Lychnis flos-cuculi	*Lychnis flos-cuculi* L.	s	2/1		1/1			
Melandrium album	indeterminate	s	3/3					
Menyanthes trifoliata	m i s s i n g	s			1/–			
Potamogeton alpinus	m i s s i n g	f	6/–	6/–				
P. pusillus	Potamogeton *friesii* Rupr.	e	1/1		1/–			
Potentilla sp. I	*Potentilla* cf. *inclinata* Vill.	s	3/3	1/1				
Potentilla sp. II	*Potentilla* sp.	s	6/6					
Ranunculus acer	*Ranunculus acris* L.	f			4/–		–/2	
.	*R.* cf. *acris* L.	f			./2			
.	*R. reptans* L.	f			./1			
Ranunculus sp.	*Ranunculus* sp.	f				1/1		
Sparganium minimum	*Sparganium minimum* Wallr.	e		4/4				
Stellaria graminea	*Stellaria palustris* Retz.	s	14/13					
S. holostea	*S. holostea* L.	s	1/1					
Thalictrum lucidum	*Thalictrum lucidum* L.	f	3/3		1/1			
Thesium cf. *alpinum*	*Thesium* cf. *alpinum* L.	f	2/2		1/1			

Table 12. Continued

Name of taxon		Type of remains	Depth of sample in cm acc. to collection (acc. to paper)					Extra samples
In Birkenmajer & Środoń 1960	After revision		0–40 (125–80)	40–75 (80–50)	75–100 (50–30)	100–120 (30–20)	130 (20–0)	
			Number of specimens					
Valeriana tripteris	*Valeriana officinalis* L.	f	2/1	8/8	1/1			
Viola sp. I	*Viola* sp. div.	s	3/–	9/9	1/1	4/4		
.	*V.* cf. *palustris* L.	s		./1				
Viola sp. II	*V.* cf. *palustris* L.	s	5/5	3/–				
.	*V.* cf. *alba* Bess.	s	./1	./1				
Cenococcum geophilum	*Cenococcum graniformae* (Sow.) Ferd. & Winge	st	+/12	+/4	+/8	–/4	–/29	
Plant remains present in the collection but not included in the paper by Birkenmajer & Środoń 1960								
Betula "alba"	*Betula* sect. *Albae*	f						7
B. nana ?	*B.* sect. *Albae*	sc		1				
Betula sp.	*B.* cf. *humilis* Schrank	f			2			
.	*Betula* sp.	f	2					
Picea	*Pinus silvestris* L.	s	6					
.	*Larix* cf. *decidua* Mill.	s	12					
.	*L.* cf. *decidua* Mill.	sh	15					
.	*L.* cf. *decidua* Mill.	ws	1					
.	*Picea* vel *Larix*	ws						1
.	*Juniperus communis* L.	s	1					
Carex rostrata	*Carex rostrata* Stokes	f		5				17
Valeriana dioica	*Valeriana dioica* L.	s	1					1
indeterminate	*Betula* sect. *Albae*	f		55		2		
.	*B.* sect. *Albae*	sc		1				
.	*B.* cf. *humilis* Schrank	f		7				
.	*B.* cf. *nana* L.	f					1	
.	*Betula* sp.	f		1				
.	*Larix* sp.	n	1					1
.	*Larix* sp.	sh	4					
.	*Picea* cf. *abies* (L.) Karst.	n		5				
.	*Picea* sp.	s						2
.	*Picea* sp.	t		2				
.	*Pinus sylvestris* L.	s				1		
.	*Pinus sylvestris* L.	n						1
.	*Pinus* sp.	n				4		
.	*Sambucus* sp.	f						1
.	Asteraceae	s						1
.	*Carex* cf. *rostrata* Stokes	f						1
.	*Carex* sp. div. (2-sided)	f	1		60	4	5	27
.	*Carex* sp. div. (3-sided)	f			4			20
.	*Carex* sp.	f						3
.	cf. *Carduus* sp.	s		1				
.	*Cirsium* sp.	s						3
.	*Comarum palustre* L.	f			1			
.	Cyperaceae	s			1			
.	*Juncus* sp.	s		3				
.	*Luzula luzuloides* (Lam.) Dandy & Wilmott	s	1					
.	*Ranunculus gmelini* DC.	f		1				
.	*R. reptans* L	f	1					

(cont.)

Table 12. Continued

Name of taxon		Type of remains	Depth of sample in cm acc. to collection (acc. to paper)					Extra samples
In Birkenmajer & Środoń 1960	After revision		0–40 (125–80)	40–75 (80–50)	75–100 (50–30)	100–120 (30–20)	130 (20–0)	
			Number of specimens					
indeterminate	*Ranunculus* sp.	f			1			1
.	cf. *Scheuchzeria palustris* L.	s			1			
.	*Schoenus nigricans* L.	f	2				35	
.	*Schoenus* cf. *nigricans* L.	f			1			
.	*Spiraea* sp.	f		1				
.	*Thalictrum lucidum* L.	f	1					
.	*Thesium* sp.	f						2
.	*Urtica dioica* L.	f	1					
.	*Valeriana officinalis* L.	f				1		
.	*Valeriana* sp.	f	10	2	3			17
.	*Viola* sp.	s		1				
.	*Ceratophyllum* sp.	f						1

Table 13. List of macroscopic plant remains from Białka Tatrzańska – KRAM-P coll. Q-31

Abbreviations: f – fruit, s – seed, e – endocarp, l – leaf, br – bract, p – perianth, st – sclerotia
Dots in vertical are ditto marks

Name of taxon		Type of remains	Layers of geological profile		
In Sobolewska & Środoń 1961	After revision		b	c	d
			Number of specimens		
Betula nana L.	*Betula nana* L.	l	1/1		
B. nana L.	*Betula* cf. *nana* L.	f			1/1
Alchemilla sp.	*Alchemilla* sp.	f			5/5
Cardamine pratensis L.	*Cardamine pratensis* L.	s			1/1
Carex sp. div.	*Carex* sp. div. (3-sided)	f	84/66	24/19	38/32
Cerastium cf. *vulgatum* L.	Caryophyllaceae	s			1/1
Gramineae	m i s s i n g	br		1/–	2/–
Potamogeton filiformis Pers.	*Potamogeton filiformis* Pers.	e		2/2	
Potentilla cf. *Crantzii* (Cr.) Beck	*Potentilla* cf. *crantzii* (Crantz) Beck ex Fritsch	f	1/1		
Potentilla sp.	*Potentilla* sp.	f		1/1	1/–
.	*Comarum palustre* L.	f			./1
Ranunculus flammula L.	*Ranunculus reptans* L.	f	3/3	5/6	4/4
R. cf. *oreophilus* M.B.	*R. reptans* L.	f		2/2	
R. sceleratus L.	*R. gmelini* DC.	f	5/5	2/2	8/9
Ranunculus sp.	indeterminable	f	1/1		
Rumex acetosa L.	*Rumex acetosa* L.	p	3/1		
Plant remains present in the collection but not included in the paper by Sobolewska & Środoń 1961					
Gramineae	Poaceae	s			1
indeterminate	*Ranunculus reptans* L.	f	1		
.	*R.* cf. *gmelini* DC.	f	2		
.	*Cenococcum graniformae* (Sow.) Ferd. & Winge	st			1

Table 14. List of macroscopic plant remains from Zator KRAM-P coll. Q-3

Abbreviations: f – fruit, fruit stone, s – seed, e – endocarp, cx – calyx, l – leaf, v – valve of pod, m – macrospore
+++ abundant; ++ frequent; + occasional
Dots in the vertical are ditto marks

Name of taxon		Type of remains	Samples									
In Koperowa & Środoń 1965	After revision		1–7	8–15	16–22	23–26	27–28	29–31	32–52	53–58	59–65	66–71
			Number of specimens									
Alyssum sp.	*Alyssum* sp.	v				1/1						
Armeria maritima	*Armeria maritima* (Mill.) Willd.	cx				1/1						
Batrachium sp.	*Batrachium* sp.	f	12/9	1/1	9/9	208/184	55/59	–/69	–/4	–/5	–/8	
Betula cf. *nana*	*Betula* cf. *nana* L.	f				1/1						
Callitriche autumnalis	*Callitriche autumnalis* L. em. Wahlenb.	f				1/1						
Carex sp. div.	*Carex* sp. div. (2-sided)	f	+/39	+/–	+/4	+++/207	++/70	++/31				
.	*C.* sp. div. (3-sided)	f	./35		./1							
Cruciferae	Brassicaceae	s			15/14							
Gramineae	Poaceae	f	1/1		4/4	3/3						
Heleocharis palustris	*Eleocharis palustris* (L.) Roem. & Schult.	f			2/2	11/11	1/1					
Hippuris vulgaris	*Hippuris vulgaris* L.	f	1/1			1/1						
Myriophyllum sp.	*Myriophyllum spicatum* L.	f			1/1							
Potamogeton filiformis	*Potamogeton filiformis* Pers.	e				81/75						
.	*Ranunculus reptans* L.	f				./1						
P. lucens	*Potamogeton dorofeevii* Wieliczk.	e				3/3	1/1	1/1				
Potamogeton sp.	*P. dorofeevii* Wieliczk.	e				6/6	2/1					
.	*P. cf. vaginatus* Turcz.	e					./1					
.	*Potamogeton* sp.	e					./1					
Potentilla sp.	*Potentilla* sp.	s	1/1									
Ranunculus flammula	*Ranunculus reptans* L.	f	1/1				29/29		15/15	3/3		
R. sceleratus	*R. gmelini* DC.	f				12/12	2/2					
Salix herbacea	*Salix herbacea* L.	l				2/2						
Selaginella selaginoides	*Selaginella selaginoides* (L.) PB. ex Schrank & Mart.	m		1/1								1/1
Sparganium minimum	*Sparganium hyperboreum* Laest.	e				1/1						
Stellaria media	*Stellaria media* (L.) Vill.	s	1/1									
Viola sp.	*Viola* sp.	s	1/1					2/2				

(cont.)

Table 14. Continued

Name of taxon		Type of remains	Samples									
In Koperowa & Środoń 1965	After revision		1–7	8–15	16–22	23–26	27–28	29–31	32–52	53–58	59–65	66–71
			Number of specimens									
Plant remains present in the collection but not included in the paper by Koperowa & Środoń 1965												
Polygonum hydropiper	*Polygonum hydropiper* L.	f							75			
.	*P. aviculare* L.	f							3			
.	*P. persicaria* L.	f							1			
.	*Rubus* cf. *occidentalis* L.	f							1			
Salix sp.	*Salix* sp.	l				1						
Varia	*Betula* cf. *nana* L.	f	1									
.	*Caltha palustris*	s	1									
.	*Carex* sp. div. (2-sided)	f	7		4		1					
.	*Carex* sp. (3-sided)	f		1								
.	Cyperaceae	f	2			3						
.	*Eleocharis* sp.	f				1						
.	*Ranunculus* sp.	f	1									

Table 15. List of macroscopic plant remains from Dobra – KRAM-P coll. Q-82

Abbreviations: f – fruit, fruit stone, s – seed, sc – scale, n – needle, sh – short shoot, l – leaf, cx – calyx, bl – bulbil, pd – pod, m – macrospore, st – sclerotia
Dots in the vertical are ditto marks

Name of taxon		Type of remains	Depth of samples (m)			Extra samples (Dobra,, Dobra "C", Dobra "X")
In Środoń 1968	After revision		9.50–9.90 (Dobra III, "E", "C14")	9.90–10.45 (Dobra II)	12.00–12.50 (Dobra Ia, Dobra Ib)	
			Number of specimens			
Alnus cf. *incana* (L.) Mnch.	*Alnus* cf. *incana* (L.) Moench	f			1/1	
Betula nana L.		f,l,sc,sh	52/.	2/–	165/.	
.	*Betula nana* L.	f	./24		./15	
.	*B. nana* L.	l	./3		./1	17
.	*B. nana* L.	sc	./3		./9	
.	*B. humilis* Schrank	f			./22	
.	*B. humilis* Schrank	sc			./4	
Picea sp.	m i s s i n g	n			1/–	
Salix herbacea L.	m i s s i n g	l			1/–	
Alchemilla sp.	*Alchemilla* sp.	s			4/3	1
Alyssum montanum L.	*Alyssum montanum* L.	s	1/1			
Alyssum sp.	m i s s i n g	pd			1/–	
Arabis alpina L.	*Arabis alpina* L.	s	12/13	14/14	7/7	
Armeria	*Armeria alpina* (DC.) Willd.	cx	1/–	1/–	2/2	
Callianthemum coriandrifolium Rchb.	*Callianthemum coriandrifolium* Rchb.	f		1/1		
Carex sp.	m i s s i n g	f	32/–		65/–	
Cerastium cf. *lanatum* Lam.	*Cerastium lanatum* Lam.	s	7/7		8/7	
C. cf. *lapponicum* Cr.	*C.* cf. *alpinum* L.	s	2/2			
Cruciferae	Brassicaceae	s	43/31		2/–	
.	*Arabis alpina* L.	s			./2	
.	*Cardamine* cf. *flexuosa* With.	s	./2			
Dianthus superbus ssp. *speciosus* (Rchb.) Hay.	*Dianthus* sp.	s			1/1	
Leontodon autumnalis L.	*Leontodon autumnalis* L.	s	31/31			
L. pseudotaraxaci Schur.	*L. pseudotaraxaci* Schur	s	4/4			
Luzula cf. *nemorosa* (Poll.) E.Mey.	*Luzula* cf. *luzuloides* (Lam.) Dandy & Wilmott	s	–/9		1/–	
.	*Luzula* sp.	s			./1	
Melandrium rubrum (Weig.) Garcke	*Melandrium rubrum* (Weigel) Garcke	s	68/64	2/2		

(cont.)

Table 15. Continued

Name of taxon		Type of remains	Depth of samples (m)			Extra samples (Dobra,, Dobra "C", Dobra "X")
In Środoń 1968	After revision		9.50–9.90 (Dobra III, "E", "C14")	9.90–10.45 (Dobra II)	12.00–12.50 (Dobra Ia, Dobra Ib)	
			Number of specimens			
Minuartia verna (L.) Hiern.	indeterminate	s			2/2	
Polygonum bistorta L.	*Polygonum bistorta* L.	f	6/6			
P. viviparum L.	*P. viviparum* L.	bl	38/8		3/–	
Potentilla aurea L.	*Potentilla aurea* L.	s		7/7		
P. Crantzii (Cr.) Beck	*P. crantzii* (Crantz) Beck ex Fritsch	s			38/38	
P. heptaphylla L.	*P. heptaphylla* L.	s	9/5	14/14	47/44	
.	*Potentilla* sp.	s	./4			
P. puberula Krašan	*P. pusilla* Host.	s	1/1		11/11	
Potentilla sp.	*Potentilla* sp. div.	s			2/2	
Ranunculus flammula L.	*Ranunculus reptans* L.	f	1/1		4/4	
R. cf. *montanus* Willd.	*Ranunculus* cf. *pseudomontanus* Schur	f	21/21			
R. cf. *oreophilus* M.B.	*R.* cf. *oreophilus* M. Bieb.	f	9/9			
R. cf. *repens* L.	*R.* cf. *pseudomontanus* Schur	f	13/13			
Ranunculus sp.	*R.* cf. *pseudomontanus* Schur	f	11/11			
Rumex acetosella L.	*Rumex acetosella* L.	f	1/1			
Selaginella selaginoides (L.) Lk.	m i s s i n g	m	1/–			
Silene cucubalus Wib.	Caryophyllaceae	s			1/1	
Silene cucubalus ssp. *prostrata* (Gaud.) Sch. et Kell.	Caryophyllaceae	s			3/2	
Soldanella cf. *carpatica* Vierh.	indeterminate	s	2/2			
Stellaria media Vill.	Caryophyllaceae	s			1/1	
.	*Lychnis* cf. *chalcedonica* L.	s	4/3			
Taraxacum cf. *alpinum* (Hoppe) Heg. et Heer	*Taraxacum alpinum* (Hoppe) Hegetschw. & Heer	s	6/6			
Thalictrum alpinum L.	*Thalictrum alpinum* L.	s	2/2		1/1	
Viola sp.	*Viola* sp.	s	1/1		3/2	
.	*Alchemilla* sp.	s			./1	
Plant remains present in the collection but not included in the paper by Środoń 1968						
Picea excelsa Lk.	Picea sect. *Picea*	n				1
Rubus	*Rubus idaeus* L.	f				17

Salix	*Salix* sp. div.	l				4
Sambucus	*Sambucus racemosa* L.	f				4
Comarum palustre L.	*Potentilla* cf. *crantzii* (Crantz) Beck ex Fritsch	s			1	
Melandrium apetalum	*Silene wahlbergella* Chowd.	s	1			
Cenococcum	*Cenococcum graniformae* (Sow.) Ferd. & Winge	st	91	51	∞	12
Varia	*Betula humilis* Schrank	f			25	5
.	*B. humilis* Schrank	sc			8	1
.	*B. nana* L.	f		1	15	
.	*B. nana* L.	sc			2	
.	*B. nana* L.	l	1			
.	*B.* cf. *nana* L.	f	4			
.	*Salix* sp.	l	1			
.	*Alchemilla* sp.	s				4
.	*Armeria* sp.	cx	1			
.	Brassicaceae	s	3		1	
.	*Carex* sp. div. (2-sided)	f	26	9	16	41
.	*Carex* sp. div. (3-sided)	f	15	2	4	30
.	*Galeopsis* sp.	s			1	
.	*Luzula* sp.	s	2			
.	*Melandrium rubrum* (Weigel) Garcke	s				2
.	Polygonaceae	f	27			
.	*Polygonum viviparum* L.	b	4			1
.	*Potentilla* cf. *heptaphylla* L.	s				1
.	*Potentilla* sp.	f	3	1		
.	*Ranunculus* sp.	f	3		1	
.	*Rumex acetosella* L.	f	1			
.	*Rumex* sp.	f				2
.	*Salix* ex gr. *herbacea* L.	l	9			
.	*Saponaria officinalis* L.	s	2	2		
.	*Schoenus nigricans* L.	f	9	21	5	19
.	Vacciniaceae	l	1			
.	*Cenococcum graniformae* (Sow.) Ferd. & Winge	st				4
indeterminate	*Saponaria officinalis* L.	s			31	

Table 16. List of macroscopic plant remains from Łążek – KRAM-P coll. Q-42

Abbreviations: f – fruit, s – seed, n – needle, co – cone, csc – cone scale
∞ – abundant
Dots in the vertical are ditto marks

Name of taxon		Type of remains	Samples			
In Mamakowa 1968	After revision		I	II	III	IV
			Number of specimens			
Larix sp.	*Larix* cf. *decidua* Mill.	n		∞/56	∞/48	∞/∞
Larix sp.	*Larix* cf. *decidua* Mill.	co				5/5
Larix sp.	*Larix* cf. *decidua* Mill.	csc				3/2
Larix sp.	*Larix* cf. *decidua* Mill.	s		7/4		32/33
.	*Pinus sylvestris* L.	s		./2		
Betula verrucosa	*Betula pendula* Roth	f			7/6	13/13
.	*B.* cf. *humilis* Schrank	f			./2	
Betula humilis	*B. humilis* Schrank	f			6/4	9/2
.	*Betula* sp.	f				./2
.	*Carex* sp. div. (2-sided)	f			./2	
Betula nana	*Betula* cf. *humilis* Schrank	f		3/2		
Carex sp.	*Carex rostrata* Stokes	f			18/18	49/49
Comarum palustre	*Comarum palustre* L.	f		1/1	15/12	1/-
Plant remains present in the collection but not included in the paper by Mamakowa 1968						
Betula sp.	*Betula* sect. *Albae*	f		1		
indeterminate	*Carex* sp. div. (2-sided)	f				3
.	*Eleocharis palustris* (L.) Roem. & Schult.	f				1

Table 17. List of macroscopic plant remains from Rzochów – KRAM-P coll. Q-32

Abbreviations: f – fruit, s – seed, sc – scale, e – endocarp, n – needle, sh – short shoot, mc – male catkin, m – macrospore, msp – microsporangium, st – sclerotia
Dots in the vertical are ditto marks

Name of taxon		Type of remains	Number of specimens
In Środoń 1976	After revision		
Alnus glutinosa	*Alnus incana* (L.) Moench	f	4/4
.	*Alnus* sp.	f	./1
A. glutinosa	m i s s i n g	mc	+/–
Betula t. *humilis*	*Betula* sect. *Albae*	f	180/75
B. t. *verrucosa*	*B. pendula* Roth	sc	27/27
Pinus silvestris	*Pinus sylvestris* L.	n	94/60
P. silvestris	m i s s i n g	mc	1/–
P. silvestris	*P. sylvestris* L.	s	9/6
P. silvestris	*P. sylvestris* L.	sh	21/18
Rubus cf. *idaeus*	*Rubus* cf. *idaeus* L.	s	1/1
R. saxatilis	*R. saxatilis* L.	s	1/1
Alisma plantago-aquatica	*Alisma plantago-aquatica* L.	s	6/5
Calla palustris	*Calla palustris* L.	s	5/5
Callitriche cf. *polymorpha*	*Callitriche* cf. *cophocarpa* Sendtn.	f	1/1
Carex acutiformis	not revised	f	12/12
C. leporina	not revised	f	6/6
C. panicea	not revised	f	1047/1047
C. paniculata	not revised	f	7/7
C. paradoxa	not revised	f	18/18
C. pseudocyperus	*C. pseudocyperus* L.	f	19/18

Table 17. Continued

Name of taxon		Type of remains	Number of specimens
In Środoń 1976	After revision		
Carex pulicaris	*C. cf. pauciflora* Lightf.	f	3/3
Carex sp. div.	*Carex* sp. div. (2-sided)	f	110/79
.	*Carex* sp. div. (3-sided)	f	./16
.	Polygonaceae	f	./1
Comarum palustre	*Comarum palustre* L.	f	56/55
Filipendula ulmaria	*Filipendula ulmaria* (L.) Maxim.	s	54/51
Heleocharis palustris	*Carex* sp. div. (2-sided)	f	8/7
.	*Betula* cf. *humilis* Schrank	s	./1
Hottonia palustris	*Hottonia palustris* L.	f	1/1
Lycopus europaeus	*Lycopus europaeus* L.	f	75/75
Lythrum salicaria	*Lythrum salicaria* L.	s	8/11
Mentha aquatica	*Mentha aquatica* L.	s	3/3
Phragmites communis	not revised	f	3/4
Poa trivialis	not revided	f	1/1
Polygonum hydropiper	*Carex* sp. (3-sided)	f	1/1
Potamogeton sp.	*Potamogeton* sp.	e	1/1
Potentilla sp.	*Potentilla* sp.	s	2/2
Ranunculus sceleratus	*Ranunculus sceleratus* L.	f	1/1
Rorippa cf. *silvestris*	Brassicaceae	s	1/1
Sagittaria sagittifolia	*Sagittaria sagittifolia* L.	s	1/1
Salvinia natans	*Salvinia natans* (L.) All.	m	3/3
S. natans	*S. natans* (L.) All.	msp	12/11
Schoenoplectus tabernaemontani	*Schoenoplectus lacustris* (L.) Palla	f	1/1
Solanum cf. *dulcamara*	indeterminable	s	1/1
Sparganium ramosum	*Sparganium neglectum* Beeby	e	21/17
Stellaria cf. *media*	*Stellaria* cf. *media* (L.) Vill.	s	1/1
Thalictrum cf. *flavum*	*Thalictrum* sp.	s	2/2
Typha sp.	*Typha* sp.	f	17/16
Urtica dioica	*Urtica dioica* L.	s	41/42
Valeriana cf. *officinalis*	*Valeriana officinalis* L.	s	1/1
Veronica serpyllifolia	indeterminate	s	1/1
Viola sp.	*Viola* sp.	s	2/1
Remains not included in the paper by Środoń 1976			
Indeterminate	*Alnus* sp.	f	1
.	*Betula* sect. *Albae*	f	2
.	*Betula* sect. *Albae*	sc	1
.	*Pinus sylvestris* L.	n	1
.	*Pinus sylvestris* L.	s	1
.	*Carex* cf. *paradoxa* Willd.	f	3
.	*Carex* sp. (3-sided)	f	1
.	*Comarum palustre* L.	f	2
.	*Nymphaea* cf. *alba* L.	s	1
.	*Urtica dioica* L.	f	1
.	*Cenococcum graniformae* (Sow.) Ferd. & Winge	st	7
Varia	*Betula* sect. *Albae*	f	1
.	*Eleocharis palustris* (L.) Roem. & Schult.	f	1
.	*Glyceria* cf. *maxima* (Hartm.) Holmb.	s	1
.	*Hydrocharis morsus-ranae* L.	s	1