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THE PLIOCENE PROFILE OF DOMAŃSKI WIERCH NEAR CZARNY DUNAJEC IN THE LIGHT OF PALYNOLOGICAL INVESTIGATIONS (WESTERN CARPATHIANS, POLAND)

Profil plioceński Domańskiego Wierchu koło Czarnego Dunajca w świetle badań palinologicznych

ABSTRACT

The study presents the results of palynological investigations on the sediments at Domański Wierch, situated in the western part of the Nowy Targ—Orawa Basin, near Czarny Dunajec. The research enabled the reconstruction of the picture of several plant communities which had developed according to the topography of the terrain and habitat differentiation. The communities in the wet habitats at the bottom of the Basin were composed chiefly of *Alnus* with an admixture of *Fraxinus, Populus* and *Pterocarya.* Drier habitats, situated upon the slopes of the elevation, were occupied by deciduous forests of different kinds. Higher up there were coniferous forests with a predominance of *Picea.*

Having analysed the composition of the vegetation and drawn a comparison between the pollen diagram from Domański Wierch and those of the Miocene and Pliocene from South Poland, the author concludes that the sediment under consideration should be traced back to the younger Pliocene.

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INTRODUCTION

The Domański Wierch elevation (753 m a.s.l.) is situated in the western part of the Nowy Targ—Orawa Basin (Fig. 1). Foetterle was the first to mention in the year 1851 the occurrence of plant and animal remains in the locality Ustié in the Slovakian part of the Basin, about 22 km westwards of Domański Wierch (v. Knobloch 1968). In the years 1892—1893 Raciborski corroborated this information finding macrofossils of *Glyptostrobus, Pteris crenata, Fagus* sp., *Quercus* (two species), *Liquidambar* sp., and *Acer* sp. at Ustié and in its immediate vicinity at Liesek. Raciborski also stated the occurrence of Neogene clays with lignites in the localities of Ciche and Miętustwo, situated in the close vicinity of Domański Wierch. Halicki (1930) brought further information about new localities in the Basin in which he discovered Neogene clays containing numerous lignites.

Palaeobotanical investigations in that part of the Basin were undertaken again after the discovery of a layer with numerous impressions of leaves in the Domański Wierch sediments. Preliminary results of palaeobotanical and geological investigations were published by Szafer (1950) and Birkenmajer (1954, 1958). These results aroused such a great interest that in the years 1956/57 the Institute of Geology sank a special bore-hole in Domański Wierch from the highest point of the elevation to the depth of 228 m near a place called „At the shrine". The material from that boring served for the elaboration of a detailed geological profile (Urbaniak 1960). Preliminary results of investigations on the fruit-and-seed flora were published by Łańcucka-Środoniowa (1963, 1965) who also gave a general description of the flora from the lignite clays from Chyżne and Jabłonka situated in the western part of the Nowy Targ —Orawa Basin. In 1969 Plewa published a paper on the granulometrical investigations in the gravel layers of Domański Wierch. Zastawniak (1972)

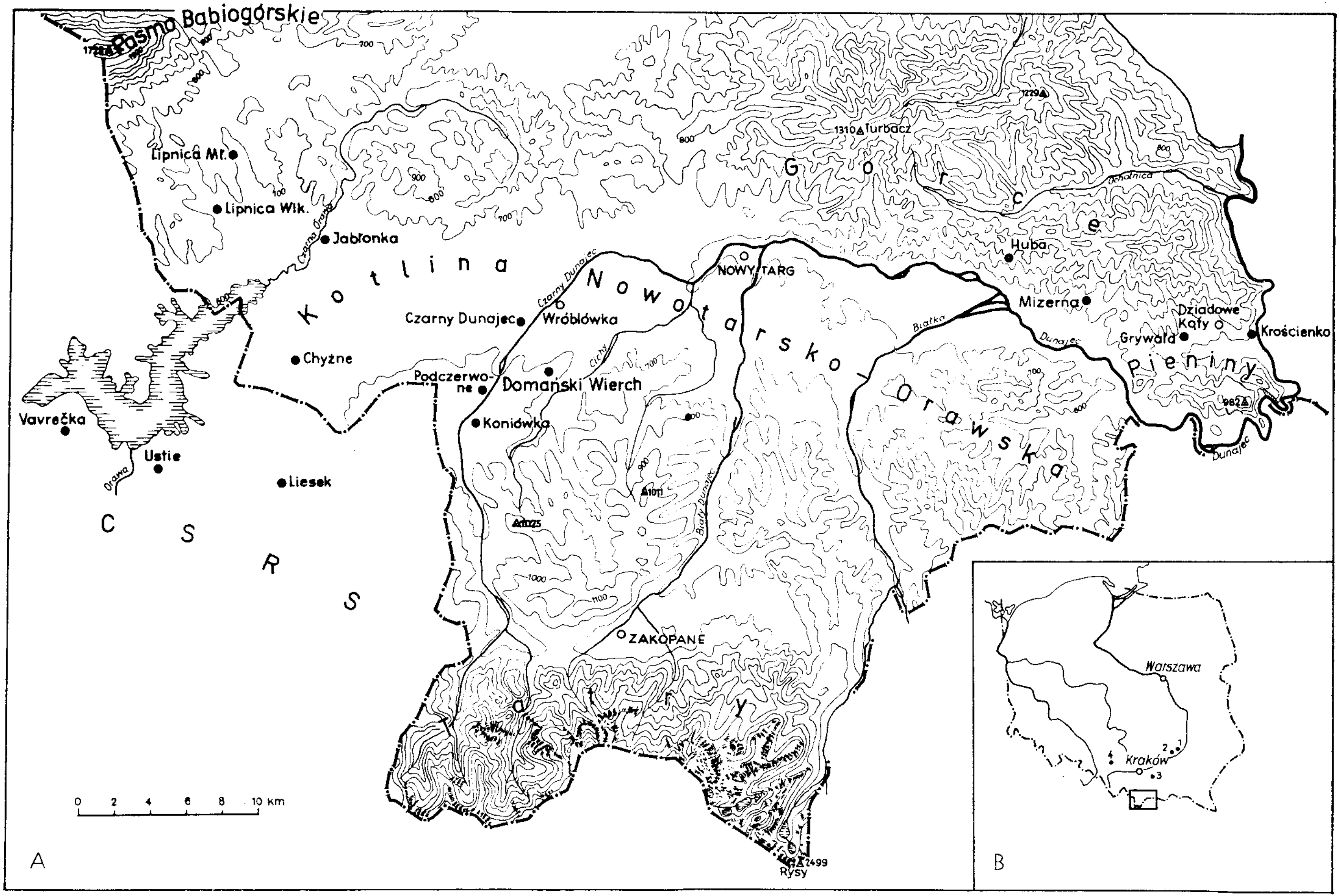

Fig. 1. A. Situation of Domański Wierch in the Nowy Targ—Orawa Basin. B. Localities with Miocene floras from South Poland examined with palynological method.
1 — Piaseczno, 2 — Świniary, 3 — Kłaj (Gdów-Bay), 4 — Gliwice Stare.

Ryc. 1. A. Położenie Domańskiego Wierchu w Kotlinie Nowotarsko-Orawskiej. B. Stanowiska mioceńskich flor z Polski południowej, zbadane metodą analizy pyłkowej.
1 — Piaseczno, 2 — Świniary, 3 — Kłaj (Zatoka Gdowska), 4 — Gliwice Stare.

described the leafy flora occurring there in two levels. Some suggestions concerning the age of the Domański Wierch sediments on the basis of palynological research were submitted by the author of the present paper at the session of the Geological Institute devoted to the Neogene of Poland (Oszast 1970).

The palaeobotanical research on the Neogene floras are also carried on in the Slovakian part of the Basin. Paclt (1965) described the macroscopic remains from the lignite clays at Vavrečko near Namestovó and Knobloch (1968) characterized the flora of the clayey-sandy series from several localities situated on the south-eastern margin of the Orawa Basin.

REMARKS ON THE GEOLOGICAL PROFILE, THE STATE OF PRESERVATION OF PLANT REMAINS AND METHODS OF RESEARCH

In the geological profile obtained by boring and described by Urbaniak (1960) a boundary line was distinctly to be seen at the depth of 14 m, dividing the upper sediment series (1—14 m) from the lower one (14—228 m). These differed in lithological and petrographical respects. The upper part is composed of loamy sediments with Tatra quartzites and quartzite rubble, whereas the lower part contains alternate deposits of clays, heterogranular sand and clayey-sandy sediments with fragments of sandstones.

From the core of the 228 m profile, 306 samples were taken for palynological investigations. In most cases they were taken every 20 cm, in some segments of the profile, however, particularly in gravel, it was not possible to take samples so often. The sediment was macerated with the hydrofluoric acid in combination with Erdtman's acetolysis (1943), sometimes Knox's flotation method was also applied. At times the sediment was previously solved in a mixture HF and HCl (in a 3 : 1 proportion) to achieve greater accuracy in cleansing the material from calcium compounds. The usually abundant plant detritus was burnt out in H_2O_2.

In 77 samples only of the total of 306 were sporomorphs found in sufficient number to permit a per cent calculation of the pollen spectrum. The remaining samples were either totally deprived of sporomorphs or just a few, at most a dozen or so appeared on the slide surface (4 sq. cm). Unless the number of pollen grains obtained on five slides amounted to a hundred or more they were not taken into consideration in the pollen diagram. This is why pollen diagram is presented in the form of histograms illustrating both the spectra of individual samples and the — longer or shorter — profile segments in which the consecutive samples had enough pollen to enable the calculation of the spectrum in per cent. The lack of continuity in the diagram is a result not only of the occurrence of parts where pollen was scarce or altogether absent, but also of coarse gravel strata of varying thickness, from which no samples were taken. The absolute quantities of sporomorphs found on the different levels are presented in Table I. It consists of two parts, one comprising the grains of tree and shrub pollen (Table I[1], Part 1), and the other a list of sporomorphs of herbaceous plants, the *Pteridophyta* as well as*Hystrichosphaeridae* (Table I, Part 2). This latter part of the table is presented in a somewhat simplified manner, presenting only the horizons in which sporomorphs were found. In calculating the pollen spectrum in per cent the basic sum total (100%) was composed of the sum of sporomorphs of trees, shrubs and herbaceous plants.

Striking traits of the material under consideration are the bad state of preservation of most remaining sporomorphs, the differences in the extent of their corrosion, and their frequency of occurrence. The marked change in frequency of occurrence in the consecutive horizons is undoubtedly related to the process of deposit sedimentation. The recurrence of coarse--grained sediments alternating with fine-grained ones testifies to a changing sedimentation rate, which at times is intensified (gravels) and at times slowed down (clays). The coarse-grained sediments usually contain mere traces of intensely-corroded pollen grains or are even totally deprived of them, which in all probability should be attributed to the weathering of the sediment, creating favourable conditions for the destruction of sporopollenin. Another factor which may have played a fairly important part here are mechanical forces which, as stated by Havinga (1967), can bring about the destruction of pollen grains into tiny fragments in no way differing from indeterminable plant detritus.

The different degree of corrosion found in pollen grains within the same sample leads to the assumption that the sediment was a mixed one and that it therefore may contain sporomorphs of different ages. In pollen spectra this is demonstrated not only by the non-uniform condition in which the sporomorphs have survived but also by their inconsistent composition. Therefore, it sometimes happens that in the forest flora of a temperate climatic type there occur occasionally pollen grains of exotic forms, e. g. *Symplocos*.

Apart from plant pollen, the sediment revealed also *Hystrichosphaeridae*. They were found in horizons where the pollen was most corroded, while in the samples containing well-preserved sporomorphs they were either entirely absent or occurred in insignificant amounts. This sort of *Hystrichosphaeridae* occurrence in the sediment throws light on the source of at least part of the rebedded material, whose origin should probably be traced back to te wash-out of Flysch rock.

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[1] Tables I—V are to be found on the back cover.

THE CHARACTER OF THE VEGETATION

Forest communities predominated in the vegetation cover of the examined area. In the upper mountain regions these were chiefly coniferous forests. A considerable preponderance of conifer pollen in the Domański Wierch diagram is one of its characteristic features (Fig. 2), while in the fruit-seed flora only cccasional specimens of coniferous trees were encountered (Szafer 1952, Łańcucka-Środoniowa 1959) and in the foliaceous flora they were not found at all (Zastawniak 1972). This proves that coniferous trees occupied higher-situated habitats. It is interesting to note that every sample contains well-preserved pollen grains of the *Picea* sometimes amounting to more than 50 per cent of the over-all number of sporomorphs. Środoń (1967) maintained that the occurrence of spruce pollen ranging from 1 to 3 per cent indicated its presence *in situ*. Therefore, the high values of spruce pollen in the Domański Wierch profile prove that it was a constant and important component in forest communities there. In describing Pliocene vegetation in the localities situated in the eastern part of the Basin, Szafer (1946) assumed the occurrence of a mixed forest with a large proportion of the *Picea* and *Tsuga* in upper mountain regions. At Domański Wierch it is the *Picea* which predominates, while the *Tsuga*, as the *Sciadopitys* and *Taxodiaceae*, occur much less frequently. In comparing the flora from different localities in Slovakia Němejc (1943, 1967, 1958) drew attention to the absence of spruce macrofossils in the older Tertiary. They did not, in fact, occur until the Late Sarmatian, and it was only in the Pliocene that they occurred with greater frequency. In Nemejc's opinion this may be significant as a stratigraphic criterion. Planderová (1970) in comparing the occurrence of the major sporomorph types in Neogene sediments of the Slovak region in West Carpathians noted spruce pollen ranging from 5 to 10 per cent only as late as the lower Pannonian, on the other hand she either did not find it in the respective Miocene horizons, or, if she did, it was only in insignificant amounts (1 to 2 p. c.).

The occurrence of spruce in pollen diagrams coming from different parts of Europe has even led Rein (1955) and other palynologists to conclude that spruce pollen in traces only occurs in the Late Pliocene (Reuverian), whereas during the Tegelene Interglacial it increases in amount, sometimes even reaching as much as 40%. Thus the large proportion of spruce pollen in the Domański Wierch profile is certainly of significance in considering the age of this sediment.

The forest communities developing upon the slopes raising above the bottom of the sedimentation basin were of quite different character. These were mostly deciduous forests, composed, according to their respective exposure and habitat, of various trees such as: *Acer*, *Aesculus*, *Carpinus*, *Carya*, *Castanea*, *Fagus*, *Juglans*, *Quercus*, *Sorbus*, *Tilia*, and *Ulmus*. In the undergrowth grew shrubs of the *Cornus, Corylus, Rubus, Sambucus* and *Viburnum* genera.

On the damp bottom of the Basin, as well as at the river-side habitats tree communities developed, composed chiefly of *Alnus* with an admixture of *Fraxinus, Salix,* and probably also of *Populus* as attested by Z a s t a w n i a k (1972), who found evidence of this in the foliaceous flora. It was here too, that *Pterocarya,* a tree preferring habitats in alluvial soils, probably grew. These forests were accompanied by ferns of the *Polypodiaceae* and *Osmundaceae.*

In the palynological picture of this plant community a characteristic feature is the recurrent predominance of the alder, its sporomorphs at times exceeding 70 per cent of the over-all amount of sporomorphs. Horizons with an abundant occurrence of alder recur several times in the profile, always in the stratum of gravel-covered clays. The first great concentration of alder pollen in the diagram is noted at the depth of 191—169 m. Besides the *Alnus* one finds here *Aesculus, Betula, Carpinus, Carya, Castanea, Corylus, Fagus, Liquidambar, Pterocarya, Quercus, Tilia,* and *Ulmus.* Whereas some of them, such as *Liquidambar* and *Pterocarya* formed part of the alder forests, the pollen of the remaining trees has probably come from forest communities overgrowing the slopes. It was from alder forests too, that the pollen of *Filipendula* and *Lysimachia* as well as of aquatic plants of the *Batrachium, Potamogeton* and *Sparganium* were derived. The increase in the proportion of alders at the 130—119 m depth presents a similar palynological picture, with differences in the respective amount of sporomorphs. The number of alder sporomorphs amounts here to 72 per cent of the over-all number: here, too, the value of the *Fraxinus* was the highest for the whole profile (up to 30%). The proportion of herbaceous and aquatic plants in the whole is very much the same. The third segment where alder is predominant between 103 and 100 m, is poorer in generic composition than the former ones it is to be noted, though, that the proportion of the *Pterocarya* is large (20%).

Alder was observed to predominate for the last time at the 47 to 44 m depth: there a picture was preserved of communities similar both in composition and in quantitative relations, to the alder forest situated at the greatest depth in the profile. Higher up, the proportion of the alder in pollen flora decreases, nevertheless in the highest samples it reaches 20%.

The recurrent picture of virtually similar plant communities with alder as the predominant tree does not denote the succession of the plant but is the result of the discontinuity of the diagram. The pollen flora of the horizons which have been preserved in the intervals between one alder complex and another, does not show any essential changes in its composition. This seems to prove that the sediments of Domański Wierch had accumulated during one climatic period. It can be assumed that the periods of intense fluvial action, combined with gravel accumulation, were of short duration and that the „catastrophic'' filling up with gravel brought about only a partial destruction of vegetation. Thus, after some time the primary plant community would re-appear in its original form, the alder rapidly regaining its previous predominance over the area. Another factor which certainly favoured this reappearance was that the habitat would be well provided with water and the soil enriched after periods when the flow of water had been more intense than usual.

In the European Tertiary sediments there are commonly two types of pollen grains of the *Alnus* genus, namely the *keferesteinii* type (a small, four-pore one) more frequent in sediments of the older Tertiary and the *incana-glutinosa* type (a larger, five-pore one). In the Tertiary sediments on Polish territory, a large amount of alder pollen was noted by Raniecka-Bobrowska (1966, 1970) in the Miocene sediments in Lower Silesia. According to her, the predominance of the small, four-pore pollen was so common a phenomenon in the early Miocene in Central Europe as to make her suggest that this particular should be called „The First Alder Phase". Later periods brought an abundance of alder with larger, five-pore pollen („The Second, Younger Alder Phase"). The boundary line dividing these two periods in Raniecka-Bobrowska's opinion (l. c.) can be taken as the disappearance of the former type of grain and the appearance of the latter. Pacltová (1963) also observed two types of alder pollen grain in the floras of the older and younger Miocene in Czechoslovakia.

Only the five-pore pollen grains of the *Alnus incana-glutinosa* — type have been found at Domański Wierch. We shall revert to the problem of the occurrence of two different types of alder forms in Tertiary sediments of the Nowy Targ—Orawa Basin when we discuss the profile from Czarny Dunajec.

The Domański Wierch profile also presents a picture of the vegetation of dry, well-insolated sward, as testified to by a fairly abundant list of herbaceous plants, such as *Artemisia, Centaurea jacea*-type, *Chenopodiaceae, Compositae, Ephedra,* numerous *Gramineae, Helianthemum, Hippophaë, Rumex acetosa*-type, *Scabiosa* et al. On the other hand, no evidence has been found in the pollen flora of the occurrence of any extensive water reservoir. This has been pointed out by Łańcucka-Środoniowa (1965), who based her statement on the results of preliminary investigations on plant macrofossils. Further, the Domański Wierch sediment shows no traces neither of evergreen trees or shrubs nor of distinctly thermophil species. The few sporomorphs of exotic plants were probably rebedded, while the bulk of the vegetation is composed of genera typical of the temperate zone. Among the characteristic features of the climate in which the vegetation grew at that time, was increased precipitation, perhaps periodic heavy rains or torrential storms as seems to be indicated by the gravel strata bearing traces of increased erosion and accumulation.

In comparing the results of the analysis of foliaceous and pollen flora stress should be laid on the marked coincidence in the composition of trees and shrubs of which the deciduous forest communities are composed. As an example the results of determination of the leaves and pollen grains in the top part of the profile, comprising the layer from 3·10 to 18·20 m were compared (Zastawniak 1972). For the pollen diagram of this section of the profile 20 samples were taken in seven of which it was posible to calculate the pollen spectra. Although *Pinus* and *Picea* pollen predominated, the sporomorphs of all genera determined on the basis of their foliage — except the *Populus* and *Parrotia* — were found (*Acer, Carpinus, Castanea, Fagus, Quercus, Ulmus*).

OTHER NEOGENE POLLEN-DIAGRAMS FROM THE NOWY TARG—ORAWA BASIN

The diagram from Huba near Czorsztyn

In 1949 sediment was collected at a locality named „at Huba", situated in the eastern part of the Basin, near the bridge on the Dunajec on the road from Nowy Targ to Czorsztyn. Seeds and fruits from this locality were described by Szafer (1954), and geological investigation was carried out by Birkenmajer (1954, 1958).

The profile collected for pollen analysis is 8·6 m thick. It is formed chiefly of light, bluish-greenish clay with a varying degree of sand admixture in different horizons. In the top of the profile there is a peaty mud layer, 2·5 m thick, covered with a half-meter layer of yellow loam with admixture of sand. Palynological analysis carried out in 1955, revealed the presence of pollen in the top layer of peat, while the clayey and loamy horizons did not show any traces of microfossils. The results of this research have not been published: in 1970 the same material was again submitted to analysis, using hydrofluoric acid for maceration. Nevertheless, the result of the repeated analysis was the same, no sporomorphs were found in the clay layer (Fig. 3). An unfavourable feature of the material under examination was the large intervals between the samples up to half a meter in length.

The quantitative and qualitative sporomorph composition is presented in Table II. The basis sum in the calculation of the per cent values was the sum of the pollen of trees, shrubs and herbaceous plants, excluding aquatic plants. Numerous, well-preserved sporomorphs represent the Tertiary tree and shrub genera, together resulting in a picture of a rich, multi-species and termophilic forest vegetation.

Among the coniferous trees it is the genera of the *Taxodiaceae-Cupressaceae* group which prevail. In the pollen diagram they have been

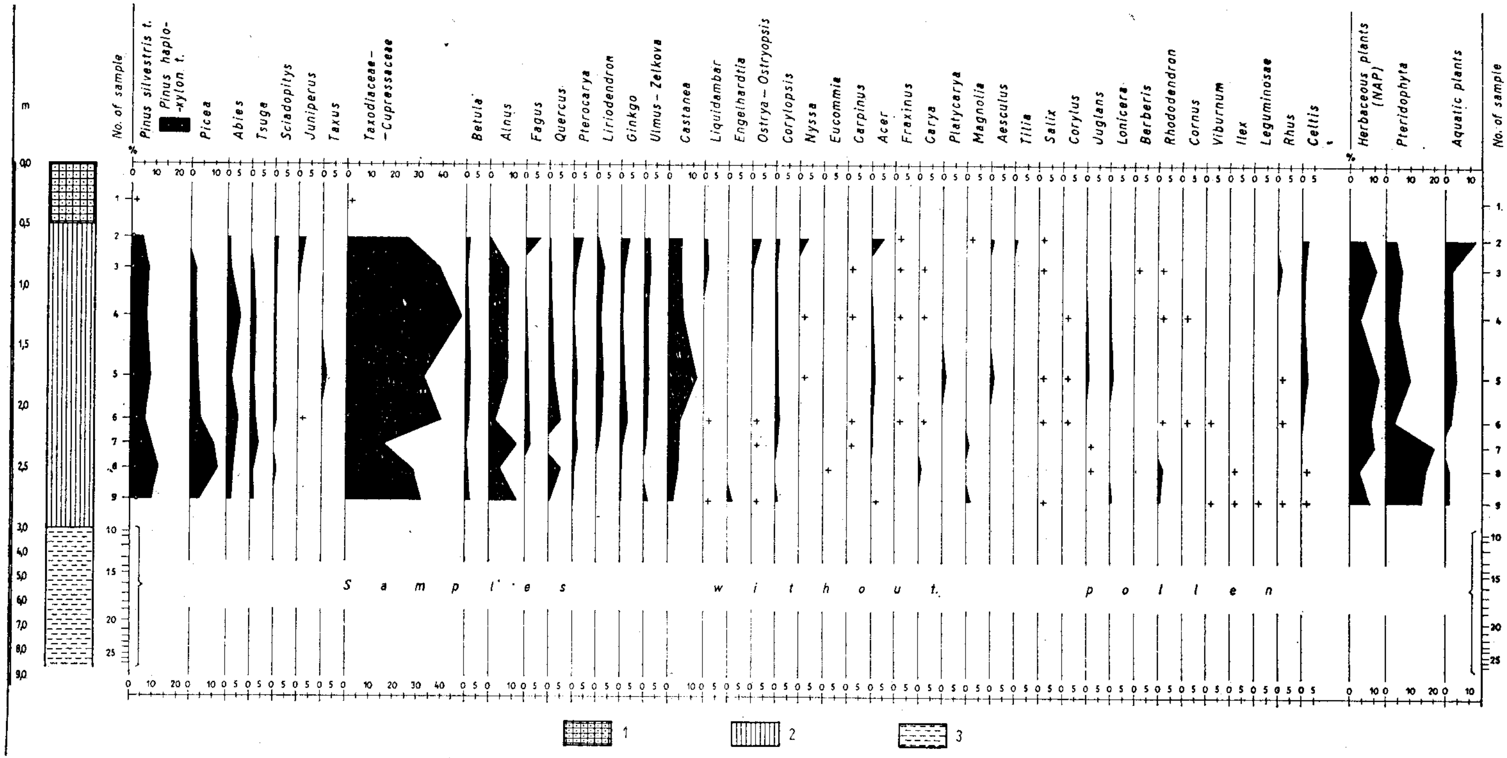

Fig. 3. Huba. Pollen diagram.
1 — sandy loam, 2 — peaty mud, 3 — clay.
Ryc. 3. Huba. Diagram pyłkowy.
1 — glina piaszczysta, 2 — mułek torfiasty, 3 — ił.

presented on a common curve, including Taxodium (most numerous of all), *Cryptomerya, Sequoia,* and *Glyptostrobus.* Of the deciduous trees, the *Castanea* genus is fairly well represented (up to 10 per cent). It is interesting to note that in the case of *Magnolia* and *Liriodendron,* pollen occurs much less frequently than their macrofossils. Szafer (1954), having found them in abundance at Huba, suggested that under favourable conditions these trees might even have persisted up to Late Pliocene. The seed and fruit of both genus were repeatedly found in the Lower and Upper European Pliocene (Kirchheimer 1949, Berger 1952, Mädler 1939). They were probably more widely distributed in the European Neogene than previously thought, ever increasing number of their fossil localities testifying to this. Recently, *Magnolia* macrofossils were found by Palamarev (1970) in the Miocene deposits of brown coal in West Bulgaria. It seems, too, that these trees had a fairly large resistance scale: witness the occurrence of *Magnolia* pollen in the Early Pleistocene of Holland (Zagwijn 1959). The pollen of the following other Tertiary genera are preserved at Huba: *Aesculus, Carya, Celtis, Corylopsis, Engelhardtia, Eucommia, Nyssa, Ostrya, Platycaria, Pterocarya, Rhus,* and *Zelkova.* Of the herbaceous plants the most frequent were the *Cyperaceae,* while of the aquatic plants the presence of *Brasenia, Euryale, Nuphar,* and *Trapa* genera should be mentioned.

The diagram from Krościenko on the Dunajec

Of the Neogene sediments material has been collected from the Potoczki brick-yard situated near Krościenko, to serve for palynological analysis. From the 12-m thick profile 80 samples of a clayey sediment were taken. The sediment was uniform throughout the profile with a tiny sand admixture only. It had accumulated under conditions typical of an undisturbed reservoir, as evidenced by the abundance of aquatic plant pollen, particularly by a high percentage of the *Nuphar* genus in the profile base and the good condition in which all the sporomorphs have been preserved. The tranquil character of the Krościenko sedimentation had been previously pointed out by Klimaszewski (1946, 1951) and Birkenmajer (1951, 1954) and the present palynological findings reconfirm it. The absolute sporomorphs values from the 37 samples so far analysed are presented in Table III, while the Krościenko pollen diagram is given in Fig. 4. Further samples are now under examination.

The Krościenko pollen flora has proved to be largely accordant with the macrofossil flora investigated by Szafer (1946, 1947). The first among the coniferous trees was the *Picea,* which together with an admixture of *Abies, Pinus, Sciadopitys,* and *Tsuga* composed coniferous-forest communi-

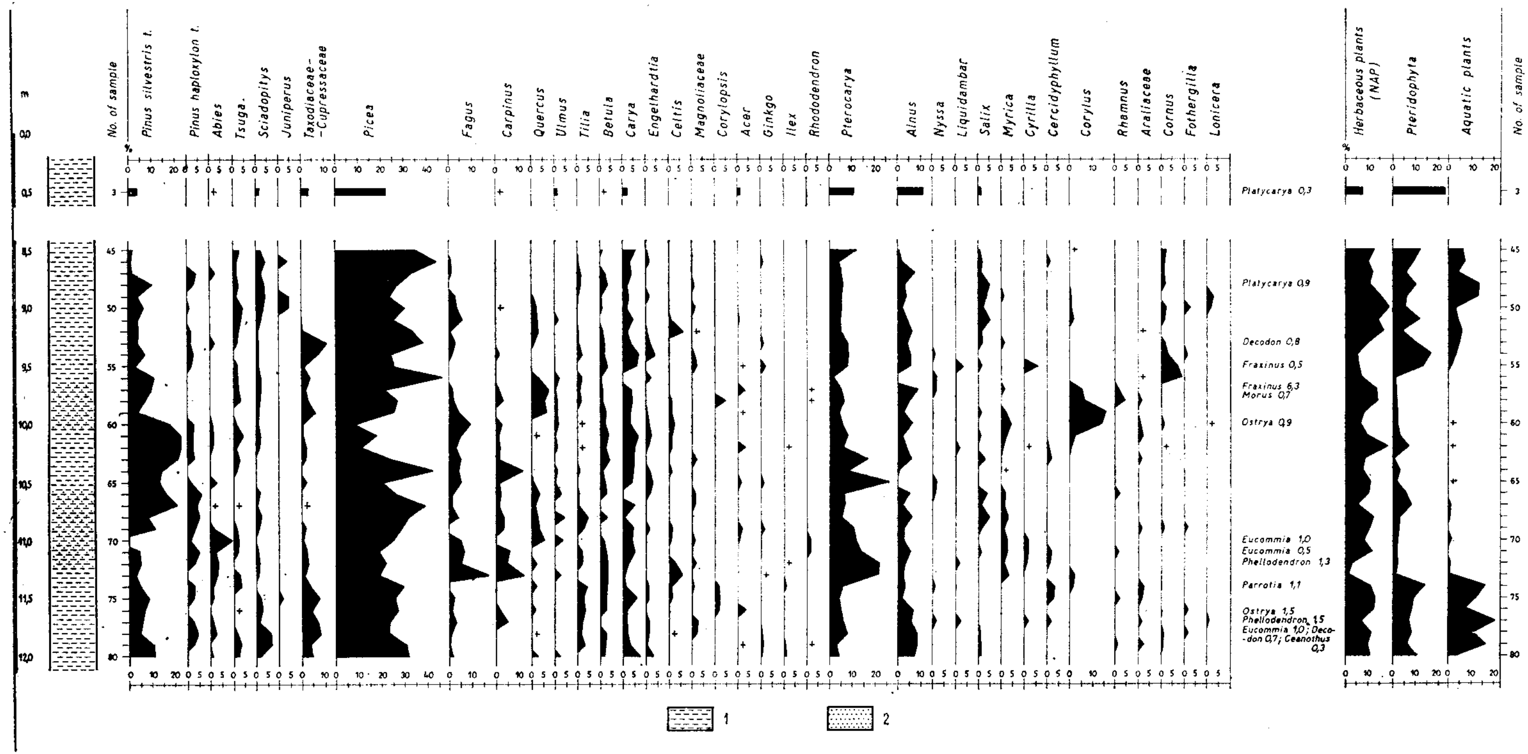

Fig. 4. Krościenko. Pollen diagram.
1 — clay, 2 — sand.
Ryc. 4. Krościenko. Diagram pyłkowy.
1 — ił, 2 — piasek.

ties. The deciduous and mixed forests growing both in the immediate and more distant environment of the reservoir were composed — judging by the tree pollen — of *Acer, Alnus, Betula, Carpinus, Carya, Castanea, Celtis, Corylopsis, Corylus, Fraxinus, Ostrya, Pterocarya, Salix, Tilia,* and *Ulmus.* The most frequently noted genus was the *Pterocarya,* as is also the case with macrofossil flora.

On the basis of the composition of the fruit-and-seed flora, Szafer (l. c.) traced its age to the Lower Pliocene. Although the Krościenko pollen flora is much variegated, still it is the temperate-zone trees that prevail there, which seems to indicate that climate under which the vegetation of that time lived, was colder than the climate suggested by the Huba vegetation.

Preliminary remarks on the profile at Czarny Dunajec

The deep (1000 m) profile of Neogene sediments from Czarny Dunajec, obtained from a boring carried out in 1968—69 by the Institute of Geology, is now being analysed. So far only a few dozen samples have been examined: here too, as at Domański Wierch, a great many samples were pollenless or with only a scanty amount of pollen. However, even a preliminary analysis of samples with well-preserved pollen taken from different depth levels, leads to the assumption that the Czarny Dunajec profile in all probability comprises two Neogene horizons (Fig. 5, Tab. IV). The younger horizon, which constitutes the profile segment from 30 to ca. 400 m down, has pollen spectra roughly resembling those of the Lower Pliocene sediments at Krościenko. As at Krościenko, an important part is played by spruce, the number of sporomorphs exceeding 50 per cent of the over-all sum. Of other coniferous trees we noted *Pinus* of the *silvestris* and *haploxylon* type, trees of the *Taxodiaceae-Cupressaceae* group, and, in smaller amounts, *Abies, Sciadopitys* and *Tsuga.* From circa 600 m down the proportion of *Picea* decreases rather rapidly (to less than 10%) and from 880 m down the pollen of these trees is not encountered at all. The decrease in spruce is accompanied by a simultaneous increase in *Pinus* of the *haploxylon* type, and of trees of the *Taxodiaceae-Cupressaceae* group. Among the deciduous trees there is a marked increase — as compared to the upper segment — in the amount of pollen of the *Engelhardtia* genus (up to 15%). Particularly noteworthy is the proportion of the alder. In the upper segment there occurs only the pollen of the *Alnus incana-glutinosa* type, whereas in the horizons from 800 m down there is a sudden appearance of large amounts of pollen (up to 46%) of the *Alnus kefersteinii* type exclusively. We are not so far thoroughly acquainted with the palynological picture of the horizons between 400 m and 800 m, nevertheless, the characteristic occurrence of two different forms of alder, recalling its

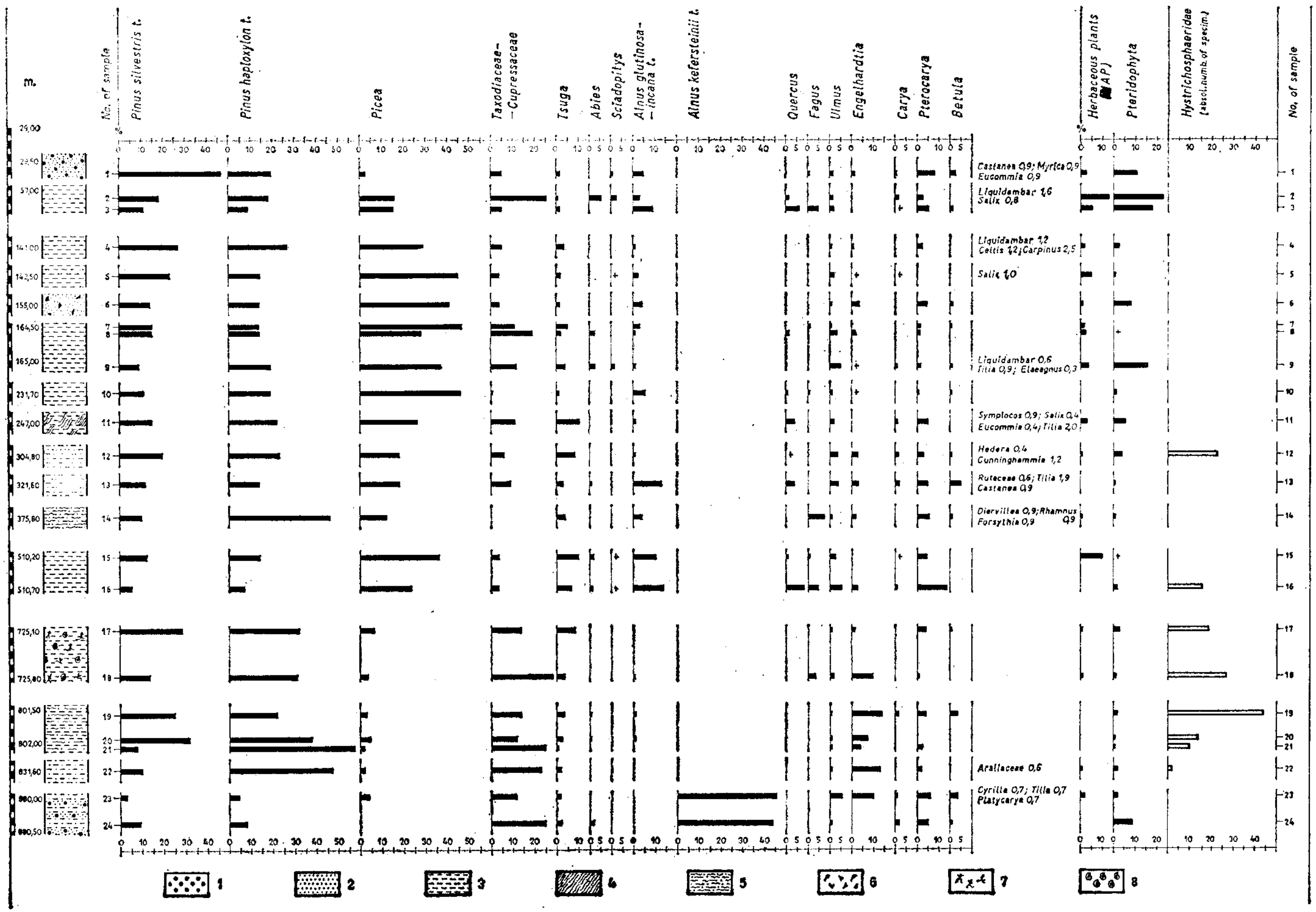

Fig. 5. Czarny Dunajec. Pollen diagram.
1 — Heterogranular sand with gravel, 2 — sand, 3 — clay, 4 — pulverized clay intercalated with brown-coal, 5 — pulverized, laminated clay, 6 — sand with fragments of lignite, 7 — clay with plant remains, 8 — clay with fragments of gastropod shells.

Ryc. 5. Czarny Dunajec. Diagram pyłkowy.
1 — piasek różnoziarnisty ze żwirem, 2 — piasek, 3 — ił, 4 — ił pylasty z wkładkami węgla brunatnego, 5 — ił pylasty, warstwowy, 6 — piasek z okruchami lignitu, 7 — ił ze szczątkami roślin, 8 — ił z fragmentami skorupek ślimaków.

occurrence in the Miocene diagrams of Lower Silesia (Raniecka-Bobrowska 1966, 1970), the quite marked change in the proportions of two coniferous trees, as well as of some deciduous ones, e. g. the *Engelhardtia,* seems to confirm the assumption that within the Czarny Dunajec profile two Neogene horizons, one younger and one older, are represented, viz. the Miocene and the Pliocene. In the central part of the profile, between 400 and 600 m approximately, some changes occur in the pollen spectra: however, the present, incomplete investigation of the profile does not permit tracing it in any great detail.

Preliminary findings can hardly be taken as a basis for final conclusions, however, the occurrence of certain relevant facts, such as the presence of alder and spruce throughout the profile and of large amounts of *Engelhardtia, Pinus* of *haploxylon* type and *Taxodiaceae-Cupressaceae* type in its lower part, seems to suggest that once this deep profile is elaborated in full, it will perhaps be possible to trace the complete vegetation succession in the two Neogene horizons, which would be of importance in stratigraphy of the Carpathians sediments of this age.

A comparison of pollen diagrams from Huba, Krościenko and Czarny Dunajec

Though Szafer (1954) in his estimate of the age of the Huba sediment on the basis of the macroscopic vegetation material located it, as well as that of Krościenko, in the Lower Pliocene (l. c. p. 98), he also emphasized that „the flora and climate of Huba are not directly connected with Krościenko, but there was probably some transitory link between them, so far unrecognized" (l. c. p. 112). In fact, the pollen diagram from Huba differs rather markedly from that of Krościenko. At Krościenko it is the *Picea* genus that prevails among the coniferous trees, while the group *Taxodiaceae-Cupressaceae* is poorly represented (only once attaining 10 per cent). At Huba trees of this group prevail, reaching up to 50 per cent of the over-all amount of pollen flora, whereas *Picea* does not play a prominent role here at all.

As regards deciduous trees, at Huba they are represented by a great many Tertiary genera, such as *Castanea* (over 10%), *Corylopsis, Engelhardtia, Eucommia, Liquidambar, Nyssa, Ostrya, Platycarya,* and *Rhus*; while at Krościenko the main bulk of flora is made of genera predominant in the Quaternary forest communities of Europe, most of them now growing in this area. Of the Tertiary plants only those genera abound which nearly always survived into the Late Tertiary and as has been repeatedly proved, have been found as early as the oldest Pleistocene (Zagwijn 1960, 1963, 1967; Florschütz, Someren 1950). Among them are *Pinus* of the *haploxylon* type, *Sciadopitys, Tsuga,* and particularly *Ptero-*

carya, its pollen and even macrofossils had been found in the sediment of the older Pleistocene (Środoń 1955, 1957; Stachurska 1955, 1967; Sobolewska 1956; Brelie, Kilper, Teichmüller 1959). Moreover, the vegetation at Huba differs from that at Krościenko in the amount of herbaceous plants, which is not generally large in Miocene floras, on the other hand the proportion of these plants markedly increases from the Pliocene on. Now, while at Huba the herbaceous plants do not exceed 10% of the over-all sum of pollen, at Krościenko they are constantly higher in number, reaching 25 per cent. It would thus seem correct to attribute a stratigraphic significance to the differences which have come to light. The composition of the flora from Huba indicates the presence of a forest with greater climatic requirements than those of the Krościenko forest. The rich proportion of Tertiary forms brings it closer to Miocene flora than to Pliocene which is why it was assumed that the Huba flora was older than the Lower-Pliocene flora of Krościenko. Attention has previously been drawn to the resemblances existing between the floras of Krościenko and those of the upper, in all probability Pliocene segment of the Czarny Dunajec profile, as well as to the common traits in the pollen spectra from Huba and for those from the lower segment of the Czarny Dunajec profile.

THE AGE OF THE DOMAŃSKI WIERCH SEDIMENTS

Previous estimates

The age of the Domański Wierch sediments continues to be an open question. According to what Szafer (1950, 1952) suggested on the basis of preliminary results of an investigation on fruit-and-seed flora, the locality has preserved the links of the Middle or Upper Miocene, Mio-Pliocene, and — in the top — of Pleistocene.

Birkenmajer (1954, 1958), on the basis of Szafer's results and his own geological observations, expressed the view that the Domański Wierch sediments were probably formed in the Upper Tortonian, however, he did not exclude the possibility of its being younger, of the Sarmatian in particular.

Urbaniak (1960), having made a detailed petrographic analysis, and taken Birkenmajer's views as a basis, distinguished one part in the profile, which she attributed to the Pleistocene, reaching down to the 14 m, and another Neogene part, comprising the strata from 14 m to 228 m in depth.

Łańcucka-Środoniowa (1965) on the basis of preliminary investigations of the fruit-and-seed material derived from the Domański

Wierch profile, and their comparison with the lignite-clay flora from several Oravian localities, is inclined to class the base layers of the profile as belonging to the Tortonian, while the clay-and-gravel layers overlying the lignite clays probably belong to Sarmatian. However, she admits the possibility of distinguishing some younger stratigraphic horizons as a possible result of future research.

Zastawniak (1972) on the basis of an analysis of foliaceous flora, attributed the age of the Domański Wierch cone to the Pliocene.

The present author's suggestion that the whole Domański Wierch profile should be traced to the youngest Pliocene or to the transition period between the Pliocene and Pleistocene, is founded upon the results of palynological investigations (Oszast 1970).

Simplified comparative diagrams as an aid in the estimation of sediment age

As results from a number of palynological works, Tertiary floras of different ages in Europe are distinguished not only by differences in their generic composition, but also by the variety in the respective quantitative proportions of Tertiary plants which vary with time (Brelie 1959, 1961, 1967; Boulter, Chaloner 1970; Krutzsch 1957; Krutzsch, Majewski 1967; Mai, Majewski, Unger 1963; Meo-Vilain 1968; Zagwijn 1960, 1967). These quantitative differences in the diagrams of older and younger sediments have been taken into consideration in our discussion on the age of the Domański Wierch cone. Thus, a comparison was drawn between several Tertiary floras by means of diagrams composed of three curves, which illustrate the quantitative proportions of three groups of plants viz. Tertiary, Quaternary and herbaceous ones. The first curve comprises the plant genera and families which are found in the European Tertiary floras and which in the Central European areas tend to disappear in the late Pliocene, exceptionally only extending into the older Pleistocene. Table V presents a list of these forms compared to the Domański Wierch cone. The second curve relates to the trees and shrubs predominant in the European Quaternary forest communities, such as *Alnus, Betula, Carpinus, Corylus, Fraxinus, Picea, Pinus* of *diploxylon* type, *Quercus, Salix, Sambucus, Sorbus,* and *Viburnum.* This interpretation is not to be accepted unconditionally, for among the above-listed genera of trees and shrubs there must also have been some which had species living both in the Tertiary and in the Quaternary and — on the other hand — some which grew only in the Tertiary. Though realising fully the controversial nature of the assumed criteria (which is due to the difficulties involved in the species notation of trees and shrubs according to the structure of pollen grains) we have nevertheless adopted this form of differentiation in order to obtain some uniform basis of comparison. The third element of the comparative diagrams is the summary curve of herbaceous plants which, however, does not include aquatic plants.

A comparison of the Domański Wierch diagram and the Miocene diagrams from South Poland

Of the South Poland Miocene floras so far examined by the pollen analysis method for the purposes of comparison with the Domański Wierch vegetation recourse has been made to pollen diagrams derived from Piaseczno near Tarnobrzeg (Oszast 1967), Gliwice Stare in Upper Silesia (Oszast 1960; Szafer 1961), as well as to the diagram derived from Huba near Czorsztyn discussed in the present paper and to pollen spectra from Czarny Dunajec.

Although the different geographic positions of the above-discussed localities do not seem likely to yield close correlations, yet these floras present a general picture of Miocene vegetation in the South Poland area, comparable to the new flora. Each of them usually contains the same Quaternary genera; on the other hand, the occurrence of Tertiary-plant genera varies from one locality to another. At Piaseczno 67 taxons could be related to families or genera encountered only in the Tertiary; there are 50 such taxons at Gliwice Stare, whereas at Huba of the 47 taxons noted 30 are forms encountered in Tertiary floras only. In the fragments of the Czarny Dunajec profile, of the 49 genera designated so far, 35 are Tertiary forms. Comparative diagrams (Figs. 6—9) illustrate the quantitative proportion of the three above mentioned groups of plants. It becomes apparent that regardless of the position of the locality and of the number of genera included within the given flora, the Miocene pollen diagrams have a common trait, namely a high number of Tertiary plants. It always exceeds 50 per cent of the total sum of plants, sometimes even reaching 90 per cent. This is simultaneously coupled with low amounts of herbaceous plants oscillating at about 10 per cent only.

The Domański Wierch diagram (Fig. 12) comprises a definitely diminished number of Tertiary genera, amounting to 20 taxons only. Some of them, such as *Aralia, Nyssa, Rhus, Symplocos,* were found almost exclusively as isolated pollen grains, occurring only once in the whole profile. Moreover, the proportion of these forms is very variable; thus, while in some horizons they reach maximal values of up to 35 per cent, in others they are absent altogether. It sometimes occurs that the consecutive horizons deprived of Tertiary plant pollen form profile segments of several metres in length. On the other hand, in the profile as a whole it is the Quaternary genera which prevail, with a simultaneous, always fairly high proportion of herbaceous plants (exceeding 40 per cent). Apart

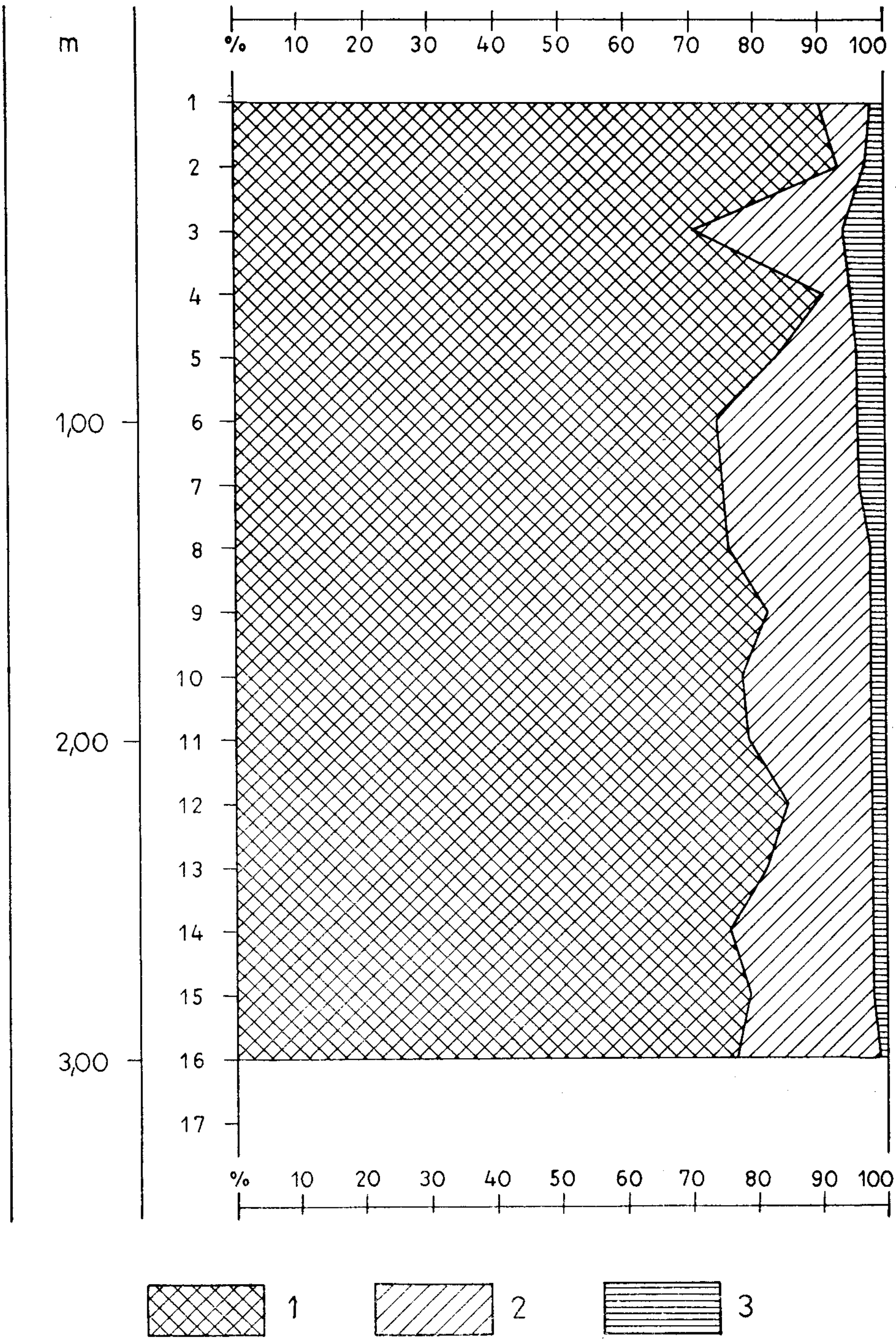

Fig. 6. Piaseczno. Comparative pollen diagram of quantitative proportion of three plant groups.

1 — Tertiary plants, 2 — Quaternary plants, 3 — Herbaceous plants.

Ryc. 6. Piaseczno. Diagram porównawczy ilościowego udziału trzech grup roślin.

1 — rośliny trzeciorzędowe, 2 — rośliny czwartorzędowe, 3 — rośliny zielne.

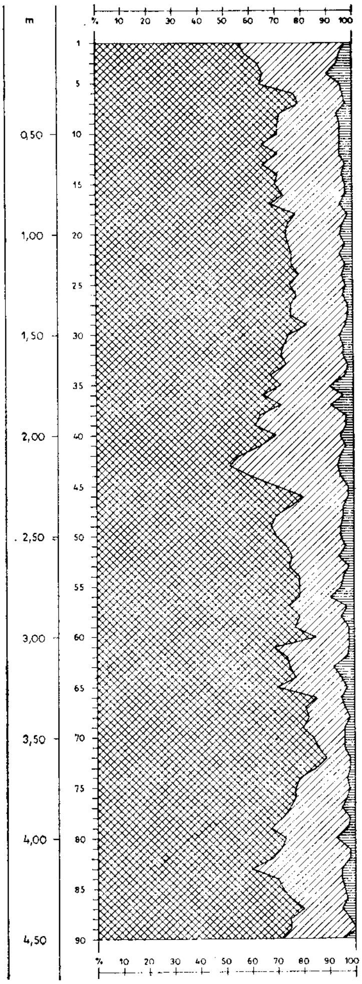

Fig. 7. Gliwice Stare. Comparative pollen diagram of quantitative proportion of three plant groups (signatures see Fig. 6).

Ryc. 7. Gliwice Stare. Diagram porównawczy ilościowego udziału trzech grup roślin (objaśnienia oznaczeń jak na ryc. 6).

from this, the palynological diagram of Domański Wierch does not present a picture similar to any of the Miocene diagrams with which it was compared, either as regards composition or the quantitative proportions of the three plant groups compared. These manifest differences permit the conclusion that the Domański Wierch diagram does not illustrate Miocene vegetation. This view has found corroboration in the results of the investigation on foliaceous flora in which no forms characteristic of Miocene forest communities have been found (Z a s t a w n i a k 1972).

As results from a comparison of Miocene floras found in the South Poland area, investigated by P a u t s c h (1957), K i t a (1963), Ł a ń-

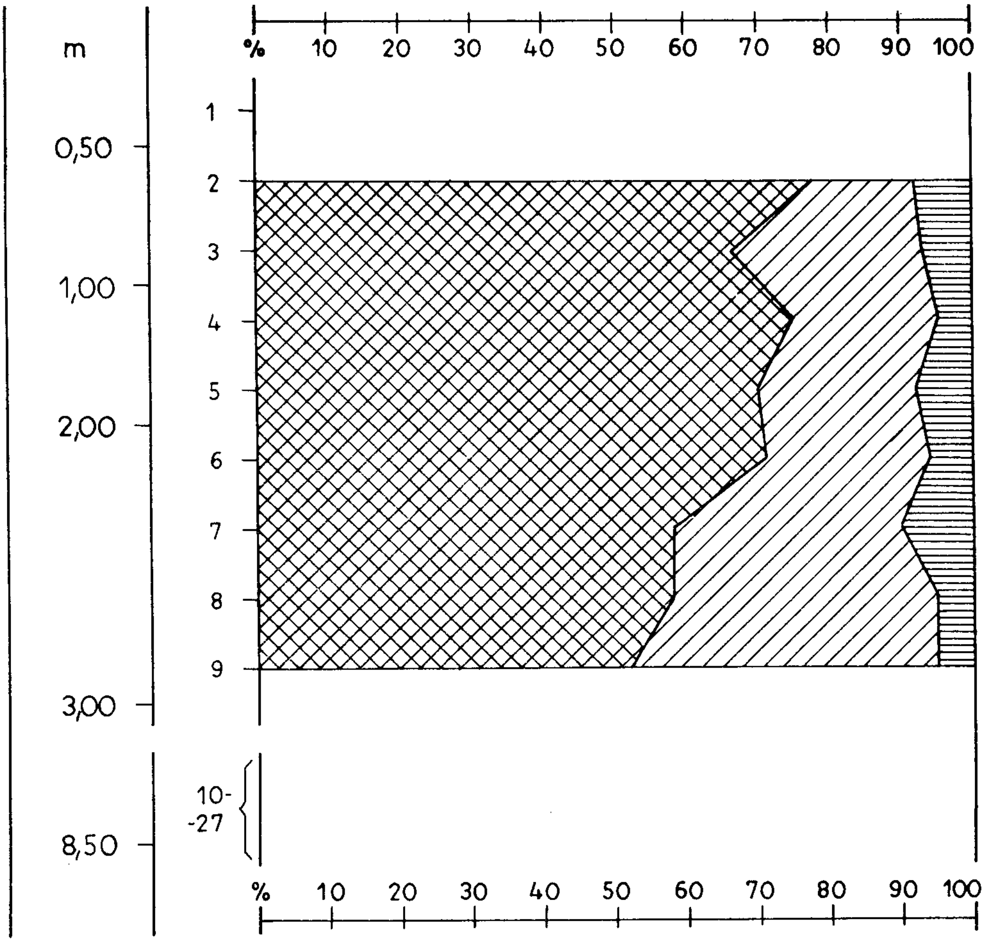

Fig. 8. Huba. Comparative pollen diagram of quantitative proportions of three plant groups (signatures see Fig. 6).
Ryc. 8. Huba. Diagram porównawczy ilościowego udziału trzech grup roślin (objaśnienia oznaczeń jak na ryc. 6).

cucka-Środoniowa (1966), and Oszast (1967), the vegetation of that age was locally differentiated according to the respective topography. Thence it may be assumed that the different picture of vegetation preserved in the Domański Wierch profile is one more proof of this differentiation connected with the position of the locality within the mountain area. This assumption, however, does not accord with the Huba diagram or with the „Miocene" pollen spectra at Czarny Dunajec. In both cases we observe the proportions of Tertiary and Quaternary plants characteristic of Miocene diagrams, this being particularly manifest in the Czarny Dunajec spectra. The two parts of the profile are easily traceable, markedly differing from each other in the quantitative proportions of the three groups of plants

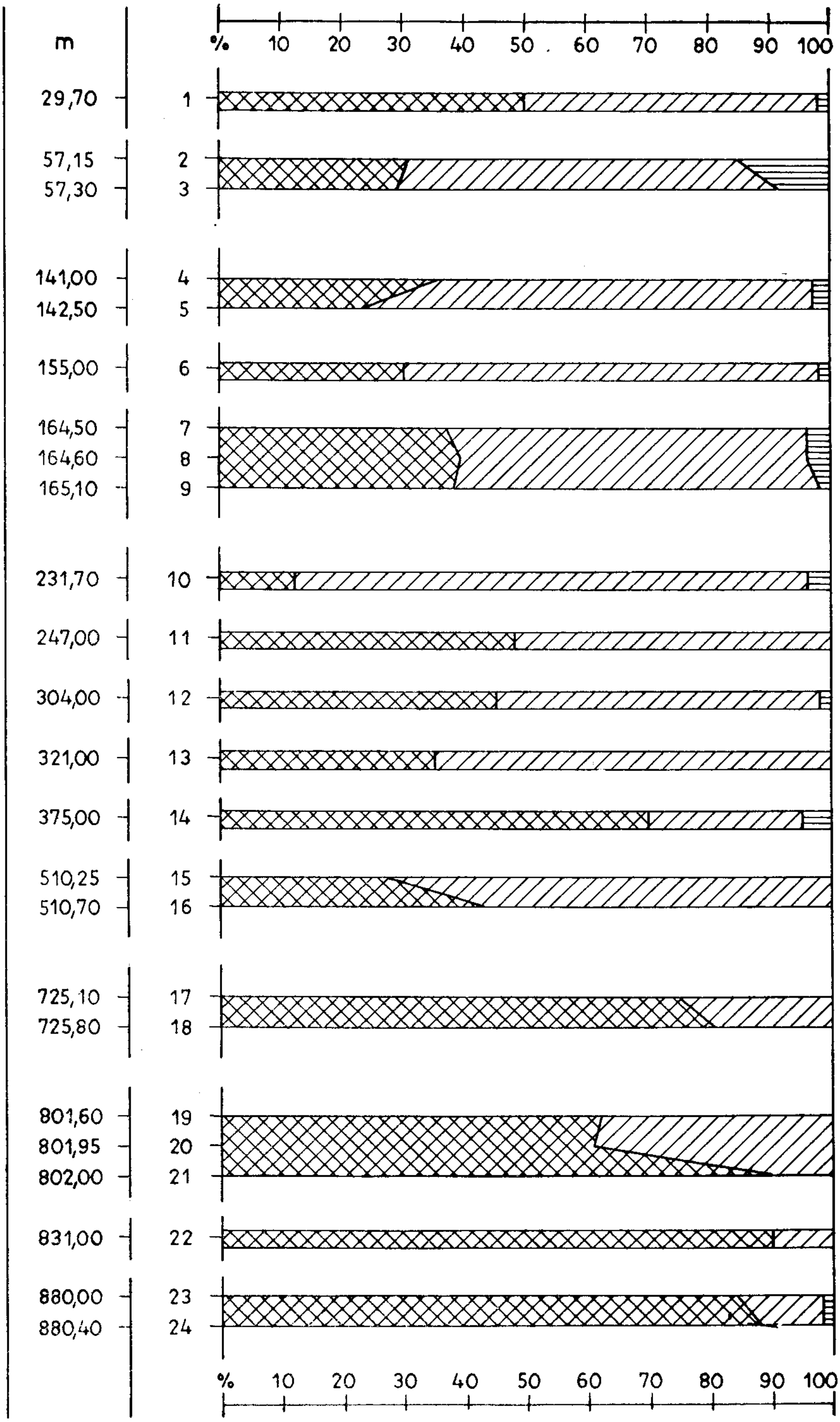

Fig. 9. Czarny Dunajec. Comparative pollen diagram of quantitative proportion of three plant groups (signatures see Fig. 6).

Ryc. 9. Czarny Dunajec. Diagram porównawczy ilościowego udziału trzech grup roślin (objaśnienia oznaczeń jak na ryc. 6).

differentiated. In the lower part of the profile they are characteristic of Miocene diagrams, and in the upper one they show a vegetation younger than Miocene flora.

The bore-hole at Domański Wierch did not penetrate through the whole series of clay-and-gravel sediments; nor was it possible to identify the strata underlying these formations (Urbaniak 1960). Taking into account both this fact and the vegetation pictures obtained at Domański Wierch and at other contiguous localities it is not possible to exclude the fact that the examined profile may have some unknown deeper-situated older links.

A comparison of the Domański Wierch diagram and the Pliocene diagram from Krościenko on the Dunajec

The comparative diagram from Krościenko (Fig. 10) differs from the Miocene diagrams in a lower proportion of Tertiary genera, while in relation to the Domański Wierch diagram, it reveals both differences and similarities. Of the 21 profile segments at Domański Wierch, in 12 (thick 2 to 10 m) it is seen — as was the case at Krościenko — that there is a prevalence of coniferous trees over deciduous ones, a marked proportion of *Picea,* a predominance of Quaternary genera, both deciduous and coniferous, and an increased amount of herbaceous plants. It we were to judge only by these segments of the profile, a considerable similarity might be accepted. When, however, we consider the profile as a whole, including the horizons deprived of Tertiary plants or showing only some remnants of them, these similarities will be less marked. The differences are more evident in the two comparative diagrams (Fig. 10, 12). At Krościenko there are 38 Tertiary taxons, while at Domański Wierch there are only 20. The over-all proportion of Tertiary genera at Krościenko amounts at most 50%, while at Domański Wierch it does not exceed 35%. The herbaceous plants at Krościenko constitute at most 25 per cent of the over-all number, while exceeding 40% at Domański Wierch. These differences are large enough to permit the conclusion that the Domański Wierch cone is younger than the Lower Pliocene. This suggestion is corroborated by the results of an investigation by Leschik (1951) concerning the Pliocene sediments at Buchenau (South-East Hesse, ca. 335 m a. s. l.). Leschik analysed 124 samples from 100-m profile in which five brown-coal layers alternated with clays and sands. The resemblance between the pollen spectra from Buchenau and Domański Wierch is really striking. Each coal insert contained a large amount of *Picea* pollen (up to 44%), while *Alnus* predominated over deciduous trees (up to 70%). Of the herbaceous plants, the spores of *Polypodiaceae* and *Osmundaceae* have been preserved in great numbers.

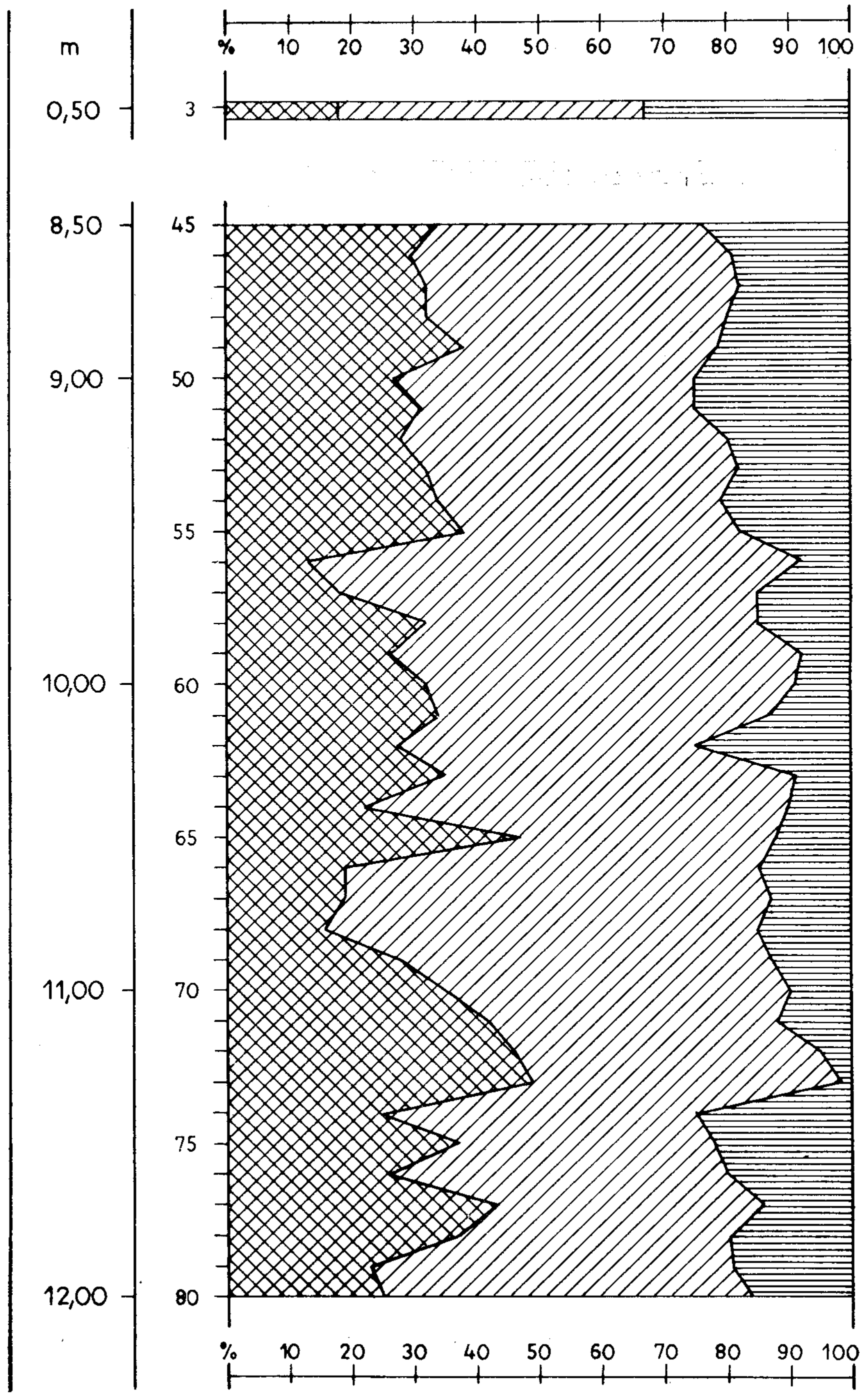

Fig. 10. Krościenko. Comparative pollen diagram of quantitative proportion of three plant groups (signatures see Fig. 6).

Ryc. 10. Krościenko. Diagram porównawczy ilościowego udziału trzech grup roślin (objaśnienia oznaczeń jak na ryc. 6).

As to the tree genera, in some horizons we also find, as at Domański Wierch, large amounts of *Pinus* of the *silvestris* type, and throughout the profile of *Pinus* of *haploxylon* type. Of the Tertiary trees mention should be made of the *Tsuga*, *Pterocarya*, and some small number of other thermophilic trees. Here again there were no trees of the *Taxodiaceae-Cupressaceae* group. At Buchenau, as in the Domański Wierch sediment, there were horizons with a small amount of pollen, horizons with corroded pollen, and marked variation in frequency.

The Buchenau sediment has been attributed by geologists to the Pliocene; Leschik, comparing its flora composition to that of the other Pliocene floras, included it in the youngest period of Upper Pliocene. Though these two localities are quite far away from each other and their topography is not the same (the author attributes the occurrence of several coal inserts with recurrent plant composition to the sinking of the Tertiary trough induced by tectonic movement), the interesting analogies between the two profiles are worthy of note.

The poblem of the boundary between the Tertiary and the Quaternary in the Domański Wierch profile

As we now know, the conventional boundary between these two periods does not coincide — as once held — with the complete disappearance of Tertiary plants; on the other hand, changes in the pollen diagrams, at the transition between the two periods, testify to a deterioration of the climate. Thus, the pollen of Tertiary plants disappears in order of succession corresponding to their respective climatic requirements. The first to disappear are the plants of markedly thermophilic character; next come the more cold-resistant trees, while the longest to survive are the coniferous trees such as *Tsuga*, *Sciadopitys*, and some *Taxodiaceae* still sometimes encountered in the Pleistocene. The disappearance of Tertiary genera is allied with a simultaneous growth in the proportion of trees of the following genera: *Pinus* of *silvestris* type, *Picea*, *Abies*, and *Alnus*.

In Poland, the problem of the border line between the Tertiary and the Quaternary has so far been studied in one example of a profile of medium depth (28 m) at Mizerna near Czorsztyn (Szafer 1954; Szafer, Oszast 1964). The plant material from this locality, situated at about 500 m to the north-east of the highroad between Maniowy and Czorsztyn, was studied from the palynological point of view and on the basis of macrofossils which occur here in great numbers. In the pollen diagram horizons, estimated by Szafer as a Plio-Pleistocene transition zone, a quantitative and qualitative decrease in the thermophilic trees of the Tertiary group can be traced (Fig. 11). They do not disappear completely, surviving in a fairly

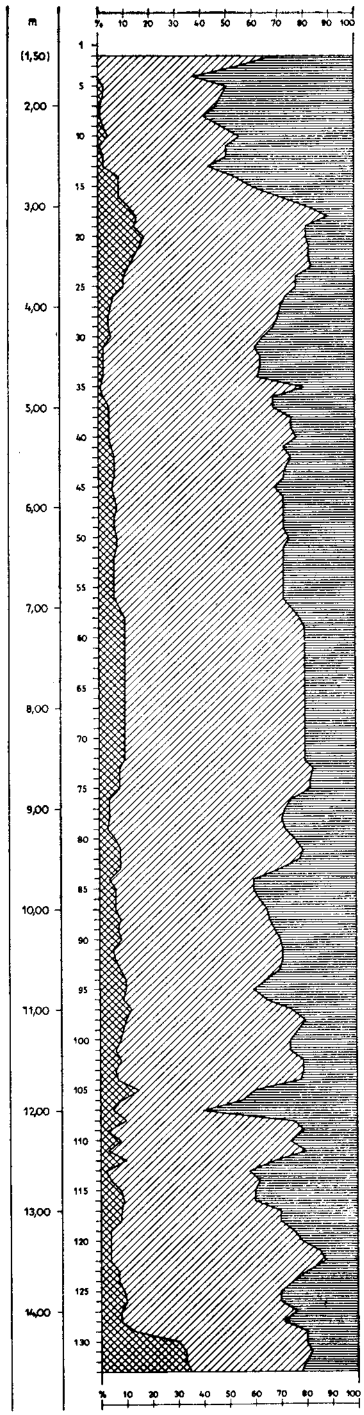

Fig. 11. Mizerna. Comparative pollen diagram of quantitative proportion of three plant groups (signatures see Fig. 6).

Ryc. 11. Mizerna. Diagram porównawczy ilościowego udziału trzech grup roślin (objaśnienia oznaczeń jak na ryc. 6).

uniform way up to 10 per cent throughout the Quaternary portion of the profile. In the top part of it there is a marked increase in the proportion of herbaceous plants, reaching up to 60 per cent. Thus here one can trace as it were, three different segments, a basal segment with an increased amount of Tertiary plants, a middle one where their proportion is reduced, and an upper one with a marked increase in the amount of herbaceous plants.

In the Domański Wierch profile one might have expected a palynological picture resembling that at Mizerna, since, as we know from earlier publications (R o m e r 1929; H a l i c k i 1930), this region contains moraine material, now degraded and transformed, which should be referred to the period of the first glaciation. S z a f e r (1950) pointed out that the profile top at Domański Wierch should probably be attributed to the Pleistocene, while according to U r b a n i a k (1960) in this profile, at 14 m occurs the Neogene-Pleistocene transition zone, and the Neogene proper comprises the strata from 14 to 228 m down.

In the pollen diagram at Domański Wierch we do not observe, however, any differentiation in the vegetation picture typical of the Plio-Pleistocene transition zone and the composition of the pollen flora seems to indicate that the profile as a whole comes from a single climatic period. In the uniformly monotonous profile no differences are to be noted in the spectra of horizons above or below the 14-m horizon. Common traits in the diagram from Domański Wierch and in that from the Pleistocene part of the Mizerna profile are to be found in a markedly increased proportion of herbaceous plants, in the constant admixture of Tertiary trees which being most cold--resistant were thus the latest to disappear from Pleistocene floras, as well as in the altered character of the forests. This consisted in the impoverishement of their specific composition. These are similarities to which one must not attribute any exaggerated significance, but which on the other hand do not preclude the occurrence of a transition zone between the Pliocene and the Pleistocene in the examined profile.

FINAL REMARKS

The above considerations are but one stage in the reconstruction of Neogene vegetation and climate in the Tatra foreland. Further investigations are necessary to study the floras of different ages which are so richly represented here and which will perhaps permit the tracing in greater detail of the recession of Tertiary vegetation in the face of Pleistocene glaciations.

The results of the present investigations can be briefly summarized as follows: the pollen diagram from Domański Wierch does not illustrate

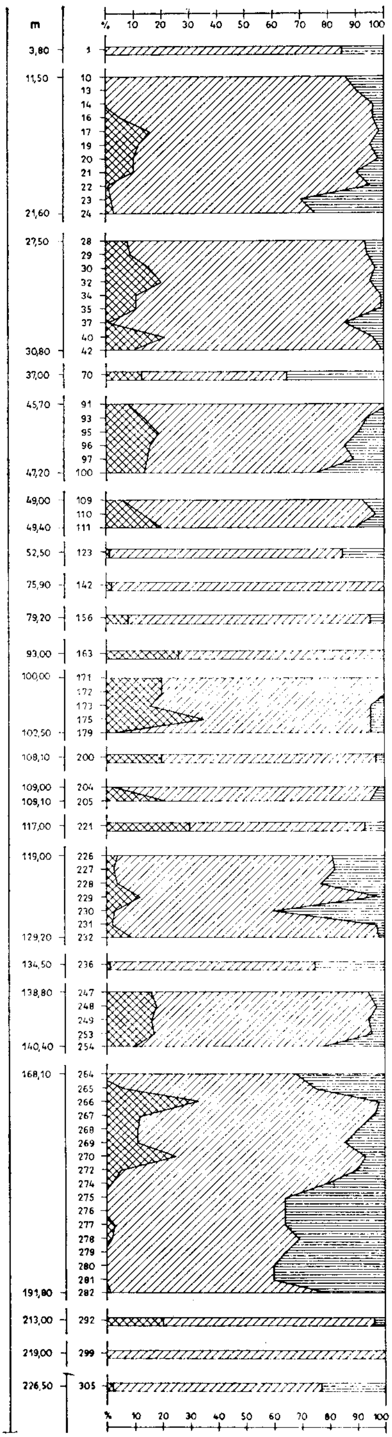

Fig. 12. Domański Wierch. Comparative pollen diagram of quantitative proportion of three plant groups (signatures see Fig. 6).

Ryc. 12. Domański Wierch. Diagram porównawczy ilościowego udziału trzech grup roślin (objaśnienia oznaczeń jak na ryc. 6).

Miocene vegetation, though permitting the tracing of the sediments from this locality to the youngest Pliocene.

The diagram does not show any traces of a border-line between two different climatic periods. The whole sediment was deposited during one climatic period.

The abundant proportion of the *Picea* within the Pliocene floras of West Carpathians (Krościenko, Domański Wierch, the younger part of Czarny Dunajec profile) is an indication of the predominance of this genus at that time. Its scanty proportion in the floras older than the Pliocene (Huba, the older part of Czarny Dunajec) leads to the assumption that the expansion of the *Picea* did not start in this region until the youngest Neogene.

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STRESZCZENIE

PROFIL PLIOCEŃSKI DOMAŃSKIEGO WIERCHU KOŁO CZARNEGO DUNAJCA W ŚWIETLE BADAŃ PALINOLOGICZNYCH

Domański Wierch jest wzniesieniem położonym w Kotlinie Nowotarsko-Orawskiej, na południe od Czarnego Dunajca (ryc. 1). Kotlinę wyścielają miąższe osady neogeńskie i czwartorzędowe. Częste odsłonięcia neogenu wykształcone są w postaci iłów lignitowych z dobrze zachowanymi szczątkami roślin.

Stromy brzeg południowo-wschodni wzniesienia Domańskiego Wierchu rozcina głęboki wąwóz Jaszczurów, gdzie w roku 1947 prof. dr J. Gołąb odkrył warstwę iłów z licznymi odciskami liści (por. Zastawniak 1972).

Rezultaty wstępnych badań paleobotanicznych z Domańskiego Wierchu i ze stanowisk leżących w jego najbliższym sąsiedztwie wzbudziły duże zainteresowanie (Szafer 1950). W latach 1956/57 Instytut Geologiczny wykonał w najwyższym punkcie wzniesienia (753 m n.p.m.) wiercenie badawcze, które z przyczyn technicznych zostało niestety przerwane na głębokości 228 m, nie osiągając podłoża neogenu. Z uzyskanego rdzenia pobrano 306 prób do badań palinologicznych.

UWAGI O PROFILU GEOLOGICZNYM, STAN ZACHOWANIA MATERIAŁU ROŚLINNEGO I METODA BADAŃ

Według Birkenmajera (1954, 1958), Domański Wierch przedstawia „wielki stożek napływowy utworzony zapewne w tortonie przez system potoków spływających z wzniesień fliszu podhalańskiego i pasa skałkowego, a także z dźwigającego się masywu tatrzańskiego przykrytego fliszem". Ku północnemu zachodowi stożek przechodzi w iły lignitowe odsłaniające się w łożysku Czarnego Dunajca. W profilu geologicznym Domańskiego Wierchu Birkenmajer (1958) wyróżnił 12 serii zmieniających się na przemian żwirów i konglomeratów oraz iłów piaszczystych. U r b a n i a k (1960), autorka szczegółowego opracowania profilu pochodzącego z wiercenia, wyróżniła w nim dwie części różniące się litologicznie i petrograficznie. W górnej części (do 14 m) występują iły i gliny z kwarcytami tatrzańskimi, a w dolnej (14—228 m) zalegają na przemian warstwy ilasto-piaszczyste i ilasto-żwirowe. U r b a n i a k (l. c.) przypuszcza, że osady te akumulowały się w głębokim obniżeniu terenu prawdopodobnie tektonicznego pochodzenia. Badania granulometryczne pokryw żwirowych Domańskiego Wierchu przeprowadziła P l e w a (1969); opierając się na wynikach badań własnych i B i r k e n m a j e r a, stwierdziła, że stożek Domańskiego Wierchu został utworzony z materiału fliszowego, zniesionego przez wody z kierunków SW, SSE i ESE. Obecność żwirów powyżej poziomów ilastych świadczy o okresowo gwałtownej akumulacji.

Próby do badań palinologicznych pobierano co 20 cm, z wyjątkiem miąższych warstw żwirowych. Osad był macerowany kwasem fluorowodorowym w połączeniu z metodą acetolizy (E r d t m a n 1943), dodatkowo stosowano także metodę flotacyjną K n o x a (1942). Próby zawierające dużo $CaCO_3$ rozpuszczano uprzednio w mieszaninie kwasu fluorowodorowego i solnego (1 : 3), a nadmiar drobno roztartego detrytusu roślinnego spalano w wodzie utlenionej.

Uderzającą cechą badanego materiału roślinnego był zły stan zachowania większości sporomorf, ich różny stopień skorodowania i zmieniająca się gwałtownie frekwencja. Wiąże się to niewątpliwie z procesem sedymentacji, raz bardzo gwałtownej, o czym świadczą poziomy żwirowe, to znów spokojniejszej, czego dowodzą poziomy ilaste. Różny stopień korozji sporomorf w tej samej próbie nasuwa przypuszczenie, że osad był wymieszany i zawierał sporomorfy różnego wieku. Sugestię tę potwierdza niekonsekwentny skład niektórych spektrów, w których pojawiają się nieoczekiwanie pojedyncze sporomorfy rodzajów egzotycznych np. *Symplocos*, gdy całe spektrum reprezentuje roślinność odmienną w swym wyrazie klimatycznym.

Oprócz pyłku roślinnego znajdowano w osadzie *Hystrichosphaeridae*. Ich obecność i sposób występowania (ryc. 2) rzuca światło na źródło przynajmniej części materiału obcego, w danym przypadku pochodzącego z rozmycia skał fliszowych.

CHARAKTERYSTYKA ROŚLINNOŚCI

Diagram pyłkowy z Domańskiego Wierchu (ryc. 2) wykazuje, że dominującą rolę w szacie roślinnej badanego terenu odgrywały zbiorowiska leśne. W wyższych piętrach górskich były to głównie lasy szpilkowe, w których panowała *Pinus* i *Picea* z domieszką *Abies, Tsuga* i *Sciadopitys*. Wysokie udziały dobrze zachowanego pyłku świerka wskazują, że drzewo to było stałym i ważnym składnikiem zbiorowisk leśnych tego terenu. Zwrócił już na to uwagę Szafer (1946) opisując roślinność plioceńską że wschodniej części Kotliny. Także Němejc (1943, 1967, 1968) i Planderová (1970) podkreślają zwiększony udział tego drzewa we florach młodszego neogenu Czechosłowacji.

Odmiennym zbiorowiskiem roślinnym były lasy liściaste zajmujące zbocza wzniesień. W ich skład wchodziły rodzaje *Acer, Aesculus, Carpinus, Castanea, Cornus, Corylus, Fagus, Juglans, Quercus, Tilia, Ulmus* a z krzewów *Rubus, Sambucus, Sorbus, Viburnum.*

Wyraźnie zaznaczają się w diagramie zbiorowiska olszynowe, które zajmowały siedliska na podmokłym dnie Kotliny i nad rzekami. Panowała w nich *Alnus,* przekraczając niekiedy 70% ogólnej sumy sporomorf, z udziałem *Fraxinus, Populus, Pterocarya, Liquidambar* i *Salix* oraz paproci typu *Polypodiaceae,* rzadziej *Osmundaceae.* Poziomy obfitszego występowania olszy powtarzają się w profilu parokrotnie, zawsze w warstwach iłu nakrytych żwirami. Po każdej przerwie wywołanej wzmożonym działaniem erozji wodnej następowała regeneracja zbiorowiska olszynowego bez istotniejszych zmian w składzie gatunkowym. Kolejne odradzanie się olszyn odbywało się w tym samym okresie klimatycznym, który charakteryzował się wzmożonymi opadami z okresowymi nawałnicami burzowymi.

Oprócz zbiorowisk leśnych zachowały się w diagramie ślady zarośli i nasłonecznionych muraw. Dowodzi tego obecność roślin zielnych i krzewów, jak *Artemisia, Centaurea* typ *jacea, Chenopodiaceae, Compositae, Ephedra,* liczne *Gramineae, Helianthemum, Hippophaë, Rumex* typ *acetosa, Scabiosa* i in. Brak we florze pyłkowej dowodów obecności bardziej rozległego zbiornika wodnego, na co zwróciła już uwagę Łańcucka-Środoniowa (1965) na podstawie wstępnych badań nad makroskopowymi szczątkami roślinnymi. Brak także śladów drzew i krzewów zimozielonych oraz gatunków wyraźnie ciepłolubnych. Nieliczne sporomorfy roślin egzotycznych są tu prawdopodobnie na wtórnym złożu, a główny trzon roślinności budują rodzaje strefy umiarkowanej.

INNE NEOGEŃSKIE DIAGRAMY PYŁKOWE Z KOTLINY NOWOTARSKO-ORAWSKIEJ

W celu uzyskania szerszego tła dla interpretacji wieku roślinności Domańskiego Wierchu opracowano dodatkowo profile neogeńskich osadów ze stanowiska w Hubie położonego we wschodniej części Kotliny, z Krościenka oraz Czarnego Dunajca, sąsiadującego z Domańskim Wierchem. Flory z Huby i Krościenka opracował Szafer (1946, 1947, 1954) na podstawie szczątków makroskopowych roślin, zaliczając Krościenko do dolnego pliocenu, natomiast florę z Huby uznał za najprawdopodobniej starszą od krościeńskiej.

Profil z Huby o miąższości 8,6 m zbudowany jest głównie z jasnego iłu z domieszką piasku. W stropie profilu obecna jest 2,5-metrowa warstwa mułku torfiastego, nakryta półmetrową warstwą żółtej, silnie zapiaszczonej gliny. Pyłek roślinny zachował się tylko w torfie. W spektrach pyłkowych dominują rodzaje drzew z grupy *Taxodiaceae-Cupressaceae* przedstawione na diagramie (ryc. 3) krzywą sumaryczną obejmującą rodzaje *Taxodium* (najliczniejszy), *Cryptomeria, Sequoia* i *Glyptostrobus.* Z drzew liściastych dość bogato reprezentowana jest *Castanea* (do 10%), a z innych rodzajów obecne są *Aesculus, Carya, Celtis, Corylopsis, Engelhardtia, Eucommia, Liriodendron, Liquidambar, Magnolia, Nyssa, Ostrya, Pterocarya, Rhus,* i *Zelkova.* Z roślin zielnych najobfitsze są *Cyperaceae,* a wśród roślin wodnych stwierdzono obecność rodzajów *Brasenia, Euryale, Nuphar* i *Trapa.*

Profil z Krościenka o miąższości 12 m obejmuje 80 prób, z których dotychczas opracowano tylko 37. Akumulacja osadu odbywała się tu w warunkach spokojnych, w zbiorniku wodnym, o czym świadczy obfitość pyłku roślin wodnych, a zwłaszcza wysoki w spągu profilu udział rodzaju *Nuphar.* Wśród drzew lasu szpilkowego pierwsze miejsce zajmował świerk z domieszką *Abies, Pinus, Tsuga* i *Sciadopitys.* Lasy liściaste i mieszane bliższego i dalszego otoczenia zbiornika oraz zbiorowiska leśne dolin były dość urozmaicone, dowodzi tego obecność pyłku *Acer, Alnus, Betula, Carpinus, Carya, Castanea, Celtis, Corylopsis, Fagus, Fraxinus, Pterocarya, Quercus, Salix, Tilia* i *Ulmus* (ryc. 4, tab. III).

Z najbliższego sąsiedztwa Domańskiego Wierchu pochodzi uzyskany z wiercenia profil z Czarnego Dunajca, obejmujący około 1000 m osadu neogeńskiego. Wykonano dotychczas analizę kilkudziesięciu prób, których spektra pyłkowe wykazują istotne różnice w zależności od tego, czy pochodzą z dolnej czy z górnej części profilu (ryc. 5, tab. IV). Odcinek górny, od 30 do mniej więcej 400 m, charakteryzuje się, podobnie jak w Krościenku, dużymi wartościami pyłku świerka (do 56%). Od 600 m udział tego drzewa szybko maleje, a na głębokości 880 m zanika całkowicie. Równocześnie zwiększa się rola *Pinus* typ *haploxylon* i drzew z grupy *Taxodiaceae-Cupressaceae* oraz udział rodzaju *Engelhardtia* (do 15%). Szczególnie interesujące jest występowanie olszy, która powyżej 600 m reprezentowana jest przez pyłek *Alnus* typ *incana-glutinosa;* natomiast w głębszej części profilu ten typ pyłku zanika całkowicie, a jego miejsce zajmuje pyłek typu *Alnus kefersteinii.* Nasuwa to przypuszczenie, że w głębokim profilu z Czarnego Dunajca zachowały się oba piętra neogenu, tj. miocen i piocen. Można przeto spodziewać się, że pełne opracowanie tego profilu pozwoli na wykazanie różnic w składzie roślinności miocenu i pliocenu w tej części Karpat.

DYSKUSJA NAD WIEKIEM OSADU

Wiek osadów Domańskiego Wierchu był dotychczas różnie oceniany. Według przypuszczeń Szafera (1950, 1952), opartych na wstępnych wynikach badań flory owocowo-nasiennej, zachować się tu mogły ogniwa miocenu środkowego lub górnego, mio-pliocenu, a w stropie plejstocenu. Birkenmajer (1954, 1958), opierając się na wynikach badań Szafera i własnych obserwacjach geologicznych, wypowiedział pogląd, że osady Domańskiego Wierchu zostały złożone prawdopodobnie w górnym tortonie. Nie wykluczył on jednakże wieku młodszego, zwłaszcza sarmatu. Łańcucka-Środoniowa (1965), na podstawie wstępnych oznaczeń części materiału nasion i owoców pochodzących z Domańskiego Wierchu i iłów lignitowych z Orawy, skłonna była przypisać wiek tortoński warstwom spągowym profilu, a przypuszczalnie sarmacki utworom ilasto-żwirowym leżącym nad iłami. Dopuszcza ona jednak, w miarę dalszych badań, możliwość wyróżnienia także i młodszych pięter stratygraficznych. Urbaniak (1960) wyróżniła w profilu część plejstoceńską lub przejściową między neogenem a plejstocenem, sięgającą do głębokości 14 m, oraz część neogeńską, obejmującą warstwy od 14 m do 228 m.

Zastawniak (1972) na podstawie analizy flory liściowej oceniła wiek stożka domańskiego jako plioceński.

Autorka obecnego opracowania wyraziła na podstawie badań palinologicznych pogląd, że osad stożka Domańskiego Wierchu należy wiązać wiekowo z najmłodszym pliocenem lub ze strefą przejściową plio-plejstoceńską (Oszast 1970).

W rozważaniach nad wiekiem badanego osadu użyto do pomocy kilku neogeńskich diagramów pyłkowych z obszaru Polski południowej i porównano je z diagramem z Domańskiego Wierchu pod względem ilościowego udziału roślin trzeciorzędowych, czwartorzędowych i zielnych. W tym celu skonstruowano uproszczone diagramy porównawcze złożone z trzech krzywych (ryc. 6—12). Pierwsza z nich obejmuje rodzaje drzew i krzewów znanych z europejskich flor trzeciorzędowych, które na obszarze Europy Środkowej zanikały przy końcu pliocenu, sięgając wyjątkowo do starszego plejstocenu. Tabela V obejmuje listę tych rodzin i rodzajów, które w porównywanych diagramach tworzą sumaryczną krzywą roślin trzeciorzędowych. Druga krzywa obejmuje sumę rodzajów drzew i krzewów odgrywających istotną rolę w plejstoceńskich i współczesnych zbiorowiskach leśnych Europy. Zaliczono do nich rodzaje *Abies, Acer, Alnus* typ *incana-glutinosa, Betula, Carpinus, Corylus, Fraxinus, Picea, Pinus* typ *silvestris, Quercus, Salix* i *Tilia*. Jest to lista określająca wymienione rodzaje w sposób umowny jako „czwartorzędowe", gdyż wiadomo, że wiele z nich żyło także w trzeciorzędzie, a niektóre gatunki z tych rodzajów mogły być nawet ograniczone do trzeciorzędu. Mimo dyskusyjnego charakteru takiego ujęcia, wynikającego z trudności gatunkowego oznaczania drzew i krzewów na podstawie budowy ziarna pyłku, przyjęto ten umowny podział, aby uzyskać jednolitą podstawę do porównań diagramów z różnych pięter neogenu. Trzecia krzywa ilustruje sumę roślin zielnych, z wyłączeniem roślin wodnych.

Pierwsza grupa diagramów porównawczych obejmuje profile górnomioceńskie ze stanowisk: Piaseczno koło Tarnobrzega (O s z a s t 1967), Gliwice Stare na Górnym Śląsku (O s z a s t 1960; S z a f e r 1961), Huba koło Czorsztyna i Czarny Dunajec (ryc. 6—9). Flory te, rozrzucone na obszarze Polski południowej (ryc. 1), posiadają pewne wspólne cechy charakterystyczne dla roślinności górnomioceńskiej, co pozwala na porównanie ich z florą nowo opracowaną. Mają one te same rodzaje „czwartorzędowe", natomiast różna jest w nich liczba taksonów roślin trzeciorzędowych: w Piasecznie 67, w Gliwicach Starych 50, w Hubie 30, a w Czarnym Dunajcu z 47 oznaczonych dotychczas typów sporomorf 36 można było powiązać z roślinami znanymi tylko z flor trzeciorzędowych. Wspólną cechą wszystkich porównywanych diagramów jest niezależny od położenia geograficznego stanowiska i liczby taksonów trzeciorzędowych, bogaty ilościowo udział sporomorf roślin trzeciorzędowych, zawsze przekraczający 50% ogólnej sumy (dochodzi do 90%). Udział roślin zielnych jest w nich zawsze niewielki, na ogół nie przekracza 10% ogólnej sumy sporomorf.

We florze pyłkowej z Domańskiego Wierchu liczba taksonów roślin trzeciorzędowych, obejmująca także formy znalezione jednorazowo, wynosi 20. Ich udział w spektrach poszczególnych poziomów jest bardzo nierównomierny, wyjątkowo dochodzi do 35%, a w szeregu prób, obejmujących niekiedy kilkumetrowe odcinki profilu, brak ich zupełnie. W całym profilu dominują rodzaje „czwartorzędowe", z wyraźnie większym udziałem roślin zielnych (ryc. 12). Te dość zasadnicze różnice pozwalają na wyrażenie opinii, że diagram pyłkowy z Domańskiego Wierchu nie ilustruje roślinności mioceńskiej. Potwierdzają to wyniki badań nad florą liściową, która jest pozbawiona form przewodnich dla mioceńskich zbiorowisk leśnych (Z a s t a w n i a k 1972).

Inne flory mioceńskie z obszaru Polski południowej, opracowane przez P a u t s c h (1957), K i t ę (1963), i Ł a ń c u c k ą - Ś r o d o n i o w ą (1966), porównane z florami z Piaseczna i Gliwic Starych dowodzą, że roślinność Polski południowej była w miocenie zróżnicowana lokalnie, przede wszystkim w zależności od topografii terenu (O s z a s t 1967). Można by więc sądzić, że odmienny obraz palinologiczny roślinności zachowanej w osadzie z Domańskiego Wierchu jest jeszcze jednym dowodem takiego zróżnicowania, wynikającego z położenia stanowiska w rejonie górskim. Takiemu przypuszczeniu przeczy profil z Huby i część mioceńska profilu z Czarnego Dunajca; diagramy pyłkowe z tych stanowisk, położonych w najbliższym sąsiedztwie Domańskiego Wierchu, zachowały obraz roślinności charakterystyczny dla miocenu.

Dolnoplioceńska roślinność z Krościenka, porównana z roślinnością z Domańskiego Wierchu, wykazuje zarówno podobieństwa, jak i różnice. Wspólną dla obu diagramów jest przewaga drzew szpilkowych nad liściastymi oraz panowanie świerka. Jednakże w Krościenku liczba taksonów trzeciorzędowych wynosi 38 i osiąga 50% udziału w całości flory, a rośliny zielne nie przekraczają wartości 25%. W diagramie z Domańskiego Wierchu udział roślin trzeciorzędowych jest znacznie niższy a rośliny zielne przekraczają wartość 40%. Dlatego słuszne wydaje się stwierdzenie, że stożek Domańskiego Wierchu jest młodszy od dolnego pliocenu.

W rozważaniach nad wiekiem osadu Domańskiego Wierchu był brany pod uwagę okres przejściowy między pliocenem a plejstocenem dla stropowej części profilu (S z a f e r 1950; B i r k e n m a j e r 1954, 1958; U r b a n i a k 1960; P l e w a 1969). W spektrach pyłkowych okres ten powinien się wyrazić zmienionym składem roślinnym, ilustrującym stopniowe zanikanie form trzeciorzędowych jako sygnał pogarszania się klimatu. W Polsce zagadnienie pogranicza trzeciorzędu i czwartorzędu było dotychczas rozważane na jednym tylko przykładzie stanowiska w Mizernej koło Czorsztyna (S z a f e r 1954; S z a f e r i O s z a s t 1964). W poziomach diagramu pyłkowego zaliczonych przez S z a f e r a do strefy przejściowej plio-plejstoceńskiej istotnie obserwuje się ubożenie jakościowe i ilościowe drzew grupy trzeciorzędowej (ryc. 11). Nie zanikają one jednak całkowicie, w czwartorzędowej części profilu utrzymują się stale, w niskich procentach, najbardziej wytrzymałe drzewa trzeciorzędowe, jak np. *Pterocarya, Tsuga, Sciadopitys*. W całym diagramie można zatem wyróżnić trzy odcinki: spągowy ze znaczniejszym udziałem roślin trzeciorzędowych, środkowy ze zmniejszonym ich udziałem i górny, wyraźnie wzbogacony w rośliny zielne. W profilu Domańskiego Wierchu nie obserwujemy istotnych różnic w spektrach prób pochodzących z części profilu powyżej i poniżej 14 m, a jednolity i monotonny skład flory pyłkowej przemawia za tym, że cały profil pochodzi z jednego okresu klimatycznego.

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Table I
Tabela I

Domański Wierch. Absolute numbers of sporomorphs. P.1.Trees and shrubs AP
Domański Wierch. Bezwzględne ilości sporomorf. Cz. 1. Drzewa i krzewy AP

Nos of samples / Nr prób	1	3	4	5	7	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Abies	3	1	–	–	–	6	2	–	5	2	3	–	15	–	–	5	5	–	3	1	–
Acer	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Aesculus	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–
Alnus incana-glutinosa t.	40	–	–	1	–	86	1	–	–	–	2	12	1	2	–	5	–	–	2	4	–
Araliaceae	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Betula	34	–	–	–	–	88	4	1	–	–	1	1	1	3	–	5	2	1	5	8	1
Carpinus	4	–	–	–	2	8	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Carya	–	–	–	–	–	–	–	–	–	–	–	2	1	–	–	–	–	–	–	–	–
Castanea	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–
Celtis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cornus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–
Corylus	5	1	–	–	–	9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Elaeagnus	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
Engelhardtia	–	–	–	–	–	–	–	–	1	–	–	5	3	–	–	–	–	–	–	–	–
Eucommia	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Fagus	–	–	–	–	–	3	5	1	–	–	1	4	–	–	2	5	10	–	5	9	2
Fraxinus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	4	5	–
Ginkgo cf. biloba	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Juglans	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	1	–
Juniperus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ligustrum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Liquidambar	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	–	–	–
Lonicera	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Myrica	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
Nyssa	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Picea	1	–	1	2	2	–	27	2	11	12	3	52	59	2	20	35	47	7	51	27	3
Pinus haploxylon t.	–	–	–	–	–	–	–	–	10	5	–	–	–	–	11	14	–	10	5	–	–
Pinus silvestris t.	78	–	1	–	2	214	11	4	73	168	4	49	45	23	82	51	35	118	37	28	7
Platycarya	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Pterocarya	–	–	–	–	–	–	–	–	–	–	–	7	4	–	–	–	–	–	–	–	–
Quercus	6	–	–	–	1	5	11	1	1	3	4	–	1	–	1	5	9	–	8	19	2
Rhus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Rubus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–
Salix	1	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	1	–	–
Sciadopitys	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sorbus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Symplocos	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Taxodiaceae-Cupressaceae	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
Taxus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Tilia	–	–	–	–	–	3	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–
Tsuga	–	–	–	–	–	–	–	–	2	1	–	5	4	–	2	3	–	–	1	–	–
Ulmus-Zelkova	–	–	–	–	–	1	–	–	–	–	–	2	8	–	–	2	–	–	–	1	–
Viburnum	1	–	–	–	–	3	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–

Nos of samples / Nr prób	28	29	30	32	33	34	35	36	37	40	42	47	59	63	64	65	66	67	69	70	71	72	73	74	84
Abies	24	21	4	1	1	1	9	1	–	11	–	–	–	2	1	–	–	–	–	3	2	1	–	–	–
Acer	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Aesculus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–
Alnus incana-glutinosa t.	2	2	–	3	–	2	1	1	–	7	3	–	–	–	1	–	1	–	–	5	–	5	–	–	–
Araliaceae	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Betula	–	–	–	–	–	–	–	1	–	2	–	–	–	–	–	–	1	–	–	15	–	6	1	–	6
Carpinus	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	1	–	–	2	–	–	–	–	1
Carya	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–
Castanea	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Celtis	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cornus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	–	1
Corylus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–
Elaeagnus	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Engelhardtia	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Eucommia	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Fagus	1	–	–	–	1	–	2	3	–	–	–	–	2	5	2	1	5	1	–	8	–	1	–	–	3
Fraxinus	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	3	–	–	–	–	2
Ginkgo cf. biloba	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Juglans	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Juniperus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ligustrum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Liquidambar	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Lonicera	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Myrica	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–
Nyssa	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Picea	102	81	9	6	2	23	71	1	6	47	22	–	2	20	10	2	21	2	2	49	1	8	1	4	10
Pinus haploxylon t.	7	7	27	15	–	17	4	13	–	13	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Pinus silvestris t.	106	92	121	77	5	116	66	43	104	77	84	22	5	21	4	20	17	2	20	7	11	18	1	17	6
Platycarya	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Pterocarya	–	2	–	–	–	–	2	1	–	6	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Quercus	–	–	–	–	1	–	–	–	–	–	–	–	1	–	4	–	4	–	–	14	–	3	–	1	3
Rhus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Rubus	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Salix	–	–	–	–	–	–	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–
Sciadopitys	–	–	–	–	–	–	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
Sorbus	–	–	–	–	–	–	–	–	–	1	–	–	1	1	–	–	–	–	–	–	1	–	–	–	–
Symplocos	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Taxodiaceae-Cupressaceae	2	–	–	–	–	5	1	–	–	4	2	–	–	1	–	–	–	–	1	–	–	–	–	–	–
Taxus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Tilia	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Tsuga	20	6	8	20	–	5	15	1	–	7	2	1	–	–	–	1	–	–	–	–	–	–	–	–	–
Ulmus-Zelkova	–	–	–	–	–	–	–	–	–	5	1	–	–	–	1	1	–	–	1	1	–	1	–	–	–
Viburnum	–	–	–	–	1	1	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Nos of samples / Nr prób	86	87	89	91	92	93	94	95	96	97	98	100	107	108	109	110	111	115	121	123	134	142	144	145	153
Abies	–	–	–	1	–	4	1	–	8	11	–	6	4	10	2	16	6	1	–	–	1	–	–	–	–
Acer	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	3	–	–	–	–	–	–	–	–
Aesculus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Alnus incana-glutinosa t.	2	–	1	1	–	12	–	57	72	42	–	119	2	5	4	174	102	–	3	2	1	–	–	–	–
Araliaceae	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Betula	–	–	1	–	–	4	–	3	3	5	1	2	1	1	3	5	3	4	5	2	1	1	–	1	–
Carpinus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	2	–	–	–	–	–	–	–	–
Carya	–	–	–	–	–	2	–	–	2	–	–	–	–	–	–	–	3	–	–	–	–	–	–	–	–
Castanea	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Celtis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cornus	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Corylus	–	–	–	1	–	–	–	5	–	1	–	1	–	–	–	12	–	1	–	1	–	–	–	–	–
Elaeagnus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Engelhardtia	–	–	–	–	1	4	–	4	4	1	–	5	–	–	–	2	1	–	–	–	–	–	1	–	–
Eucommia	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Fagus	1	1	–	–	1	–	1	3	3	–	–	7	2	–	–	6	4	–	–	1	–	–	–	–	–
Fraxinus	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
Ginkgo cf. biloba	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Juglans	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–
Juniperus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ligustrum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Liquidambar	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	–	–	–	–	–
Lonicera	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Myrica	–	–	–	–	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–
Nyssa	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Picea	2	4	10	51	1	63	22	14	20	30	–	29	13	9	35	55	15	1	–	5	4	–	14	1	–
Pinus haploxylon t.	–	–	1	–	–	–	–	3	1	–	–	4	6	3	–	50	24	–	–	–	–	–	3	–	1
Pinus silvestris t.	11	7	1	42	8	73	2	13	24	57	–	30	33	–	102	141	80	22	10	102	49	113	26	33	4
Platycarya	–	–	–	–	1	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	1	–	–
Pterocarya	–	–	3	6	–	7	2	7	13	15	–	14	5	5	2	23	19	–	–	–	–	–	–	7	–
Quercus	1	1	–	–	–	–	1	1	4	–	–	–	–	–	1	–	1	–	4	–	–	–	–	–	–
Rhus	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
Rubus	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–
Salix	–	–	–	–	–	1	–	1	8	–	–	1	–	–	1	–	1	–	–	–	–	–	–	–	–
Sciadopitys	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
Sorbus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Symplocos	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–
Taxodiaceae-Cupressaceae	–	–	–	2	2	4	–	5	17	12	–	7	–	3	3	–	3	–	–	1	–	2	2	2	3
Taxus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Tilia	–	–	–	–	–	–	–	1	2	1	1	1	–	–	1	1	2	–	–	–	1	2	–	–	2
Tsuga	–	–	–	–	–	1	1	1	4	6	–	8	2	9	2	37	10	1	–	–	–	1	–	–	–
Ulmus-Zelkova	1	–	–	1	–	–	–	–	11	9	–	4	–	2	1	2	2	–	1	–	–	–	–	–	–
Viburnum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	1	–	–	–	–	–	–

Nos of samples / Nr prób	154	156	159	162	170	171	172	173	174	175	179	200	204	205	212	213	221
Abies	–	2	1	–	–	1	2	6	–	1	–	1	1	5	–	–	–
Acer	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–
Aesculus	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–
Alnus incana-glutinosa t.	–	4	3	3	1	33	29	3	–	21	–	–	8	2	–	1	11
Araliaceae	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–
Betula	2	–	–	3	–	1	–	–	–	2	–	–	–	–	–	–	7
Carpinus	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	2
Carya	–	–	–	–	–	–	–	–	–	4	–	–	–	3	–	–	–
Castanea	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
Celtis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cornus	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
Corylus	1	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–
Elaeagnus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Engelhardtia	–	–	1	1	1	–	1	–	2	–	–	–	–	7	–	3	8
Eucommia	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Fagus	–	1	–	4	–	–	–	–	–	–	–	1	8	12	1	–	27
Fraxinus	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–
Ginkgo cf. biloba	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Juglans	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Juniperus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ligustrum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Liquidambar	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	2
Lonicera	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Myrica	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
Nyssa	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Picea	11	48	25	35	12	23	11	40	18	–	2	52	17	69	2	–	19
Pinus haploxylon t.	16	–	–	–	–	1	–	–	–	–	–	7	–	13	–	–	2
Pinus silvestris t.	10	32	13	41	21	23	38	62	–	13	280	38	64	88	–	15	38
Platycarya	–	–	–	–	–	1	2	–	–	–	–	–	–	–	–	–	–
Pterocarya	–	–	–	6	1	3	8	8	1	15	5	3	–	17	1	2	13
Quercus	–	–	–	–	–	–	–	–	–	–	1	–	2	–	–	–	9
Rhus	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
Rubus	–	–	–	–	–	–	1	–	–	–	–	–	1	–	–	–	1
Salix	–	–	–	–	–	1	2	–	–	–	–	–	–	3	–	–	–
Sciadopitys	1	–	–	–	–	1	–	7	–	1	–	–	–	2	–	–	–
Sorbus	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1
Symplocos	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–
Taxodiaceae-Cupressaceae	5	1	2	16	3	2	9	5	2	14	2	2	–	10	–	–	6
Taxus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Tilia	–	–	–	–	–	–	–	–	–	–	–	2	–	1	–	–	1
Tsuga	–	8	–	8	–	1	2	–	2	3	2	13	5	22	–	–	5
Ulmus-Zelkova	–	–	1	3	–	1	–	1	1	5	3	–	–	14	–	–	8
Viburnum	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1

Nos of samples / Nr prób	222	226	227	228	229	230	231	232	236	241	246	247	248	249	251	253	254	256	257	258	259	262	264	265	266
Abies	–	–	1	1	4	4	4	1	–	–	–	–	8	12	–	–	–	1	–	–	–	–	6	4	4
Acer	–	–	–	–	2	–	1	–	–	–	–	–	2	–	1	–	–	–	–	–	–	–	–	–	–
Aesculus	–	1	–	–	2	–	1	–	–	–	–	–	2	–	1	–	–	–	–	–	–	–	3	–	–
Alnus incana-glutinosa t.	–	1	2	4	9	7	406	346	16	–	5	25	59	–	–	3	15	4	2	4	–	1	5	14	83
Araliaceae	–	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1
Betula	–	15	10	9	22	27	5	4	6	3	2	2	1	–	–	–	4	–	–	2	1	1	9	13	8
Carpinus	–	1	2	1	7	2	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
Carya	–	–	–	–	–	–	1	–	–	–	–	2	7	–	–	–	–	–	–	–	–	–	–	–	5
Castanea	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	–	–
Celtis	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–
Cornus	–	1	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Corylus	–	–	–	–	1	1	3	8	4	–	–	–	3	4	–	5	–	–	–	2	–	–	3	2	5
Elaeagnus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Engelhardtia	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–	–	1	–	1	–	–	–	–	38
Eucommia	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Fagus	1	4	3	6	31	–	1	–	–	–	–	2	3	–	1	5	1	–	–	–	–	2	5	8	–
Fraxinus	–	59	4	–	10	–	–	–	2	–	–	1	1	–	–	–	–	–	–	–	–	–	5	–	–
Ginkgo cf. biloba	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
Juglans	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Juniperus	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
Ligustrum	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–
Liquidambar	–	–	–	–	–	–	22	25	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	1
Lonicera	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Myrica	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
Nyssa	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Picea	5	8	19	14	77	14	7	15	34	6	–	15	26	44	21	30	23	–	1	2	1	2	42	21	17
Pinus haploxylon t.	3	–	–	–	–	2	3	–	–	–	–	–	–	10	–	3	–	–	–	–	5	–	–	–	4
Pinus silvestris t.	8	12	17	19	25	93	9	10	21	17	8	67	60	58	36	42	27	5	2	34	37	14	31	36	21
Platycarya	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1
Pterocarya	1	–	–	–	–	2	–	7	1	–	1	13	16	15	–	6	4	1	–	2	–	–	–	2	26
Quercus	–	34	7	15	34	26	1	1	19	–	1	–	2	–	–	–	–	–	–	–	–	1	30	34	–
Rhus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Rubus	–	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Salix	–	–	2	2	2	3	2	6	2	–	–	–	1	1	–	1	–	–	–	–	–	2	–	–	–
Sciadopitys	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	–	–	–	–	–	–	–	1
Sorbus	–	1	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Symplocos	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Taxodiaceae-Cupressaceae	–	–	–	–	–	–	6	15	–	–	–	3	5	–	–	5	1	–	–	–	–	–	–	–	4
Taxus	–	–	–	–	–	–	1	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Tilia	1	1	–	–	–	5	1	2	4	–	–	–	–	–	–	–	–	–	1	1	–	2	–	–	–
Tsuga	–	–	–	–	–	4	2	1	–	–	2	5	10	–	–	–	1	–	–	–	–	–	1	2	1
Ulmus-Zelkova	2	–	2	–	3	2	31	18	–	–	–	2	1	5	1	6	1	1	–	–	–	–	5	2	4
Viburnum	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Nos of samples / Nr prób	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	288	290	291	292	294	295
Abies	1	1	4	8	–	–	–	–	4	2	5	4	–	–	–	5	–	–	1	–	–	4	–	–
Acer	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Aesculus	–	–	–	2	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Alnus incana-glutinosa t.	27	34	150	100	5	2	–	4	2	5	4	7	1	–	–	4	–	1	1	1	–	3	–	–
Araliaceae	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Betula	1	1	2	2	–	9	–	–	4	10	6	11	5	3	3	4	1	–	1	1	–	2	1	–
Carpinus	–	–	1	–	–	1	–	–	–	–	2	1	–	–	–	–	–	–	–	–	–	–	–	–
Carya	–	–	8	5	–	–	–	1	–	–	1	–	–	–	–	–	–	–	1	–	–	–	–	–
Castanea	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Celtis	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cornus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Corylus	1	3	–	–	–	–	–	–	–	1	1	–	–	–	1	–	–	–	–	1	–	3	–	1
Elaeagnus	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Engelhardtia	1	–	–	4	–	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	–
Eucommia	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Fagus	–	–	7	7	–	1	1	–	5	5	5	2	–	1	1	–	–	–	–	–	–	–	–	–
Fraxinus	1	–	–	–	–	–	–	–	–	–	–	1	1	1	–	–	–	–	–	–	–	1	–	–
Ginkgo cf. biloba	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Juglans	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Juniperus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ligustrum	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Liquidambar	–	–	2	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Lonicera	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Myrica	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nyssa	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Picea	16	11	9	27	2	7	–	18	34	18	21	16	1	2	1	16	–	2	–	2	1	23	3	1
Pinus haploxylon t.	3	1	19	25	–	4	1	5	–	–	1	–	–	–	–	–	–	–	–	–	–	–	3	–
Pinus silvestris t.	50	26	81	59	6	57	16	39	57	34	26	17	145	133	109	83	3	–	12	13	12	46	13	13
Platycarya	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–
Pterocarya	4	6	4	24	–	–	–	6	–	–	1	–	–	–	–	2	–	–	–	–	1	3	–	–
Quercus	1	–	5	–	–	9	1	–	14	3	1	2	–	–	4	–	–	2	1	–	1	–	–	–
Rhus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Rubus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Salix	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sciadopitys	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–
Sorbus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Symplocos	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Taxodiaceae-Cupressaceae	–	6	4	4	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–
Taxus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Tilia	1	–	18	3	–	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	1
Tsuga	6	–	5	3	–	1	1	2	–	–	1	–	–	–	–	–	–	–	1	3	1	15	2	2
Ulmus-Zelkova	4	2	7	3	–	1	–	–	3	2	2	–	–	1	–	–	–	–	–	–	–	–	–	–
Viburnum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Nos of samples / Nr prób	296	297	298	299	304	305	306
Abies	2	–	–	–	–	–	–
Acer	–	–	–	–	–	–	–
Aesculus	–	–	–	–	–	–	–
Alnus incana-glutinosa t.	1	–	1	1	1	–	–
Araliaceae	–	–	–	–	–	–	–
Betula	2	–	–	7	–	1	1
Carpinus	–	–	–	1	–	–	–
Carya	–	–	–	–	–	–	–
Castanea	–	–	–	–	–	–	–
Celtis	–	–	–	–	–	–	–
Cornus	–	–	–	–	–	–	–
Corylus	–	–	1	2	–	–	–
Elaeagnus	–	–	–	–	–	–	–
Engelhardtia	–	–	–	–	–	–	–
Eucommia	–	–	–	–	–	–	–
Fagus	–	–	–	1	–	–	–
Fraxinus	–	–	–	5	–	–	–
Ginkgo cf. biloba	–	–	–	–	–	–	–
Juglans	–	–	–	–	–	–	–
Juniperus	–	–	–	–	–	–	–
Ligustrum	–	–	–	–	–	–	–
Liquidambar	–	–	–	–	–	–	–
Lonicera	–	–	–	–	–	–	–
Myrica	–	–	–	–	–	–	–
Nyssa	–	–	–	–	–	–	–
Picea	–	1	–	8	–	–	–
Pinus haploxylon t.	–	–	–	–	–	55	–
Pinus silvestris t.	90	5	50	36	33	1056	19
Platycarya	–	–	–	–	–	–	–
Pterocarya	–	–	–	–	–	1	–
Quercus	–	–	–	3	2	–	1
Rhus	–	–	–	–	–	–	–
Rubus	–	–	–	–	–	–	–
Salix	–	–	–	–	–	–	–
Sciadopitys	–	–	–	–	–	–	–
Sorbus	–	–	–	–	–	–	–
Symplocos	–	–	–	–	–	–	–
Taxodiaceae-Cupressaceae	–	–	–	–	–	–	–
Taxus	–	–	–	–	–	–	–
Tilia	–	–	–	–	–	–	–
Tsuga	1	1	–	–	–	2	–
Ulmus-Zelkova	–	–	–	1	–	–	–
Viburnum	–	–	–	–	–	–	–

Domański Wierch. Absolute numbers of sporomorphs. P.2. Herbaceous plants, Pteridophyta (NAP) and Hystrichosphaeridae. Numerals before brackets indicate the absolute number of sporomorphs and of Hystrichosphaeridae. No. of sample is given in the brackets

Domański Wierch. Bezwzględne ilości sporomorf. Cz. 2. Rośliny zielne i paprotniki (NAP) oraz Hystrichosphaeridae. Liczba przed nawiasem odpowiada ilości sporomorf i okazów Hystrichosphaeridae w próbie. Numer próby podany jest w nawiasie

Armeria	1(173),
Artemisia	1(1), 1(7), 6(10), 1(20), 1(60), 1(66), 2(70), 1(71), 7(73), 1(110), 1(156), 1(222), 1(227), 1(228), 20(230), 1(236), 2(264), 3(265), 3(278), 1(279), 4(281), 1(283), 1(284)
Batrachium	1(226), 1(231), 1(232), 1(269), 1(270), 1(274), 1(281)
Boraginaceae	1(221)
Campanula	2(100), 2(281), 1(297)
Caryophyllaceae	2(4), 1(70), 1(72), 1(96), 2(230), 1(236), 1(262), 1(270), 1(277), 2(284)
Centaurea jacea t.	1(24), 1(204), 1(226), 2(230), 1(262), 1(265), 1(278)
Chenopodiaceae	1(11), 1(17), 1(20), 1(23), 1(66), 3(70), 3(72), 1(156), 2(226), 2(228), 1(229), 13(230), 2(236), 2(26), 4(265) 1(278), 1(282), 1(284), 3(299)
Compositae	1(1), 1(6), 1(7), 6(10), 1(11), 1(22), 6(23), 6(24), 1(28), 1(29), 1(30), 3(32), 1(40), 1(72), 3(86), 1(95), 2(96), 1(100), 1(121), 5(123), 1(170), 2(221), 1(226), 1(229), 7(230), 1(231), 5(236), 1(246), 1(249), 6(254), 1(256), 1(262), 27(264), 1(265), 1(266), 1(267), 2(275), 2(276), 3(277), 4(278), 1(281), 1(282), 2(284)
Convolvulus	1(10), 1(107)
Cruciferae	1(15), 1(17), 6(70), 1(145), 1(227), 1(228), 1(283), 1(291), 1(292), 2(297), 1(298), 5(299), 1(304), 1(305)
Cyperaceae	1(1), 7(10), 1(12), 1(20), 2(24), 2(40), 22(97), 1(98), 2(175), 1(226), 1(246), 1(264), 2(265), 1(272), 1(288)
Ephedra	1(269)
Ericaceae	6(1), 1(7), 29(10), 1(12), 2(20), 1(32), 1(95), 1(205), 2(227), 1(228), 1(266), 1(267), 1(269),
Filipendula	1(230), 1(265), 1(269), 1(274), 1(281),
Gramineae	10(1), 2(4), 2(5), 2(6), 4(7), 11(10), 6(11), 3(12), 1(13), 1(14), 5(15), 3(17), 1(18), 21(20), 9(21), 1(22), 34(23), 22(24), 3(25), 1(30), 2(33), 3(59), 4(63), 1(64), 8(66), 1(67), 15(70), 3(71), 5(72), 1(73), 1(74), 3(84), 2(86), 3(87), 4(96), 8(97), 1(107), 1(109), 7(110), 6(111), 1(115), 5(121), 13(123), 1(134), 1(204), 4(205), 1(221), 23(226), 11(227), 14(228), 19(229), 145(230), 25(236), 2(241), 2(246), 14(247), 10(254), 1(256), 4(257), 4(258), 6(262), 10(264), 22(265), 1(266), 3(268), 3(271), 4(272), 18(275), 26(276), 14(277), 20(278), 13(279), 7(280), 6(281), 2(282), 7(283), 6(284), 3(288), 2(292), 1(295), 1(296), 3(297), 1(298), 50(299), 8(304), 9(305), 3(306)
Hippophaë	2(14), 1(23), 2(29), 3(33), 1(36), 2(269)
Iridaceae	1(70)
Labiatae	1(16), 1(29), 1(35), 1(226), 1(231), 1(246), 1(275), 1(278)
Lysimachia	1(226), 1(229), 3(236), 3(264), 3(270), 3(271), 1(272), 1(274), 1(281)
Lythrum	1(10)
Nuphar	1(96), 1(109), 1(144), 1(173), 1(266), 1(271), 1(272)
Oenothera	1(173), 1(272)
Plantago cf. major	1(6), 1(17), 1(18), 8(20), 1(33), 1(37), 1(66), 1(67), 1(69), 4(70), 1(72), 1(97), 2(227), 1(228), 10(230), 1(254), 1(257), 2(275), 2(278), 3(281), 2(284), 2(299)
Polygonum persicaria	1(4), 3(24), 1(29), 2(70), 2(271), 2(227), 1(230), 1(246)
Potamogeton	3(231), 1(232), 3(274), 1(281)
Potentilla	1(22), 1(230), 1(267), 1(281), 1(299)
Primulaceae	2(230), 1(231)
Ranunculaceae	1(2), 1(3), 1(6), 1(10), 1(11), 2(12), 1(15), 3(23), 1(28), 6(29), 1(59), 1(66), 5(70), 1(73), 3(74), 1(100), 9(123), 2(228), 7(230), 4(236), 1(249), 1(254), 1(257), 1(258), 1(266), 18(275), 1(276), 3(277), 12(278), 2(281), 7(284), 13(299), 1(306)
Rosaceae	4(1), 1(6), 2(10), 2(23), 3(24), 1(59), 12(64), 1(66), 1(67), 2(70), 1(95), 6(96), 3(97), 1(109), 3(121), 1(123), 1(124), 1(221), 4(226), 1(228), 10(229), 2(230), 6(232), 8(236), 1(241), 1(254), 2(259), 2(262), 3(265), 1(269), 6(275), 3(276), 1(277), 1(279), 2(280), 1(281), 1(282), 2(284), 1(291), 1(295), 5(299), 1(306)
Rumex acetosa t.	1(6), 1(7), 1(15), 1(20), 1(24), 1(64), 1(66), 1(226), 17(230), 1(236), 2(262), 1(264), 3(265), 1(267), 1(268), 1(272), 3(275), 1(276), 2(277), 1(279), 2(284), 2(290), 13(299), 2(304), 1(305)
Sanguisorba	1(269)
Scabiosa	1(226), 1(272), 1(274), 2(276)
Sparganium	1(1), 2(10), 1(173)
	1(6), 1(20), 1(64), 1(226)
Umbelliferae	2(10), 1(18), 1(123), 1(226), 2(230), 2(231), 1(232), 1(262), 1(279), 1(280)
Valeriana	3(275)
Botrychium	5(28), 2(29), 2(30), 2(32), 1(34), 1(35), 6(40), 1(72), 1(91), 1(97), 1(100), 1(145), 3(173), 2(227), 1(228), 1(253), 2(275), 8(276), 2(277), 1(281)
Cyatheaceae	1(40), 3(86), 2(87), 1(98), 1(228), 1(236), 3(254), 1(281)
Equisetum	1(269)
Gleicheniaceae	1(65), 1(69), 1(115), 1(212), 3(269)
Lycopodium sp.	1(1), 1(17), 2(71), 1(123), 1(201), 1(281)
Lycopodium selago	1(14), 1(111), 1(144), 1(170), 1(205), 1(296)
Mohria	1(84), 1(123)
Ophioglossum	1(29), 1(34), 1(35)
Osmunda	1(16), 1(17), 2(28), 2(29), 1(40), 1(74), 1(111), 1(115), 1(179), 1(205), 1(268), 3(269), 4(270), 4(272), 3(274), 1(292)
Polypodiaceae	10(1), 2(4), 27(10), 3(11), 3(13), 3(14), 2(15), 3(18), 3(19), 18(20), 6(21), 2(23), 2(24), 1(25), 6(28), 11(29), 1(30), 2(32), 2(33), 4(34), 11(35), 1(36), 18(37), 9(40), 5(42), 10(47), 1(63), 1(64), 19(70), 14(71), 14(72), 2(31), 7(86), 1(91), 14(93), 2(94), 2(95), 20(96), 6(97), 3(98), 61(100), 1(107), 1(108), 11(109), 8(110), 69(111), 3(115), 1(121), 6(123), 2(144), 2(145), 3(156), 5(170), 4(171), 5(173), 2(174), 17(175), 21(179), 2(200) 8(221), 1(222), 7(226), 18(227), 4(228), 6(229), 9(230), 8(231), 9(232), 23(236), 4(240), 7(247), 1(248), 2(253), 1(254), 1(256), 1(257), 2(258), 5(262), 3(264), 18(265), 25(266), 8(267), 2(268), 109(269), 90(270), 27(291), 28(272), 1(274), 5(276), 7(277), 3(278), 5(279), 3(281), 3(282), 5(292), 1(299)
Selaginella	1(17)
Sphagnum	1(1), 1(4), 7(10), 2(17), 2(20), 1(25), 1(67), 1(70), 1(100), 1(111), 1(171), 1(175), 1(227), 1(229), 1(246), 1(247), 1(248), 1(254), 1(267), 1(268), 1(276), 1(278), 1(292)
Indeterminatae	1(16), 1(17), 1(20), 2(36), 2(66), 1(69), 1(70), 3(71), 3(81), 1(84), 8(95), 4(96), 6(97), 1(98), 9(100), 2(159), 2(162), 1(175), 3(200), 2(205), 1(221), 8(226), 9(229), 1(230), 2(231), 2(232), 7(272), 2(275), 2(276), 1(277), 5(278)
Hystrichosphaeridae	14(28), 12(29), 60(32), 6(34), 1(35), 10(36), 1(40), 4(65), 1(66), 1(74), 3(84), 6(86), 1(87), 1(89), 5(98), 3(100), 7(107), 3(108), 1(109), 1(111), 2(115), 7(121), 21(123), 9(144), 3(145), 4(153), 5(154), 5(155), 3(156), 8(159), 1(162), 22(170), 1(171), 22(174), 7(179), 6(200), 6(212), 23(213), 26(221), 1(222), 7(236), 2(241), 3(247), 2(252), 3(254), 2(256), 4(259), 10(262), 3(264), 1(292), 6(294), 10(295), 10(296), 15(297), 16(298), 9(299), 1(304), 2(305)

Table II
Tabela II

Huba. Absolute numbers of sporomorphs
Huba. Bezwzględne ilości sporomorf

Nos of samples Nr prób	1	2	3	4	5	6	7	8	9
Abies	–	2	8	37	5	21	11	13	9
Acer	–	13	–	1	4	1	1	–	1
Aesculus	–	2	2	5	5	7	3	5	1
Alnus	–	1	48	52	29	12	36	23	45
Berberis	–	–	1	1	–	1	–	1	–
Betula	–	5	4	9	7	7	1	6	8
Carpinus	–	–	2	1	–	1	1	–	–
Carya	–	–	1	1	–	2	–	4	–
Castanea	–	15	18	16	45	16	18	11	5
Celtis	–	6	8	7	9	2	–	2	2
Cornus	–	–	–	2	–	1	1	–	1
Corylopsis	–	4	2	4	8	2	4	–	4
Corylus	–	–	–	1	1	3	–	–	–
Cryptomeria	–	4	5	6	3	8	3	2	1
Engelhardtia	–	10	4	5	5	3	2	7	7
Eucommia	–	–	1	1	2	1	2	2	1
Fagus	–	16	–	4	6	9	7	–	–
Fraxinus	–	2	2	1	1	3	–	–	–
Ginkgo cf. biloba	–	9	8	5	8	5	3	1	1
Glyptostrobus	–	10	10	15	18	22	13	15	10
Ilex	–	–	–	–	1	–	–	1	2
Juglans	–	–	–	3	3	–	1	1	–
Juniperus	–	8	4	–	–	2	4	2	1
Liriodendron	–	1	18	7	11	9	4	–	–
Liquidambar	–	3	9	–	–	2	–	1	1
Lonicera	–	–	1	1	4	–	–	–	3
Magnolia	–	1	–	1	1	1	–	1	5
Nyssa	–	9	2	1	1	1	1	2	1
Ostrya-Ostryopsis	–	10	2	2	2	2	2	2	2
Picea	–	–	12	13	12	19	31	56	15
Pinus silvestris t.	1	15	50	44	42	28	43	45	37
Pinus haploxylon t.	–	2	5	27	4	16	16	13	11
Platycaria	–	1	2	3	3	4	5	5	3
Pterocarya	–	10	7	11	7	4	7	3	1
Quercus	–	1	3	8	8	24	–	24	1
Rhododendron	–	–	1	2	–	2	–	8	1
Rhus	–	–	8	1	3	3	1	1	1
Salix	–	1	2	2	–	–	–	1	2
Sciadopitys	–	3	5	5	2	4	–	4	–
Sequoia	–	4	7	3	8	9	8	7	7
Solanaceae cf. Lycium	–	–	–	–	–	–	1	–	–
Taxodium	1	63	233	305	100	165	24	25	113
Taxus	–	–	–	2	7	1	–	–	–
Tilia	–	3	–	–	–	3	3	3	3
Tsuga	–	–	7	13	5	12	11	5	7
Ulmus-Zelkova	–	6	15	8	8	7	2	–	6
Viburnum	–	–	–	–	–	1	1	1	–
Alisma	–	–	3	4	8	1	–	1	–
Artemisia	–	1	–	–	–	–	–	–	–
Brasenia	–	4	1	2	1	–	–	–	–
Caryophyllaceae	–	–	–	–	–	1	1	–	–
Centaurea	–	–	–	1	–	–	–	–	–
Chenopodiaceae	–	–	1	1	3	–	3	–	–
Compositae	–	5	3	4	2	3	4	7	9
Convolvulaceae	–	–	–	–	–	–	–	1	–
Cyperaceae	–	9	52	1	18	24	15	11	–
Ericaceae	–	–	4	–	2	–	5	–	3
Euryale	–	1	5	1	–	–	–	–	–
Gramineae	–	–	3	9	7	–	–	–	12
Leguminosae	–	–	–	1	–	1	–	1	1
Liliaceae	–	1	–	1	2	–	–	1	–
Menyanthes	–	–	1	1	1	–	–	–	–
Myriophyllum	–	–	–	1	1	1	1	–	1
Nuphar	–	7	1	1	1	1	1	1	–
Nymphaea	–	9	–	1	1	1	–	–	–
Potamogeton	–	7	3	10	2	7	–	3	5
Rosaceae	–	–	–	1	1	–	–	–	3
Rubiaceae	–	–	2	1	11	4	2	–	6
Sagittaria	–	–	–	1	1	1	–	–	–
Sparganium	–	1	2	1	3	2	–	3	1
Trapa	–	–	1	1	1	–	1	–	–
Umbelliferae	1	1	2	1	3	–	–	–	–
Indeterminatae	–	–	2	–	3	–	2	9	–
Equisetum	–	–	2	–	–	–	–	–	–
Lycopodium selago	–	–	3	6	1	2	3	8	3
Osmunda cf. claytoniana	–	2	25	13	7	3	3	–	5
Polypodiaceae	–	10	13	32	12	47	64	46	46
Sphagnum	–	–	1	–	–	–	9	–	4

Table III
Tabela III

Krościenko. Absolute numbers of sporomorphs
Krościenko. Bezwzględne ilości sporomorf

Nos of samples Nr prób	3	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Abies	1	-	-	6	-	-	-	-	-	5	-	-	-	-	-	-	1	4	2	-	-	6	-	1	-	4	20	5	9	3	2	2	-	2	8	-	2
Acer	3	-	-	-	-	1	-	2	-	-	-	1	-	8	-	1	-	-	9	-	-	3	-	-	-	4	1	-	-	-	-	-	7	-	-	1	-
Alnus	32	1	5	20	7	10	6	16	17	14	18	12	-	23	11	7	21	6	10	12	1	-	7	5	10	6	5	11	7	3	6	3	13	11	24	20	16
Araliaceae	-	-	-	-	-	-	-	-	1	-	-	-	1	-	3	-	2	7	-	2	-	1	-	-	-	2	-	-	-	-	4	3	-	3	-	-	-
Betula	1	2	-	6	7	1	2	-	2	8	7	6	1	3	3	7	7	11	6	8	2	5	4	-	5	-	3	5	7	7	5	5	5	-	7	5	3
Carpinus	1	-	-	-	-	-	1	-	-	-	5	-	-	4	7	-	8	3	5	2	29	3	3	2	5	7	-	11	11	30	-	-	3	10	-	-	-
Carya	7	12	8	10	4	7	5	17	6	13	16	13	-	10	10	8	9	21	14	10	11	10	-	12	1	11	9	10	6	1	2	12	3	3	6	8	19
Castanea	-	-	-	-	-	-	-	-	-	4	4	8	-	-	3	7	1	-	1	-	2	4	-	-	-	-	-	-	4	-	3	5	3	-	-	-	-
Ceanothus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Celtis	-	-	-	-	-	-	-	1	17	-	-	-	-	-	2	2	7	4	3	-	2	-	-	-	-	2	1	-	6	13	1	2	-	-	1	-	-
Cercidiphyllum	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3	-	-	-	-	-	-	-	3	2	-	5	5	-	3	-	-	-
Chamaecyparis	9	4	-	3	7	-	-	-	17	38	20	-	-	-	-	2	-	-	2	-	-	-	-	-	-	2	-	-	-	-	-	3	-	-	-	-	-
Cornus	-	4	2	4	-	5	2	-	4	-	9	15	21	-	-	-	3	-	1	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	2	2	-
Corylopsis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	3	-	-	-	-
Corylus	-	1	-	-	-	1	1	4	-	-	-	-	-	14	15	44	45	7	1	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Cyrilla	-	-	-	-	-	-	-	-	-	-	-	12	-	-	-	-	1	-	1	-	-	-	-	-	-	-	3	3	3	-	-	-	-	3	-	-	-
Cupressus	-	-	-	-	-	-	-	-	9	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Decodon	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	2	-	-
Engelhardtia	-	1	4	-	-	4	-	1	-	7	13	-	5	-	-	1	5	8	2	-	4	7	3	-	-	3	-	-	-	-	2	2	-	2	3	1	7
Eucommia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	3	-	-
Fagus	-	-	3	2	-	7	10	24	1	12	3	-	-	4	5	12	30	16	8	10	10	12	2	2	7	-	11	14	12	42	-	4	2	6	2	1	4
Fothergilla	-	-	-	-	-	-	6	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2	2	4	-	-
Fraxinus	-	-	-	-	-	-	-	-	-	-	-	1	-	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ginkgo cf. biloba	-	-	2	-	-	-	-	-	1	3	-	4	-	-	-	-	-	-	-	-	-	2	-	-	-	3	-	-	-	1	-	-	-	-	1	2	1
Ilex	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	1	2
Juniperus	-	-	11	-	-	13	13	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Liriodendron	-	-	-	-	-	-	-	-	1	-	3	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2	-	-	3	-	3	-	-	-
Liquidambar	-	-	-	-	-	-	2	-	-	-	-	6	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	4	-	-	-	-	4	-	-	-
Lonicera	-	-	-	-	-	7	4	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Magnolia	-	-	-	-	2	-	-	-	-	-	-	3	-	-	-	-	-	-	-	3	-	-	2	-	-	-	2	-	2	-	1	-	-	5	2	-	-
Morus	-	-	-	-	-	-	-	-	-	-	-	-	-	2	7	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-
Myrica	-	-	-	-	-	3	-	-	-	4	-	-	-	2	-	5	13	5	1	-	1	-	2	2	4	3	7	5	2	7	-	-	-	-	-	-	-
Nyssa	-	-	-	-	-	-	-	-	-	-	2	-	4	4	3	-	-	-	-	-	-	4	1	-	-	-	3	-	2	-	1	-	-	3	-	-	-
Ostrya-Ostryopsis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
Parrotia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Phellodendron	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	3	-	-	-
Picea	86	79	116	87	57	68	85	98	95	140	75	55	111	57	67	71	26	57	32	50	107	50	38	94	51	68	51	37	52	45	53	51	56	46	69	78	73
Pinus haploxylon t.	-	-	-	10	6	-	2	-	3	3	8	3	-	-	-	-	9	8	7	6	-	4	9	9	8	7	2	10	7	-	5	5	-	5	14	6	-
Pinus silvestris t.	11	5	3	4	22	11	19	16	13	15	22	6	26	26	18	11	57	73	65	45	34	33	23	51	13	27	-	9	12	3	8	17	13	11	14	27	26
Platycarya	1	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pterocarya	31	26	10	14	13	14	14	18	15	28	25	17	4	12	16	11	18	24	18	35	21	64	9	16	8	25	30	27	51	51	10	8	9	11	23	8	9
Quercus	-	-	-	-	-	2	6	10	9	4	-	-	7	20	14	18	-	1	-	-	-	2	5	4	4	7	10	-	5	-	4	-	3	-	1	-	6
Rhamnus	-	-	-	-	-	-	-	-	-	-	-	-	-	2	10	-	-	-	-	-	-	-	2	-	-	3	-	2	-	-	-	3	3	-	-	3	-
Rhododendron	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	-	2	-	-	1	-
Salix	3	1	4	3	10	10	5	18	3	5	-	2	-	-	-	3	-	2	-	5	-	-	5	3	7	3	-	1	-	-	-	-	-	-	2	2	2
Sambucus	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Sciadopitys	4	5	11	6	8	12	9	7	2	4	3	2	5	6	4	3	3	7	5	-	-	-	2	1	3	3	-	1	3	2	-	4	5	3	20	17	2
Sequoia	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	1	-	3	1	1	-	-	-	-	-	3	-	-	-
Staphylea	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
Stewartia	-	-	-	-	-	-	-	-	-	4	5	2	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Taxodiaceae-Cupressaceae	-	-	-	-	-	-	-	-	-	-	-	-	-	4	6	15	2	2	4	3	-	4	-	-	-	-	-	3	6	2	6	11	8	14	24	7	10
Taxodium	-	-	-	-	-	-	-	-	-	-	3	-	3	-	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tilia	3	-	1	5	3	1	-	-	1	2	7	-	5	3	5	-	1	-	1	-	3	-	1	1	7	6	-	4	5	-	7	5	7	4	4	8	-
Tsuga	-	6	2	3	4	3	11	12	6	6	-	3	4	5	8	-	3	13	3	5	3	-	-	1	-	3	4	3	-	5	5	-	1	-	4	8	5
Ulmus	3	-	-	-	-	-	-	5	-	-	-	-	5	1	3	3	5	1	3	-	3	1	4	-	6	-	6	-	-	5	-	-	-	-	-	-	5
Viburnum	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-	2	1	-	-	-	-	-	-	-	-	-
Zelkova	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	2	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Artemisia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Batrachium	-	1	-	1	-	-	-	-	1	3	-	-	1	-	1	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-
Balsaminaceae	-	-	-	-	-	-	-	-	-	3	-	-	-	-	5	3	9	-	3	1	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
Campanula	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caryophyllaceae	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	2	-	-	-	-	4	-	-	-	-	-	-	-	-	1	-	-
Chenopodiaceae	-	1	-	-	1	-	1	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Compositae	-	1	-	-	-	8	6	2	2	8	1	2	-	3	-	-	-	-	3	-	-	-	3	-	1	11	1	-	-	-	1	2	-	-	3	5	-
Convolvulus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cruciferae	-	-	-	-	-	-	-	-	1	-	-	-	-	-	3	-	-	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyperaceae	10	12	9	13	17	31	14	28	-	3	5	1	-	-	1	-	-	-	-	1	-	-	2	-	-	-	-	-	2	-	2	3	-	-	4	-	-
Ericaceae	-	1	-	-	-	1	-	1	-	-	2	2	-	6	2	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2	-	8	7	10	8	3
Euphorbiaceae	-	-	-	-	-	-	-	-	-	-	-	-	9	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gentiana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Gramineae	4	-	-	-	2	-	3	3	-	4	2	4	1	-	-	5	2	-	-	4	1	6	5	-	4	5	2	-	2	-	-	5	-	-	4	1	1
Iridaceae	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	1	-	-	-	-	3	-	-	-	-	-
Labiatae	-	-	-	2	-	-	-	1	1	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-	-	-	1	2	-	-	-	2	-	-	-	-	-
Liliaceae	2	3	-	-	-	-	-	1	-	4	1	1	-	-	-	-	-	4	-	-	-	-	-	-	-	-	2	3	-	1	-	-	-	-	-	-	-
Plantago media t.	4	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Pleurospermum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polygonum persicaria t.	1	-	2	-	-	1	1	2	-	-	1	-	1	-	-	-	-	3	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ranunculaceae	-	-	-	2	-	-	-	-	-	-	-	-	-	4	7	5	-	4	5	-	1	-	1	12	9	3	3	6	-	-	2	-	-	-	-	-	-
Rosaceae	-	-	-	-	1	-	-	1	-	-	-	1	-	14	3	4	2	1	18	8	5	5	-	-	-	1	-	-	-	-	2	-	-	-	-	-	-
Rubiaceae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	-	5	2	-	1	-	2	2	-	-	2	4	-	-	-	-	4
Rumex	-	-	-	-	-	1	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Umbelliferae	-	-	1	3	-	4	2	-	1	5	1	1	2	3	-	-	1	-	1	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-
Valeriana	-	-	4	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Viola	-	-	-	-	-	-	-	-	-	-	-	-	-	2	5	-	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indeterminatae	2	6	11	3	2	8	9	11	5	6	1	-	-	4	-	6	-	6	-	1	2	6	2	-	3	-	5	3	-	-	6	4	9	6	10	9	5
Butomus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	4	-
Nuphar	-	14	17	10	26	26	8	12	11	16	11	3	-	-	-	-	1	-	1	-	-	-	-	2	1	-	2	-	-	-	25	27	14	38	35	48	10
Nymphaea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
Potamogeton	-	1	-	-	2	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3	-	-	-	-	-	-
Typha	-	-	2	-	5	4	1	2	5	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Botrychium	1	1	-	-	-	4	2	5	16	1	8	-	-	-	-	-	-	-	2	-	-	1	-	-	1	-	-	-	-	-	5	4	4	-	2	3	5
Lycopodium selago	2	2	1	2	2	2	-	-	-	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	4	3	13	2	3	6	-
Lycopodium annotinum	-	1	-	1	-	3	1	1	1	4	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	1	-	2	-	-	-	4
Osmunda	2	1	1	-	4	4	-	-	-	-	-	-	-	-	-	3	1	-	-	-	-	-	-	-	-	-	-	-	2	1	2	-	1	-	1	1	-
Polypodiaceae	65	47	51	55	34	40	40	40	30	29	40	28	2	4	4	3	6	10	18	1	7	3	7	19	2	5	4	2	3	1	12	11	17	12	19	14	14
Sphagnum	-	1	4	11	2	-	4	3	4	2	4	1	-	-	1	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	3	4	6	-	4	3	1

Czarny Dunajec. Absolute numbers of sporomorphs

Czarny Dunajec. Bezwzględne ilości sporomorf

Depth in m / Głębokość w m	29,70	57,15	57,30	141,00	142,50	155,00	164,50	164,60	165,10	231,70	247,00	304,80	321,60	375,85	510,25	510,70	725,10	725,80	801,60	801,95	802,10	831,60	850,00	880,40
Nos. of samples / Nr prób	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Abies	–	7	–	–	–	–	–	5	11	1	–	4	1	–	5	7	–	–	1	1	–	–	–	2
Acer	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
Alnus incana-glutinosa t.	6	4	21	1	7	5	5	2	4	19	2	2	17	4	30	72	–	1	2	2	–	–	–	–
Alnus kefersteini t.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	63	44
Araliaceae	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	–
Betula	3	–	3	–	–	2	1	–	5	3	–	2	6	1	1	–	1	–	6	–	–	–	5	1
Buxus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–
cf. Camptotheca	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–
Carpinus	–	–	6	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
Carya	1	2	1	–	1	–	–	–	4	–	2	4	2	–	1	6	–	–	3	–	–	–	1	2
Castanea	1	–	–	–	–	–	–	–	5	–	–	–	–	1	–	–	–	–	1	2	–	–	1	–
Celtis	–	–	3	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Cyrilla	–	–	–	–	–	–	–	1	–	–	–	1	–	–	–	2	–	–	–	–	–	–	2	–
Diervilla	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	1	–
Engelhardtia	2	–	–	1	1	4	–	4	2	1	–	8	3	2	–	14	2	16	25	15	5	13	14	–
Eucommia	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Fagus	1	–	12	–	–	–	1	–	–	4	–	–	–	8	2	24	–	6	–	–	–	–	–	–
Forsythia	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
Fraxinus	–	–	–	–	–	–	–	–	–	–	–	1	–	1	1	–	–	–	–	–	–	–	–	–
Ilex	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
Liquidambar	–	2	3	–	–	–	–	–	–	2	–	3	–	–	–	1	–	–	–	–	–	–	–	–
Myrica	1	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ostrya-Ostryopsis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	–	–
Picea	3	20	38	42	117	51	76	51	167	161	48	46	24	13	104	124	6	6	5	9	2	2	–	–
Pinus haploxylon t.	22	23	22	38	38	17	23	26	87	31	41	50	18	49	40	38	33	52	38	87	69	47	12	8
Pinus silvestris t.	54	23	26	39	60	17	25	23	41	37	28	57	15	10	34	29	27	23	44	54	10	10	4	9
Platycarya	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Pterocarya	9	3	12	3	6	6	2	2	8	2	9	8	6	6	13	73	4	2	7	–	3	2	8	5
Quercus	–	2	15	–	–	–	–	3	–	4	7	1	5	–	2	44	–	–	2	–	–	–	–	–
Rhamnus	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Rutaceae	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	3	–	–	–	–	–	–	–	–
Salix	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	6	–	–	–	–	–	–	–	–
Sciadopitys	1	3	–	–	1	–	–	–	6	–	–	–	–	–	1	2	–	–	–	–	–	–	–	–
Sequoia	–	–	–	–	–	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Symplocos	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Taxodiaceae-Cupressaceae	6	32	12	7	11	5	18	35	54	3	21	18	11	–	10	18	13	48	25	42	29	23	16	25
Tilia	–	–	–	–	–	1	–	–	–	3	–	5	–	2	–	–	–	–	–	–	–	–	1	1
Tsuga	2	1	4	5	6	2	8	4	18	4	19	21	3	4	28	36	8	6	6	5	1	2	4	2
Ulmus-Zelkova	2	2	5	1	5	1	1	6	23	4	4	9	5	1	7	30	1	3	2	2	1	1	8	1
Armeria	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Artemisia	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Chenopodiaceae	–	–	–	–	–	–	1	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Compositae	–	1	–	1	3	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	1
Cyperaceae	–	6	3	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	1
Ericaceae	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	2	–	–	–	–	–
Gramineae	–	5	4	1	–	–	–	–	–	1	–	–	–	–	2	17	–	–	–	–	–	–	1	–
Papilionaceae	–	–	2	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Polygonum persicaria	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Rosaceae	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Rubiaceae	–	–	2	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–
Rumex cf. acetosa	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Umbelliferae	–	2	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Viola	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Indeterminatae	2	3	–	–	–	–	–	3	11	8	–	2	–	6	–	39	–	–	1	–	–	–	1	–
Botrychium	–	–	–	1	–	–	–	–	–	3	–	1	–	–	–	–	–	–	–	–	–	2	–	–
Cyatheaceae	–	–	–	1	1	–	–	–	–	–	–	3	–	–	2	–	–	3	–	3	1	–	–	1
Equisetum	–	1	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Lycopodium selago	1	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Osmunda cf. claytoniana	–	–	–	1	1	–	–	–	1	11	3	–	–	1	–	1	1	2	–	–	–	–	–	3
Polypodiaceae	13	35	43	1	–	10	–	9	2	38	–	11	7	–	1	–	1	–	3	1	–	–	3	5
Hystrichosphaeridae	4	–	–	4	–	2	1	1	–	–	–	12	–	23	–	–	16	19	27	44	14	5	2	–

Table V
Tabela V

The list of Tertiary plant sporomorphs in some Neogene diagrams from the southern Poland

Lista sporomorf roślin trzeciorzędowych z kilku neogeńskich profilów Polski południowej

	Piaseczno	Gliwice Stare	Huba	Czarny Dunajec	Krościenko	Mizerna	Domański Wierch
Acanthopanax	+	+	–	–	–	–	–
Actinidia	–	–	–	–	–	+	–
Aesculus	–	–	+	–	–	–	+
Ailanthus	–	+	–	–	–	–	–
Alnus kefersteinii t.	+	–	–	+	–	–	–
Aralia	+	+	+	+	+	–	–
Araliaceae gen. div.	+	+	+	+	+	+	+
Berberidaceae	+	–	–	–	–	–	–
Buxus	+	+	–	–	–	–	–
Carya	+	+	+	+	+	+	+
Caragana	+	–	–	–	–	–	–
Cassia	+	–	–	–	–	–	–
Castanea	+	+	+	+	+	+	+
Castanopsis	+	+	+	+	–	+	–
Celtis	+	+	+	+	+	+	+
Cercidyphyllum	+	–	–	–	+	–	–
Chamaecyparis	–	–	–	+	+	–	–
Cinnamomum	+	–	–	–	–	–	–
Cistaceae	+	–	–	–	–	–	–
Cornaceae-Pollenites Edmundi	–	+	–	–	–	+	–
Corylopsis	+	+	+	+	+	+	–
Cotinus cf. coggyria	+	–	–	–	–	–	–
Cryptomeria	–	+	+	+	–	–	–
Cunninghamia	+	+	–	–	–	–	–
Cyrilla	+	–	–	–	+	–	–
Decodon cf. globosus	+	–	–	–	+	–	–
Diospyros	+	–	–	–	–	–	–
Elaeagnus	+	+	–	–	–	–	+
Engelhardtia	+	+	+	+	+	+	+
Eucommia cf. ulmoides	+	+	+	+	+	+	+
Fagus ferruginea t.	–	+	–	–	–	–	–
Fagus silvatica t.	+	+	+	+	+	+	+
Fothergilla	+	–	–	–	+	–	–
Ginkgo cf. biloba	+	–	+	–	+	–	–
Glyptostrobus	+	+	+	+	–	–	–
Hamamelis	+	–	–	–	–	–	–
Keteleeria	+	–	–	–	–	+	–
Lauraceae	+	–	–	–	–	–	–
Leguminosae gen. div.	+	–	+	–	–	–	–
Liriodendron	–	–	+	–	+	–	–
Liquidambar	+	+	+	+	+	+	+
Magnolia	+	–	–	–	+	+	–
Morus	+	–	–	–	+	–	–
Myrica	–	+	–	+	+	–	–
Myrtaceae	+	–	–	–	–	–	–
Nerium oleander	+	–	–	–	–	–	–
Nyssa	+	+	+	+	+	+	+
Oleaceae	+	–	–	–	–	+	–
Ostrya	+	+	+	+	+	–	–
Parrotia	+	–	–	–	+	–	–
Phellodendron	+	–	–	–	+	+	–
Phyllocladus	–	+	–	–	–	–	–
Pinus haploxylon t.	+	+	+	+	+	+	+
Pistacia	+	+	–	+	–	–	–
Platanus	+	–	–	–	–	–	–
Platycarya	+	+	+	+	+	–	+
Podocarpus	–	+	–	–	–	–	–
Pseudotsuga	–	+	–	–	–	–	–
Pterocarya	+	+	+	+	+	+	+
Punica	+	+	–	–	–	–	–
Rhamnaceae cf. Ceanothus	+	+	–	–	+	+	–
Rhus	+	+	+	–	–	+	+
Rutaceae gen. div.	+	+	–	–	–	–	–
Sciadopitys	+	+	+	+	+	+	+
Sequoia	+	+	+	+	+	–	–
Staphyllea	+	–	–	–	+	+	–
Stewartia	+	–	–	–	+	+	–
Styrax	+	+	–	–	–	–	–
Symplocos	–	–	–	+	–	–	+
Tamarix	+	–	–	–	–	–	–
Taxodiaceae-Cupressaceae gen. div	+	+	+	+	+	+	+
Taxodium	+	+	+	+	+	+	+
Tsuga cf. diversifolia	+	+	+	+	+	+	+
Tsuga cg. canadensis	+	+	+	+	+	+	–
Tsuga cf. pattoniana	–	+	–	–	–	–	–
Tsuga cf. sieboldii	–	+	–	–	–	–	–
Ulmus-Zelkova	+	+	+	+	+	–	–
Cyatheaceae	+	+	–	+	–	–	–
Gleicheniaceae	+	+	–	+	–	–	–
Lygodium	+	+	–	+	–	–	–
Mohria	+	+	–	+	–	–	–
Osmunda cf. claytoniana	+	+	–	+	+	+	–
Schizeaceae	–	+	–	+	–	–	–